Northeast Swale
Resource Management Plan
2013

Meewasin

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The Report was written by Amber Jones and map work was completed by Sarina Gersher of Meewasin.

Technical Steering Committee

Laura Hartney – Manager, Future Growth, City of Saskatoon
Chris Schultz – Senior Planner, Future Growth, City of Saskatoon
Dave Leboutillier – Planning and Design Engineer, Transportation Branch, City of Saskatoon
Galen Heinrichs – Strategic Services Branch, City of Saskatoon
Tyson McShane – Senior Planner, Land Branch, City of Saskatoon
Cal Sexsmith – Future Growth Engineering Manager, Infrastructure Service, City of Saskatoon
Elisabeth Miller – Senior Planner, Neighbourhood Safety, City of Saskatoon
Carey Humphrey – Manager of Leisure Services, City of Saskatoon
Gary Pedersen – Naturalized Park Supervisor, City of Saskatoon
Brenda Wallace – Manager, Environmental Services Branch
Mike Velonas – Manager of Conservation and Planning, Meewasin Valley Authority
Luc Delanoy – Conservation Officer, Meewasin Valley Authority
Barb Hanbidge – Wetland specialist, Ducks Unlimited Canada
Stan Shadick – Vegetation and wildlife specialist, Saskatoon Nature Society
Candace Neufeld – Ecologist, Environment Canada
Chet Neufeld – Vegetation specialist, Native Plant Society of Saskatchewan
Peter Goode – Principal, Stantec
Anna Leighton – Vegetation specialist
Dennis Scott – Saskatoon City Police
Mel Stauffer – Geologist, University of Saskatchewan
Les Henry – Soil and Hydrology specialist, University of Saskatchewan
Rebecca Row – Planner, RM of Corman Park
Bob Rogers – Wildlife specialist, Wildlife Federation
Graham White – Councillor, RM of Aberdeen

Vision

A prized natural feature within Saskatoon's urban landscape: a refuge for wildlife and people alike, where disturbance mimics natural patterns, biodiversity is high, native species flourish, and residents or visitors of Saskatoon can learn from and enjoy wilderness right outside their own backyard.

Executive Summary

The Northeast swale is a channel scar, the result of an ancient river carving a path on the landscape, creating unique geological, hydrological, and ecological conditions. It is an ecological corridor connecting Peturrson's Ravine in Saskatoon to the greater swale northeast of the city, forming several connections with the South Saskatchewan River along its path. Although there are pockets of disturbance, the swale is essentially a 2800 hectare (ha) natural area that contains a variety of environments including steep rocky ridges, rolling prairie, lush valleys, treed areas, and ephemeral wetlands. These conditions support a diversity of biological activity including over 200 documented plant species, 103 avian species, and a variety of mammals within the 300 ha of swale in Saskatoon alone. The Northeast swale is considered a priority area for protection, which is supported by both Weichel (1993) and Bizecki-Robson & Nelson (1998).

The Recommendations of the Resource Management Plan (RMP) apply mainly to the Northeast swale within Saskatoon city limits. Most of the Northeast swale is within Meewasin Valley Authority's (Meewasin) Conservation Zone as defined by the *Meewasin Valley Authority Act* (*MVA Act*) and is shown in Figure A-1, Appendix A. The land in the Northeast swale is primarily owned by the City of Saskatoon (the City), with some private ownership. In 2002, Meewasin and the City approved the Guidelines for Development (Stantec Consulting Ltd. [Stantec], 2002). These guidelines inform the City's University Heights (UH) Sector Plan (Community Service Department, 2007). The development guidelines will be replaced by the 2012 update (Stantec) that is currently awaiting approval and will be incorporated into a revised UH sector plan, to be completed in 2013.

The two main goals of the RMP align with Meewasin's mandate of conservation, development, and education and flow out of the Vision on page iv:

- To protect and restore biodiversity, unique landscape characteristics, and heritage features inherent in the Northeast swale;
- To provide opportunities for education, recreation, and active commuting in appropriate areas of the swale to the residents and visitors of Saskatoon and area.

The expanding urban landscape offers opportunities and challenges in achieving these goals. The opportunities for education and recreation are significantly increased with the projected urban expansion around the swale. However, the challenges with encroaching urbanism are many, and include: more intensive adjacent land use, fragmentation of the landscape from road and utility crossings, negative perception of nature/wildlife in the city, human impact upon sensitive natural habitat and wildlife, changes to the natural disturbance regime, and impact from surface runoff on wetlands and groundwater. These challenges will be addressed through resource management, planning, and development considerations as outlined in the following summary of recommendations.

Summary of Recommendations

3.1 Legal Instruments

- Pursue long term legal protection of the Northeast swale and the greater swale:
    - Provide input to the City's UH sector plan revision process to ensure it aligns with Meewasin's mandate, policy, and priorities, particularly with respect to sites within Meewasin's jurisdiction; this should include the integration and protection of the Northeast swale;
    - Consider designating Northeast swale lands as Environmental Reserve (ER) within the city;
    - Work with the Rural Municipalities (RM) of Corman Park and Aberdeen to better understand land development pressures in and around the greater swale and recommend that sensitive areas be designated as ER should development (subdivision) occur;
    - Investigate the management and funding implications of designation of the Northeast swale as discussed above;
    - Work with the City and other private landowners to enter into Conservation Easement Agreements;
    - Update Meewasin's Northeast Sector Policy to incorporate current information and priorities for the Northeast swale.

3.2 Management

- Maintain biodiversity by invigorating the native grass and forb species to increase the health and resilience of existing vegetation:
    - Burn at least 25% and up to 75% of the Northeast swale landscape in a 10 year period;
    - Graze the Northeast swale with sheep and/or goats; or a combination of cattle with sheep and/or goats:
        - Upgrade fence to a wildlife friendly design that is appropriate for the type of grazing animals being used;
        - Limit wetland access from grazing animals, either through exclusion fencing, or by discouragement such as provision of water, salt, and adequate forage outside of the wetland;
    - Control invasive species and noxious weeds;
    - Use an adaptive management approach and monitor accordingly:
        - Complete follow up assessments on species cover, species diversity yield, and health;
        - Monitor management activities and adapt techniques accordingly;
- Restoration of Disturbed Areas:
    - Stop seed production of noxious weeds;
    - Consult a restoration specialist to develop a restoration plan to establish native vegetation that includes monitoring newly planted vegetation and controlling weeds for at least 2-3 years.

- Integrate the landscape planning into the Recreation Plan that will be developed for the Northeast swale.

3.3 Development Considerations

- Provide a framework for decision making by:
  - Adopting the *Northeast Swale Development Guidelines* (Stantec, 2012);
  - Considering the fit of the Northeast swale as an integral element of any new development;
- Provide input on the mitigation of potential ecological impacts to the Ministry of Highways and Infrastructure on the proposed perimeter highway.

3.4 Recreation, Education, and Interpretive Planning:

- Develop Recreation, Education, and Interpretive plans that ensure:
  - Passive recreation uses only, no off-leash dogs and on-leash dogs limited to certain areas;
  - Considers varying intensity and activity types for different areas:
    - Greenway – multi-use trail, Northeast swale ecological buffer, and transition zone for storm water management;
    - Ecological core – controlled access for passive recreation;
    - Storm water ponds and recreation zone – uncontrolled higher intensity use for recreation and education; development of trails;
  - Incorporation of the interpretive opportunities for both individuals and groups (such as school groups).

3.5 Communications Strategy

- Develop a Communications Strategy that:
  - Celebrates the swale as a treasured and valuable resource and amenity to Saskatoon and region;
  - Fosters a sense of stewardship and understanding for those living near and visiting the Northeast swale.

3.6 Funding

- Develop a detailed 5-year burning, grazing, and vegetation management budget;
- Pursue commitments for funding to implement the recommendations of the RMP that are Meewasin's responsibility;
- Work with the City and other key stakeholder to determine roles and responsibilities in managing and developing the swale.

1 Introduction

The swale is the result of an ancient river channel carving a scar on the landscape and leaving unique geological, hydrological, and ecological conditions. The land is not suitable for agriculture or development and is a tract of native vegetation and preserved wetlands within a highly altered landscape. It is a valuable natural resource and regional amenity that creates an ecological corridor through Saskatoon and into the rural landscape, connecting with the South Saskatchewan River in several places (Figure A-1, Appendix A). Although there are pockets of disturbance, the swale is essentially a 2800 hectare (ha) natural area that contains a variety of environments including steep rocky ridges, rolling prairie, lush valleys, treed areas, and ephemeral wetlands. These conditions support a diversity of biological activity including over 200 documented plant species, 103 avian species, and a variety of mammals within the 300 ha of swale in Saskatoon alone. Weichel (1992) identified the Northeast swale as a "priority for protection" in the *Inventory of Natural Areas Remaining in the Vicinity of Saskatoon*. The Meewasin Valley Authority (Meewasin) further studied the natural areas in the Meewasin Valley and rated the Northeast swale as highest priority for protection along with four other sites (Bizecki-Robson & Nelson, 1998). Delanoy (2001), in the *Vegetation and Wildlife Survey of the Northeast Swale near Saskatoon,* noted the varied terrain and intermixing of species in the Northeast swale and its importance as wildlife habitat.

In this document, the swale is considered in two distinct parts: **the Northeast swale** which includes the area within Saskatoon city limits, most of which is in Meewasin's jurisdiction, and is defined by Stantec Consulting Ltd. [Stantec] (2012); and **the greater swale** which includes the remainder of the 25 km scar channel, the boundary of which is estimated on Figure A-1, Appendix A, and is within the Rural Municipalities (RMs) of Corman Park and Aberdeen. This document is a Resource Management Plan (RMP) primarily for the Northeast swale; the greater swale is also considered as context, recognizing that the swale is one continuous landform from Peturrson's Ravine to Clark's Crossing, and that the impact to one part of the swale can affect the rest. Recommendations within this report are limited to the Northeast swale unless clearly stated otherwise. Any recommendations given for the greater swale are suggestions only as they apply to an area outside of Meewasin's jurisdiction where Meewasin has no legal authority. Other natural areas, particularly Peturrson's Ravine and Saskatoon Natural Grasslands (SNG), are physically connected to the swale and are important ecologically. For this reason they are also considered within the report, and many of the management recommendations are extended to these natural areas. However, both Peturrson's Ravine, and SNG have their own Resource Management Plans (Golder Associates [Golder], 1995; Delcan Western Ltd. [Delcan], 1994) which remain the primary planning documents for resource management. This RMP in no way supersedes either of those plans, or any other Meewasin policy document.

The Northeast swale is in a transition period and it will be subject to the planned expansion of the city around it. Currently, the Northeast swale is isolated, fenced, and has limited use by people. Because of this, biodiversity is high, and niche species are supported by the unique environmental conditions. The core area of native habitat has a fairly continuous link between other remnant natural areas such as SNG, Crocus Prairie, and Peturrson's Ravine and north into the rural landscape. The boundary of the

swale is indistinct and allows movement of plants, animals, and other biological activity. A trip out to the swale, especially on a calm spring morning, may present 60-70 bird species, sightings of large mammals such as moose or deer, calls of frogs, and wildflowers emerging on the rocky ridges. The soundscape is relatively silent, the nights are truly dark, and the viewscape gives a glimpse of downtown Saskatoon far in the distance.

In the foreseeable future, this natural landscape (the Northeast swale) can expect to have increased interaction with the urban environment. There will be two arterial road crossings; residential lots and a trail adjacent to the east boundary; and Fedoruk Drive bounding the south edge. Eventually, the Northeast swale will be completely surrounded by neighbourhood development and roads. The biodiversity and ecological corridor present in the Northeast swale will be threatened by these changes. However, an unbroken ecological core of over 250 ha will be maintained that can likely support similar levels of biodiversity with careful implementation of resource management, ongoing monitoring, and thoughtful planning of educational or recreational facilities.

The Northeast swale has the potential to be a prized natural feature within Saskatoon's urban landscape similar to Nose Hill Park in Calgary, Stanley Park in Vancouver, or our own South Saskatchewan River Valley. The opportunity to utilize and enjoy this diverse natural landscape, unlike any other in the city, also presents a unique set of challenges. The Northeast swale RMP presents a vision for this important natural area. It looks at the specific management practices needed to protect the ecological and heritage resources of the swale while incorporating the recreational, educational, and interpretive opportunities that exist.

1.1 Legal Standing

Much of the Northeast swale is within Meewasin's Conservation Zone as defined by the *Meewasin Valley Authority Act* (*MVA Act*)[1] and is shown in Figure A-2, Appendix A. Development on these lands requires Meewasin Valley Authority approval per section 10 of the *MVA Act* which allows Meewasin to coordinate or control the use, development, conservation, maintenance, and improvement of the land within its jurisdiction. Meewasin's Northeast Policy (1987) further defines Meewasin's roles and responsibilities for planning and development of the Northeast area.[2] The Northeast Policy states that "Land resources which are significant for research, natural habitat or environmental interpretation should be conserved." The policy is currently under review and the forthcoming update of the Northeast Policy will recognize the Northeast swale as a natural resource with both natural and cultural importance, and that conservation, development, and education initiatives will recognize and acknowledge the significance of this site to the Meewasin Valley.

[1] Meewasin's jurisdiction is made up of three parts: The Conservation Zone – those lands listed in Schedule A of the *MVA Act;* The Buffer Zone – those lands listed in Schedule B; and the Exempt lands as defined by the Development Review Exemption Bylaw. The requirements pertaining to each is available in Meewasin's Development Plan.

[2] The Northeast area includes lands within the Conservation Zone lying north of College Drive and east of the South Saskatchewan River and south of College Drive between Cumberland Avenue and Circle Drive.

The City of Saskatoon (the City) considers natural and human heritage, as well as the protection of grasslands in their 2012-2022 Strategic Plan (2012), and has highlighted the *Conservation of Natural Areas and Archaeological Sites* (Section 9.2.1) as an objective in their 2009 Official Community Plan: *"*a) To identify and protect important ecosystems and other natural areas and archaeological sites, as part of the land development process; b) To enhance the beauty and enjoyment of the City and Region; and c) To conserve the biodiversity of both plant and animal life for the enjoyment of present and future generations."

In 2002, Meewasin and the City approved the *Development Guidelines and the Northeast Swale* (Stantec, 2002) which is currently reflected in the City's University Heights (UH) Sector Plan (2007). The 2002 guidelines will be replaced by the updated *Northeast Swale Development Guidelines* (Stantec, 2012) that is currently awaiting approval and will be incorporated into the revised UH sector plan. The recommendations from the 2012 *Development Guidelines* are shown in Figure A-3, Appendix A including the Northeast swale boundary, the three transportation/utility corridors, potential storm water works, the greenway, and potential trail locations.

The Northeast swale boundary shown in Figure A-3 was determined by Stantec with Meewasin's input and based on previous studies (BBT 1985, 1986; Delanoy, 2001). It defines a landform of particular geological, ecological and hydrological characteristics (Stantec, 2012). As shown on Figure A-3, Meewasin's jurisdiction does not follow the Stantec boundary of the Northeast swale; it includes additional area, including much of the greenway east and west of the boundary which is delineated along the quarter section lines and does not include swale lands northeast of section 18-37-4 W3M. Meewasin is currently reviewing the Northeast policy, which will reflect the recommendations from the 2012 *Development Guidelines* and the RMP.

1.2 Process

In March of 2012 Meewasin formed a technical steering committee[3] as well as meeting with various stakeholders including the City Planning and Development Branch, the City Land Branch, City Infrastructure Services, the Swale Watchers[4], and Stantec to provide direction on the Northeast swale RMP. There was agreement that the 2002 *Development Guidelines* (Stantec) were no longer appropriate for guiding development around the swale as they did not fully consider the current breadth of research done within the swale on vegetation, wildlife, and wetland characteristics; as well as the better understanding of the importance of these environments. In response to this, the City created a steering committee made up of personnel from the City and Meewasin to revise the guidelines. The RMP's technical steering committee was consulted to provide ideas and advice to Stantec through the writing of the guidelines, along with other stakeholders. The resulting guidelines sought to balance the protection of the Northeast swale with the need for transportation and utilities for the growing city of Saskatoon within the UH sector.

[3] The technical steering committee's membership is given in Acknowledgements.

[4] The Swale Watchers is a group of concerned citizens and environmental organizations with the mandate to increase awareness about the swale and work toward its protection.

1.3 Value

As a large remnant of native prairie and wetland complex nestled within an urban environment, the Northeast swale has great value. With less than 20% of native prairie remaining in Saskatchewan (Bailey, McCartney, & Schellenberg, 2010), native grasslands are now one of the most imperiled ecosystems on the planet (Gauthier & Riemer, 2003) and are considered endangered (Trottier, 1992). Only 5% of the original plains rough fescue prairie remains in Saskatchewan (Grilz & Romo, 1995). The large natural area offers high quality biodiversity, proximity to urban areas, economic benefits, opportunities for recreation and education, and a natural filter for our air and water. This value may not be readily apparent as grasslands do not have the immediate appeal of, for example, a mountain ecosystem or a river landscape. Similarly, the semi-permanent wetlands in the swale, although extremely important for their ecological and hydrological functions, may not be as aesthetically desirable as glassy lakes. The attributes of the swale are many, but they are subtle; they require observation and interpretation, and they are easily lost if not recognized as something worth protecting.

Biodiversity is seen as an irreplaceable asset for humanity and to the biosphere (Reid & Miller, 1992) and is crucial to maintain resilience in an ecosystem against human-induced or natural stresses (Biodiversity Unit, 1993). Biodiversity provides social, cultural, and economic value through biological resources such as food, medicine, and shelter (Pimentel, Wilson, McCullum, Huang, Dwen, Flack, Tran, Saltman & Cliff, 1997) as well as a host of key ecological processes such as nutrient cycling, soil building, management of water, and air purification (Joseph, 2009; Biodiversity Unit, 1993). Maintaining biodiversity within the swale is important at a very local scale as it offers a range of high quality experiences and educational opportunities, has incredible aesthetic value, and adds another dimension to the park system of Saskatoon and area. On a much larger scale, the swale supports both national and provincial diversity through the rare and endangered species present; it also resists the general global trend of reduced biodiversity and it supports a grassland ecosystem within a provincial landscape that has been severely affected by agriculture.

The Northeast swale has historically been protected from cultivation, and later urban development, largely due to its geological constraints including numerous wetlands, rocky ridges, and high water table. Today the economic, social, and environmental value of the swale is recognized as detailed below.

1.3.1 Ecological

The ecological value of the swale lies largely in its diversity both at the landscape level and the species level. There is a diversity of environments including upland grasslands, wetlands, and trees and shrubs all present in close proximity to each other allowing for a very high number of plant, animal, amphibian, and microbial species, some of which are rare or endangered[5].

- Large size, over 2800 ha, approximately 300 ha in Saskatoon;
- Connects to the river in Saskatoon at Peturrson's Ravine, again at a ravine near Columbus Bosco Homes, near Clark's Crossing, and once more within the RM of Aberdeen (Figure A-1, Appendix A);

[5] Federally listed species at risk found in the Northeast swale are available in Table 2-1.

- Diversity of environments offer a large variety of plant species (over 200), birds (over 100), mammals, amphibians, reptiles, and insects that are present in the Northeast swale on a regular basis;
- Unique grassland community of mixed grass and fescue prairie, sitting on the transition of two ecoregions (the moist mixed grassland and aspen parkland);
- Rare plant and animal species occur both within the Northeast swale and in Peturrson's Ravine.

1.3.2 Urban Connection

Canadians spent approximately $11.7 billion on nature related activities in 1996 including outdoor recreation in natural areas, wildlife viewing, recreational fishing, and hunting (Federal-Provincial-Territorial Task Force on the Importance of Nature to Canadians, 2000). The Northeast swale provides access to nature, as well as the opportunity for informal physical activity which is utilized more often than formalized recreation facilities (Gilles-Corti & Donavon, 2002), provides increased benefits, and is a more rewarding experience (Frumkin & Louv, 2007).

- Natural area will extend right into the city, offering opportunities to be close to nature, participate in informal recreation, and learn from the natural environment;
- Students from Saskatoon and area can learn about the environmental and historical features present in the swale, and participate in Meewasin's management;
- Researchers from the scientific community can learn from the remnant grassland and wetland complex.

1.3.3 Human Heritage

The relatively untouched nature of the swale means that there are many heritage features still present and easily observed both within city limits (including limestone quarries, kilns, and the Moosewoods-Batoche Trail) as well as near Clark's Crossing. These features should be preserved and utilized as opportunities for the region's residents and visitors to explore our history.

1.3.4 Water Management

The swale is an integral part of the prairie drainage system. Wetlands store water, creating unique vegetative communities that provide habitat for the majority of the birds in the swale. Wetland plants also work as a natural filter, removing unwanted substances before entering into the groundwater. Also, the storage of water at a higher elevation in the landscape reduces overland runoff into the river or other large bodies of water, keeping it within the local hydrological cycle and increasing precipitation as well as mitigating the potential for floods. The marl bog ecosystem within Peturrson's Ravine, one of the connections between the swale and river, supports several nationally rare plant species (Golder, 1995).

1.3.5 Economic

The Northeast swale's value is not easily measured in monetary terms. Studies have been done to assess the value of a tree (Berg, 2012), but this value is mostly based on the ability of a tree to store carbon; it does not take into account the aesthetic or other values that trees provide. The City uses the Trunk Formula Method that was developed by the Council of Tree and Landscape Appraisers, to assign an economic value to a mature urban tree that takes into account its condition, location, and the type of

species[6]. No similar method is used in Saskatoon for natural trees, or for native grassland's. Economic value is often linked to the Ecological Services that a natural area provides. These services include (Joseph, 2009):

- Protection of water resources by influencing rainfall patterns, soil infiltration, runoff, and flooding;
- Soil formation which is linked to the type of vegetation;
- Clearing of vegetation can cause salinization of soils, leaching of nutrients, and accelerated erosion of topsoil;
- Nutrient storage and cycling, pollution breakdown, and absorption;
- Contribution to climate stability through carbon storage;
- Maintenance of the ecosystem and provision of habitats.

Another simple measurement to assess economic value is to compare the costs of installing and maintaining a natural area compared to a typical urban park. An Illinois study showed that turf costs between USD $7,800 and $14,825 to install per acre, while native landscaping was between USD $3,400 and $5,975 (Northeastern Illinois Planning Commission, 2004). In the Northeast swale, these costs would be negligible as the native landscaping is already complete. The same studies also looked at maintenance costs and found that the 10 year average maintenance cost of turf grass was between USD $5,500 and $6,471 per acre, while the native landscape was between USD $1,600 and $1,788.

As well as providing money saving advantages, natural areas and green spaces also tend to boost retail and housing prices in nearby neighbourhoods. These increases are largely dependent on the area and types of green space. Property value increases of 2% are seen in Baton Rouge, Louisiana, while in Manchester, Connecticut property value increases are at 6%. Even higher increases are found in the Grand Rapids metropolitan area, Michigan, where lots are as much as 35% higher than lots at a distance from natural areas (Sander, Poasky, & Haight, 2010). These trends are noticeable in the new suburb of Evergreen in Saskatoon. The lots along the north edge of Evergreen, near Canam Park, are generally more expensive than those surrounded by only residential properties (Land Branch, 2011).

1.4 Goals

Meewasin's goals are given in its Development Plan. They are a) to protect the natural and heritage resources of the Meewasin Valley; b) to develop and encourage projects which enhance the natural and heritage resources and add to the quality of life in the Saskatoon area; and c) to increase understanding and awareness of the natural and heritage resources of the Meewasin Valley. These goals form the base for the two primary goals for the Northeast swale:

- To protect and restore biodiversity, unique landscape characteristics, and heritage features inherent in the Northeast Swale;

- To provide opportunities for education, recreation, and active commuting in appropriate areas of the swale to the residents and visitors of Saskatoon and area.

[6] Geoff McLeod, Parks Services Branch, City of Saskatoon, personal communication.

The main purpose of this RMP is to reconcile these two potentially conflicting goals. The expansion of the City around the Northeast swale is one of the biggest threats to biodiversity, the unique landscape characteristics, and heritage features. However, one of the biggest assets of the Northeast swale is the presence of these features in a location that is readily available to the public, providing opportunities to learn about them, and in doing so instill within the public a desire to be stewards of the Northeast swale. The objectives for the conservation and development of the Northeast swale must be considered within the context of urban development, so that they can realistically be met under the constant changes and increased pressures.

1.5 Objectives

Conservation

- Ensure development surrounding and within the Northeast swale recognizes it as a vital, valuable, integral part of the urban landscape;
- To preserve biodiversity and the dynamic nature of the prairie ecosystem present in the Northeast swale;
- To undertake proactive resource management measures including conservation grazing, prescribed controlled burning, and weed management to maintain biodiversity;
- Ensure connectivity between the South Saskatchewan River, the existing natural areas, and the greater swale;
- To restore areas where human intervention has damaged the ecosystem and threatens biodiversity.

Communication

- Provide the framework for establishing a Communications Strategy that will:
    - Celebrate the swale as a treasured and valuable resource to Saskatoon and region;
    - Foster a sense of stewardship and understanding for those living near and visiting the Northeast swale.

Education/Interpretation and Recreation/Transportation

- Provide the framework and concepts for establishing Recreation, Education, and Interpretive Plans that will:
    - Create inspiring interpretive site exploration opportunities for both individuals and guided tours (such as school groups);
    - Facilitate research utilizing the expertise of the University of Saskatchewan (U of S) and other research institutions;
    - Accommodate passive recreation opportunities;
    - Recognize the Northeast swale's potential as an active transportation corridor.

1.6 Challenges to Achieving Objectives

1.6.1 Changing Land Use

The biggest threat to the Northeast swale is the imminent expansion of urban areas surrounding it. Currently land use transitions from the native prairie and wetland complexes of the Northeast swale to cultivated land in the south and managed pasture containing a mixture of tame and native forage species to the north. Although these surrounding land uses are different from those within the Northeast swale and support completely different species, the current edge permits movement, unlike the new urban edge, which will be strictly linear and constructed of pavement and manicured ornamental species that will inhibit the movement of animals and plants and the flow of wind, water, and biotic materials. After urbanization, the core of the swale will remain intact; however, the resulting piece will be comparatively isolated making it more susceptible to edge effect which may result in a net loss of habitat and species diversity (Bennett, 2003).

1.6.2 Fragmentation of Landscape (Road Development)

There is a recognized need for motorized transportation and utility corridors crossing the Northeast swale. Road development in the Northeast swale will not only directly disturb areas of native habitat; it will have further reaching effects by fragmenting the landscape to potentially create an island of ecological activity. Habitat fragmentation invariably results in an overall loss of habitat on a landscape level (Bennett, 2003). In addition, the direct impacts to wildlife include a physical and biological barrier; an effect on the quality and quantity of their habitat, and mortality from collisions with motorized vehicles (Glista, Devault, & Dewoody, 2009). Other ecological effects on plants, soil, and water can be attributed to the presence of a road such as increased pollution including dust, litter, fertilizers, weed seeds, and salt; increased run off; the management of roadside vegetation; and increased light and noise (Ontario Road Ecology Group, 2010). Roads also facilitate the spread of invasive species by causing native habitats typically resistant to weed encroachment to become more vulnerable to invasion (Gelbard & Belnap, 2003).

1.6.3 Negative Perceptions of Nature in the City

Wildlife and natural areas clearly have many benefits and are viewed as a positive component of the urban landscape. However, some elements of the natural area may be perceived as negative including increased populations of certain types of wildlife, seemingly uncontrolled vegetation, and increased fire hazards.

As mentioned in section 1.6.2, wildlife will be affected by road crossings through the swale. This is also a driving hazard and a concern for human safety. Other large mammals are seen as a threat to humans and their pets, including coyotes and cougars. However, a study done on the diets of urban coyotes revealed that only 1.3% of their nutritional intake was from domestic cats compared to 42% small rodents, 23% fruit, 22% deer, 18% rabbits, and 1.9% garbage (Gehrt, 2006). Gehrt goes on to state that coyotes serve an important ecological function for rodent control and white-tailed deer control; however, other impacts on wildlife populations were also noted that may not be as desirable.

The Northeast swale's wild nature gives it an untended appearance which can be viewed negatively if the value and beauty of it is not understood. Noxious weeds within the Northeast swale, even if they

are originally a result of unmanaged disturbed areas, can spread to nearby parks, lawns, and agricultural areas and the problem seen to have originated in the swale. Additionally, if the Northeast swale is not managed appropriately, the invasion of undesirable plants will continue, potentially creating a sort of waste land that deters people instead of attracting them as a well-managed and diverse natural landscape would.

If vegetation litter levels are allowed to increase without management via periodic grazing, controlled burning, and mowing, the natural area can become a fire hazard. However, proper management, as suggested in this RMP, along with effective communications can alleviate negative perceptions and reduce the risk.

1.6.4 Increased Access

Urban development, and recreational or educational initiatives developed in the Northeast swale will increase its use. While desirable, this increased presence of humans may have a negative impact on the fragile ecosystems within the Northeast swale.

1.6.5 Change in Disturbance Regime

Any change in the disturbance regime can affect the composition of the vegetation and the overall heterogeneity of the landscape. Increases in disturbance include road or trail construction, soil excavation, and overgrazing; Decreases in disturbance include a lack of historical management such as wildfire and grazing. Increased disturbance can result in the establishment of non-native, invasive species that compete with the native vegetation and eventually reduce the number of species present. Grassland communities are thought to be the result of fire, drought, and grazing, and without these periodic disturbances the encroachment of woody vegetation would continue. Although, this would not necessarily result in a site-level reduction in species diversity, it would result in the loss of grassland. As pointed out in section 1.3, grasslands are endangered ecosystems that support a niche for wildlife and plants that cannot survive in other ecosystems.

1.6.6 Impact from Surface and Groundwater Changes

Increased or improperly managed surface drainage into the Northeast swale has the potential to cause detrimental effects. Surface flows can erode banks, pooling of water can kill vegetation and cause compositional changes, and contaminated water with excess nutrients from fertilizers, pesticides or other toxins, and invasive species seed can enter the swale affecting water quality and species composition. Groundwater contamination is also a possibility, especially with the groundwater being so close to the surface. Water quantity changes (increases or decreases) can cause an impact to the hydrologic function of the wetlands and change the natural cycles of drawdown and recharge expected in these semi-permanent and temporary wetlands (Stewart & Kantrud, 1971).

2 Background

2.1 Ecoregion

The swale is in the Saskatoon plain landscape area of the moist mixed grassland Ecoregion in the Prairie Ecozone. The moist mixed grassland Ecoregion is a broad plain interrupted by deep, scenic valleys, and

subdued, hilly uplands. The primary slope is downward to the north and east, following the slope of the bedrock surface. The plain has a cover of glacial drift that is thick enough to obscure the underlying bedrock topography. Secondary slopes from the uplands to drainage systems such as the South Saskatchewan, Qu'appelle and Souris rivers occasionally break the general northeastward slope. The Saskatoon plain is a level glacial lake and eroded glacial till plain west and north of Saskatoon, it has limited surface drainage, east to the South Saskatchewan River. The area has very gently undulating glaciolacustine slopes with Dark Brown loamy soils in the south and an eroded till plain with associated gravel in the north part. The main land use for the stony and gravelly soils is for pasture, although some crop production is supported (Acton, Padbury, & Stuchnoff, 1998).

2.2 Geology

The swale is the result of a braided river valley, the South Saskatchewan River, which drained Glacial Lake Saskatoon into the larger Saskatchewan River Basin. The glacier deposited glacial till which is a heterogeneous mixture of all particle sizes from clay to boulders that was further eroded by the meltwater. BBT (1986) describes both the small swale and the Northeast swale as:

> Two old abandoned current scars running from southwest to northeast roughly parallel to the river. The one of greatest interest runs in a trough across the central and northern portions of section 12 and 18. The second is located 1 km to the northwest and runs across the inside of a bend in the river through portions of section 13, 14, 23, 24 and 25-37-5 W3.

The ridges within the Northeast swale are usually comprised of glacial till but may contain sand and gravel. These landforms, particularly the hummocky moraine, are poorly drained and form potholes or sloughs that aid in the control of groundwater levels (BBT, 1986). Topsoil erodes from the high areas to the low areas, resulting in very thin, poorly developed soils on the well drained ridges and deeper topsoil in the depressions. Consequently, the depressions are very productive and commonly develop lush vegetation such as aspen, sedges, willow and other species that are a valuable habitat and cover for wildlife (Raymond Moriyama Architects & Planners, 1978).

The Strawberry Hills, to the east of Saskatoon, are a glacial moraine deposit and glacial beach ridge with knob and kettle topography. These hills collect water that eventually ends up into the Forestry Farm aquifer which underlies the entire area including the Northeast swale, but does not underlie the small swale to the north (Chritiansen, 1970). The ground water below the Northeast swale is not affected by its surface topography (BBT, 1986) and is less than 6 m below the surface within the Northeast swale (BBT, 1985, 1986) which has helped define a zone of "unserviceable land" (Stantec, 2012). In the Northeast swale there is a thin mantle of silt, sand, clay or gravel overlying the glacial till in the depressions with till extending to the surface on the hummocks. The upper floral till and the upper floral sand have been removed by erosion (BBT, 1986). Springs and piping failures tend to form where the sand in the aquifer is deepest including where the swale meets the river at Peturrson's Ravine which is the result of a massive piping failure.

2.3 Soil

Soils throughout the Northeast swale vary considerably depending on the method of deposition of parent material and the topographic position. Much of the swale has steeper slopes with variable and very stony Runway soils. Runway complexes include Chernozemic, Regosolic and Gleysolic soils of variable texture developed on a wide variety of glacial and recent deposits associated with broad glacial meltwater channels, spillways, and eroded till plains. These thin soils are found on steeper slopes and along ridge tops in the Northeast swale and support a high diversity of grasses and wildflowers. Saline soils are found in the intermittently flooded depressional areas found in much of the swale. A glacio-fluvial event deposited Weyburn Asquith soil complexes which are Dark Brown Chernozemic soils that occur in undulating landforms, including along the western edge of the Northeast swale and continuing north from the Northeast swale. Weyburn soils occupy the tops of the more moderately sloping ridges and knolls, and Asquith soils occupy the lower slope position. Weyburn soils are moderately to excessively stony while Asquith soils are generally free from stones. Soils in the swale are typically loam-textured and calcareous. The northernmost area of the Northeast swale and into the greater swale contains saline soils associated with the semi-permanent wetland (Acton & Ellis, 1978).

2.4 Climate

The Northeast swale is within the subhumid continental climate (Acton et al, 1998). The average annual temperature is 5^{o}C. The hottest month is July with a mean annual temperature of 18.2^{o}C and a historical maximum of 40^{o}C in 1919. 2012 saw a maximum of 32^{o}C and an average 19.2°C. The coldest month is typically January, with an average of -17°C. The coldest temperature ever recorded is -50°C in February 1931 (Environment Canada). In 2012, January had a mean temperature of -10.4 C, and an extreme cold of -38.3^{o}C.

Average annual precipitation is 350 mm with the highest rates of precipitation occurring in June and July. Refer to Figure 2-1 for a monthly breakdown of average precipitation and temperature.

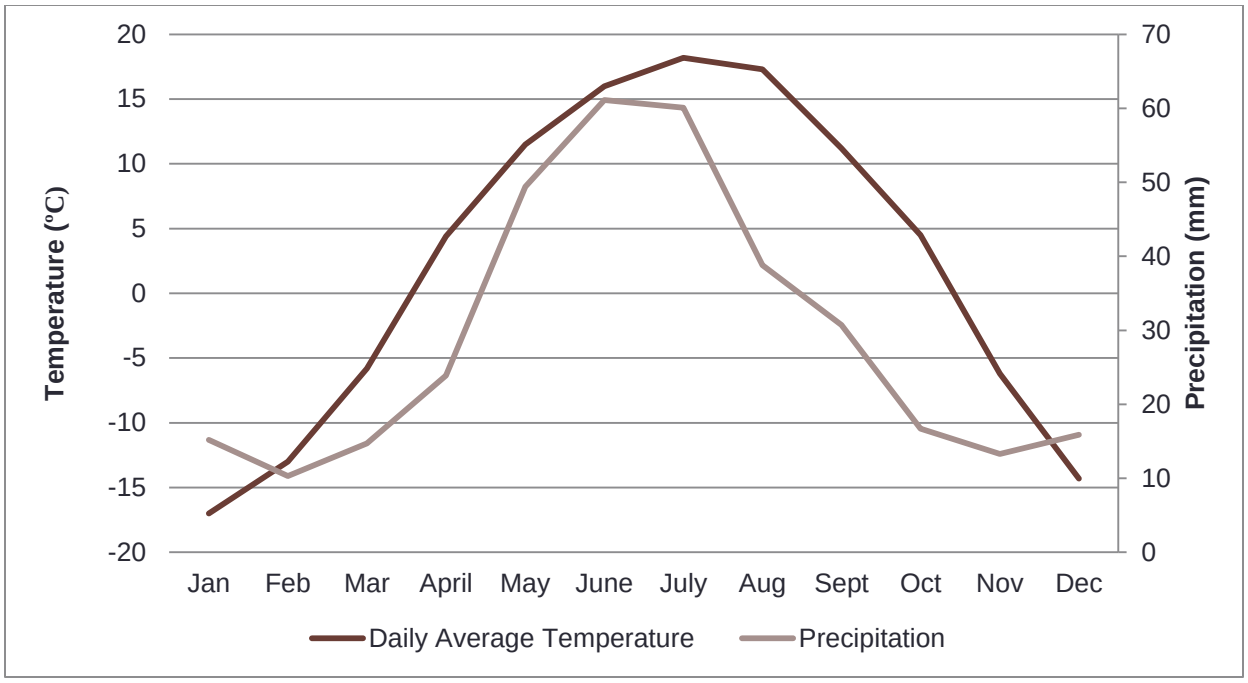

Figure 2-1. Monthly breakdown of daily average temperature and precipitation for Saskatoon between 1971-2000 (Environment Canada)

2.5 Plant Communities

The Northeast swale was first assessed by John Hudson in 1993. He observed that the area within the city was overgrazed but still possessed a large number of species due to its variety of environments that included water-eroded hills separated by swales, with some groundwater seepage at the margins. He indicated some interesting plants that can still be found in the Northeast swale including *Gentiana affinis* (oblong-leaved gentian) and *Solidago ptarmicoides* (white upland goldenrod). He assessed a portion of the swale that lies just outside the city including a *Scholochloa* (whitetop, spangletop) marsh. He described the valley bottoms within the Northeast swale to be invaded by non-native weeds including perennial sow thistle and wild barley. However, the uplands were found to be native prairie in reasonable shape. The full list of species that Hudson identified can be found in Table B-1, Appendix B.

Limestone boulder in the Northeast swale.

In 2001, Meewasin completed an intensive survey of the Northeast swale (Delanoy, 2001). All lands with natural vegetation within Meewasin's jurisdiction in the Northeast quadrat of Saskatoon, as well as the area north of city limits that has similar vegetation, were included in the study area. The study area was delineated along quarter section lines so the adjacent cultivated land was also included. The inventory showed four main groups of vegetation including trees (4%), shrubs (11%), herbaceous (45%), cropland (39%), and small disturbances (1%). The treed areas were dominated by aspen but also included cottonwood, maple, Siberian elm, and willow. Predominant cover within the shrubby areas was composed of snowberry and wolf willow and also included non-native invasive species such as caragana, European buckthorn, Siberian elm, Kentucky bluegrass, and smooth bromegrass. Native grasses were also prevalent as ground cover within shrubby areas and included western porcupine grass and plains reed grass. The herbaceous area was further divided into "ungrazed native grassland" and "grazed native grassland" which made up 8% and 20% of the total area respectively. The community was described as the western porcupine grass/northern wheatgrass community in the transition zone between the Mixed Grass and Fescue Prairie associations, as described in *Managing Saskatchewan Rangeland, Revised Edition* (Johnson, 1997). Also within the herbaceous area are marsh and meadow complexes including semi-permanent and seasonal wetlands with varying degrees of salinity and diverse vegetation.

Since 2001, the Northeast swale has been routinely assessed by Meewasin and changes in vegetation have been observed through the collection of species lists and general observations. In 2011, a bioblitz[7] had volunteer scientists explore the area including a vegetation survey. The full species list can be found Table B-1, Appendix B. Twenty-six new species were identified including the crowfoot violet, considered rare (S3[8]) by the Saskatchewan Conservation Data Centre (SCDC). Other interesting species found in the Northeast swale are sweet grass, meadow blazing star, and large leaf aven.

In 2001, much of the grassland was overgrazed and considered "altered native (grazed)" (Delanoy,2001) but is now in good condition except for areas where cultivation, topsoil stripping, or intense cattle activity such as a corral area have taken place.

Despite targeted management of weedy species, non-native invasive species are still present. Smooth brome has almost been eliminated from the Northeast swale except for along the swale boundary and in a few localized areas. Kentucky bluegrass remains a prominent feature of the landscape, especially along the valley bottoms where moisture and nutrients are plentiful and where grazing would have been intense. Weeds regulated by the *Weed Control Act 2010* occur in the Northeast swale including noxious weeds such as Canada thistle, nodding thistle, perennial sow thistle, absinthe, leafy spurge, scentless chamomile, common burdock, and common tansy. Other non-native species that have been shown to impact native grasslands include species that are seeded for forage production and have many positive attributes with regards to nutritional quality for grazing animals and wildlife habitat. However, they often compete with the native species and have a detrimental effect on biodiversity. These include sweet clover, alfalfa, smooth brome, cicer milk vetch, birds foot trefoil, and bird vetch. A full discussion on the impact and management required for these and other invasive species can be found in Section 3.2.

[7] A bioblitz is an intense survey of a designated natural area by volunteer scientists to record all living things.
[8] S3 means rare to uncommon provincially; there are 21-100 occurrences in Saskatchewan; vulnerable and may be susceptible to extirpation by large scale disturbance (Saskatchewan Conservation Data Centre).

2.6 Rare and Endangered Plant Species

The full extent of the species distribution within the swale has not been determined. The Saskatchewan Conservation Database Centre (SCDC) keeps records of rare species. Rare and endangered species in the area are shown on Figure A-4, Appendix A. Meewasin routinely submits new records of rare and endangered species to the SCDC. However, there are three additional known plant species within the Northeast swale that are considered rare that have not been updated in the SCDC database: the crowfoot violet (S3), western red lily (S3S4,) and narrow-leaved water plantain (S3). The crowfoot violet occurrences were mapped during a rare plant survey conducted by Meewasin in 2012. Over 500 individual crowfoot violet plants were located in the central corridor in the Northeast swale in seven patches as well as some individual occurrences as shown in Figure A-4, Appendix A. There are likely more occurrences of crowfoot violet within the Northeast swale that have not yet been documented.

Crowfoot violet (*Viola pedatifida)* during rare plant survey 2012.

The narrow-leaved water plantain was identified by Stantec in 2012 while assessing the wetlands for the Northeast Swale Development Guidelines (Stantec, 2012). The plant's approximate location is given in Figure A-4, Appendix A. The full extent of this plants distribution in the swale has not been determined.

Surveyors from the 2012 Crowfoot Violet Survey also looked for western red lily, however no plants were found. This may have been due to timing, as western red lily flowers later in the season than when the Crowfoot violet survey was completed (early June). However, the western red lily, a very showy plant, was not identified at any time during the spring or summer of 2012. It is not known whether this plant is no longer present within the Northeast swale, or if the conditions were unsuitable for it during this field season, further study is needed to confirm its presence and distribution.

2.7 Human Heritage

2.7.1 Moose Woods-Batoche Trail

The Moose Woods-Batoche Trail played an important role in the settlement of Saskatoon and area in the late 1800s before the railway was extended to Saskatoon. The first settlers began to arrive in 1883, many choosing to travel along the trail from Moose Jaw rather than to travel by way of the river. The trail was used by Métis and Sioux to travel to Batoche and to Cree reserves near Duck Lake. During the Riel Rebellion of 1885, the Whitecap Sioux travelled this trail to join the Métis in Batoche in 1885. The Moose Woods-Batoche Trail entered Saskatoon from the south. It ran along Broadway Avenue and

University Drive to the Memorial Gates of the University then continued past the current location of the Royal University Hospital and the Chemistry Building. The trail continued off campus northeast to the outskirts of the city as far as Clark's Crossing (Lough & Deuerkop, 1980).

Moosewoods-Batoche trail remnants in the Northeast swale.

Trail remnants are still visible within the Northeast swale and near Clark's Crossing. The location within the Northeast swale is shown in Figure A-4, Appendix A. The trail ruts are an opportunity for interpretation as they provide insight into the transportation systems used during various time periods and by different groups in the area such as First Nations, Métis and early Saskatoon-era settlers. There are numerous recollections from settlers about life along the trail and these could be used in the interpretative and signage linkages.

The Moosewoods – Batoche Trail is labeled on the 1884 Dominion Lands Plan of Township No. 37, Range 5, West of Third Meridian. It shows the trail in a slightly different location than the trail remnants located by Stantec in 1999[9]. The location surveyed in 1884 should be re-assessed to determine if trail remnants are still visible. The two locations could be the result of the trail being slightly altered to avoid an obstacle on the original route, or could be a branch leading to an unknown feature. Both trail locations are shown on Figure A-4, Appendix A.

[9] Saskatchewan Archaeological Resource Record FbNp–72. 1999. Saskatchewan Municipal Affairs, Culture and Housing.

2.7.2 Limestone Quarrying and Kilns

The glacial rivers that formed the Northeast swale deposited large limestone boulders. These limestone boulders are very useful for building, both for mortar and for the actual stones, as well as for fertilizer. Within the swale are boulders with splitting pins still intact as well as boulders with drill holes, evidence of failed limestone quarrying. In other parts of the swale, there are numerous pits where boulders were successfully removed.[10] North of Peturrson's Ravine, two limestone kilns have been found, likely built in the late 1880's, and used by early builders to produce lime for mortar (Champ, 1991). These heritage features are shown in Figure A-4, Appendix A.

Pinned limestone boulder located in the Northeast swale.

It is well known that early U of S construction projects sourced stone from the vicinity of Saskatoon. Parks (1916) describes a ridge of limestone that extends southwest towards Saskatoon from a point on the southeast side of the river near Clarkboro Ferry, which is likely describing the Northeast swale. Parks further details the location of the stone as "Approximately 2¼ miles from Saskatoon the ridge held large boulders that yielded as much as 18 cubic metres of stone, which were used for construction of the University of Saskatchewan". Other accounts indicate that the stone was located "6 miles northeast

[10] Saskatchewan Archaeological Resource Record FbNP-73. 1999. Saskatchewan Municipal Affairs, Culture and Housing.

of the [University] site" (Morton, 1959). More about the linkages between the stone located in the northeast swale and the uses for it in Saskatoon can be found in Appendix C.

2.7.3 Clark's Crossing

The northern most portion of the greater swale is rich with human heritage resources. Meewasin's 100 Year Plan (Moriyama, 1979) considers developing this area into a heritage village and interpretative centre called *Clarkstown* to create a living experience of the past. Stantec (Enns-Kavanagh, Friesen, Wienbender, Whatly, & Amundson, 2002) completed an *Archaeological Inventory of Clark's Crossing* that identifies numerous features including:

- Historic homesteads
- Trail remnants – *Round Prairie – Batoche Trail*, *Telegraph Trail*, and *Historic Trail*
- Ferry at Clark's Crossing
- Lime quarrying and kilns
- Telegraph Lines and station
- Middleton's Camp, Camp of the 7th Fusiliers
- Clarkboro Townsite
- CN Rail Bridge

2.8 Wildlife

2.8.1 Birds

The Northeast swale is well known for its variety of wildlife and is sought out by naturalists for bird-watching. Over the last 20 years, 191 species of bird have been identified. Bernie Gollop described it in *A guide to Nature Viewing Sites in and around Saskatoon* (Gollop, 2000) and recorded 181 species. His study area included both the Northeast swale in Saskatoon as well as the portion of the greater swale up to the ravine at Bosco Homes (see Figure A-1, Appendix A). Since then observations have been recorded by Delanoy (2001) who observed 58 species; Shadick (2009) who recorded 30 species, Jensen (2009) who recorded 69 species; volunteer scientists at the 2011 ecoblitz (including Meewasin personnel) recorded 70 species; and Jensen (2012) completed a 40 hour survey and recorded 103 species. This includes rare and endangered species which are shown in

Table 2-1. A detailed list of all birds seen in the Northeast swale is shown in Table B-2, Appendix B.

Table 2-1. Federally listed species at risk found in the Northeast swale.

Bird Name	COSEWIC	SARA	Reported Observation
Sprague's Pipit	Threatened	No Status*	1993, 2001
Barn Swallow	Threatened	No Status*	1993, 2001, 2009,2011, 2012
Loggerhead Shrike	Threatened	Threatened	1993, 2001
Horned Grebe	Special Concern	Special Concern*	1993, 2001, 2009, 2011, 2012
Short-eared Owl	Special Concern	Special Concern	1993, 2001, 2011, 2012
Burrowing Owl	Endangered	Endangered	1993, 2001
Common Nighthawk	Threatened	Threatened	1993, 2001, 2011, 2012

*Under consideration for the Species at Risk Act, Schedule 1

The 2012 Bird Survey for the Northeast Swale (Jensen) found that four species of interest still inhabit the swale either for nesting or foraging. The tree swallow and the horned grebe were observed on 100% of the field trips indicating that both are nesting in the swale. The barn swallow, although seen on 75% of the field trips, did not have suitable nesting habitat and is presumed to be nesting in adjacent farm yards. The common nighthawk was heard calling only once, while no nest can be confirmed, there is suitable nesting habitat along the rocky ridges within the swale. Other species of interest including the loggerhead shrike, Sprague's pipit, Baird's sparrow, burrowing owl and short-eared owl were not observed. This is not unexpected as all of these species are now rare to uncommon. Habitat does exist for the loggerhead shrike, burrowing owl, Baird's sparrow, and short-eared owl. However, the Baird's sparrow has not been seen in the Saskatoon area for many years and the burrowing owl is very sensitive to development pressure. Potential nesting habitat for the loggerhead shrike exists within treed areas near the more permanent wetlands. The short-eared owl's habitat includes moderate grasslands but may only use the swale during eruptive years. A short-eared owl was observed by Luc Delanoy in 2011 and again in 2012. Historically, Sprague's pipit may have used the mid-grass prairie in the Northeast swale for nesting, but only as a second choice to its more preferred short grass. The considerably

Nest found in the Northeast swale. Photo credit: Chet Neufeld

reduced numbers of Sprague's pipits now occurring in Saskatchewan mean that they are typically only found in short grass prairie.

Jensen observed a total of 103 avian species including fowl, raptors, ducks, and upland birds. This was a thorough study, completed in the spring, with a total of 40 hours spent in the field in the early mornings and at dusk. Sixty-two of these species were presumed to be nesting because they were observed on at least 50% of the field trips and their specific nesting requirements are available within the swale. Seven of these species had confirmed nests, several others were seen carrying nesting materials or exhibiting defensive behaviour typical of a nearby nest, and many ducklings were seen. Jensen added four species to the total species list that had never been identified in the swale before; these are the alder flycatcher, greater scaup, grey-cheeked thrush, and Ross's goose.

Three unique habitats were identified including upland grassland, treed areas, and aquatic. All three of these habitats are considered critical as they are being used by many species as nesting habitat. Any changes to the Northeast swale which will compromise any of these habitats will impact the diverse avian activity of the swale and could impact the species of interest still using the swale for nesting or foraging. Jensen's report can be found in Appendix D.

2.8.2 Mammals, Amphibians, Reptiles, and Insects

The Northeast swale is home to a variety of insects, amphibians, reptiles, and mammals. Incidental observations have been recorded for all of these orders, but no detailed surveys. A total of 19 mammals have been observed in the swale (Hudson, 1993; Gollop, 2000; Delanoy, 2001; Jensen, 2009; Meewasin, 2011). The most recent listing of mammals was during the 2011 ecoblitz when 11 mammals were observed including moose, short tail shrew, coyote, beaver, Richardson's ground squirrel, thirteen-lined ground squirrel, meadow mouse, mule deer, white-tailed deer, muskrat, and badger. Fourteen species of insects have been recorded (Meewasin 2011, 2012) as well as 8 butterflies (Gollop, 2000; Meewasin 2012). Four different types of frogs have been recorded including the Northern Leopard Frog (Chet Neufeld 2011, 2012) which is listed under SARA; and one reptile (common garter snake). A full listing of all species observed is recorded in Table B-3, Appendix B.

Volunteer scientist pond dipping during the 2011 Ecoblitz in the Northeast swale.

2.9 Wetlands

The majority of the wetlands in the Northeast swale are class IV semi-permanent wetlands under the Steward & Kantrud (1971) system, with some areas of class II temporary and III seasonal (Stantec, 2012) as shown on Figure A-5, Appendix A. Semi-permanent wetlands (Class IV) are usually wet throughout the growing season (May to September) and are characterized by marsh vegetation in the central zone of the wetland, as well as coarse emergent plants or submerged aquatics, including cattails, bulrushes and pondweeds. Seasonal ponds and lakes (Class III) are characterized by shallow marsh vegetation in the deepest zone but are usually dry by midsummer and are typically dominated by emergent wetland grasses, sedges, and rushes. Temporary wetlands (Class II) are periodically covered by standing or slow moving water.

They typically have open water for only a few weeks after snowmelt or several days after heavy storm events. Water is retained long enough to establish wetland or aquatic processes. They are dominated by wet meadow vegetation such as fine-stemmed grasses, sedges, and associated forbs (Stewart & Kantrud, 1971). The wet-dry cycles that these temporary, seasonal, and semi-permanent wetlands experience have been observed in the swale over time; as recently as 2003 when Meewasin last flew the valley, the entire swale was almost completely dry.

A functional assessment (Stantec, 2012) showed that the majority of the wetlands have a management class of "preserve" with some temporary wetlands being in management class 1 meaning that they provide important water storage, waterfowl habitat, amphibian habitat, and native plant habitat (Minnesota Board of Water and Soil Resources). The Stantec assessment found a provincially rare wetland plant, the narrow-leaved water plantain *(Alisma gramineum)*. Further study is needed on this plant to delineate its distribution.

2.10 Human Intervention

Although the Northeast swale's geological constraints have saved it from development and cultivation, limestone, gravel, and topsoil have all been excavated from the Northeast swale. The Northeast swale shows evidence of dugouts, gravel pits, topsoil excavation, heavy farm use (corrals), and of course the limestone quarries. The recent human interventions are shown in Figure A-6, while the historical excavations of limestone are shown on Figure A-4, Appendix A. In general, these areas are of poor vegetative quality with few native species, and many non-native invasive species including noxious weeds. Since 2001 when the site was first assessed, Meewasin has been working to reclaim these disturbed areas where possible and remove debris abandoned in the swale. There are also two roads, Lowe Road and Agra Road that run through the swale within Saskatoon, one of which bisects a large wetland. The full extent of disturbance outside city limits has not been documented.

Unintentional flooding in 2009 caused by expansion of storm water retention ponds in the Northeast swale.

The south section of the Northeast swale has been impacted by a large scale disturbance caused by the construction of storm water retention ponds. Prior to 2003, a borrow pond was dug to provide fill material for the Silverspring neighbourhood and to manage storm water for the neighbourhood. In 2009, prior to construction of the Evergreen neighbourhood, additional borrow ponds were dug that were converted into the current storm water retention ponds. These are shown in Figure A-6, Appendix A, and consist

of both a dry pond and a wet pond. The construction of these ponds caused severe unintentional flooding in 2009 including the creation of an overland water channel that flowed through Peturrson's Ravine and into the river, disturbing the soil and vegetation and allowing non-native invasive species to establish. The area directly impacted by flooding is shown in Figure A-6 and the photo on the previous page.

2.11 Development

The Northeast swale is part of the UH Sector in Saskatoon. The first neighbourhood to be developed near the Northeast swale was Silverspring. Design and construction of the neighbourhood occurred throughout the late 1980s and into the 1990s, and some of it was constructed on native prairie connected to the Northeast swale. Development of Evergreen began in 2009 and is currently under construction. The UH Sector Plan (Community Services Department, 2007) shows neighbourhood development along both sides of the Northeast swale.

2.12 Connected Natural Areas

The Northeast swale is connected to the South Saskatchewan River at Peturrson's Ravine. As shown on Figure A-7, Appendix A, it is also connected to many other natural areas managed by Meewasin, the City, and the U of S. The South Saskatchewan River provides the backbone of connectivity between many of the existing natural areas and parks. Further connections are possible by utilizing natural

Aerial view of Saskatoon showing the south portion of the Northeast swale as it connects to Saskatoon Natural Grasslands and Peturrson's Ravine.

features such as water and perennial cover[11] to guide the establishment of linear parks that will help to solidify or increase connectivity between existing natural areas and park space.

The surrounding natural areas also contain numerous unique historical and ecological features. More information on these areas is available from Meewasin in their respective planning documents:

- *Saskatoon Natural Grasslands Resource Management Plan* (Delcan, 1994)
- *Peturrson's Ravine Resource Management Plan* (Golder, 1995)
- *Saint Joseph High School Landscape Management Plan* (Sivertson, 1996)
- *Vegetation Survey of Natural Riverbank Lands North and West of the Regional Psychiatric Centre* (Meewasin, 1996)
- *Vegetation and Wildlife Inventory of Clark's Crossing* (Meewasin, 2003)
- *Vegetation Survey for the University Chemical Landfill Remediation Site and Adjacent City of Saskatoon Buffer Lands* (Meewasin, 2004)
- *Episcopal Corporation of Saskatoon [Peggy McKercher Conservation Area] Environmental Site Description* (Meewasin, 2006)
- *U of S Chemical Landfill Remediation Site Development Concept* (Stantec, 2007)
- *Restoration and Resource Management Plan for Peggy McKercher* (Meewasin, 2008)
- *Kernen Prairie Resource Management Plan*[12]

2.12.1 Conservation of Saskatoon Natural Grasslands (SNG)

In 1989, a group of concerned citizens, Meewasin, and environmental groups including the Saskatoon Nature Society joined forces to preserve a section of the grasslands. Working with the City of Saskatoon, the U of S and the Province of Saskatchewan (Ministry of Environment), they were successful in conserving 14 ha (34 ac). On February 26, 1993, the City of Saskatoon sold SNG to Meewasin for $1 to "conserve the natural grasslands area in a natural state and use the natural grasslands area for the purposes of the general public"[13]. This is now known as Saskatoon Natural Grasslands, a 14 ha area of fescue dominated prairie connected to the Northeast Swale.

[11] Includes *native perennial cover* - permanent cover that is confirmed to be dominated by native species; and *perennial cover* - permanent cover that is confirmed to be dominated by introduced species or the distribution of native species is unknown.
[12] University of Saskatchewan in-house report.
[13] Agreement between the City of Saskatoon and Meewasin Valley Authority, May 7, 1993.

3 Resource Management Instruments

The Resource Management Plan for the Northeast swale must establish a framework for decision making that realizes the vision, meets the goals and objectives, and addresses the challenges outlined in section 1. As stated in section 1.1, the current UH sector plan reflects the 2002 *Development Guidelines* (Stantec); the revised UH sector plan will reflect the 2012 *Development Guidelines* (Stantec). The 2012 *Development Guidelines* along with the RMP will assist Meewasin in assessing development proposals within and along the Northeast swale. Other instruments available for protection include legal tools, suggested strategies for resource management, communications, and recreation, education and interpretation, and the framework for consideration of the cumulative effects of any proposed developments as well as the fit of the natural area into the urban landscape.

3.1 Legal Instruments for Protection

3.1.1 Environmental Reserve and Public Parks

The *Planning and Development Act, 2007* (PDA), provides the ability for an approving authority to dedicate land as Environmental Reserve (ER) if it has water features; contains wildlife habitat or other environmentally sensitive areas with historical or natural features; or is subject to flooding. An environmental reserve may be left in its natural state or established as a public park. The PDA also requires that a portion of any land subject to subdivision be dedicated as municipal reserve (MR). MR designation is not desirable as it allows development that presents more of a potential risk to the critical resources and features of the Northeast swale[14]. The City of Saskatoon Leisure services branch has indicated that they do not intend to dedicate any land within the Northeast swale as MR, or that public facilities typical of MR be developed within the Northeast swale.[15] ER designation is applied to land that is unsuitable for development and/or otherwise valuable as a natural area. Dedicating the land of the Northeast swale as ER would formalize the common goal of protecting the area from development by providing legal protection of the property that is recognized on the title to the land.

Use of and behaviour in parks, recreation areas, natural areas, and other open space within Meewasin and/or City jurisdiction is governed by bylaw. Meewasin sites outside of city limits, as well as Meewasin-owned SNG, fall under the Public Parks Bylaw 001. Within city limits, parks are subject to the Recreation Facilities and Parks Usage Bylaw, 1998 which also provides classes of City Parks. Natural areas are not specifically mentioned within the bylaw; where they exist, they are typically designated as Special Use Parks which allows for management such as burning and grazing recommended for a naturalized area[16]. Further investigation of the implications of these legal designations, under both local and provincial Acts, regulations, and bylaws, is required.

3.1.2 Conservation Easements

A conservation easement is a legally binding agreement between a landowner and an easement holder (such as Meewasin) that allows the landowner to protect the ecologically sensitive features of their

[14] The PDA permits public buildings and agricultural uses on municipal reserve lands.
[15] Cary Humphrey, Manager, Leisure Services Branch, personal communication.
[16] Gary Pedersen, Naturalized Park Supervisor, City of Saskatoon, personal communication.

property in perpetuity, retain title, and be eligible for enhanced income tax benefits. Meewasin holds five Conservation Easements under Environment Canada's Ecological Gifts Program (EGP), including one within the Northeast swale near Clark's Crossing. This easement includes 28 ac of native prairie that contains wildlife habitat and a natural corridor to the South Saskatchewan River as well as other natural and historical features including remnants of the Telegraph[17] and Moosewood-Batoche trails. The easement permits management of the area with grazing but protects it from cultivation, development, introduction of non-native invasive plants, dumping of any materials, and other activities that will degrade the site. The landowner receives a tax deductible receipt for the Fair Market Value of their gift.

3.1.3 Recommendation

Potential legal instruments to protect the Northeast swale should not restrict, limit, or otherwise encumber the resource management activities recommended in this document, including future development of passive recreational, educational, and interpretive facilities.

- Pursue long term legal protection of the Northeast swale and the greater swale:
    - Provide input to the City's UH sector plan revision process to ensure it aligns with Meewasin's mandate, policy, and priorities, particularly with respect to sites within Meewasin's jurisdiction; this should include the integration and protection of the Northeast swale;
    - Consider designating Northeast swale lands as Environmental Reserve within the city;
    - Work with the RMs of Corman Park and Aberdeen to better understand land development pressures in and around the greater swale and recommend that sensitive areas be designated as Environmental Reserve should development (subdivision) occur
    - Investigate the management and funding implications of designation of the Northeast Swale as discussed above;
    - Work with the City and other private landowners to enter into Conservation Easement Agreements;
    - Update the Northeast Sector Policy to incorporate current information and priorities for the Northeast swale.

3.2 Management of the Northeast Swale

The fescue grassland has moisture and soil conditions that are conducive to tree growth but because of disturbances such as fire, grazing, and drought, grassland conditions were historically maintained (Romo, 2003). The dynamic landscape achieved by these unpredictable applications is difficult to mimic within a remnant prairie such as the Northeast swale where disturbance no longer follows historic patterns.

The original grazers would have included bison, elk, antelope, mule deer, rabbits, prairie dogs, and grasshoppers and other insects (Moen, 1998). Before European settlement, it is estimated there were 50-70 million bison in North America (Saskatchewan Ministry of Agriculture [SMA], 2012). Most bison

[17] The Telegraph trail is a branch of the Fort Carlton trail which went from the Touchwood Hills to Fort Carlton (Enns-Kavanagh et al., 2002).

were migratory animals and Canadian herds roamed north to the Parkland where treed areas offered shelter, snow provided a water source, and the fescue grasslands offered forage for winter grazing (SMA, 2012). Nomadic bison would have removed large amounts of material including mostly grasses and sedges; created a lot of trampling which exposes soil and impacts woody vegetation and then moved to a new area. They had a vast range so a single patch of grassland would not be affected that often, allowing a lengthy rest period. Other ungulates including mule deer and elk would have browsed the trees and shrubs preferentially, as well as the grass and forbs.

Sheep grazing in the Northeast swale.

Burning was an important component of the traditional management regime, and contributed functions such as fuel reduction, preparation of the seedbed, disease control, shrub suppression, removal of litter, increased herbage yields, increased forage, and increased wildlife (Wright & Bailey, 1982). Fire was either intentionally or accidentally set by First Nations' peoples, or set by lightning strikes (Moen, 1998). Palliser noted "In autumn these fires were very common, when the grass is like tinder and a spark from a pipe may be sufficient to set 200 square miles of prairie in a blaze" (Palliser Expedition, 1857). The frequency and intensity of prairie fire has decreased with the settlement of the prairies due to fragmentation of the landscape and fire suppression (Wright & Bailey, 1982). It seems that the Great Plains were burned throughout the year, Peter Fidler's historical accounts from 1792-93 (Fidler, 1991) in southwestern Alberta stated "Every fall and spring and even in winter when there is no snow, these large plains either in one place or other is constantly on fire… The lightning in the spring and fall

frequently light the grass and in the winter it is done by Indians". It is generally accepted that fire played a much smaller role on the prairie since the settlement period circa 1900.

Mimicking the historical disturbance is not as simple as placing a bison herd within the swale and allowing uncontrolled wildfires. Maintaining large, free-ranging, and potentially destructive animals is logistically challenging. Other reserves such as Prince Albert National Park and Grasslands National Park are able to house free-ranging bison herds with 400 and 190 animals respectively (Parks Canada, 2009; Parks Canada, 2011). The Northeast swale, although a large natural area within Saskatoon, is only 300 ha and would not be appropriate for bison. Using bison as an economically productive management tool is likely possible outside of city limits, and can be seen within the greater swale near the Clarkboro ferry.

3.2.1 Management Zones

The Northeast swale has been separated into several management zones to account for the historical and more recent management, the ecological conditions, the presence of current and future roads (and the rehabilitation of existing roads), the surrounding land use, and the extent of disturbance. These zones are shown on Figure A-7, Appendix A. These management zones will allow the managers to tailor techniques to the differing conditions of the swale, as well as provide convenient breaks where fencing and other infrastructure can be used to facilitate management.

The connection of Meewasin's existing natural areas is recognized here by including Peturrson's Ravine, Crocus Prairie, and Saskatoon Natural Grasslands, with the potential to incorporate management over the larger scale. The U of S Reclamation site and adjacent lands are also considered as they form a connection between the Northeast swale and Meewasin's other sites. No management can take place without prior approval by the U of S and the City.

Transportation and utility corridors, identified on Figure A-8, Appendix A, are exempt from the management zones. Any portion of the corridor not used for road development will be managed with the adjacent management zone. The wetlands, as well as a 10 m riparian buffer, are their own management zone as they have very different management considerations. When wet, they will not be used for burning and grazing. However, the wetlands fluctuate over time so management of these areas will be adjusted accordingly, including the potential to burn or graze. Detailed discussion and recommendations on the wetlands in the Northeast swale can be found in section 3.2.6 and 3.2.10.

The Greenway is also shown on Figure A-7, Appendix A. As described in the cross-section of the Greenway in the 2012 *Development Guidelines* (Stantec), the Greenway consists of a 15 m ecological buffer, a 3-4 m trail zone, and a 3-5 m transition zone. Stantec recommends that the ecological buffer be maintained or seeded to native species and that the vegetation management be complementary with the Northeast swale management. Therefore, the specific management practices of the Greenway will be consistent with the adjacent management zone shown on Figure A-7.

3.2.2 Recent Management

Cattle grazed the Northeast swale in a continuous rotation throughout recent history as it was not suitable for cultivation or other development. In 2000, Delanoy (2001) noted that cattle were grazing in

a continuous rotation from May until November in zone 2. One bull and 25 cow/calf pairs were on site at that time and 3 of 4 quarters in zone 2 (NE, NW, SW of 18-37-5 W3) were in poor range condition due to the grazing management. SE-18 in zone 2, as well as zone 5 were not grazed. Zone 3 was moderately grazed with horses until 1988.

Grazing was discontinued from zone 2 of the Northeast swale in 2004. In 2008 Meewasin began a moderate grazing regime with cattle, goats, and sheep in zone 5. There were 520 cattle grazing days and 990 goat and sheep grazing days between June 20th and July 3rd, which translates to an approximate stocking rate of 1.42 Animal Unit Months per ha (AUM/ha). A grazing program was continued through part of the winter. Grazing did not occur in the summer of 2009 or 2010. In 2011 and 2012 Meewasin implemented sheep grazing into zone 2 of the Northeast swale at a very low stocking rate, primarily within the burn patches for both conservation management and as part of an interpretive initiative.

Other management within the Northeast swale since 2001 included mowing and spraying of smooth brome and other invasive plants. Leafy spurge has been monitored and control measures implemented including hand-picking, spraying, and bio-controls. Prior to 2009, most management was implemented in zones 4 and 5, as well as in nearby Crocus Prairie and SNG, and was in response to the ongoing threat of invasive species from the storm water retention ponds, associated haul roads, and nearby construction.

Prescribed burning was implemented in the Northeast swale in 2008. There were approximately 33 ha burned between 2008 and 2011 at different times of the year as shown in Table 3-3. These burns occurred mainly in zone 2 and zone 5 of the Northeast swale as shown in Figure A-9, Appendix A. In 2012, three burns were completed and will be mapped in the spring to determine the extent. Wildfire has impacted the Northeast swale as recently as the fall of 2000 when approximately half the natural area within the city was impacted (Delanoy, 2001). The safety of allowing wildfire within an urban environment is questionable so controlled fires are preferred. Additionally, wildfires are currently less prevalent as lightning strikes are less likely with only remnant natural areas remaining, careful control of litter, and active fire suppression. Areas impacted by wildfire are also shown in Figure A-9.

Meewasin personnel implementing a prescribed burn on the riverbank.

3.2.3 Literature Review of Conservation Management Practices

Fire and grazing were important for the healthy functioning and diversity of the prairie landscape. Romo (2007) states that, "The prairie landscape was, historically, a shifting mosaic of patches created by burning and grazing". Adopting some form of these management tools is important to maintaining a healthy remnant of grassland.

Romo (2003) has suggested using a state-space model (Turner, Romme, Gardner, O'Neill, & Kratz, 1993) to guide the reintroduction of disturbance as a process in remnant fescue grasslands. The state-space model considers the interval between disturbances as a proportion of the recovery time and the disturbed area as a proportion of the landscape to determine the amount of the remnant prairie that should be burned. The recovery time for the unique grassland present in the swale has not been measured. However, Kernen Prairie which is similar in both species composition and soil type, although not recent grazing practices, is estimated to recover from fire within 10-11 years (Romo, 2003). The grazing recovery interval on native prairie dominated by fescue grass was estimated at 12-24 months (Abouguendia, 2001).

Romo (1996) concluded from a review of the literature that fire in plains and mountain rough fescue communities can produce extremely variable responses due to the changing behavior of fire, the complexity of species interaction and the specific site and environmental conditions. He further concluded that this variability makes using fire a challenge as a tool for landscape management, as well as a benefit to ensure heterogeneity across the landscape.

Grazing following burning was shown to promote patch-level heterogeneity across landscapes as animals devoted 75% of grazing time within areas burned in the last year in tall grass prairie (Fuhlendorf & Engle, 2004). This approach, coupled with varying burn size and intensity over time can lead to a desirable shifting mosaic of grassland patches. However, Mori (2009) observed no increased preference of cattle (at 50% recommended stocking rates) to burn patches at Kernen Prairie, a remnant of fescue grassland.

In addition to using burning and grazing to maintain landscape level diversity, these tools have also been suggested as a means to control invasive species. Burning has caused a reduction in Kentucky bluegrass in the Central Great Plains (Knops, 2006; Stacy, Perryman, Stahl, & Smith, 2005). The Central Great Plains are in the tall grass prairie ecoregion where many of the native grasses are warm season (C4) species unlike smooth brome and Kentucky bluegrass which are cool season (C3) species. In the swale, many of the native grasses including rough fescue and western porcupine grass are C3 species meaning that the invasive grasses are functionally similar to native grasses in the Northern Great Plains and will respond more similarly to disturbances, making fire and grazing less effective. However, a study in the Northern Great Plains (Hendrickson & Lund, 2010) found that Kentucky bluegrass decreased with both burning and burning following a chemical application. This same treatment caused an increase in smooth brome indicating that both treatments are necessary and need to be adapted to the specific composition of the area to be managed.

At SNG there was a slowing of Kentucky bluegrass, although not a significant reduction, after 2 burns in 10 years (Godwin & Thorpe, 2004a). The authors suggest that more frequent burns would have a greater effect as would the introduction of grazing. A further study (Godwin & Thorpe, 2011) looked at grazing at SNG and found that while Kentucky bluegrass increased in both grazed and ungrazed areas, the increase was significantly less in the grazed areas. They also found that the goats and sheep used at this site preferentially grazed shrubs and woody material and resulted in a significant decrease in woody expansion. They concluded that grazing had a positive effect at SNG and that more prolonged grazing be incorporated into future management.

The main grazing animals available are cattle, goats, and sheep. The dietary preference of all three species is shown in Table 3-1. Cattle's preference for grasses has been shown to result in an increase in broad-leaf weeds and shrubs in a pasture exclusively grazed by cattle (Goodwin, Sheley, Nowierski, & Lym, 2006). In contrast, sheep and goats both consume non-grass species for the majority of their diets so grasses tend to increase (Goodwin et al, 2006). Sheep have been a successful management tool against leafy spurge. Leafy spurge is unpalatable and toxic to cattle and horses, while sheep and goats are not affected (Muller, Fay, & Petersen, 1990 as cited by SMA, 2008).

Table 3-1. Relative proportions of grass, forbs, and browse in the diets of cattle, sheep, and goats from Taylor (1981)

Kind of Forage	Cattle	Sheep	Goats
Grass	60%	40%	20%
Forbs	20%	40%	30%
Browse	20%	20%	50%

Winter and fall grazing generally seems to have a more significant impact on non-native grasses than spring or summer grazing. While spring grazing can be detrimental to native species (Bailey et al., 2010).

3.2.4 Management Challenges

There are several major management concerns that need to be addressed at the Northeast swale including the invasion of non-native plants such as invasive grasses and noxious broadleaf weeds and the encroachment of woody species. The lack of natural disturbance such as fire and grazing, the introduction of invasive species from nearby construction projects, the increasingly fragmented landscape, and other impacts related to the increasingly urban environment have all resulted in the expansion of these problems. The result is a landscape that is both compositionally different from the historic Northern Great Plains grasslands, as well as less diverse.

3.2.4.1 Noxious and Nuisance Weeds

Several non-native species are found in the Northeast swale and are considered invasive. Some species such as absinthe, bird's foot trefoil, bird vetch, burdock, cicer milk vetch, scentless chamomile, reed canary grass, tansy, nodding thistle, caragana, European buckthorn, Siberian elm, and alfalfa are relatively low in numbers. These species are recent invaders and should be monitored and removed as soon as possible as they are still more easily controlled with small scale treatments. Other species such as Canada thistle, perennial sow thistle, smooth brome, leafy spurge, sweet clover, Kentucky bluegrass and wolf willow are more established within the Northeast swale. Management of these species will require a long term effort and commitment with an integrated approach that includes burning, grazing,

mowing, chemical treatment, and biological control. A list of the most important invasive species found in the swale is given in Table 3-2.

Table 3-2. Invasive species found in the Northeast swale and their provincial designation

Species	Designation*
Absinthe	Noxious
Canada thistle	Noxious
Common burdock	Noxious
Common tansy	Noxious
European Buckthorn	Noxious
Leafy spurge	Noxious
Nodding thistle	Noxiuos
Perennial sow thistle	Noxious
Scentless chamomile	Noxious
Bladder campion	Noxious
Reed canary grass	None
Smooth brome	None
Alfalfa	None
Bird vetch	None
Bird's foot trefoil	None
Kentucky bluegrass	None
Sweet clover	None
Cicer milkvetch	None
Caragana	None
Siberian elm	None
Alfalfa	None

*Designation of Prohibited, Noxious, and Nuisance Weeds in Accordance with *The Weed Control Act 2010*.

Invasion of non-native and noxious species is a continuous challenge in the Northeast swale. The proximity to areas of development such as Fedoruk Drive, the City's rock storage (north of Agra Road), and the storm water ponds all add to the invasion of these species. Unfortunately, current construction practices involve stripping and movement of topsoil without proper follow up with seeding and weed control. Future neighbourhood development along the Northeast swale will likely increase this source of seeds. Continued use of haul roads, management trails, and existing grid roads all provide a potential means for seeds to be transported into the Northeast swale. This is particularly a problem along the wetland margins where changes in water level leave a disturbed draw down area. Under natural conditions the draw down area facilitates the establishment of sedges and other wetland seral species. However, the noxious weeds often have a competitive advantage and will quickly colonize the area to the detriment of the native species.

3.2.4.2 Expansion of Kentucky Bluegrass

Kentucky bluegrass occupies much of the landscape. In 2001, 9.1% of herbaceous cover was Kentucky bluegrass, second only to western porcupine grass in abundance. Although, it is unknown whether Kentucky bluegrass is truly an invasive species[18] or if it was actually present in the low slope positions as it is found now (Coupland [personal communication] as cited by Delcan, 1994), there appears be a trend toward an increase in Kentucky bluegrass in the moister, heavily grazed areas which is a typical response

[18] The Resource Management Plan for Saskatoon Natural Grasslands (Delcan, 1994) describes the controversy of whether or not Kentucky bluegrass is a native species and if this should change the management approach.

of Kentucky bluegrass to heavy grazing pressure (Weaver, 1954; Looman, 1982; Trottier, 1986 as cited by Delcan, 1994). However, vegetation has not been resampled since 2001; a detailed sampling program is required to quantify the expansion of the species. Similar landscapes on adjacent natural sites including SNG and Crocus Prairie indicate expansion of Kentucky bluegrass in the period 1994 to 2007 (Godwin & Thorpe, 2004b). At the Northeast swale, the drier positions, particularly on the ridge tops, are relatively free of Kentucky bluegrass. On wider, flatter ridges, some recent encroachment is evident. However, these are currently maintained with spot control.

3.2.4.3 Encroachment of Woody Species

Woody invasion is one of the biggest challenges in grasslands (Grant, Madden, & Berkey, 2004; Burkinshaw & Bork, 2009) with effects on overall biodiversity including a decrease in grassland bird populations. Grant et al. (2004) found that even 25% woody cover (primarily aspen and willow) resulted in habitat unsuitable for nine grassland bird species such as savannah sparrow, bobolink, grasshopper sparrow, Baird's sparrow, chestnut collared longspur, upland sandpiper, western meadowlark, Le Conte's sparrow, and sedge wren.

Wolf willow is a native shrub; however, in the swale its presence appears to be associated with a decrease in native grasses and forbs and a resulting decrease in diversity. Wolf willow in the Northeast swale is often found in a community with Kentucky bluegrass and snowberry; other weedy species such as brome grass, Russian pigweed, bluebur, and thistles are also found with it. At SNG, wolf willow increased from 7.9% to 18.6% of the total cover, an 85% increase over ten years, while overall shrub cover increased from 7% to 18.6% (Godwin & Thorpe, 2004b) Over the same period, there was a corresponding increase in Kentucky bluegrass and a decrease in overall number of species (Godwin & Thorpe, 2004b). The reduction of grassland that results from the increase in woody species can have an overall effect on species diversity (Godwin, Thorpe, Pivnick, & Bantle, 1998) and species richness (Bowles & Jones, 2004). Godwin et al. (1998) found that the largest variety of plant and animal species is within the transition area between aspen groves and open grass while Bowles & Jones (2004) measured a general decline in native species richness as woody vegetation increased on 62 Chicago area prairies.

Wolf willow appears to be spreading in the south end of the Northeast swale shown by the dome shape formations with older trees in the center and younger trees near the edge. This indicates that every year the extent of the patch expands. East of Lowe Road (zones 1, 2, and 3), these formations do not occur. Instead wolf willow patches are more uniform in size and age. Random sampling of the age of wolf willow at the Northeast swale indicated that wolf willow plants found at the center of the patch as well as at the edge are approximately 10 years old. Younger plants aged at 1-2 years are scattered throughout the landscape, but not found within the patches. One explanation for the seemingly limited expansion of wolf willow in the last ten years is that the stress incurred during the severe drought of 2000-2002 coupled with wildfire that burned much of the Northeast swale east of Lowe Road has affected the wolf willow. It may indicate that similar stress with fire and/or grazing could provide control for wolf willow. However, further study is required to determine the significance of these findings and to understand the implications for management and biodiversity.

Shrub encroachment is a wide-spread problem on the Canadian prairies since the settlement of the prairies and the removal of fire and grazing. As early as the 1920's, Moss (1955) observed the encroachment of shrubs and trees into Alberta grasslands. A comparison between the southern and central Parklands of Alberta showed an increase of shrubs and trees from 5% in the 1900's to 15% in 1980 in the southern Parklands and from 15% to 80% in the Central Parklands (Bailey, 2008a). In Saskatchewan, the Prairie Farm and Rehabilitation Administration (PFRA) pastures have noted woody encroachment as a problem on 32 of their 87 pastures (Luciuk, Bowes, Kirychuk, Weins, & Gaube, 2003). Of these 32 pastures, 28 are at least 40% covered by brush which is expanding at 2% per year (Bowes, 1998). Luciuk et al. (2003) suggests that the brush encroachment is more severe on pastures that were previously treed, but may also be related to the ongoing grazing management practices.

3.2.5 Burning Program

As suggested by Romo (2003), burning should be attempted every month of the year. In reality, this is unlikely as conditions throughout December to March are often unfavorable for burning, though not impossible. Burns should vary in frequency, intensity, and space in order to create the most heterogeneous effect on the landscape. The state-space model (Turner et al., 1993) can help predict how often and how much of the landscape to burn to both allow complete recovery of the structure, composition, and function as well as creating enough disturbance to enhance biodiversity. For fescue prairie, with a recovery interval of 10 years; approximately 25-75% of the remnant should be burned every 10 years. This results in at least 2.5-7.5% of the remnant to be burned each year. The state-space model further instructs that the widest range of burn patch sizes as well as fire return intervals be included.

Since Meewasin started tracking burned areas in 2008, approximately 33 ha, or 18.7% of the upland area of theNortheast swale has been burned. Table 3-3 shows the actual burn size per year (from 2008-2011) as compared to the recommended burn size. As shown, the total area burned within the Northeast swale and connected natural areas is within the recommendations of the state-space model. However, zone 2 has received the most burning, while other areas have received little to no burning. Wildfire has also affected much of the natural area within the Northeast swale.

Table 3-3. Burns in the Northeast swale and connected natural areas from 2008-2011, and recommended annual burn size

Management Zone (Figure A-8)	Total Area* (ha)	Burned Area** (ha) between 2008-2011	Annual burned area (ha/yr)	Recommended annual burn size (ha/yr)
Northeast Swale				
Management Zone 1	16.5			0.4-1.2
Management Zone 2	95.2	30.57	7.64	2.4-7.1
Management Zone 3	13.8			0.3-1.0
Management Zone 4	12.8			0.3-1.0
Management Zone 5a	4.1			0.1-0.3
Management Zone 5b	33.3	2.30	0.57	0.8-2.5
Northeast Swale Total	175.6	32.9	8.2	4.4-13.2
Connected Natural Areas				
Peturrson's Ravine	18.1	1.37	0.34	0.5-1.4
Crocus Prairie	28.8	4.16	1.04	0.7-2.2
U of S Reclamation Site and Adjacent Land	16.0	9.33	2.33	0.4-1.2
Saskatoon Natural Grasslands	13.9	8.4	2.09	0.3-1.0
Natural Areas Total	78.5	21.9	5.81	1.9-5.8
Northeast Swale and Natural Areas Total	**361.2**	**89.0**	**14.03**	**6.3-18.9**

* Wetland area not included
** Includes wildfires and prescribed burns

The burning program must balance the cost implications, safety, and the requirements of the landscape. The size of the burn can have a direct effect on the cost of the burn with larger burns being less expensive per area burned. The preparation of the fireguard is the most labour intensive and costly part of a burn so reducing the perimeter to area ratio of the burn results in a more cost effective scenario. Roads and wetlands are both examples of existing fireguards that can be used when conducting a burn. Table 3-4 shows the personnel costs of various burns completed by Meewasin.

Table 3-4. Personnel costs for selected prescribed burns completed by Meewasin in 2010 and 2011

Location	Person Hours	Burn size (ha)	Total Cost of Burn	Unit Cost ($/ha)	Fireguards required
Northeast Swale	24	0.72	$552	$760.28	yes
Northeast Swale	32	1.9	$696	$368.51	yes
Cranberry Flats	3	0.2*	$69	$343.62	no
Beaver Creek	5	1.2*	$128	$105.83	no
Northeast Swale	10	5.3	$255	$47.88	no
Oliphant's Acreage	15	12.0*	$345	$28.64	no
Northeast Swale	37.5	14.4	$788	$54.72	yes
Northeast Swale	30	1.8	$765	$415.93	yes

*Estimated area

These same costs are used to show the relationship between burn size and the unit cost of burns completed by Meewasin in Figure 3-1. As shown, smaller burns are more costly per unit area than larger burns whether or not a fireguard is needed. Burns that do not require a fireguard are less costly for the most part. However, the two largest burns had similar costs per unit area even though only the 12 ha burn required a fireguard.

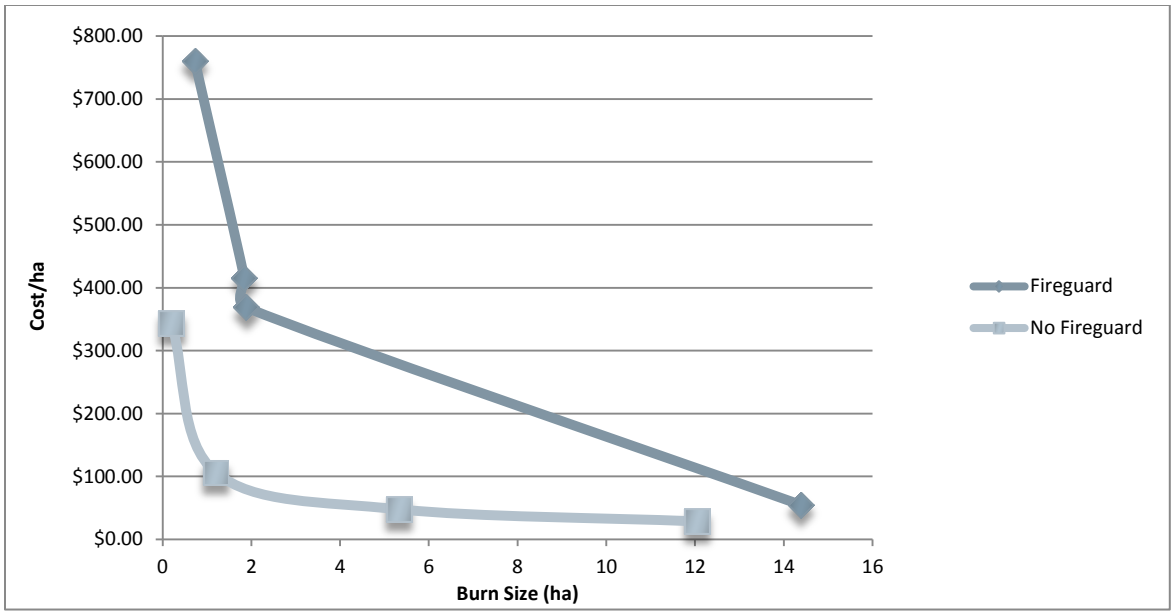

Figure 3-1. Comparison of Burn size to the cost/ha of burns in the Meewasin Valley for burns with or without fireguards.

The incomplete burning that occurs in marginal conditions results in a patchwork of burned and unburned areas which effectively results in multiple micro-burns and helps meet the recommendations of the state-space model (Turner et al., 1993). It is therefore beneficial to burn under these conditions to achieve the effect of multiple small burns while still maintaining the economic efficiency associated with large burns. Burning when there is green grass with an intact litter layer can sometimes result in patchiness while burning when there is partial snow cover always does. Green grass occurs between mid-May and early September on land that has not been burned or intensively grazed in the last year. Drawbacks to burning under this condition included substantial smoke production and potential disturbance to nesting birds. Disturbance to birds can be alleviated by dragging for nests prior to burning; however, this contributes additional costs to the program. Patchy snow cover occurs in the early spring (March or April) in landscapes with strong relief like that found in zone 2 of the Northeast swale; it is especially likely after a winter with heavy snow. These conditions can also occur through the winter when snows partially melt, particularly in October or November.

An example of a burn done in patchy snow is the burn conducted in April of 2011 in the Northeast swale. The total area burned was 14.4 ha. The combination of large size and no need for fireguard construction resulted in a reasonable unit cost of $54.72/ha. The burn actually resulted in numerous micro-patches of burned and unburned area, as shown by the Northeast swale burn of 2011 on Figure A-9, Appendix A.

3.2.5.1 Safety and Communications

Meewasin follows a safety protocol designed by the province for prescribed burning, and only attempts *basic* fires as determined by the *Prescribed Burn Complexity Rating Guide* found in Appendix E. In order to complete a burn, a *Prescribed Burn Proposal* (also found in Appendix E) is completed by the Resource Conservation Officer, signed by the Manager of Planning and Conservation and the Chief Executive

Officer and submitted to Saskatoon Fire and Protective Services for their approval. Affected stakeholders, including all nearby landowners, are contacted either by phone or by an information pamphlet dropped in their mailboxes. Being able to make use of particular conditions conducive to burning, requires flexibility in when to burn as site conditions change rapidly. Currently, a burn permit is submitted to the Saskatoon Fire Department for approval which can take up to 2 days. If this process was streamlined, Meewasin could burn as soon as ideal conditions presented themselves and have a more effective and efficient process.

3.2.5.2 Recommendations

- Burn at least 25% and up to 75% of the landscape in a 10 year period[19]. This works out to an average of 2.5% and up to 7.5% of the landscape per year; the annual allocation can vary:
  - Burn size will be randomly determined between 5 and 20 ha to ensure efficiency. Burning during marginal conditions (snow cover or green grass with litter) can result in patches smaller than 5 ha. Occasionally smaller burns may be implemented;
  - Use an opportunistic approach to determine the timing of burns that takes advantage of changing weather conditions and makes an effort to burn in all seasons;
  - Determine burn location based on site constraints of the Northeast swale to allow for the maximum use of natural fire breaks;
  - Establish a 5 ha non-burn patch in each management zone as a control;
  - Burning conditions will determine the type of burn between head, back, or flank fire. If conditions allow for any type then it will be randomly determined;
  - Recognize that variable conditions will result in varied burns and recovery intervals;
  - Monitor changes in the landscape, looking at recovery intervals, species composition, diversity, and compare to controls to adapt management as necessary;
  - Highest quality prairie should be burned first if resources are limited.
- Ensure safe practices are used and effective communications are maintained:
  - Attempt only basic prescribed fires as defined in the provincial prescribed fire operations manual;
  - Establish an occupational health and safety protocol for burning;
  - Work toward streamlining the permitting process with Saskatoon Fire and Protective Services to allow for an opportunistic approach that still ensures Fire and Protective Services are kept aware of prescribed burning;
  - Continue to communicate burns with affected landowners.

[19] Naturally occurring wildfires are undesired, in the event that they occur the area affected will be considered within the total burned that year.

3.2.6 Grazing Program

Grazing should follow many of the same principles as burning in order to achieve a heterogeneous landscape. As noted in the literature review, grazing can have a very positive effect on the landscape in terms of increasing heterogeneity and overall biodiversity if implemented carefully.

3.2.6.1 Type of Animal

Animals available for grazing management include cattle, sheep, and goats. As shown in Table 3-1, these animals preferentially graze on different plant material. Multiple species grazing is desirable but might not be practical. Sheep are an ideal grazing animal as they eat equal amounts of forbs and grass as well as some browse. They can also be free-ranged with the use of dogs to provide a very natural grazing pressure across the landscape. Paddocks can easily be constructed with portable electric fencing to facilitate specific weed management and brush control. The sheep program that Meewasin has run for several years (2004, 2005, 2011, and 2012) has had significant added value in its interpretative appeal. However, this program is a net cost, partially because of the great benefit derived from the interpretive program but also because of the constraints of the site and the type of animals. Sheep and goat are both marketable meat products, and revenue generating models should be considered.

Meewasin's management will continue to use sheep. However, goats should be considered if an appropriate contractor can be located. Goats prefer woody material, can handle steep terrain as found in certain areas of the Northeast swale (zone 2 and zone 4), and are free-ranged in a similar way to sheep. The management requirements and recommendations are very similar between goats and sheep.

Goats grazing at Saskatoon Natural Grasslands in 2008.

Cattle's diet may actually be most similar to bison as bison eat primarily grasses, sedges, and forbs and infrequently eat brush (Bailey, 2008b). Bison would have trampled the woody vegetation, and so intensive rotational grazing with cattle has the potential to mimic what the bison accomplished on a smaller scale. Grazing with cattle should be considered using a revenue-generating model that is beneficial for the landscape. In order to maintain a revenue positive model, cattle would not likely be attended at all times as suggested with sheep and goat grazing which increases the risk for the animals, as well as for the surrounding urban areas. Cattle grazing, especially at high stocking rates or in a continuous grazing system, can be detrimental to the prairie and the wetlands, as was seen with the overgrazing that occurred in 2001 (Delanoy, 2001). Additional infrastructure, especially fencing, will be required to manage the cattle in a sustainable grazing system. Finding a producer willing to graze cattle in the swale has been challenging as it is a relatively small area with many constraints.

3.2.6.2 Carrying Capacity and Stocking Rates

There are no published stocking rates for the moist mixed grassland ecoregion in which the Northeast swale is located. Thorpe (2007a) gives stocking rates for loam ecosites (as found in most of the Northeast swale) for similar plant communities (Western porcupine grass/northern wheat grass/sedge pasture sage[20]) in both the mixed grassland and the aspen parkland of 0.72 and 1.1 AUM/ha respectively, as shown in Table 3-5.

Table 3-5. Published stocking rates for similar community type, Ecoregion, and Ecosite as found in the Northeast swale

Community	Stocking Rate (AUM/ha)	Ecoregion	Ecosite
Western porcupine grass/ northern wheat grass/sedge pasture sage*	0.72	Mixed Grassland	Loam
Western porcupine grass/ northern wheat grass/sedge pasture sage*	1.1	Aspen Parkland – drier part of the region	Loam
Plains rough fescue/western porcupine grass/sedge**	1.0	Mixed Grassland – moister regions	Not given
Western porcupine grass/ northern wheat grass/sedge pasture sage***	0.65	Mixed Grassland	Thin

*Thorpe, 2007a;
**Bailey et al., 2010
***Thorpe, 2007b

The Management of Canadian Prairie Rangeland (Bailey et al., 2010) gives specific recommendations for plains rough fescue-western porcupine grass-sedge range types found in moister regions of the mixed grass prairie, and gives an "ecologically sustainable stocking rate" of 1.0 AUM/ha[21] (0.40 AUM/ac) and is

[20] The western porcupine grass/northern wheat grass/sedge/pasture sage community is considered 71% similar to the reference community in the mixed grass prairie ecoregions and 52% similar to the reference community in the aspen parkland (Thorpe, 2007a).

[21] AUM is an Animal Unit Month and is the amount of dry forage required by one animal unit for one month based on a forage allowance of 26 pounds per day. One animal unit equals one 1000lb cow with her calf or 5 sheep or goats. In this report AUM's are used to define stocking rates – as in the number of AUM/ha that a pasture can support. AUM is also used in carrying capacity ($Carrying\ capacity = stocking\ rate\ \left(\frac{AUM}{ha}\right) \times\ total\ land\ (ha)$); or utilization (number AUMs taken from unit B) (Johnson, 1997).

also shown in Table 3-5. While a more site specific stocking rate could be determined from assessing the yield of the grassland, no measurements of above ground cover or biomass have been collected since 2001. At that time, the range was in poor condition due to overgrazing of cattle and likely had lower than average biomass production due to the dry conditions (Delanoy, 2001).

Other factors to consider when determining the carrying capacity and stocking rate:

- Grazing animals should be discouraged from grazing in the wetland edge as they can have a detrimental effect on the water quality, hydrologic function, wildlife habitat and population, and plants including rare or culturally important species such as sweet grass, western red lily, and narrow-leaved water plantain. Additionally there are species poisonous to grazing animals including seaside arrowgrass and water hemlock. Therefore, approximately 10 m around each wetland should be considered the riparian buffer[22] and not be included in grazing calculations to reduce the risk. Excluding this land reduces the overall carrying capacity both because it reduces the amount of land available for grazing, as well as lowering the productivity of the land. Wetland margins are generally one of the most productive parts of a landscape.
- The rates given in Table 3-5 are intended for use by the agricultural industry and are the highest stocking rates that a prairie can sustain to maximize production. Unfortunately, there are no published minimum stocking rates needed for conservation grazing purposes. However, Kernen Prairie was grazed at 50% of the recommended stocking rate when testing the interaction of grazing and fire (Mori, 2009).
- Runway soils are the primary soil type found in the Northeast swale (Acton & Ellis, 1978). On the ridges, such as found in zone 2, these can be expected to be thinner soils, as described by Thorpe (2007b) with a lower stocking rate of 0.65 AUM/ha in Mixed Grassland.
- The interaction between fire and grazing is not well researched but presumably some reduction in stocking rate is necessary in a landscape affected by fire.
- Resident deer populations are estimated at about 5-10 white-tailed deer and 5-10 mule deer (Delanoy, 2001). Deer have an AUM equivalency of 0.25, so each month they would contribute 1.25 to 2.5 animal units, which is the equivalent of 60-120 sheep grazing days. Although this is fairly insignificant, it should be considered.

Considering the above points, it is recommended that for conservation grazing purposes the stocking rate be set at 75% of the lowest published stocking rate (0.72 AUM/ha) for each ecosite (thin or loam) given in Table 3-6. The exact distribution of thin and loam ecosites is unknown. However, the varied relief in zones 2 and 5 suggest equal distribution of both. While a loam ecosite is assumed throughout zone 3, as well as in Crocus Prairie, SNG, and the U of S Reclamation site. However, if a revenue generating model is attempted, then maximizing stocking rates may be more beneficial. A maximum stocking rate of 1.1 AUM/ha is suggested for loam ecosites, and 0.65 AUM/ha for thin ecosites. The calculated minimum and maximum stocking rates for each management zone is give in Table 3-6 as well as the sheep grazing days supported by each zone, and the carrying capacity.

[22] As recommended in the Environmental Farm Plan (Provincial Council of ADD Boards, 2008).

Table 3-6. Sheep grazing days required in Northeast swale management zones at given stocking rates

Management Zone	Area (ha)	Portion of Zone "Loam Ecosite"	Min. Stocking Rate (AUM/ha)	Max. Stocking Rate (AUM/ha)	Min. Sheep Grazing Days	Max. sheep Grazing Days	Min. Carrying Capacity (AUM)	Max. Carrying Capacity (AUM)
Northeast Swale								
Zone 1	16.5	100%	0.54	1.10	1333	2716	9	18
Zone 2	95.2	50%	0.51	0.88	7281	12492	49	83
Zone 3	13.8	100%	0.54	1.10	1119	2279	7	15
Zone 4	12.8	100%	0.54	1.10	1033	2105	7	14
Zone 5a	4.1	50%	0.51	0.88	317	544	2	4
Zone 5b	33.3	50%	0.51	0.88	2547	4370	17	29
Sub Total	**282.7**				**13705**	**24505**	**91**	**163**
Connected Natural Areas								
Peturrson's Ravine	18.1	0%	0.49	0.65	1322	1763	9	12
Crocus Prairie	28.8	100%	0.54	1.10	2332	4751	16	32
Reclamation Site*	16.0	100%	0.54	1.10	1298	2645	9	18
SNG	13.9	100%	0.54	1.10	1125	2292	8	15
Sub Total	**76.8**				**6078**	**11450**	**41**	**76**
TOTAL	**359.5**				**19783**	**35955**	**132**	**240**

*Also includes adjacent City-owned lands; grazing is not recommended at this time, further information is needed.

3.2.6.3 Grazing Options and Recommendations

- Sheep and/or goat grazing
    - Grazing with sheep and/or goat for appropriate number of grazing days, as shown in Table 3-6 in zones 2 and 3;
    - Flock size can vary within the recommended stocking rates with larger flocks for less days or the converse. Attempts to increase flock size where appropriate should be made in order to achieve economies of scale, for instance larger flocks (>300 animals) are encouraged within zones 2-5;
    - Ensure flock size is manageable within the urban landscape and within the area. Connected natural areas that are smaller in size and surrounded by the urban community should not exceed 150 animals.
    - Grazing can occur in all seasons. However, grazing between early April and late May should only occur every 2-3 years;
    - A recovery interval of 1-2 years should be applied with no more than 1/3 of the area within the swale to be grazed each year. However, to mimic the natural patchiness, these areas should not be rigorously controlled;
    - The manager (shepherd) should monitor the quality of forage and ensure sheep are moved to a new area when grazing reaches 80-90% removal;
    - Annual monitoring should occur of grazed areas to adjust stocking rates if necessary;
    - Due to the urban context it is advisable to provide constant husbandry of the grazing animals;
    - A communication strategy should be employed to facilitate the grazing program that includes contacting nearby landowners about any upcoming grazing as well as associated risks. The communication strategy can extend to the general public, schools,

and other organizations to increase general awareness about grazing and its benefit to the landscape.

- The Northeast swale has areas that are compromised such as the valleys which were traditionally overgrazed and are very dissimilar from the reference community. These patches can still benefit from grazing, but are not the highest priority. Instead the highest quality patches that are threatened by a lack of management should be targeted first. Additionally, grazing should target burned areas and in some cases include management of invasive or noxious species.

- Cattle grazing combined with sheep or goat grazing:
  - Stock cattle within recommended stocking rates given in Table 3-6 less the number of sheep or goat grazing days;
  - Source out nearby cattle producers that require custom grazing. Payment arrangements should take into account the expectations of the producer and Meewasin as well as the nutritional content of the native pasture, and the risks associated with grazing in an urban environment. In a typical custom grazing arrangement the producer is charged a rate based on land area or number of animals. The land manager (Meewasin) is responsible for ensuring the cattle's needs are met throughout their stay on the land;
  - Use sheep and goats in lesser numbers to graze before cattle to target invasive species and woody encroachment;
  - All zones can be grazed with a combination of small ruminants and cattle;
  - Cost/benefit analysis of cattle grazing should be considered before entering into any arrangements.

3.2.6.4 Fencing

In order to facilitate grazing, a permanent perimeter fence will be needed around zones 2 and 3 including the ecological buffer. A fence already exists around most of zone 2 as shown on the management map. However, this will need to be upgraded to a fence appropriate to the type of grazing system that is implemented and that meets the needs of the UH neighbourhood design. For instance a low page wire fence that can keep small grazing animals in or a slightly higher 2-3 strand fence for cattle. The fence must allow wild mammals including deer, moose,

Meewasin constructing a wildlife friendly fence in Canam Park, a naturalized park in Evergreen connected to the Northeast swale.

coyote, fox, and small rodents to pass over or through while still containing grazing animals. It also must allow human movement. Human movement may also be facilitated through formal entrance points that are discussed in section 3.4. The fence will act as the secondary containment for the grazing animals; primary containment will either be with electric fencing or controlled by the shepherd. In the long term, the fence will need to be relocated so that it directly bounds the swale. Electric fencing poses a small risk, especially to those with pacemakers, and should have adequate signage identifying it as a potential risk.

- Upgrade fence to a wildlife friendly design that is appropriate for the type of grazing animals being used and that allows for human movement into the Northeast swale
- Ensure electric fences are well signed to communicate to the public that the fence contains a charge and is a potential risk.

3.2.7 Control Invasive Species and Noxious Weeds

An integrated management approach is necessary when looking at invasive species. Fire and grazing will be the main methods of limiting the spread of weeds by increasing the health and resilience of existing vegetation. Coupled with this long term plan, is the need for ongoing monitoring through the efforts of an ecological groundskeeper and from incidental reports from site users that will allow for weed removal at an early stage of invasion. Follow up monitoring and subsequent weed control is particularly important in the growing season after a burn as fire can stimulate weed growth, and the disturbed area is susceptible to weed invasion.

Wherever possible, weed control is completed through mowing, rogueing, or biological agents instead of chemical treatments. Biological controls have been effective on leafy spurge, nodding thistle, and scentless chamomile. Mowing can provide adequate weed seed control and stress taller vegetation. Mowing and weed whipping are more common in zones 4 and 5 to counteract ongoing invasion from thistles. Rogueing is an important but labour-intensive aspect of the weed control program. It has had an impact on nodding thistle, absinthe, bird's-foot trefoil, bird vetch, burdock, tansy, and small patches of reed canary grass.

While chemical treatment is avoided whenever possible, it is sometimes the only practical method, especially for creeping or deep rooted species such as alfalfa, cicer milkvetch, smooth brome grass, crested wheat grass, Canada thistle, and sweet clover. Chemical amounts can be reduced by wiping the chemical directly onto a taller plant without impacting the intact understory of native plants. This is practical for tall plants such as sweet clover, Canada thistle, and bromegrass. For large patches Meewasin has an 80" wide wick mounted on a quad and for small patches a hockey style hand applicator is available. A broadleaf specific chemical can be used to select broadleaf weeds where intermixed with grasses or vice-versa. Particular grassy plants can be selected where mixed with other grasses and broadleaf plants by spraying very early or late in the season. An example is using glyphosate to select Kentucky bluegrass from most native plants when spraying towards the end of October. Many other weeds tend to grow very early or late in the season when many native plants are dormant and are very visible. An example is nodding thistle in the understory of snowberry. Woody plants are also very difficult to manage without chemical treatment. Distribution of European buckthorn, Siberian elm, and caragana are still very limited, so chemical treatment is a viable way to control them. Meewasin is

working cooperatively with the City pest control branch to reduce invasive species including leafy spurge, absinthe, tansy, nodding thistle, and burdock. The RM of Corman Park is also active in the control of leafy spurge and other noxious weeds.

3.2.8 Adaptive Management

Management of the upland native prairie involves the above recommendations for type and amount of grazing and burning, as well as targeted treatment of certain invasive species. However, we recognize that an adaptive strategy is necessary to be successful. Adaptive Management involves a balance between management and gaining knowledge about the ecosystem through our mistakes and success and can lead to better decision making (McCarthy & Possingham, 2007). Adaptive Management is different than trial and error, because it involves a clearly specified management objective, a way to recognize if management is successful, as well as monitoring how the ecosystem reacts to management (Hauser, 2008). One of the overarching conservation objectives of this RMP is to "protect and restore biodiversity inherent in the Northeast swale", for the purpose of adaptive management a more specific objective is needed:

Invigorate the native grass and forb species to achieve a grassland in good to excellent health with no loss of native biodiversity.

The realization of this objective can be measured by:

- Assessing the health of the rangeland by looking at how similar it is to the reference community;
- Measuring the invasion of non-native species;
- Quantitatively assess species diversity using an index such as the Shannon-Weiner Diversity index;
- Documenting the continued presence or loss of key species including rare and endangered species.

3.2.9 Monitoring and Research

In order to achieve an adaptive management approach, we need to continually monitor and assess the Northeast swale. The most current data we have is from 2001 and conditions have changed. Some suggested follow up assessments to be completed at regular intervals (for instance every 10 years) include:

- Determine species cover by resampling quadrats from 2001 that fall within the reduced boundary that excludes cultivated land and any areas that will become part of the UH neighbourhoods;
- Complete a yield assessment:
    - Stocking rates are more accurate when based on the actual biomass production of the pasture and can be estimated from basal cover (Thorpe & Godwin, 1992);
- Compare species composition of burned versus unburned areas over time to assess the affect of burning on diversity and to assess the burn recovery interval for the Northeast swale;

- Measure the change in woody encroachment over time by looking at historical air photos and comparing them to current ones using a similar method to what was completed at SNG (Delcan, 1994);
- Assess wetlands using the same methods used in 2012 (Minnesota Board of Water and Soil Resources) to complete a functional assessment to monitor the ongoing health and function of the wetlands.

Many of these projects are beyond Meewasin's current resources for in-house study but would be great opportunities for master's projects and research partnerships with the U of S or Saskatchewan Research Council (SRC).

3.2.10 Wetland Management

Wetlands have different management requirements than the uplands, including:

- Limiting access from grazing animals, either through exclusion fencing, or by discouragement such as provision of water, salt, and adequate forage outside of the wetland;
- Monitoring the presence of sea side arrow grass as this is toxic to grazing animals and should be carefully avoided;
- Discouraging dogs and other pets from accessing the wetlands;
- Monitoring and completing weed control for invasive species that have established in the disturbed wetland margins;
- Monitoring newly planted plugs and seeded areas completed in 2012.

3.2.11 Restoration

Some areas of the Northeast swale have been highly impacted by human activity. The most prominent are the storm water management ponds shown as zone 4, Figure A-6. In 2009 Meewasin approved the construction of the extended storm water retention ponds and associated storm water sewer and outfall, subject to the following conditions (MVA Board Memo, August, 2009):

- *that the City and Meewasin work in collaboration to develop a landscape plan showing more comprehensive revegetation of the wet and dry ponds and a recommended alignment for the development of future trail;*
- *completion of an infiltration analysis for the dry pond area; and*
- *ongoing monitoring of groundwater levels.*

The City contracted Stantec to develop a restoration plan for this area, but it was never implemented. According to the City Infrastructure Services Branch, it was seeded in 2011, but the establishment was very poor with relatively no native grasses occurring in the dry pond area in 2012. The vegetation is composed almost entirely of weedy species including noxious weeds and invasive grasses. The long term vision for this area is to restore it to native vegetation and incorporate it into the recreational and educational plan for the swale. There are other smaller areas that also need complete restoration work, including the edges of Agra Road and the areas of topsoil excavation north of Agra Road as shown on Figure A-6, Appendix A. A list of species recommended for the Northeast swale greenway was developed by Meewasin for inclusion in the *Development Guidelines* (Stantec, 2012) and can be used for

other areas requiring restoration. Any restoration program should be followed up with 2-3 years of monitoring and management of non-native invasive species.

Small restoration patches occur where weeds are removed. An interesting technique used in restoring these patches is to use wild harvested seed and locally produced plugs from this seed. Meewasin has had success with this technique at the Northeast swale and has solicited volunteers to implement the planting program. This provides an educational opportunity as well as re-introducing uncommon or missing species, helping to reduce species loss common in remnant prairie landscapes.

Recommendations:

- Work with the City to satisfy the conditions of approval for the storm water ponds developed in 2009 that includes:
    - Development of a short term weed management plan that at a minimum stops seed production of noxious weeds;
    - Take the initial steps, in consultation with a restoration specialist to establish native vegetation, using native species common to the area. Nearby areas including the edges of Agra Road and smaller soil excavation areas can be restored simultaneously;
    - Monitor and control weeds as needed for the next 2-3 years after native grass planting;
    - Integrate landscape planning and trail alignment into the Recreation, Education, and Interpretation Plan (discussed in section 3.4).

3.3 Development Considerations

The Northeast swale is a finger of a natural area extending into the urban landscape and offering a diversity of experiences and environments. Allowing interlocking fingers of countryside and urban development is an ideal way of providing access to the natural world while still maintaining a high density of urban connections (Alexander, Ishikawa, & Silverstein, 1977). The design of the future neighbourhoods should strive to make meaningful connections and provide an active interface between urban and natural. Meewasin will look to the *Northeast Swale Development Guidelines* (Stantec, 2012) to provide the framework for evaluating development review applications within and near the swale that relate to the specifics of where a road can be built, how close the neighbourhood lots can come to the Northeast swale, and the locations of utilities. However, as an organization striving toward a "balance of health and fit"[23], Meewasin looks beyond simple building parameters to holistically consider how the Northeast swale fits into the neighbourhood, or conversely how humans fit into the natural system. This includes conceptual thinking on the human uses of the swale like recreation, interpretation, education, and active transportation; as well as the interaction of the neighbourhood with the Northeast swale. This plan, in concert with the 2012 *Development Guidelines* (Stantec), will provide a more inclusive framework for decision making that will ensure that future developments

[23] In the *Meewasin Valley Concept*, Moriyama (1979) describes the attempt to reach a "*balance* of *health* and *fit*" for all planning in the Meewasin Valley. He describes "health" using the World Health Organization's definition of: "a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity", and that the health of our natural areas are inextricably related to each other and to human health. "Fit" is the principle of "working in harmony with natural processes and with people".

regarding infrastructure for roads or suburbs, as well as for recreation and education, meet our goals as described in section 1.4 for the area and as an organization.

3.3.1 Cumulative Effects

Developments within and around the swale can have more than just a direct impact on the swale. Some cumulative effects that are being considered, and may need further study include:

- Impact on ground water and surface water flow due to changes in the watershed on a landscape scale;
- Changes to previous migration routes of all wildlife from large mammals, insects, reptiles, and birds across the upland, between the wetlands, and through the air;
- Increased nutrient loading from all input sources such as lawn fertilizer, pesticides, pet excrements, vehicle emissions, and others which will affect native vegetation, water bodies, and eventually wildlife;
- Increased surface water from all input sources including irrigation of yards and other green spaces, downspouts, sump pump discharge, and increased run off from non-permeable surfaces that will affect native vegetation and water bodies and eventually wildlife;
- Increased noise levels as well as a change in noise patterns. Sources include traffic, yard equipment, maintenance and construction equipment, people, pets, and other sources;
- Increased light pollution from headlights, house and backyard lighting, path lighting, and street lighting;
- Increased disturbance from construction;
- Spread of invasive species which will be impacted by the increased moisture and nutrients; the increased disturbance providing more opportunities for establishment; and increased sources introduced both unintentionally and intentionally.

3.3.2 Perimeter Highway

The Ministry of Highways and Infrastructure is proposing to build a perimeter highway on the northeast limits of Saskatoon that crosses the swale (see Figure A-1, Appendix A). The location of this highway has been agreed to by the City, the RM of Corman Park, and the Ministry of Highways and Infrastructure. The crossing of a major highway through the swale carries with it considerable risks to the ecosystem. The highway will increase fragmentation within the swale and isolate the Northeast swale from the greater swale. The increased noise and light associated with the highway may disrupt mating of birds and amphibians, as well as their natural cycles. Unless wildlife crossings are constructed, wildlife may not be able to cross the road safely. There are further potential risks such as changes to the quality and quantity of surface and groundwater, direct impact from construction, and the likelihood of invasive species encroachment.

Meewasin has no official capacity to make recommendations on the existence, design, or construction of the perimeter highway as it lies outside of Meewasin's jurisdiction. Because the highway has the potential to directly impact the Northeast swale, Meewasin should work closely with the Ministry of Highways and Infrastructure to alleviate the concerns mentioned above.

3.3.3 Agra Road

Agra Road runs from Central Avenue to Lowe Road, crossing and providing access to the Northeast swale. It will continue to provide access to residents living along the road until other provisions are made. The long term fate of the road will be dependent on the design of the nearby UH neighbourhood, and the future Recreation, Education, and Interpretation Plan (see section 3.4). The portion of the road that currently crosses the Northeast swale could be incorporated into a future trail network (as shown in Figure A-3) or removed and restored. Outside of the Northeast swale, Agra Road could be integrated into the neighbourhood as a local street or removed. In the case that it is removed, it should become part of the greenway and restored with the standards specified by Stantec (2012). If it is developed into a street, the design parameters recommended by Stantec for the approved transportation and utility corridors shown in Figure A-3 should be applied.

3.4 Recreation, Education and Interpretation

A Recreation, Education, and Interpretive Plan should be developed for the Northeast swale. The future plan will provide details on trail design and locations, other recreational infrastructure, trail surface recommendations, interpretive programs, design of the living classroom, and linkages with other trail networks. The following concepts, challenges, and recommendations should be considered.

3.4.1 Recreational, Educational, and Interpretive Needs of the Northeast Swale

The recreational uses of the Northeast swale will likely include activities similar to those found in Saskatoon's other natural areas such as hiking, wildlife watching, dog-walking, biking, picnicking, and appreciation of the scenic vistas by both residents of the UH neighbourhoods and the larger community of Saskatoon and region. The natural landscape of the Northeast swale can be used as a resource for education and research by both the U of S and other school groups. The Saskatoon public and catholic school boards have indicated their interest in the Northeast swale to incorporate learning opportunities into the curriculum and to provide a living laboratory or outdoor classroom to enrich the educational experience.

Volunteer group collecting seeds at Beaver Creek Conservation Area.

3.4.2 Discussion of Potential Challenges

Use of the area can have a negative impact on the native vegetation through inappropriate or overly intensive use. For instance the establishment of unplanned trails either by repetitive use or by unauthorized trail building efforts can disturb the native vegetation which encourages weed invasion into the disturbed area. Other impacts possibly include soil compaction, degradation, and erosion. Additionally, trails can lead users further into the area toward the sensitive wetland margins as well as impacting wildlife including nesting birds. However, the existence and severity of impacts are dependent on the frequency, intensity, and type of activity occurring in the area. Insights on potential impacts and best practices can be gained from looking at other natural areas:

- **Saskatoon Natural Grassland**. When the park was first established, some unauthorized trails were created. However, since 2000 off trail use has not shown to be an issue, SNG could benefit from increased disturbance, such as grazing pressure and fire.
- **Nose Hill Park (Calgary, AB)** which in 1997 got over 5000 users/year has over 300 km of unauthorized trails resulting in soil erosion, compaction, and general degradation to the area (02 Planning + Design Inc [02 Planning], 2005). They have implemented the *Nose Hill Trail and Pathway Plan* (02 Planning, 2005) that recommends that many of the unauthorized trails be closed and that appropriate trails be built along desire lines including two trails crossing the park (both east-west and north–south).
- **Peturrson's Ravine** has areas of severe degradation because of the high impact activity (mountain biking) and associated unauthorized trail building that is occurring there. Additionally, off-leash dogs are prevalent in the area creating concern both with wildlife using the area, water quality concerns, and damage to the marl bog.
- **Chief Whitecap Park** this 142 ha natural area near Saskatoon had on average 150 cars/day in 2005. It was first designated as a public park in 1996, but use peaked in 2004 with the fencing of Power Pole Park, which is directly west of the Saskatoon Golf and Country Club. Off leash dog running is the most prevalent activity and together with the increased pedestrian use is partially responsible for the some degradation of vegetation, especially on the steep banks leading to the river. Loss of flora and fauna may also be due to the presence of invasive species and vandalism. Although the area has never officially been recognized as an off-leash dog park, it has been used as such for so long that off-leash privileges are extremely difficult to revoke. Some issues relating to dog use include uncontrolled dogs, scat not being picked up, and dogs roaming nearby private property (Stantec, 2007).
- **Grasslands National Park (southern SK)** undesignated trail use was encouraged. However, this was found to be intimidating to all but the most highly skilled users, they found that some trail development was necessary to encourage families and casual users and are planning increased trail building[24].

[24] Colin Schmidt, Product Development Officer, Grasslands National Park, personal communication.

3.4.3 Impact from Trails

The development of a trail network within the Northeast swale would be a great benefit in guiding users and offering opportunities to recreate, learn, and experience nature. However, the development of trails can impact the area. The direct impacts of trail construction include loss of vegetation as well as potential for weed encroachment, soil compaction, and erosion. Additionally, the trail may act as a barrier to some wildlife and have similar effects to roads in the creation of islands within the landscape.

Trails may be a useful tool in guiding users to the places that are most appropriate for recreational and experiential use, and if planned carefully can serve to discourage use in the most sensitive areas.

3.4.4 Impact to Wildlife

The Northeast swale's largest wildlife resource is the numerous upland and wetland birds, including several rare and endangered species. There are also at least 19 species of large and small mammals, and a variety of amphibians, reptiles, and insects. Impacts to wildlife from increased recreational use are highest during nesting periods, especially from any construction, but general use of the area also is a concern. Nesting occurs at different times for different species, generally between the beginning of April and the end of August. According to SCDC (2003), even low disturbance such as foot traffic, small vehicles, and ATVs must keep a setback distance from some sensitive species as shown in Table 3-7.

Table 3-7. Saskatchewan Activity Restriction Guidelines for sensitive species in natural habitats present in the Northeast swale (SCDC, 2003)

Species	Key Wildlife Areas	Restricted Activity Dates	Low* (m)	Medium* (m)	High* (m)
Northern Leopard Frog	Ponds used for breeding, living, or hibernating	Year round	10	400	500
Loggerhead shrike	Nest site	May 1 – August 15	50	250	400
Short-eared owl	Nest site	Mar 25 – Aug 1	100	300	500
American Bittern	Nest Site	May 1 – July 31	200	400	400
Sharp-tailed grouse	Lek	Mar 15-May 15	200	400	400

*Low Activity includes foot traffic, small vehicles, ATVs; Medium includes >1 ton trucks, tractors, pipeline construction; and High includes road construction, roads, drilling rigs, mines, and quarries.

3.4.5 Dogs

Off-leash dogs can potentially impact wildlife in the area. Chasing of wildlife, mostly deer and large mammals, has been noted in the literature since it was first studied in the 1950s (Sime, 1999). The negative effects of this disturbance have been reviewed by Forrest & Cassady (2006) and range from the flushing of nests to physical injury, the introduction of disease, and death.

3.4.6 Other Human Impacts

Joyce (1994) found after interviewing the managers and reviewing maps, management plans, literature, and interpretive material of three other natural areas[25] in urban settings that the highest priority problems included:

- dumping of garbage;

[25] The three natural areas were the Living Prairie Museum in Winnipeg (16 ha), the Ojibway Prairie complex in Windsor (218 ha), and Nose Hill Natural Environment Park in Calgary (1040 ha).

- soil compaction;
- new path creation by users.

Other problems included:

- Damage by mountain and dirt bikes;
- Smoke and fire safety;
- Littering;
- Dogs-at-large, scat issues;
- Vandalism of signs, bird houses, trees, and other property;
- Bonfires;
- Theft of plants;
- Squatters;
- Horseback riding;
- Heavy recreational activities such as model airplanes, show jumping, and folk festivals.

Many of these pose a potential threat to the Northeast swale, especially garbage dumping and littering, misuse by mountain and dirt bikes, new path creation, soil compaction, and dogs-at-large. Future planning should take these potential risks into account and use education and signage, infrastructure (including trails, fences, and gates), and monitoring to help alleviate any concerns.

3.4.6.1 Recommendations

Appropriate Use of the Northeast Swale

Use of the Northeast swale by visitors should be limited to passive uses including walking, running, wildlife watching, and on-leash dog walking; picnicking and cycling can be accommodated in appropriate places. Education and interpretive opportunities should be provided through interpretive signage, guided tours, and accommodation of school groups including programing specific to their curriculum which will be described in further detail in the Education section and a future plan. Prohibited uses will include motorized vehicles (except motorized devices needed for the mobility impaired), and off-leash dog running. No facilities needed for active recreation (ie. ball diamonds, soccer fields) should be built within the Northeast swale.

The Northeast swale has been split into recreational zones to help guide appropriate areas for use as shown in Figure A-3, Appendix A and described in detail below:

- ***Greenway, Transportation Corridors, and Multi-use Trails***

The Greenway, as described in the 2012 *Development Guidelines* (Stantec) provides an ecological buffer, a trail zone, and a transition zone along the boundary of the Northeast swale as shown on Figure A-3. It provides separation between future adjacent neighbourhoods and the native grasslands and wetlands of the Northeast swale. It will be planted to native species and can also accommodate storm water management infrastructure (such as a grassy swale or river garden) and a minimum 3 m multi-use pathway. This pathway can be used for walking, running, cycling, and dog-walking and will provide access to the ecological core of the Northeast swale. Once complete, this pathway will be part of a trail network that circumnavigates the Northeast swale and can potentially be used as an alternative

commuting corridor. It will connect to trails adjacent to road rights-of-way, Meewasin trails along the river, and eventually to downtown.

All transportation corridors that cross the Northeast swale will also incorporate multi-use trails as recommended by Stantec (2012). These corridors can provide non-motorized access to the Northeast swale and serve as staging points for recreational and educational activities. Fedoruk Drive runs between the Northeast swale and Evergreen and will have a multi-use trail adjacent to the road right-of-way (Land Branch, 2009) that also can connect to other trails in the Northeast swale and Meewasin's trail network.

- *Ecological Core*

Controlled access should be provided to the ecological core of the Northeast swale. This can be accomplished by erecting a non-intrusive wildlife friendly fence that both helps to manage domestic grazing animals and provides a physical, though non-threatening barrier to potential users. The purpose of the fence is not to keep people out of the Northeast swale, but to provide a physical reminder of the important ecological area that exists within it. Entrance into the swale will be guided to the most appropriate places by providing gates at the least sensitive areas.

If interest dictates, low impact trails using techniques such as mowing, boardwalk construction, or mulching can be utilized to guide users on where to walk or to avoid. Mowed trails can be rotated from year to year to further minimize impact. The activity in the ecological core should be closely monitored to determine if an increased trail network is necessary in the future. For instance, if clear desire lines are found crossing the Northeast swale as the UH sector is populated a trail will be considered. High impact construction techniques such as leveling, stripping, and coring should be avoided in favour of the low impact methods mentioned above; construction of impermeable surfaces should be avoided.

- *Storm Water Ponds*

As mentioned in section 2.10, this area has been negatively impacted by the construction of the storm water retention ponds and requires restoration efforts. The area is ideal for establishment of trails that encourage passive recreational use. Trails can be designed and constructed as part of the restoration planning and implementation discussed in section 3.2.11 and in so doing have a positive impact on the ecology of the Northeast swale. Interpretive infrastructure can also be incorporated into this area. Other low impact uses can be considered including designated picnicking areas and staging areas.

- *Recreation Zone*

This area has retained much of its ecological integrity, and provides a great potential experience for users, similar to that found in the ecological core. However, it is adjacent to highly disturbed areas, is more isolated ecologically, and is therefore more subject to invasive species encroachment, displacement of wildlife, and other negative impacts. It is therefore seen as a more appropriate place for passive recreation and interpretation. It still offers the experience and diversity of a natural area including intact grassland, a wetland, human heritage features, and wildlife viewing but is not as sensitive to increased activity as the ecological core. Care must still be taken to minimize impacts

including effective communications, trails, monitoring, and enforcement to guide users to appropriate areas and discourage unaccepted uses such as motorized use, off-leash dogs, or off-trail biking.

- ***Education and Interpretation***

There are countless opportunities for education and interpretation within the Northeast swale. This can include both passive interpretive programs such as signed trails, bird watching, and plant identification. Further opportunities involve guided tours, similar to what is occurring right now by naturalist organizations such as Saskatoon Nature Society, the Native Plant Society of Saskatchewan, Meewasin, and others. Formal education can also utilize the Northeast swale for field trips and as a living laboratory or outdoor classroom that is an extension of the nearby schools. This can involve activities from passive observation to being actively involved in management activities such as helping with controlled burns, collecting seed, or in reclamation efforts. Research partnerships through the U of S and other institutions can benefit both the scientific community and Meewasin as we strive to understand and learn from the complex ecosystems occurring in the Northeast swale.

Educational and Interpretive activities can occur with minimal impact to the Northeast swale by following similar guidelines to those suggested for recreation. Highest intensity use should be limited to the south portion of the area within the recreation zone and around the storm ponds. However, the additional benefits of accessing the ecological core is recognized so guided tours are welcome with a knowledgeable leader or teacher that can ensure impact is minimized. Additionally, research activities will likely be carried out in all areas of the Northeast swale.

- ***Signage***

Signage will be necessary within all zones of the swale. In addition to being an essential element of an interpretive program, and for providing users with directional and safety information, it is also a component of the conservation and communication strategy. Signage can protect the swale by providing summarized information on the importance of the ecological area, explain appropriate uses and other rules, and direct users away from very sensitive areas. It can also be used for branding of the natural area and should fit into the overall communications strategy discussed in the next section.

- ***Parking***

Desire for additional (formal) vehicular parking space near the Northeast swale is likely to increase as it becomes a more well-known regional amenity and as recreational facilities, as suggested in this report, are developed and/or formalized. The gravel parking lot at Crocus Prairie and Peturrson's Ravine can accommodate approximately 16 cars. The 2012 *Development Guidelines* (Stantec), allow for the use of corridor #3 (Figure A-3, Appendix A) for parking which can potentially accommodate up to 98 parallel parking spots[26]. Temporary parking areas to accommodate special events or large groups can be created by mowing an appropriate area within the Northeast swale. Additionally, efforts will be made to encourage and facilitate active transportation for accessing the Northeast swale. The demand for parking can likely be met with the combined capacity of corridor #3 and the existing Crocus Prairie lot

[26] Dave Leboutillier, Planning and Design Engineer, Transportation Branch, City of Saskatoon, personal communication.

(over 100 spots total) without impacting native prairie and wildlife habitat. Therefore, no new permanent parking lots are recommended within the Northeast swale.

3.5 Communication Strategy

The Communications Strategy will be a follow up document to this plan. Effective communications are important for ensuring that the Northeast swale is recognized as a valuable amenity and for the protection of its resources and should outline ways to educate the public on the value of the Northeast swale and the ecological services it provides; foster ownership of the swale; encourage appropriate use; and provide excitement about its existence.

Some suggested components:

- Naming and branding of the Northeast swale
    - Rename the Northeast swale to highlight a special feature. Branding and logo should also incorporate this feature to serve as a constant reminder.
- Signage
    - Provide information on the importance and interesting features of the Northeast swale, provide rules and expectations, and direct users.
- Trails, fencing, and gates
    - Infrastructure such as trails, fencing, and gates can help communicate where and how to use the Northeast swale. The potential fencing surrounding the ecological core can act as another reminder to users of its importance; the future trails will inform visitors where to walk; and the formalized entrances can encourage use in certain areas while discouraging it in others.
- Literature
    - Clear and simple literature should be created for the swale explaining its value, encouraging use in appropriate ways, and explaining the risks of using it inappropriately;
    - Literature can be targeted at a wide audience with general information about the swale's value or can be more specifically geared toward residents of neighbourhoods touching the swale.
    - Specific issues that residents of neighbourhoods may require include:
        - Reasons for the fence and greenway;
        - Landscaping of personal yards – encourage use of native plants, manage water including reduction of irrigation and collection of rainwater;
        - Consider examples from Lands branch in Evergreen (signage on fence) and pamphlets in Saskatoon Natural Grassland.

- Events
    - The 2011 Ecoblitz and 2012 Swale of a Day events increased awareness about the swale. Similar events will further increase the knowledge and understanding of the area.

Volunteer scientists collecting data during the 2011 Ecoblitz at the Northeast swale.

- Web-based, social, and traditional media
    - Other tools that can be used to achieve the Communications objectives. The details of a strategy for this will be determined in the Communications strategy.

3.6 Funding Implications

Many of the recommendations presented in this report have cost implications. It will be critical to develop partnerships and to secure needed resources from a variety of stakeholders and funding agencies. Future partnerships, funding and legal arrangements, and other agreements should not in any way limit the recommendations of this report. The following list, although not exhaustive, attempts to outline the major expected costs:

- Future planning;
- Resource management such as grazing, burning, and vegetation management;
- Educational programming development and implementation;
- Restoration of disturbed areas (storm water ponds);
- Road and utility infrastructure construction;
- Capital projects including fencing, trail development, and others;
- Maintenance of capital projects;
- Communications.

The City, as the landowner of much of the Northeast swale lands as well as being a regulator and a developer within the sector, has an interest in the development and operations of the Northeast swale. Traditionally, the City has been responsible for maintenance and operation of recreational trails and related facilities for City-owned lands in Meewasin's jurisdiction. Meewasin's mandate is centered on three core deliverables, conservation, education, and development of recreational facilities; Meewasin must continue to take a lead role in these initiatives as future funding arrangements are made and roles and responsibilities are determined.

The RMP provides a basis for preliminary discussion between Meewasin and the relevant City departments to determine the future approach to funding the recommendations of the RMP. More detailed discussions to clearly define roles and responsibilities must also occur and the results included in future planning documents.

3.6.1 Recommendations:

- Develop a detailed 5-year burning, grazing, and vegetation management budget;
- Pursue commitments for funding to implement the recommendations of the RMP that are Meewasin's responsibility;
- Work with the City and other stakeholder to determine roles and responsibilities in managing and developing the swale.

4 Conclusion

The swale has value to the urban and rural communities that it runs through. It is important as wildlife habitat, contains imperiled native grasslands, and healthy functioning wetlands. It is a resource for the enjoyment and exploration of nature, and a learning opportunity for all ages. It offers a subtle beauty as well as many ecosystem services such as carbon storage, pollution control, and water filtration. It has a high level of biodiversity both at the species level and at the landscape level that requires protection and is the basis of the Northeast swale's value.

The area around the Northeast swale will be developed in the near future. By working closely with the City, the RM's, and other stakeholders, Meewasin can realize its vision for the Northeast swale. This Resource Management Plan provides the framework, not only for the cyclical management needed to maintain the physical attributes of the swale, but also for assessing development applications, recreation, education, and interpretive planning, and for communications. The goal is to embrace the challenges of urbanization surrounding a natural area in order to provide a valuable amenity that benefits the urban community as well as the natural ecosystem.

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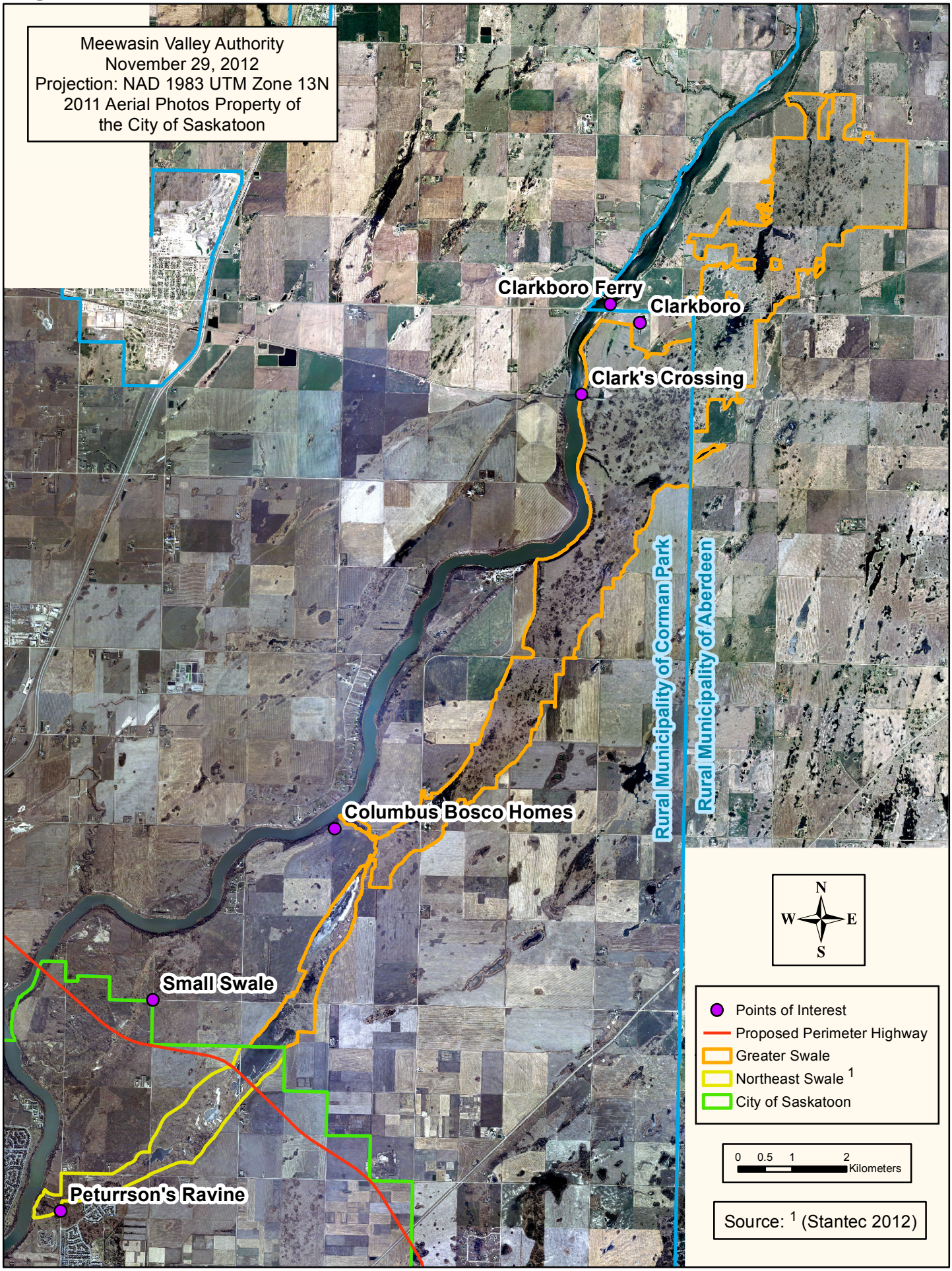
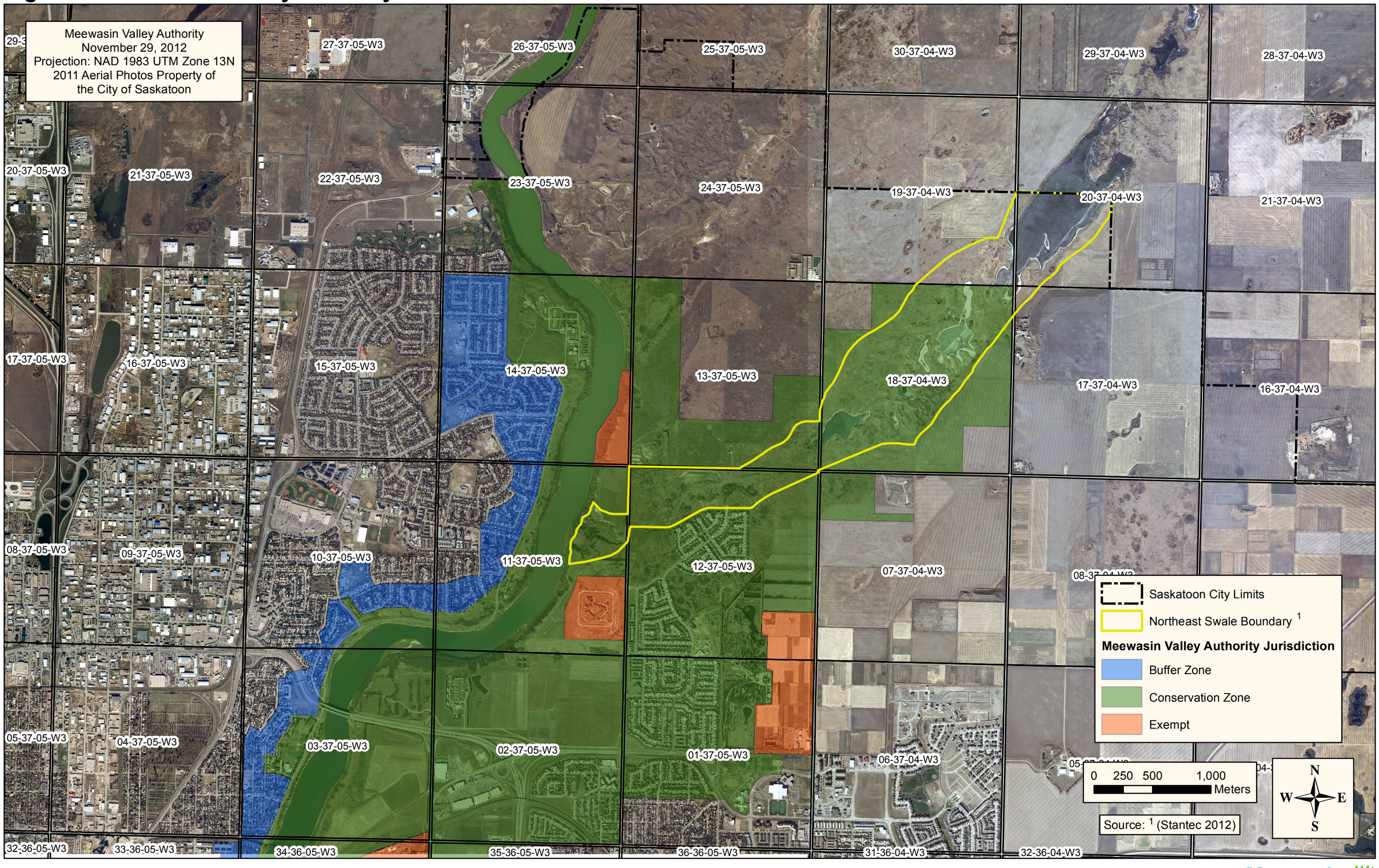
APPENDIX A.
Maps

Figure A-1. The Swale Extent



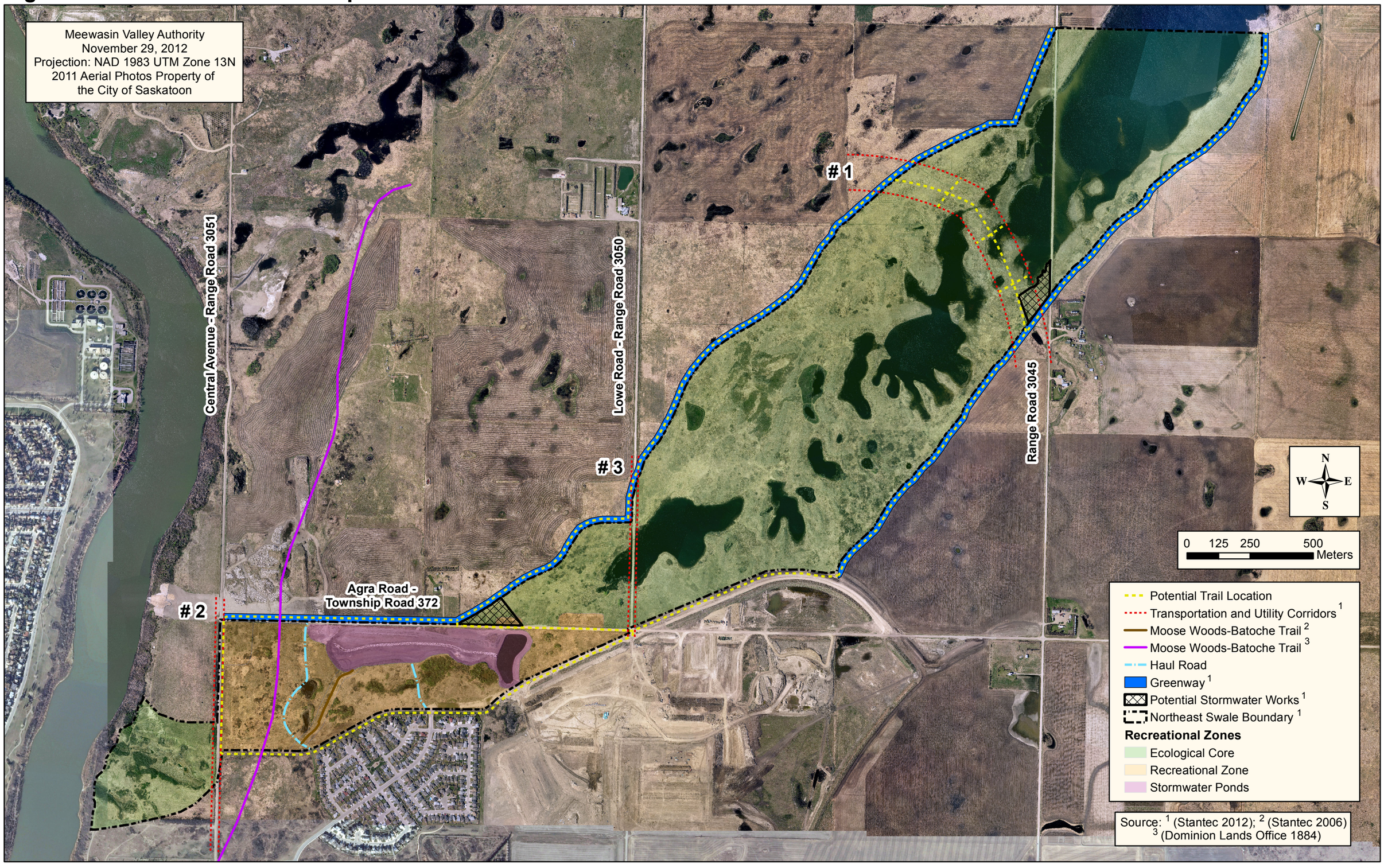
Meewasin

Figure A-2. Meewasin Valley Authority Jurisdictional Boundaries



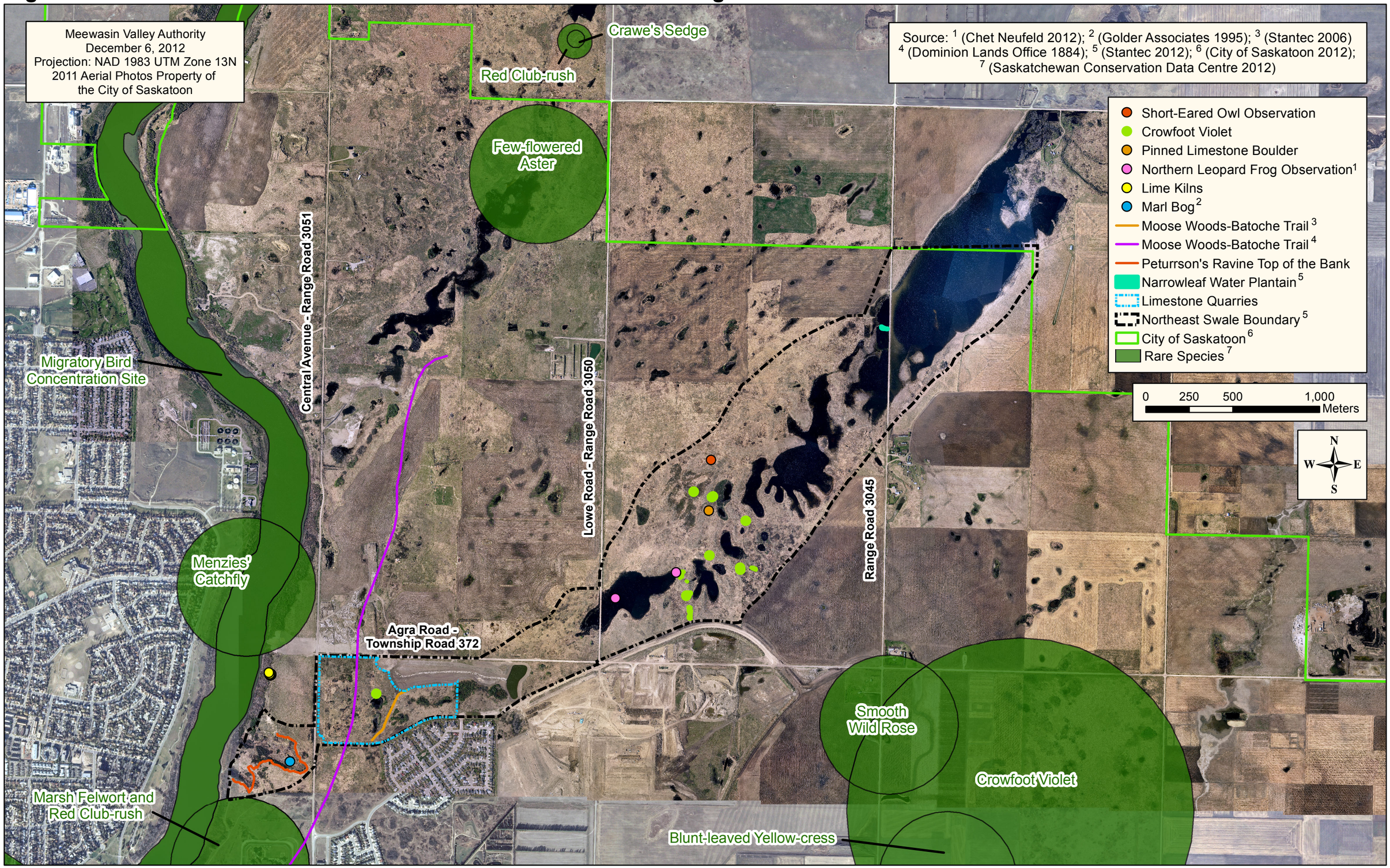
Meewasin

Figure A-3. Guidelines for Development of the Northeast Swale



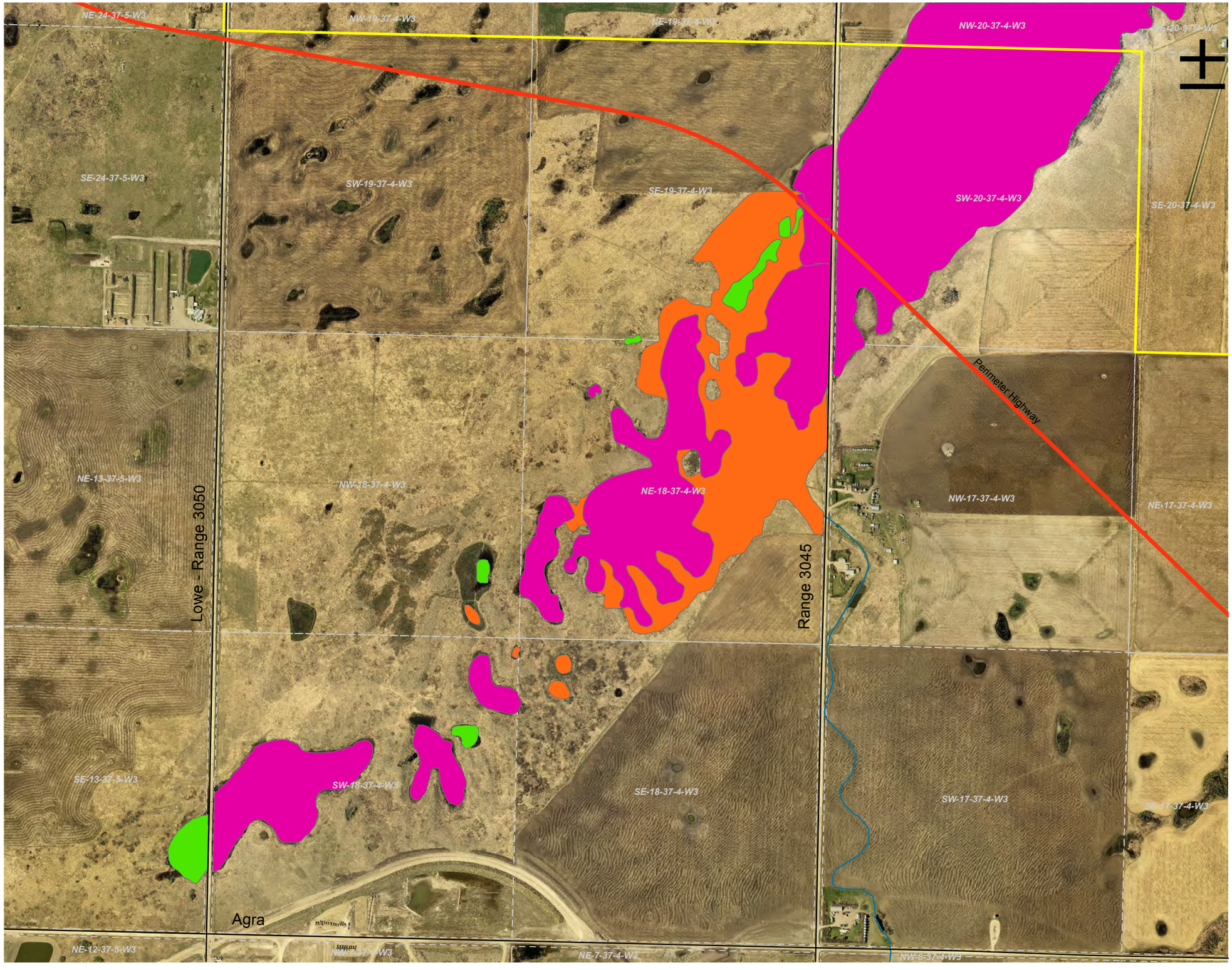
Meewasin

Figure A-4. Points of Interest in the Northeast Swale and Surroundings



Meewasin

Figure A-5. Wetland Classes (from Stantec, 2012)



North East Swale Development Guidelines

Wetland Classes (Stewart and Kantrud)

Projection: UTM Zone 13 NAD 83
Acknowledgements: Original Drawing by Stantec.
Imagery: 2011 (20cm)

Legend

- Class 1- Ephemeral
- Class 2- Temporary
- Class 3- Seasonal
- Class 4- Semi-permanent
- Class 5- Permanent
- City limits
- Perimeter Highway
- Existing roads
- Existing water course

0 100 200 300 400
Meters
Scale- 1:10,000

113253786

PREPARED FOR
City of Saskatoon

NWT NU AB SK MB Area of Interest USA

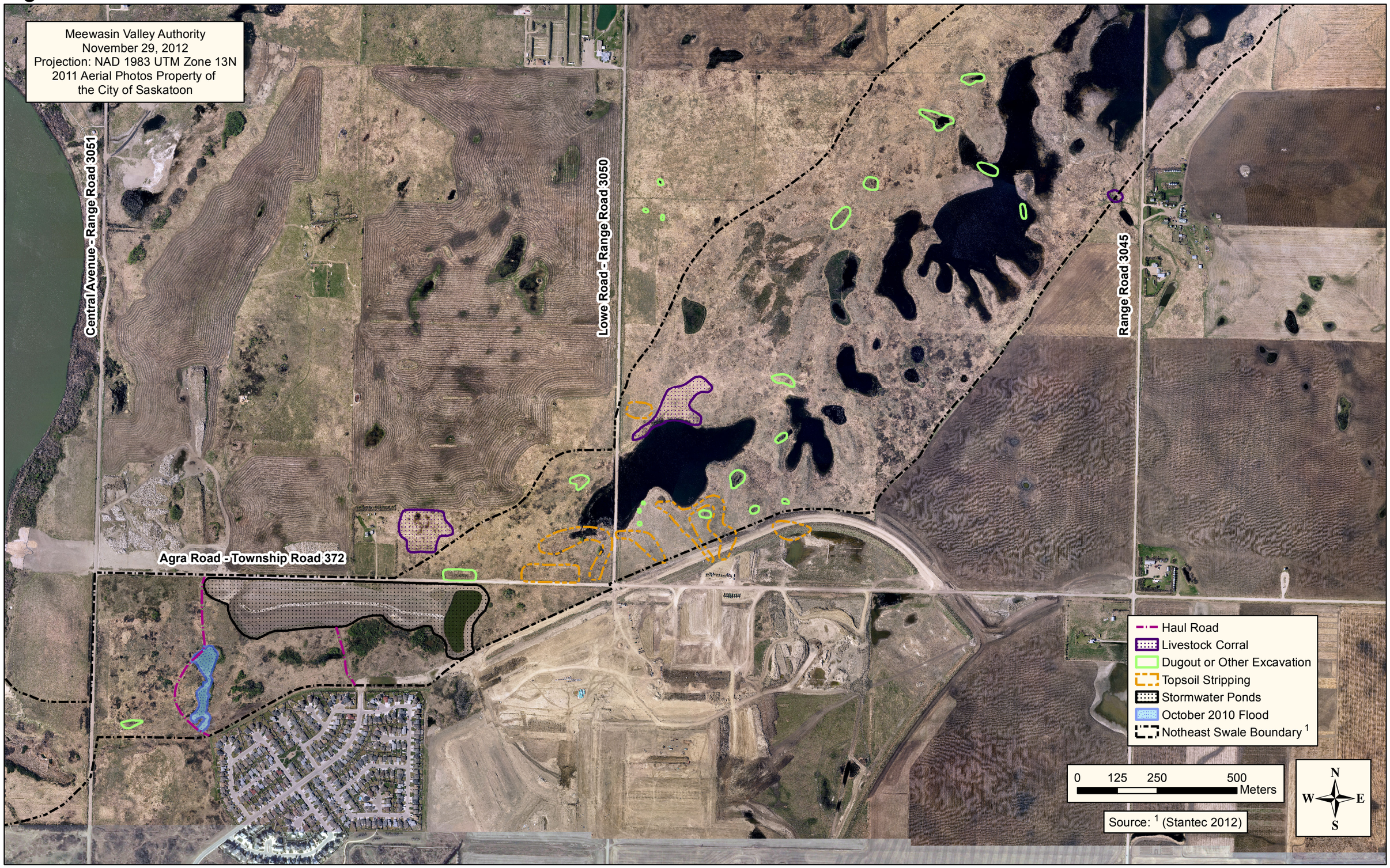
PREPARED BY
Stantec

FIGURE NO.
2

Last Modified: SEP 06, 2012 By: hgerstmar

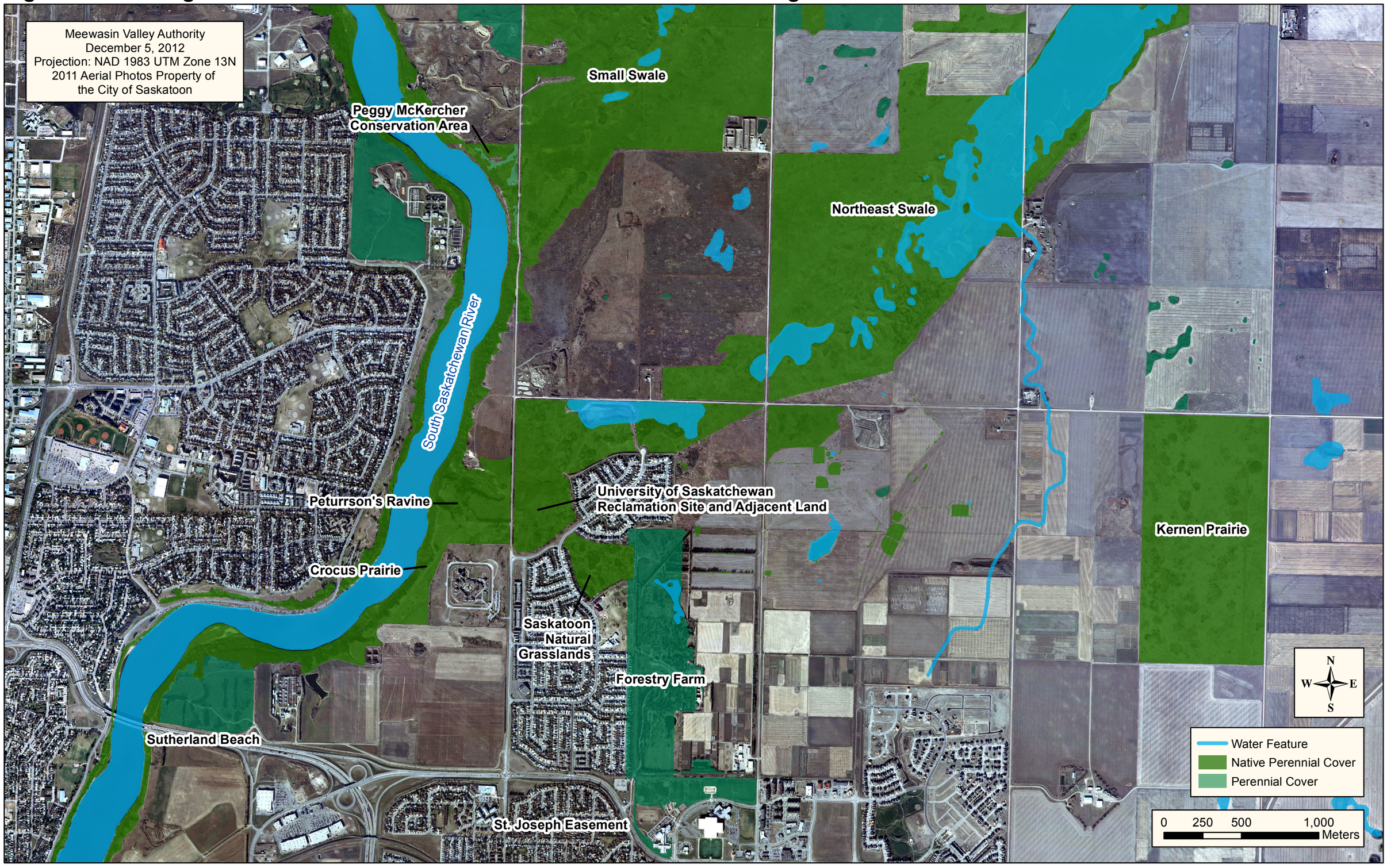
Note: From “Northeast Swale Development Guidelines” by Stantec Consulting Ltd. 2012. Copyright 2012 by City of Saskatoon. Reprinted with permission.

Figure A-6. Human Interventions in the Northeast Swale



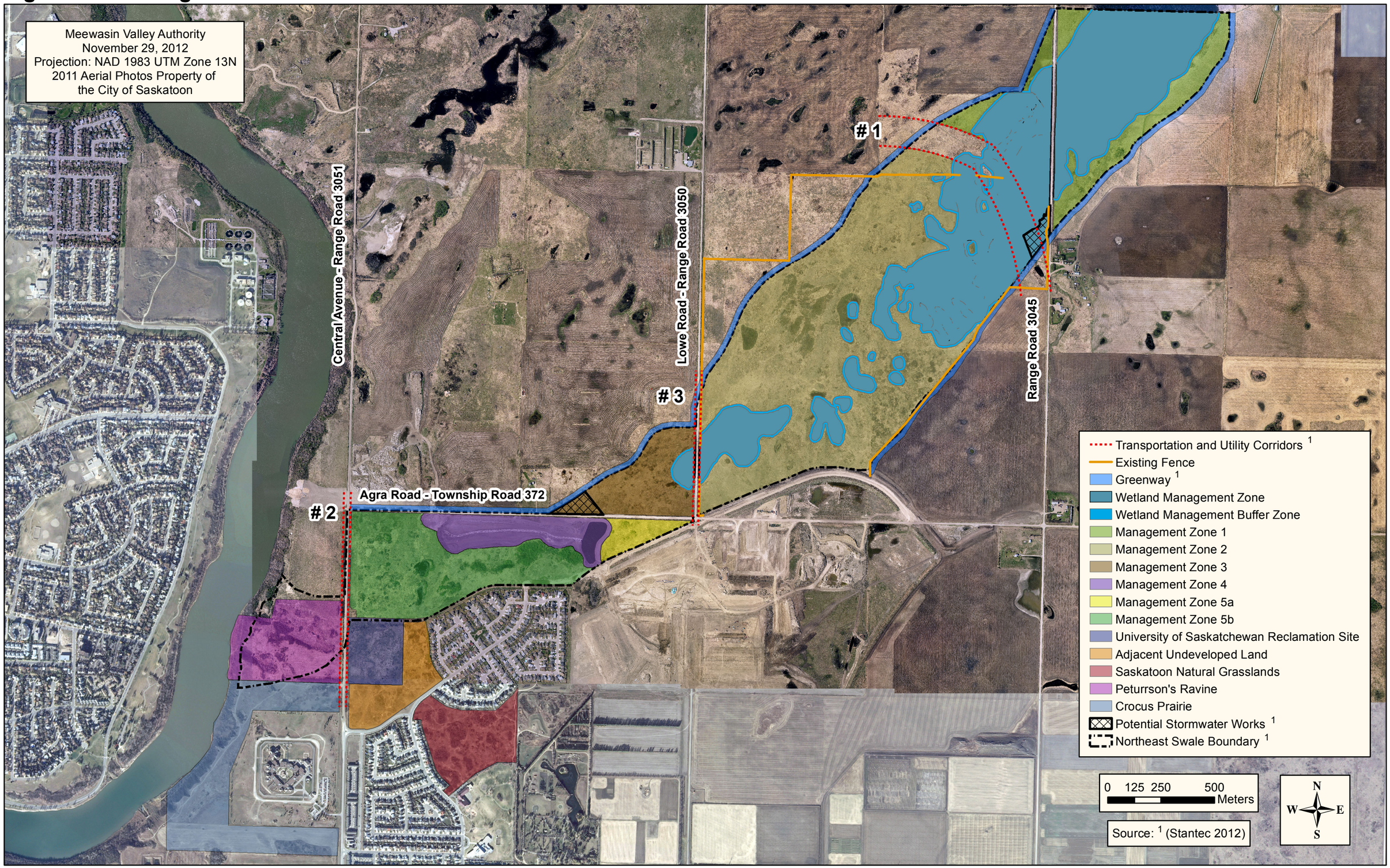
Meewasin

Figure A-7. Ecological Connections for the Northeast Swale and Surroundings



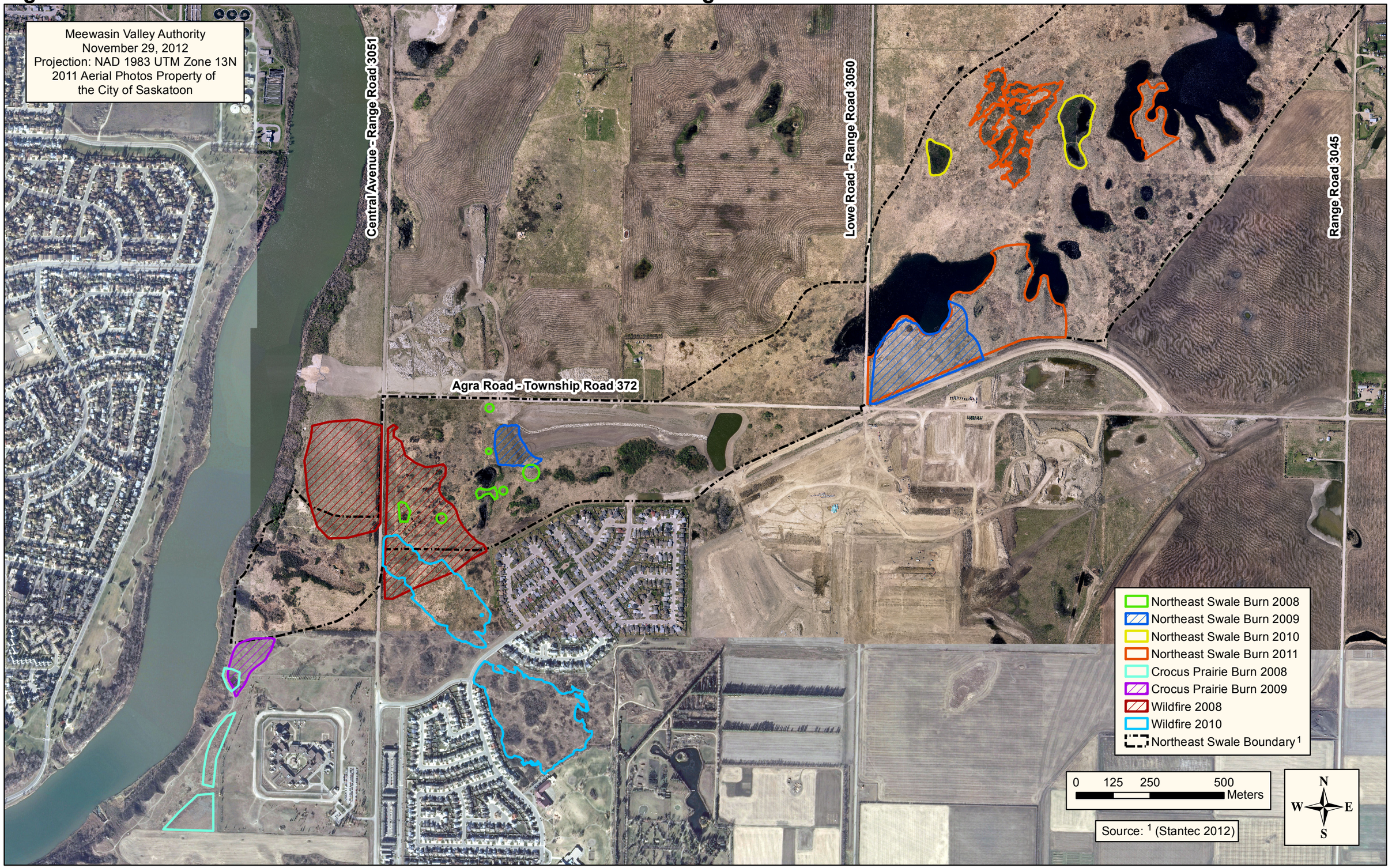
Meewasin

Figure A-8. Management Zones of the Northeast Swale



Meewasin

Figure A-9. Burn Locations for the Northeast Swale and Surroundings



Meewasin

APPENDIX B.
Tables

Table B-1. Plant Species found in the Northeast Swale

Scientific Name	Common Name	Date recorded	S rank	G rank
Acer negundo	Manitoba Maple	1993, 2000	S5	G5
Achillea millefolium	Common Yarrow	1993, 2000, 2011	S5	G5
Achillea sibirica	Siberian Yarrow	2000	S5	G5
Agoseris glauca	False Dandelion	1993, 2000	S5	G5
Agropyron cristatum	Crested Wheatgrass	1993, 2000, 2011	SNR	G5
Agropyron dasystachyum	Northern Wheatgrass	1993, 2000, 2011	SNr	G5
Agropyron repens*	Quack Grass	1993, 2000	SNA	GNR
Agropyron smithii	Western Wheatgrass	1993, 2000, 2011	SNR	G5
Agropyron subsecundum	Awned Wheatgrass	1993, 2000, 2011	SNR	G5
Agropyron trachycaulus	Slender Wheatgrass	1993, 2000, 2011	SNR	G5
Agrostis scabra	Rough Hair Grass	1993, 2000	SNR	G5
Alisma gramineum	Narrow-leaved Water Plantain	2012	S3	
Allium stellatum	Pink Flowered Onion	2000	SNR	G5
Allium textile	Prairie Onion	2000, 2011	S5	G5
Amelanchier alnifolia	Saskatoon	1993, 2000, 2011	S5	G5
Androsace septentrionalis	Pygmy Flower	1993, 2000, 2011	S5	G5
Anemone canadensis	Canada Anemone	1993, 2000, 2011	S5	G5
Anemone cylindrica	Long-fruited Anemone	1993, 2000, 2011	S5	G5
Anemone multifida	Cut-leaved Anemone	1993, 2000, 2011	S4	G5
Antennaria neglecta	Field Pussytoes	2011	S5	G5
Antennaria parvifolia	Small-leaved Pussytoes	2000, 2011	S5	G5
Apocynum androsaemifolium	Spreading Dogbane	2000	S5	G5
Apocynum cannabinum	Indian Hemp	2000	S5	G5
Arabis divaricarpa	Purple Rock-cress	1993, 2000, 2011	S5	GNA
Arabis glabra	Tower Mustard	2011	SNA	G5
Arabis hirsuta	Hirsute Rock-cress	2000, 2011	S5	G5
Arabis holbelii	Reflexed Rock-cress	2000, 2011	SNR, S5	G5
Arenaria lateriflora	Blunt-leaved Sandwort	2000, 2011	S5	G5
Artemisia biennis	Sagewort	2000	S5	G5
Artemisia campestris	Plains Wormwood	1993, 2000, 2011	S5	G5
Artemisia dracunculus	Linear Leaved Wormwood	2000	S5	G5
Artemisia frigida	Pasture Sage	1993, 2000, 2011	S5	G5
Artemisia ludoviciana	Prairie Sage	1993, 2000, 2011	S5	G5
Aster brachyactis	Rayless Aster	1993, 2000	S5	G5
Aster ciliolatus	Lindley's Blue Aster	1993, 2000	S5	G5
Aster ericoides	Many-flowered Aster	1993, 2000, 2011	S5	G5
Aster falcatus commutatus	White Prairie/Heath Aster	1993, 2000	S5	G5
Aster hesperius	Western Willow Aster	1993, 2000, 2011	S5	G5
Aster laevis	Smooth Blue Aster	2000, 2011	S5	G5
Aster pansus	Tufted White Prairie Aster	2000	S5	G5
Astragalus adsurgens ssp. robustior	Ascending Purple Milk-vetch	1993, 2000	S5	G5
Astragalus bisulcatus	Two-grooved Milk-vetch	1993, 2000	S5	G5
Astragalus canadensis	Canadian Milk-vetch	1993, 2000	S5	G5
Astragalus cicer	Cicer Milkvetch	2011		

Scientific Name	Common Name	Date recorded	S rank	G rank
Astragalus crassicarpus	Ground Plum	2000, 2011	S5	G5
Astragalus flexuosus	Slender Milk-vetch	1993, 2000, 2011	S4	G5
Astragalus goniatus	Purple Milk-vetch	2000, 2011		
Astragalus pectinatus	Narrow-leaved Milk-Vetch	2000	S5	G5
Atriplex nuttallia	Nuttall's Atriplex	2000		
Avena fatua	Wild Oat	1993, 2000	SNA	GNR
Axyris amaranthoides	Russian Pigweed	1993, 2000, 2011	SNA	GNR
Beckmannia syzigachne	Slough Grass	2000	SNR	G5
Betula occidentalis	River Birch	2000	S5	G4
Bidens cernua	Nodding Beggarticks	2000	S5	G5
Bouteloua gracilis	Blue Grama	1993, 2000, 2011	S5	G5
Bromus ciliatus	Fringed Brome	2000	S5	G5
Bromus inermis	Smooth Brome	1993, 2000, 2011	SNR	G5
Calamagrostis canadensis	Marsh Reed-grass	2000		
Calamagrostis inexpansa	Northern Reed Grass	1993, 2000, 2011	SNR	GNR
Calamagrostis montanensis	Plains Reed Grass	2000	SNR	GNR
Calamovilfa longifolia	Sand Grass	1993, 2000, 2011	SNR	GNR
Campanula rotundifolia	Harebell	1993, 2000, 2011	S5	G5
Capsella burasa-pastoris	Shepherd's Purse	2000	SNA	GNR
Caragana arborescens	Caragana	2000	SNA	GNR
Carduus nutans	Nodding or Musk Thistle	2011	SNA	GNR
Carex aquatilis	Water Sedge	1993, 2000	S5	G5
Carex aurea	Colden's Sedge	2000, 2011	S5	G5
Carex bebbii	Bebb's Sedge	2000	S5	G5
Carex duriuscula	Low Sedge	1993, 2000, 2011		
Carex exsiccata	Beaked Sedge	2000	SNR	G5
Carex filifolia	Thread-leaved Sedge	1993, 2000, 2011	SNR	G5
Carex lanuginosa	Wooly Sedge	2000, 2011	S5	G5
Carex obtusata	Blunt Sedge	1993, 2000, 2011	S5	G5
Carex pensylvanica	Sun-loving Sedge	1993, 2000, 2011	SNR	G5
Carex praegracilis	Graceful Sedge	2000	SNR	G5
Carex retrorsa	Turned Sedge	2000	SNR	G5
Carex siccata	Hay Sedge	2000	S5	G5
Carex sprengelii	Sprengel's Sedge	2011	S5	G5
Cerastium arvense	Field Chickweed	1993, 2000, 2011	S5	G5
Chamaerhodos erecta	Bunge	1993, 2000		
Chenopodium album	Lamb's Quarters	1993, 2000	SNA	G5
Chenopodium rubrum	Red Goosefoot	1993, 2000	S5	G5
Chenopodium salinum	Oak-leaved Goosefoot	2000	SNR	G5
Cirsium arvense	Canada Thistle	1993, 2000, 2011	SNA	GNR
Cirsium flodmanii	Flodman's Thistle	1993, 2000, 2011	S5	G5
Comandra umbellata	Pale Comandra or Bastard Toad Flax	1993, 2000, 2011	S5	G5
Convolvulus arvensis	Field Bindweed	2000	SNA	GNR
Corispermum hyssopifolium	Bugseed	2000		
Corispermum orientale	Villose Bugseed	2000		

Scientific Name	Common Name	Date recorded	S rank	G rank
Crataegus chrysocarpa	Firebelly or Round-leaved Hawthorn	1993, 2000, 2011	S5	G5
Crepis runcinata	Scapose Hawk's Beard	1993, 2000	S5	G5
Crepis tectorum	Narrow-leaved Hawk's Beard	2000	SNA	GNR
Deschampsia caespitosa	Tufted Hair Grass	1993, 2000	SNR	G5
Descurainia richardsonii	Gray Tansy Mustard	1993, 2000	S5	G5
Descurainia sophia	Flix-weed	1993, 2000, 2011	SNA	GNR
Disporum trachycarpum	Fairy Bells	2000	S5	G5
Distichlis stricta	Alkali Grass	1993, 2000	S5	G5
Dodecatheon pauciflorum	Saline Shooting-star	2000	S5	G5
Dracocephalum parviflorum	American Dragonhead	2000	S5	G5
Echinochloa crusgalli	Barnyard Grass	2000	SNA	GNR
Eleagnus commutata	Wolf Willow	1993, 2000, 2011	S5	G5
Eleocharis palustris	Creeping Spike Rush	1993, 2000	SNR	G5
Elymus canadensis	Canada Wild Rye	2000	SNR	G5
Epilobium angustifolium	Fireweed	2000	S5	G5
Epilobium palustre	Marsh Willow-herb	2000	S5	G5
Equisetum arvense	Common Horse-tail	2000	S5	G5
Equisetum hyemale v. affine	Common Scouring Rush	2011	SNR	G5
Equisetum laevigatum	Smooth Scouring Rush	2000, 2011	SNR	G5
Erigeron asper	Rough Fleabane	2000	S5	G5
Erigeron caespitosus	Tufted Fleabane	1993, 2000	S5	G5
Erigeron canadensis	Canada Fleabane	1993, 2000	S5	G5
Erigeron glabellus	Smooth Fleabane	1993, 2000, 2011	S5	G5
Erigeron lonchophyllus	Hirsute Fleabane	1993, 2000	S5	G5
Erigeron philadelphicus	Philadelphia Fleabane	1993, 2000	S5	G5
Erucastrum gallicum	Dog Mustard	1993, 2000	SNA	G5
Erysimum asperum	Western Wallflower	2011	S5	G5
Erysimum cheiranthoides	Wormseed Mustard	2011	SNA	G5
Erysimum inconspicuum	Small-flowered Prairie Rocket	1993, 2000, 2011	S5	G5
Euphorbia esula	Leafy Spurge	2000	SNA	G5
Festuca altaica ssp. hallii	Plains Rough Fescue	2000, 2011	SNR	G5
Festuca saximontana	Rocky Mountain Fescue	2000, 2011	SNR	G5
Fragaria vesca	American Wild Strawberry	1993, 2000	S5	G5
Fragaria virginiana glauca	Smooth Wild Strawberry	2000, 2011	S5	G5
Fraxinus pennsylvanica	Green Ash	2000	S5	G5
Gaillardia aristata	Gaillardia	1993, 2000	S5	G5
Galium boreale	Northern Bedstraw	1993, 2000, 2011	S5	G5
Galium triflorum	Sweet Scented Bedstraw	1993, 2000, 2011	S5	G5
Gaura coccinea	Scarlet Gaura	1993, 2000, 2011	S5	G5
Gentiana affinis	Prairie Gentian	1993, 2000	S4	G5
Gentianella amarella var. acuta	Northern Gentian	2000	S5	G5
Geum aleppicum	Old Man's Whiskers	2000	S5	G5
Geum macrophyllum var perincisum	Largeleaf Aven	2011	S5	G5
Geum triflorum	Three Flowered Avens		S5	G5
Glaux maritima	Sea-milkwort	1993, 2000	S5	G5

Scientific Name	Common Name	Date recorded	S rank	G rank
Glyceria striata	Fowl Manna Grass	1993, 2000	SNR	G5
Glycyrrhiza lepidota	Wild Licorice	1993, 2000, 2011	S5	G5
Grindelia squarrosa	Curly-cup Gumweed	1993, 2000	S5	G5
Gutierrezia sarothrae	Common Broomweed	1993, 2000, 2011	S5	G5
Happlopapus spinulosus	Spiny Ironplant	2000, 2011	S5	G5
Helenium autumnale	Sneezeweed	1993, 2000	S5	G5
Helianthus laetiflorus var. subrhomboideu	Beautiful Sunflower	1993, 2000		
Helianthus nuttallii	Common Tall Sunflower	1993, 2000, 2011	S5	G5
Helianthus petiolaris	Shining Sunflower	2000	S5	G5
Helictotrichon hookeri	Hooker's Oat-grass	1993, 2000, 2011	SNR	G5
Heterotheca villosa	Hairy Golden Aster	1993, 2000	SNR	G5
Heuchera richardsonii	Richard's Alum Root	1993, 2000	S5	G5
Hieracium umbellatum	Canada Hawkweed	2000	S5	G5
Hierochloe odorata	Sweet Grass	2011	S4	G5
Hippophae rhamnoides	Sea Buckthorn	2011		
Hordeum jubatum	Wild Barley	1993, 2000, 2011	S5	G5
Juncus balticus	Baltic Rush	1993, 2000, 2011	SNR	G5
Juncus longistylis	Long-styled Rush	1993, 2000	SNR	G5
Koeleria cristata	June Grass	1993, 2000, 2011	SNR	G5
Lactuca pulchella	Blue Lettuce	2000	S5	G5
Lactuca serriola	Lobed Prickly Lettuce	1993, 2000	SNA	GNR
Lappula redowskii occidentalis	Western Bluebur	2000	S5	G5
Lappula squarrosa	Bluebur	2000	SNA	GNR
Lathyrus ochroleucus	Cream-coloured Vetchling	2000	S5	G5
Lathyrus venosus	Wild Pea Vine	2000	S5	G5
Lemna minor	Lesser Duckweed	2011	S5	G5
Lepidium densiflorum	Common Pepper-grass	1993, 2000	SNA	G5
Lepidium ramosissimum	Branched Pepper-grass	2000	S5	G5
Lesquerella arenosa	Sand Bladderpod	2000, 2011	S5	G5
Liatris ligulistylis	Meadow Blazing-star	2011	S5	G5
Liatris punctata	Punctate Blazing-star	1993, 2000, 2011	S5	G5
Lilium philadelphicum	Western Red Lily	1993, 2000	S3/S4	G5
Linum lewisii	Wild Blue Flax	1993, 2000	S5	G5
Linum rigidum	Yellow Flax	2000	S5	G4/G5
Lithospermum incisum	Narrow-leaved Puccoon	2011	S4/S5	G5
Lobelia kalmii	Kalm's Lobelia	2000	S5	G5
Lolium perenne	Perennial Rye Grass	2000, 2011	SNA	GNR
Lomatium macrocarpum	Long- fruited Wild Parsley	2011	S5	G5
Lonicera dioica var. glaucescens	Twining Honeysuckle	2000	S5	G5
Lonicera tatarica	Tartarian Honeysuckle	2000	SNA	GNR
Lycopus asper	Western Water Horehound	1993, 2000	S5	G5
Lygodesmia juncea	Skeleton Weed	1993, 2000	S5	G5
Lysimachia ciliata	Fringed Loosestrife	1993, 2000, 2011	S5	G5
Malvastrum coccineum	Scarlet Mallow	1993, 2000, 2011	S5	G5
Medicage lupilina	Black Medic	2000	SNA	GNR

Scientific Name	Common Name	Date recorded	S rank	G rank
Medicago sativa ssp. Falcata	Yellow Alfalfa	1993, 2000, 2011	SNA	GNR
Medicago sativa ssp. Sativa	Alfalfa	1993, 2000	SNA	GNR
Melilotus alba	White Sweet-clover	1993, 2000, 2011	SNA	GNR
Melilotus officinalis	Yellow Sweet-clover	1993, 2000, 2011	SNA	GNR
Mentha arvense	Wild Mint	1993, 2000	S5	G5
Mirabilis hirsuta	Hairy Umbrellawort	1993, 2000	S4	G5
Monarda fistulosa v. menthaefolia	Western Wild Bergamot	2000	S5	G5
Monolepis nuttalliana	Spear-leaved Goosefoot	1993, 2000	S5	G5
Muhlenbergia cuspidata	Prairie Muhly	1993, 2000, 2011	SNR	G5
Muhlenbergia racemosa	Mat Muhly	1993, 2000	S5	G5
Musineon divaricatum	Leafy Musineon	2000	S5	G5
Oenothera biennis	Yellow Evening-primrose	2000, 2011	S5	G5
Oenothera nuttallii	White Evening-primrose	1993, 2000, 2011	S5	G5
Orthocarpus luteus	Owl's Clover	1993, 2000, 2011	S5	G5
Oryzopsis asperifolia	White Grained Mountain Rice Grass	2000	S5	G5
Oryzopsis hymenoides	Indian Rice Grass	2000	SNR	G5
Oxytropis campestris v. gracilis	Late Yellow Locoweed	1993, 2000, 2011	S5	G5
Oxytropis sericea	Early Yellow Locoweed	1993, 2000, 2011	S5	G5
Penstemon gracilis	Lilac-flowered Beardtongue	1993, 2000, 2011	SNR	G5
Penstemon nitidus	Smooth Blue Beardtongue	2000	SNR	G5
Penstemon procerus	Slender Beardtongue	1993, 2000, 2011	SNR	G5
Petalostemon candidum	White Prairie Clover	2000	S4	G5
Petalostemon purpureum	Purple Prairie Clover	1993, 2000, 2011	S5	G5
Phalaris arundinacea	Reed Canary Grass	2000	SNR	G5
Phlox hoodii	Moss Phlox	1993, 2000, 2011	S5	G5
Physostegia parviflorum	False Dragonhead	2000	S4	G4
Plantago major	Common Plantain	1993, 2000, 2011	SNA	G5
Platanthera hyperborea	Green Bog Orchid	2000	S5	G5
Poa canbyi	Canby Bluegrass	1993, 2000	SNR	G5
Poa compressa	Canada Bluegrass	1993, 2000	SNA	GNR
Poa cusickii	Early Bluegrass	1993, 2000, 2011	SNR	G5
Poa palustris	Fowl bluegrass	2000	S5	G5
Poa pratensis	Kentucky Bluegrass	1993, 2000, 2011	SNA	G5
Poa secunda	Sandberg's Blue-grass	2011	SNR	G5
Polygonum convolvulus	Wild Buckwheat	2000	SNA	G5
Polygonum convolvulus	Wild Buckwheat	1993, 2000	SNA	GNR
Populus balsamifera	Balsam/Black poplar	2000, 2011	S5	G5
Populus deltoides	Western/Plains Cottonwood	2000	S5	G5
Populus tremuloides	Trembling Aspen	1993, 2000, 2011	S5	G5
Potentilla anserina	Silverweed	1993, 2000, 2011	S5	G5
Potentilla arguta	White Cinquefoil	1993, 2000, 2011	S5	G5
Potentilla concinna	Early Cinquefoil	2000, 2011	SNR	G5
Potentilla gracilis	Graceful Cinquefoil	2000, 2011	SNR	G5
Potentilla hippiana	Wooly Cinquefoil	1993, 2000, 2011	SNR	G5
Potentilla pensylvanica	Prairie Cinquefoil	1993, 2000, 2011	SNR	G5

Scientific Name	Common Name	Date recorded	S rank	G rank
Prunus pensylvanica	Pincherry	1993, 2000, 2011	S5	G5
Prunus virginiana	Choke Cherry	1993, 2000, 2011	S5	G5
Psoralea argophylla	Silver-leaf Psoralea	1993, 2000, 2011	S5	G5
Psoralea esculenta	Indian Breadroot	1993, 2000, 2011	S5	G5
Psoralea lanceolata	Lance Leaved Psoralea	2000	S5	G5
Puccinellia nuttalliana	Nuttall's Salt-meadow Grass	2000	SNR	G5
Pulsatilla patens	Prairie Crocus	1993, 2000, 2011	S5	G5
Pyrola asarifolia	Pink Flowered Wintergreen	2000	S5	G5
Ranunculus cymbalaria	Alkali Buttercup	1993, 2000	S5	G5
Ranunculus rhomboideus	Prairie Buttercup	2011	S4	G5
Ratibida columnifera	Long-headed Coneflower	2011	S5	G5
Rhamnus cathartica	European Buckthorn	1993, 2000		
Rhus radicans v. rydbergii	Poison Ivy	2000	S5	G5
Ribes oxyacanthoides	Northern/Canada Gooseberry	2000, 2011	S5	G5
Rosa arkansana	Low Prairie Rose	1993, 2000, 2011	SNR	G5
Rosa woodsii	Wood's Rose	1993, 2000, 2011	S5	G5
Rubus idaeus idaeus	Wild-red Raspberry	2000	S5	G5
Rubus pubescens	Dewberry	2000	S5	G5
Rumex acetosa	Green Sorrel	1993, 2000	SNA	G5
Rumex pseudonatronatus	Field Dock	1993, 2000, 2011	SNA	G5
Salix bebbiana	Beaked Willow	1993, 2000, 2011	S5	G5
Salix interior	Longleaf/Sandbar Willow	2011		
Salix petiolaris	Basket Willow	1993, 2000, 2011	S5	G5
Salsola kali tenuifolia	Russian Thistle	2000	SNA	GNR
Schizachne purpurascens	Purple Oat Grass	2000		
Schizachyrium scoparium	Little Bluestem	1993, 2000, 2011		
Scirpus acutus	Viscid/Hard-stem Bulrush	2000	SNR	G5
Scirpus maritimus var paludosus	Cosmopolitan bulrush	2011	S5	G5
Scirpus validus	Great Bulrush	2000	SNR	G5
Scutellaria galericulata	Skull-cap	2000	S5	G5
Selaginella densa	Prairie selaginella/Spike-moss	1993, 2000, 2011	S5	G5
Senecio canus	Silvery Groundsel	2000, 2011	S5	G5
Senecio integerrimus integerrimus	Entire-leaved Groundsel	1993, 2000, 2011	S5	G5
Sheperdia argentea	Thorny buffaloberry	2011	S5	G5
Shepherdia canadensis	Canada Buffaloberry	2000	S5	G5
Silene drummondii var drummondii	Drummond's Campion	2011	S4	G5
Sisymbrium loeselii	Tall Hedge Mustard	2000	SNA	GNR
Sisyrinchium montanum	Blue-eyed Grass	2000, 2011	S5	G5
Smilacina stellata	Star Flowered Solomon's Seal	1993, 2000, 2011	S5	G5
Solanum triflorum	Wild Tomato	1993, 2000	SNA	G5
Solidago canadensis v. canadensis	Canada Goldenrod	1993, 2000, 2011	S5	G5
Solidago missouriensis	Low Goldenrod	1993, 2000, 2011	S5	G5
Solidago mollis	Velvety Goldenrod	2000	S5	G5
Solidago nemoralis longipetiolata	Showy Goldenrod	1993, 2000, 2011	S5	G5
Solidago ptarmicoides	Upland White Goldenrod	1993, 2000	S5	G5

Scientific Name	Common Name	Date recorded	S rank	G rank
Solidago rigida humilis	Rigid Goldenrod	1993, 2000	S5	G5
Solidago spathulata v. neomexicana	Mountain Goldenrod	2000	S5	G5
Sonchus arvensis	Perennial Sow-thistle	1993, 2000, 2011	SNA	GNR
Sorbus aucuparia	European Mountain Ash	2000	SNA	G5
Sphenopholis obtusata	Prairie Wedge Grass	1993, 2000	SNR	G5
Spiraea alba	Narrow-leaved Meadow Sweet	1993, 2000, 2011	SNR	G5
Sporobolus cryptandrus	Sand Dropseed	2000	SNR	G5
Stachys palustris	Marsh Hedge-nettle	2000	SNR	G5
Stipa comata	Needle and Thread Grass	1993, 2000, 2011	SNR	G5
Stipa curtiseta	Western Speargrass	2011	SNR	G5
Stipa spartea v. curtiseta	Western Porcupine Grass	1993, 2000	SNR	G5
Stipa viridula	Green Needle Grass	2000	SNR	G5
Suaeda depressa	Western Sea Blite	1993, 2000	S5	G5
Symphoricarpos albus	Northern Snowberry	2000	S5	G5
Symphoricarpos occidentalis	Western Snowberry	1993, 2000, 2011	S5	G5
Taraxacum officinale	Common Dandelion	1993, 2000, 2011	SNA	G5
Thalictrum venulosum	Early Meadow Rue	1993, 2000, 2011	S5	G5
Thermopsis rhombifolia	Golden-bean	1993, 2000, 2011	S5	G5
Thlaspi arvense	Stinkweed	1993, 2000, 2011	SNA	G5
Tragopogon dubius	Yellow Goat's-beard	1993, 2000, 2011	SNA	G5
Triglochin maritima	Seaside Arrow Grass	1993, 2000, 2011	S5	G5
Triglochin palustris	Marsh/Slender Arrow Grass	2000	S5	G5
Typha latifolia	Common Cattail	2000, 2011	S5	G5
Ulmus americana	American Elm	2011	S5	G5
Ulmus pumila	Manchurian/Siberian Elm	2000, 2011	SNA	GNR
Urtica dioica	Common Nettle	2000	G5	S5
Vicia americana	American Vetch	2000, 2011	S5	G5
Vicia americana v. minor	Narrow Leaved Vetch	2000	S5	G5
Viola adunca	Early Blue Violet	1993, 2000, 2011	S5	G5
Viola nephrophylla	Bog Violet	2000	S4	G5
Viola nuttalllii	Nuttall's Yellow Violet	2011	S5	G5
Viola pedatifida	Prairie Violet, crowfoot violet	2011	S3	G5
Viola rugulosa	Western Canada Violet	2000	S5	G5
Zizia aptera	Heart-leaved Alexander	2000, 2011	S5	G5
Zygadenus elegans	Smooth Camas	2000, 2011	SNR	G5

Table B-2. Avian Species observed in the Northeast Swale

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Shadick (2009)	Jensen (2009)	Ecoblitz (2011)	Jensen (2012)
Cranes and Rails								
Fulica americana	American Coot	-	✓	✓	-	-	✓	✓
Grus canadensis	Sandhill Crane	-	✓	-	-	✓	-	-
Porzana carolina	Sora	-	✓	✓	-	-	✓	✓
Doves and Pigeons								
Columba livia	Rock Dove	-	✓	-	-	✓	✓	✓
Zenaida macroura	Mourning Dove	✓	✓	✓	-	✓	✓	✓
Ducks, Geese, and Swans								
Anas acuta	Northern Pintail	-	✓	✓	-	✓	✓	✓
Anas americana	American Wigeon	-	✓	✓	✓	✓	✓	✓
Anas clypeata	Northern Shoveler	-	✓	✓	✓	✓	✓	✓
Anas Crecca	Green-winged Teal	-	✓	✓	-	✓	✓	✓
Anas cyanoptera	Cinnamon Teal	-	✓	-	-	-	-	-
Anas discors	Blue-winged Teal	-	✓	-	✓	✓	✓	✓
Anas platyrhynchos	Mallard	✓	✓	✓	✓	✓	✓	✓
Anas strepera	Gadwall	-	✓	✓	✓	✓	✓	✓
Anser albifrons	Greater White-fronted Goose	-	✓	-	-	✓	-	✓
Aythya affinis	Lesser Scaup	-	✓	-	✓	✓	✓	✓
Aythya americana	Redhead	-	✓	-	-	-	✓	✓
Aythya collaris	Ring-necked Duck	-	✓	-	-	-	-	✓
Aythya marila	Greater Scaup	-	-	-	-	-	-	✓
Aythya valisineria	Canvasback	-	✓	-	-	-	✓	✓
Branta canadensis	Canada Goose	✓	✓	✓	-	✓	✓	✓
Branta hutchinsii	Cackling Goose	-	-	-	-	✓	-	-
Bucephala albeola	Bufflehead	-	✓	-	-	-	✓	✓
Bucephala clangula	Common Goldeneye	-	✓	-	-	-	✓	✓
Chen caerulescens	Snow Goose	-	✓	✓	-	✓	-	✓
Chen rossii	Ross's Goose	-	-	-	-	-	-	✓
Clangula hyemalis	Long-tailed Duck, Oldsquaw	-	✓	-	-	-	-	-
Cygnus columbianus	Tundra Swan	-	✓	-	-	✓	-	✓
Oxyura jamaicensis	Ruddy Duck	-	✓	-	-	-	✓	✓
Grebes								
Aechmophorus occidentalis	Western Grebe	-	✓	-	-	-	-	-
Podiceps auritus	Horned Grebe	-	✓	-	✓	✓	✓	✓
Podiceps cristatus	Red-necked Grebe	-	✓	-	-	-	✓	✓
Podiceps nigricollis	Eared Grebe	-	✓	-	-	-	✓	✓
Podilymbus podiceps	Pied-billed Grebe	-	✓	-	-	-	✓	✓
Herons and Bitterns								
Ardea herodias	Great Blue Heron	-	✓	-	✓	-	-	-
Botaurus lentiginosus	American Bittern	-	✓	-	-	-	-	-
Kingfishers								
Ceryle alcyon	Belted Kingfisher	-	✓	-	-	-	-	-
Loons								
Gamia immer	Common Loon	-	✓	-	-	-	✓	-

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Shadick (2009)	Jensen (2009)	Ecoblitz (2011)	Jensen (2012)
Nighthawks								
Chordeiles minor	Common Nighthawk	-	✓	-	-	-	✓	✓
Owls								
Asio flammeus	Short-eared Owl	-	✓	-	-	-	-	-
Bubo virginianus	Great Horned Owl	-	✓	✓	-	✓	-	✓
Nyctea scandiaca	Snowy Owl	-	✓	-	-	-	-	-
Speolyto cunicularia	Burrowing Owl	-	✓	-	-	-	-	-
Surnia ulula	Northern Hawk Owl	-	✓	-	-	-	-	-
Partridges, Pheasants, and Grouse								
Perdrix perdrix	Gray Partridge	-	✓	-	-	-	-	✓
Phasianus colchicus	Ring-necked Pheasant	-	✓	-	-	-	-	-
Tympanchus phasianellus	Sharp-tailed Grouse	-	✓	✓	-	✓	-	✓
Pelicans and Cormorants								
Pelecanus erythrorhynches	American White Pelican	-	✓	-	-	✓	-	-
Phalacrocorax auritus	Double-Crested Cormorant	-	✓	-	-	✓	✓	✓
Perching Birds								
Agelaius phoeniceus	Red-winged Blackbird	✓	✓	✓	✓	-	-	✓
Ammodramus bairdii	Baird's Sparrow	-	✓	-	-	-	-	-
Ammodramus leconteii	LeConte's Sparrow	-	✓	✓	✓	✓	✓	✓
Ammodramus Nelsoni	Nelson's Sharp-Tailed Sparrow	-	✓	-	-	-	✓	✓
Ammodramus savannarum	Grasshopper Sparrow	-	✓	-	-	-	-	-
Anthus rubescens	American Pipit	-	✓	-	-	-	-	-
Anthus Spragueii	Sprague's Pipit	-	✓	-	-	-	-	-
Bombycilla cedrorum	Cedar Waxwing	-	✓	✓	-	✓	-	✓
Bombycilla garrulus	Boehemian Waxwing	-	✓	-	-	-	-	-
Calcarius lapponicus	Lapland Longspur	-	✓	-	-	✓	-	-
Calcarius ornatus	Chestnut Collared Longspur	-	-	-	-	✓	-	-
Carduelis flammea	Common Redpoll	-	✓	-	-	-	-	-
Carduelis pinus	Pine Siskin	-	✓	-	-	-	-	-
Carduelis tristis	American Goldfinch	-	✓	✓	✓	✓	✓	✓
Carpodacus mexicanus	House Finch	-	-	-	-	✓	-	-
Carpodacus purpureus	Purple Finch	-	✓	-	-	-	-	✓
Catharus fuscescens	Veery	-	✓	-	-	-	-	-
Catharus guttatus	Hermit Thrush	-	✓	-	-	-	-	✓
Catharus minimus	Grey-cheeked Thrush	-	-	-	-	-	-	✓
Catharus ustulatus	Swainson's Thrush	-	✓	-	-	-	-	✓
Chondestes grammacus	Lark Sparrow	-	-	-	-	-	-	-
Cistothorus palustris	Marsh Wren	-	✓	-	-	✓	-	✓
Cistothorus platensis	Sedge Wren	-	✓	-	-	-	✓	-
Coccyzus erythropthalmus	Black-billed Cuckoo	-	✓	-	-	-	-	-
Contopus sordidulus	Western wood-pewee	-	✓	-	-	-	-	-
Corvus brachyrhynchos	American Crow	-	✓	✓	✓	✓	✓	✓
Corvus corax	Common Raven	-	✓	-	✓	✓	✓	✓
Cyanocitta cristata	Blue Jay	-	✓	-	-	-	-	-

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Shadick (2009)	Jensen (2009)	Ecoblitz (2011)	Jensen (2012)
Dendroica coronata	Yellow-rumped Warbler	-	✓	-	-	✓	-	✓
Dendroica magnolia	Magnolia Warbler	-	✓	-	-	-	-	-
Dendroica palmarum	Palm Warbler	-	✓	-	-	✓	-	✓
Dendroica petechia	Yellow Warbler	-	✓	✓	✓	-	✓	✓
Dendroica striata	Blackpoll Warbler	-	✓	-	-	-	-	-
Dendroica tigrina	Cape May Warbler	-	✓	-	-	-	-	✓
Dolichonyx oryzivorus	Bobolink	-	✓	-	-	-	-	-
Dumetlla carolinensis	Gray Catbird	-	✓	✓	✓	✓	✓	✓
Empidonax alnorum	Alder Flycatcher	-	-	-	-	-	-	✓
Empidonax minimus	Least Flycatcher	-	✓	✓	✓	-	✓	✓
Eremophila alpestris	Horned Lark	-	✓	✓	-	✓	-	✓
Euphagus carolinus	Rusty Blackbird	-	✓	-	-	-	-	-
Euphagus cyanocephalus	Brewer's Blackbird	-	✓	✓	✓	✓	✓	✓
Geothlypis trichas	Common Yellowthroat	-	✓	✓	-	✓	-	✓
Hirundo pyrrhonota	Cliff Swallow	-	✓	-	-	-	-	-
Hirundo rustica	Barn Swallow	-	✓	✓	✓	✓	✓	✓
Junco hyemalis	Dark Eyed Junco	-	✓	-	-	-	-	-
Lanius excubitor	Northern Shrike	-	✓	✓	-	-	-	-
Lanius ludovicianus	Loggerhead Shrike	-	✓	-	-	-	-	-
Lcterus galbula	Baltimore Oriole	-	✓	✓	-	-	✓	✓
Melospiza georgiana	Swamp Sparrow	-	✓	-	-	✓	-	-
Melospiza Lincolnii	Lincoln's Sparrow	-	✓	-	-	✓	-	✓
Melospiza melodia	Song Sparrow	-	✓	✓	✓	✓	✓	✓
Mniotilta varia	Black and White Warbler	-	✓	-	-	-	-	-
Molothrus ater	Brown-headed Cowbird	-	✓	✓	✓	-	✓	✓
Oporornis philadelphia	Mourning Warbler	-	✓	-	-	-	-	-
Orus atricapillus	Black-capped Chickadee	-	✓	✓	-	✓	-	-
Passer domesticus	House Sparrow	-	✓	✓	-	-	-	-
Passerculus sandwichensis	Savannah Sparrow	-	✓	✓	✓	✓	✓	✓
Passerella iliaca	Fox Sparrow	-	✓	-	-	-	-	-
Pheucticus ludovicianus	Rose-breasted Grosbeak	-	✓	-	-	-	-	-
Pheucticus melanocephalus	Black-headed Grosbeak	-	✓	-	-	-	-	-
Pica pica	Black-billed Magpie	✓	✓	✓	-	✓	✓	✓
Pipilo maculatus	Spotted Towhee	-	✓	-	-	-	-	-
Plectrophenax nivalis	Snow Bunting	-	✓	-	-	-	-	-
Pooecetes gramineus	Vesper Sparrow	-	✓	-	-	✓	✓	✓
Progue subis	Purple Martin	-	✓	-	-	-	✓	-
Quiscalus quiscula	Common Grackle	-	✓	-	-	✓	✓	✓
Regulus calendula	Ruby-crowned Kinglet	-	✓	-	-	-	-	-
Regulus satrapa	Golden-crowned Kinglet	-	✓	-	-	-	-	-
Riparia riparia	Bank Swallow	-	✓	-	-	-	-	-
Sayornis phoebe	Eastern Phoebe	-	✓	-	-	-	-	-
Sayornis saya	Say's Phoebe	-	✓	-	-	-	-	-
Seirus aurocapillus	Ovenbird	-	✓	-	-	-	-	-
Seirus noveboracensis	Northern Waterthrush	-	✓	-	-	✓	-	-

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Shadick (2009)	Jensen (2009)	Ecoblitz (2011)	Jensen (2012)
Setophaga ruticilla	American Redstart	-	✓	-	-	-	-	✓
Sialia currucoides	Mountain Bluebird	-	✓	✓	-	-	-	-
Sitta canadensis	Red-breasted Nuthatch	-	✓	-	-	-	-	-
Spizella arborea	American Tree Sparrow	-	✓	✓	-	-	-	-
Spizella pallida	Clay-colored Sparrow	✓	✓	✓	✓	✓	✓	✓
Spizella passerina	Chipping Sparrow	-	✓	✓	-	-	✓	-
Stelgidopteryx serripennis	North Rough-winged Swallow	-	✓	-	-	-	-	-
Sturnella neglecta	Western Meadowlark	✓	✓	✓	✓	✓	✓	✓
Sturnus vulgaris	European Starling	-	✓	-	-	✓	✓	✓
Tachycineta bicolor	Tree Swallow	-	✓	✓	-	-	✓	✓
Toxostoma rufum	Brown Thrasher	-	✓	✓	✓	-	✓	✓
Troglodytes aedon	House Wren	-	✓	-	✓	✓	✓	✓
Turdus migratorius	American Robin	-	✓	✓	✓	✓	✓	✓
Tyrannus tyrannus	Eastern Kingbird	-	✓	✓	✓	-	✓	✓
Tyrannus verticalis	Western Kingbird	✓	✓	-	-	-	-	-
Vermivora celata	Orange-crowned Warbler	-	✓	-	-	✓	-	✓
Vermivora peregrina	Tennessee Warbler	-	✓	-	-	-	-	-
Vireo gilvus	Warbling Vireo	-	✓	✓	-	-	-	✓
Vireo olivaceus	Red-eyed Vireo	-	✓	✓	-	-	-	-
Vireo solitarius	Blue-headed Vireo (Solitary Vireo)	-	✓	✓	-	-	-	-
Wilsonia pusilla	Wilson's warbler	-	✓	✓	-	-	-	-
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	-	✓	✓	-	-	✓	✓
Zonotrichia albicollis	White-throated Sparrow	-	✓	-	-	✓	-	✓
Zonotrichia leucophrus	White-crowned Sparrow	-	✓	-	-	✓	-	✓
Zonotrichia querula	Harris's Sparrow	-	✓	-	-	-	-	-
Raptors								
Accipiter cooperii	Cooper's Hawk	-	✓	✓	-	✓	-	✓
Accipiter striatus	Sharp-shinned Hawk	-	✓	✓	-	✓	-	-
Buteo jamaicensis	Red-tailed Hawk	-	✓	✓	-	✓	-	✓
Buteo lagopus	Rough-legged Hawk	-	✓	-	-	-	-	-
Buteo swainsonii	Swainson's Hawk	-	✓	✓	-	✓	✓	✓
Cathartes aura	Turkey Vulture	-	-	✓	-	-	-	-
Circus cyaneus	Northern Harrier	-	✓	✓	-	✓	✓	✓
Falco columbarius	Merlin	-	✓	✓	-	✓	✓	✓
Falco peregrinus	Peregrine Falcon	-	✓	-	-	-	-	✓
Falco sparverius	American Kestrel	-	✓	-	-	-	-	✓
Haliaeetus leucocephalus	Bald Eagle	-	✓	-	-	-	-	-
Pandion haliaetus	Osprey	-	✓	-	-	✓	-	-
Shorebirds and Gulls								
Actitis macularia	Spotted Sandpiper	-	✓	-	-	-	✓	✓
Bartramia longicauda	Upland Sandpiper	-	✓	✓	-	-	✓	✓
Calidrus alba	Sanderling Sandpiper	-	-	-	-	-	✓	-
Calidrus bairdii	Baird's Sandpiper	-	✓	-	-	-	-	-
Calidrus himantopis	Stilt Sandpiper	-	✓	-	-	-	-	✓

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Shadick (2009)	Jensen (2009)	Ecoblitz (2011)	Jensen (2012)
Calidrus melanotos	Pectoral Sandpiper	-	✓	-	-	-	-	-
Calidrus minutilla	Least Sandpiper	-	✓	-	-	-	✓	-
Calidrus pusilla	Semipalmated Sandpiper	-	✓	-	-	✓	✓	-
Catoptrophorus semipalmus	Willet	✓	✓	-	✓	-	✓	✓
Charadrius semipalmatus	Semipalmated Plover	-	✓	-	-	-	-	-
Charadrius vociferus	Killdeer	-	✓	-	✓	✓	✓	✓
Chlidonias niger	Black Tern	-	✓	-	-	-	✓	-
Gallinago delicata	Wilson's Snipe	-	✓	✓	-	✓	✓	✓
Larus californicus	California Gull	-	✓	-	-	-	✓	-
Larus delawarensis	Ring-billed Gull	-	✓	-	-	✓	-	✓
Larus philadelphia	Bonaparte Gull	-	✓	-	-	-	-	-
Larus pipixcan	Franklin's Gull	-	✓	✓	-	✓	✓	✓
Limnodromus griseus	Short-billed Dowitcher	-	✓	-	-	-	-	✓
Limnodromus scolopaceus	Long-billed Dowitcher	-	✓	-	-	✓	-	-
Limosa fedoa	Marbled Godwit	✓	✓	-	-	-	-	✓
Limosa haemastica	Hudsonian Godwit	-	✓	-	-	-	-	-
Phalaropus lobatus	Red-necked Phalarope	-	✓	-	-	-	-	-
Phalaropus tricolor	Wilson's Phalarope	-	✓	-	-	-	✓	✓
Pluvialis dominicus	American Golden Plover	-	✓	-	-	-	-	-
Pluvialis quatarola	Black-bellied Plover	-	✓	-	-	-	-	-
Recurvirostra americana	American Avocet	-	✓	✓	-	-	-	✓
Tringa flavipes	Lesser Yellowlegs	-	✓	-	-	-	-	✓
Tringa melanoleuca	Greater Yellowlegs	-	✓	-	-	✓	-	✓
Tringa solitaria	Solitary Sandpiper	-	✓	-	-	-	-	✓
Woodpeckers								
Colaptes auratus	Northern Flicker	-	✓	-	✓	✓	✓	✓
Picoides pubescens	Downy Woodpecker	-	✓	-	-	-	-	✓
Picoides villosus	Hairy Woodpecker	-	✓	-	-	-	-	-
Sphyrapicus varius	Yellow-bellied Sapsucker	-	✓	-	-	-	-	✓

Table B-3. Mammals, Reptiles, Amphibians, and Insects observed in the Northeast Swale

Scientific Name	Common Name	Hudson (1993)	Gollop (2000)	Delanoy (2001)	Jensen (2009)	Ecoblitz (2011)
Mammals						
Alces	Moose	-	-	-	-	✓
Blarina brevicauda	Short tail Shrew	-	-	-	-	✓
Canis latrans	Coyote	-	✓	✓	-	✓
Castor canadensis	Beaver	✓	✓	-	-	✓
Citellus franklini	Franklin's Ground Squirrel	✓	✓	-	-	-
Citellus richardsoni	Richardson's Ground Squirrel	✓	✓	✓	✓	✓
Citellus triodecemlineatus	Thirteen-lined Ground Squirrel	✓	✓	✓	-	✓
Lepus townsendi	White-tailed Jack Rabbit	✓	✓	✓	-	-
Liomys irroratus	Pocket Mouse	-		✓	-	-
Mephitus mephitus	Striped Skunk	-	✓	✓	-	-
Microtus pennsylvanicus	Meadow Mouse	-	-	-	-	✓
Mus musculus	House Mouse	-	-	✓	-	-
Mustela frenata	Long-tailed Weasel	-	✓		-	-
Odocoileus hemionus	Mule Deer	✓	✓	✓	-	✓
Odocoileus virginianus	White-tailed Deer	✓	✓	✓	-	✓
Ondatra zibethica	Muskrat	-	✓	-	-	✓
Sylvilagus nuttalli	Mountain Cottontail	-	✓	-	-	-
Taxidia taxus	Badger	-	✓	✓	-	✓
Thomomys talpoides	Northern Pocket Gopher	✓	✓	-	✓	-
Reptiles and Amphibians						
Ambystoma tigrinum	Tiger Salamander	-	✓	-	-	-
Pseudoacris triseriata maculata	Boreal Chorus Frog	-	✓	-	-	-
Thamnopsis sirtalis parietalis	Common Garter Snake	-	✓	✓	-	✓
Insects						
Braconidae	Parastic Wasp	-	-	-	-	✓
Cantharidae	Soldier Beetle	-	-	-	-	✓
Celastrina ladon	Spring Azure Blue	-	✓	✓	-	-
Chironimidae	Non-biting Midge	-	-	-	-	✓
Colias philodice	Common Sulphur	-	✓	✓	-	-
Culicidae	Mosquito	-	-	-	-	✓
Dermacentor variabilis	Dog Tick	-	-	-	-	✓
Enodia anthedon	Northern Pearly Eye Satyr	-	✓	✓	-	-
Everes amyntula	Western Tailed Blue	-	✓	✓	-	-
Formicidae	Ant	-	-	-	-	✓
Ichneumonidae	Parastic Wasp	-	-	-	-	✓
Lepidoptera	Moth	-	-	-	-	✓
Lycaeides idas	Northern Blue	-	✓	✓	-	-
Odonata	Nymphal Dragonfly	-	-	-	-	✓
Pieris rapae	Cabbage White	-	✓	✓	-	-
Syrphidae	Hover Fly	-	-	-	-	✓
Tachinidae	Fly	-	-	-	-	✓
Tenthrididae	Saw Flies	-	-	-	-	✓
unknown diptera		-	-	-	-	✓
Vanessa cardui	Painted Lady Thistle	-	✓	✓	-	-
Zygoptera	Damselfly	-	-	-	-	✓

Appendix C.
The Northeast Swale and early University of Saskatchewan Buildings

The Northeast Swale and early University of Saskatchewan Buildings

Prepared for:

Meewasin Valley Authority

Willis Kirkham

August 31, 2012

Table of Contents

1. Acknowledgements

Thank you to Tim Hutchinson of the University of Saskatchewan Archives for providing extensive support and guidance during the research for this report.

The services and help offered by The Saskatchewan Archives Board, Local History Room at the Saskatoon Public Library, and University of Saskatchewan Library Special Collections is also appreciated very much.

2. Purpose

This report is a brief investigation into the relationship between the Northeast Swale and the University of Saskatchewan, and aims to answer the question: Were stones from the Northeast Swale used in the construction of early University of Saskatchewan buildings? The report has been prepared for the Meewasin Valley Authority, and is meant to provide background information on this topic for projects concerning the Northeast Swale, such as future land development, interpretation initiatives and further historical research.

3. University stone source

Throughout the Northeast Swale there is evidence of quarrying activity. Meewasin Valley Authority employees have found limestone boulders with drill holes, a boulder with splitting pins, large gravel pits and depressions in the ground where boulders have presumably been removed.

It is well known that early University of Saskatchewan construction projects sourced stone from the vicinity of Saskatoon. A 1916 report describes a ridge of limestone that extends southwest towards Saskatoon from a point on the southeast side of the river near Clarkboro Ferry. Approximately 2 ¼ miles from Saskatoon the ridge held large boulders that yielded as much as 18 cubic metres of stone, which were used for construction of the University of Saskatchewan (Parks, 1916). A boulder that size would weigh approximately 44 000 kilograms at 2611 kilograms per cubic metre (Stetler, n.d) and fill about three tandem trucks.

Other accounts indicate that the stone was located “6 miles northeast of the [university] site” (Morton, 1959). When taking into account the size of Saskatoon at the time, both sources describe roughly the same area to the northeast. Further, the location, topography and geology of the Northeast Swale matches the description of the ridge mentioned above.

4. University of Saskatchewan financial records

The University of Saskatchewan Archives give further evidence that the Northeast Swale provided stone for the University. Financial ledgers for the President's Residence and the Dean

of Agriculture Residence, now the Faculty Club, for the period 1911-12 indicate payments for stone were made to various individuals. A common name in the records is "Mr. Powe". In order to correlate payments for stone to landowners and parcels of land, the Saskatchewan Archives Board (SAB) homestead records were consulted.

5. Homesteads of James D. Powe

SAB has homestead files for James D. Powe for the following land descriptions:

5.1. E-22-38-4-W3M (SAB homestead file 395052)

This parcel is located approximately at the Clarkboro Ferry on the west side of the river. Powe was known as a resident in the Clark's Crossing area (Wienbender and Irvine, 2001). This information shows Powe lived very close to the northern end of the rocky ridge described above.

5.2. SE-2-37-5-W3M (SAB homestead file 734202)

Powe filed for entry on this homestead in 1893; today it would encompass the northeast corner of Sutherland. This land was adjacent to Carl Kusch's homestead, where he had built a stone house. Kusch was also the original owner of the Queen Hotel, a stone hotel in Saskatoon built in 1890 (Champ, 1991).

5.3. SW-12-37-5-W3M (SAB homestead file 912459)

Application for this parcel was made in 1904. The quarter section is approximately 3 miles north of the previous homestead, and includes portions of the present day Saskatoon Natural Grasslands, near the Regional Psychiatric Centre in the Silverspring neighborhood. The park has rocks with drill holes similar to the boulders found to the northeast, and the land is geographically and geologically linked to the Northeast Swale. This land is at the southern end of the "rocky ridge" that extends from the Clark's Crossing region. Powe can now be linked to land at the southern boundary of the Northeast Swale

It's reasonable to assume that Powe had traveled through the land extending from his Sutherland homestead to Clark's Crossing, and was aware of the unique geology of the large tract of land that is the Northeast Swale.

6. The Powe Family

It turns out the Powe family was quite prominent in early Saskatoon, and it was well known that Powe used stone from his pastures for building.

The family came to Saskatoon in 1884, were among the first pioneers in the town, and were influenced to come because Mrs. Mary Powe's brother, George Grant, was assistant commissioner to John Lake during the expedition to select a town site in the Temperance Colonization Society's land grant (Saskatoon Historical Association, 1927)

Originally settling on homestead #1 near Clark's Crossing, the family abandoned the homestead and moved to Saskatoon around 1887. Mary Powe was the postmistress at Nutana. James Powe was listed as a "builder" and carpenter in the local directory. Powe was also one of the first school board trustees in Saskatoon, and was a leading figure in the building of the Little Stone Schoolhouse in 1887, now located on the University of Saskatchewan campus. In 1893 Powe applied for entry on homestead #2 near Sutherland and built a frame house on it (Sarjeant, 1980). This is the quarter section where the present day Powe house is located (discussed below).

Along with his early school board trustee position, he was a member of Sutherland town council from 1916 to 1921 (Description of Powe house architecture, n.d.).

7. The Powe House

James Powe began constructing a large house on his homestead in Sutherland sometime around 1910-12, and likely finished in 1914. Today, it is located at the northwest corner of 115th St. and Central Ave. The architecture made a statement because the style was more typical of the upper class houses along the river in Saskatoon. According to Powe's son Milton, the foundation for the house was built using stones "gathered from Powe's pasture about 3 miles north of Sutherland..", and that stone from Powe's pasture was used for the base of the first barn at the university (Description of Powe house architecture, n.d.). Jason Bradwell, stonemason, and Alfred Clark worked on the foundation (Sarjeant, 1980). This pasture would have been homestead #2, where rocks with drill holes are still located today. Leftover stones from the foundation were used in a nearby dairy barn (a different barn from the one at the university) and bricks in a nearby house (Description of Powe house architecture, n.d.). Given the prominence of the house and Powe's reputation within the community, the source of the stones for the foundation was probably well known within the community.

8. Connection to the University of Saskatchewan

The Saskatoon Public Library, Local History Room has newspaper clippings regarding James and Mary Powe's golden wedding anniversary – organized by W. P. Bate. The event also served as a reunion for "old-timers" of Saskatoon. In the guestbook, a lot of recognizable Saskatoon

names occur, including early Saskatoon mayors James R. Wilson and James Clinkskill. Clinkskill was also one of the original members of the University of Saskatchewan Board of Governors.

In *Saskatchewan: The Making of a* University, Arthur Morton, who taught at the university beginning in 1914, describes how the university Board of Directors came to use field stone, or greystone, instead of Tyndall stone:

> "The building contracts specified that the College of Agriculture Building and the Residence were to have exterior walls of rock-faced Tyndall stone. After the stone work was started and several car loads of Tyndall stone were either on the site or in transit, a man named James Wilson proposed that the builders use a local limestone instead. This limestone was available about six miles northeast of the site. The contractors were instructed to build a sample wall of this stone for the Board's inspection. They did so; the Board approved of the result and ordered the substitution of the Greystone for the Tyndall. The local stone proved to be a much better stone than the Tyndall; it was harder and more impervious to moisture, and its varied colour made for a more pleasing appearance of the finished wall" (1959).

The Powe family was definitely prominent in Saskatoon, and Mr. Powe was well known. His relationship to prominent figures and decision makers of early Saskatoon helps to explain why he was one of the first to supply local stone to the university.

9. Other payments to local landowners

Several payments for "stone" are listed in the University's minutes of the Board Executive - April and May 1922, one being C.S. Copp. The 1922 Cummins' landowner map for the area shows C. S. Copp owned land just east of the present day swale at 4-37-26-W3M (and some surrounding quarter sections).

10. Conclusion

Various reports suggest that the land Northeast of Saskatoon known as the Northeast Swale provided a source of stone for early University of Saskatchewan buildings. The documented payments for stone from the University to homesteaders, whose land was in or near the Northeast Swale, further reinforces that the source of stone for early University buildings included the Swale. Although a direct connection has not been made to the land at 18-37-4-W3M, where the boulder with metal splitting pins is located, connections are clearly present to surrounding parcels of land with similar artefacts. Further research into documents at the University of

Saskatchewan Archives would likely uncover more records of payments for stone, and additional landowner names.

As can be seen through the experiences of the Powe family, the Northeast Swale provided stone for not just university buildings, but also dwellings and barns. The Powe family were early pioneers of Saskatoon, and through them we can learn much about the people, events, and life in general during the period. Some subjects that are touched upon through the narrative of the Powe family include: the homesteading system, the Dominion Land Survey, the Temperance Conisation Society, the early history of Saskatoon and area, Clark's Crossing and the historical significance of the site, historical trails that brought settlers to the area, and the history of the University of Saskatchewan.

Due to the relationship between the Northeast Swale and the early history of Saskatoon, the University, and settlement of Saskatchewan in general, the Northeast Swale has excellent educational and interpretive potential.

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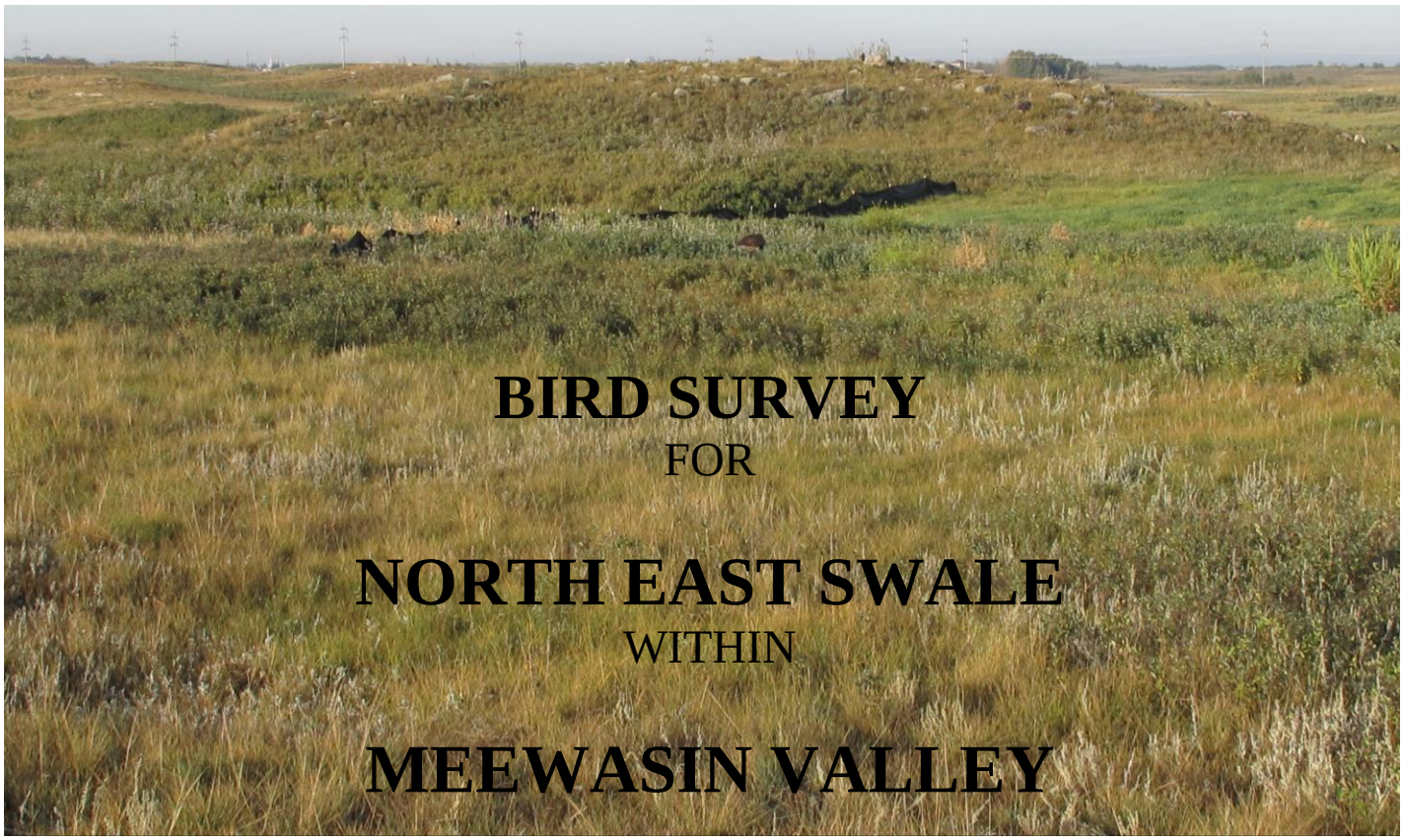
Appendix D.
Bird Survey for Northeast Swale within Meewasin Valley



BIRD SURVEY
FOR
NORTH EAST SWALE
WITHIN
MEEWASIN VALLEY

May 1 to June 2, 2012

BY

JENSEN ECOSYSTEMS SERVICES

PROJECT OUTLINE

Jensen Ecosystems Services was contracted to provide a survey of avifauna purposely to determine the species present during the spring breeding and migration period with comment on habitat(s) that are vulnerable or critical to the species observed. The area to be surveyed was approximately 243 ha (600 acres), within the NE Swale under land control of the Meewasin Valley Authority. Furthermore, particular attention was to be paid to 10 species of interest: burrowing owl, common nighthawk, loggerhead shrike, short-eared owl, Sprague's pipit, barn swallow, Baird's sparrow, horned grebe, tree swallow and yellow rail.

INTRODUCTION

The portion of the NE Swale, Figure 1, referred to in this report is a long narrow depression running in a north easterly direction between the South Saskatchewan River and an area north of Sutherland. The area is predominately shallow water bodies and native grasslands with limited woody vegetation. It is these native grasslands and the wetland/grassland interface that was of interest for native prairie breeding bird species. The swale in total is some 26 km long by up to 1.5 km wide. This breeding bird survey was limited to the native grassland, water bodies and woody vegetation found within the following land locations: SE19-37-4-W3 and SW 20-20-37-4-W3 owned by the City of Saskatoon and within the Meewasin Conservation Zone.

Figure 1. Aerial View of the North East Swale, 18-37-4-W3 from Google Earth.

FIELD SURVEY

Methods

The avian species were surveyed over 12 field trips during 3 to 4 hour time periods: 8 morning field trips were sunrise to 4 hours post sunrise and 4 evening field trips were 4 hours pre sunset to sunset. Morning or evening field trips were not conducted on the same day. The land was walked to determine species present. No special effort was directed toward finding nesting species. Nests were recorded when a species was flushed from its nest while birding on a field trip.

A GPS unit, Garmin etrex Vista HCX, was employed to track the movements of the surveyor on the land and mark features of interest (nests), please see appendix 2 for the extent of the area covered.

Results

During the 38.2 hours of survey conducted between May 1 and June 2, four species of interest (common nighthawk, horned grebe, barn and tree swallows) were observed or heard. According to Jonker and Gollop (2000), of the 10 species of interest, 7 were reported to be expected yearly (horned grebe, common nighthawk, loggerhead shrike, tree swallow, barn swallow, Sprague's pipit, and Baird's sparrow) and two were not expected annually (burrowing owl and short-eared owl) and yellow rail was not observed. Dr. B. Gollop has developed a species list of 181 birds in *A Guide to Nature Viewing Sites in & around Saskatoon (revised edition (*Jonker and Gollop, *2000).*

This survey resulted in 103 species of birds observed on 12 field trips. Table 1 provides a break down of the number of species observed during all the field trips. Thus during all 12 field trips the same 15 species were observed or heard every time whether the field trip was a morning or evening field trip. Conversely, 27 species were observed or heard on only one field trip, either a morning or evening.

Table 1. Number of species observations during this survey.

TOTAL NUMBER OF SPECIES	TOTAL NUMBER OF FIELD TRIPS
15	12
10	11
2	10
7	9
5	8
6	7
6	6
5	5
7	4
7	3
6	2
27	1

The morning field trips, sunrise to + 4 hours and evening field trips 4 hours prior to sunset produced quite different results. Morning and evening field trips observed or heard 52 and 44 species respectively. The differences in species observed may be related to less favourable birding conditions in the evening (wind, rain event shorten field day), reduced species activity levels and low species number and duration of total observation time during morning and evening birding field trips.
The table below provides a percentage breakdown by number of species observed during all the field trips. It is interesting that only 15 species were seen during all 12 field trips whether morning or evening. This suggests that these species are very numerous, gregarious, obvious or outstanding species and possibly comfortable around humans. Conversely, the 26 seen only once, or on 8% of total field trips, were migratory or very quiet, shy and possibly diminutive species. A complete species list as recorded with the number of sight or heard observations and percentage of time observed during the survey is provided in Appendix 1.

Table 2. Frequency of species observed during this survey adjusted for MSA.

SPECIES NUMBER	PERCENTAGE*
15	**100**
10	**92**
1	**86**
3	**83**
2	**80**
1	**78**
7	**75**
5	**67**
3	**60**
5	**58**
9	**50**
3	42
3	33
3	25
7	17
26	8

*Species in **bold** have had their recorded percentage adjusted by the MSA

FIELD SURVEY CONCLUSIONS

Four species of interest were observed or heard during this survey: common nighthawk, barn swallow, tree swallow and horned grebe. It could be concluded, although no nests, food carrying or flightless young were observed, that at least two species, tree swallow and horned grebe nest within the NE Swale. These two species were observed during 100% of the field trips. Barn swallows observed during 75% of the field trips definitely are not nesting within the confines of the swale proper but in adjacent farm yards. Barn swallows are insectivores, feeding on emergent aquatic insects and use the swale to forage. A single common nighthawk was heard calling which in itself is notable given their dramatic drop in population numbers. The swale could provide nesting habitat on the rocky sparsely vegetated native grassland ridges. Given the low numbers an intense survey would be required to find a nesting common nighthawk.

Nesting habitat for loggerhead shrikes is present. However, no loggerhead shrikes were observed during this survey. It is not a surprise that loggerhead shrikes were not observed during the survey given their very low numbers provincially.
The native grasslands in the NE Swale are not ideal for Sprague's pipit with the grass to tall and lush for nesting. This pipit evolved with prairie bison and patchy grazed land is a preferred nesting habitat. Sprague's pipit numbers are greatly reduced which leaves less desirable habitat unoccupied. Similarly, the unoccupied burrows present could be used by burrowing owls should species numbers rebound. Short-eared owls could nest in the NE Swale but maybe only during eruptive years. Finally, Baird's sparrow is a native nesting grassland species that has not been reported observed in the grasslands around Saskatoon for some years. A search through the provincial bird sightings website, SaskBirds, found the closest reported Baird's Sparrow by Guy Wapple near Biggar and Goose Lake (Saskbirds website report numbers 7143 and 10241 respectively).

Thus it would appear that four species, (common nighthawk, loggerhead shrike, Sprague's pipit and Baird's sparrow) are no longer to be expected annually on the NE Swale and are at best accidental species as defined by Jonker and Gollop *(2000)*.

It is presumed that any species recorded as observed or heard during 50% or more of the field trips as shown in Table 2, are potentially breeding within the NE Swale or it is an important habitat for that species. Jonker and Gollop (2000) report "*at least 60 species on or around the swale".* However, species like ring-billed gull and common raven (both observed 58% of the field trips) are not nesting within the NE Swale because their respective nesting requirements are not provided. However, the habitat is critical for their foraging behaviours. Ring- billed gulls and common raven are opportunistic feeders of unguarded nests, young birds, insects and amphibians. There are few species that may be breeding in the NE Swale but either arrive later in the spring: yellow warbler, eastern kingbird, upland sandpiper, and warbling vireo, or nest much later American goldfinch and cedar waxwing. When a specie's mean spring arrival date (MSA) was used as the first recordable date, (Leighton et al, 2002), their respective percentage occurrences were adjusted accordingly. This recalculation of observation per centage resulted in these species moving from below the 50% to above the 50% observation level used to predetermine plausible nesting species. The table in Appendix 1 provides a break down of recorded presence by species. Species in **bold** have had their recorded percentage adjusted by the MSA.

Confirmed nesting species, 7, within the swale were determined by finding active nests: northern shoveler, American wigeon, American coot, northern pintail, American robin, clay coloured sparrow and black-billed magpie. Killdeer were observed acting (broken wing act), like they were nesting or had young. Willet, marble godwit, upland sandpipers and eastern kingbirds were observed defending (overhead flight with aggressive calling to deter the observer) territory during the survey. Two species, American goldfinch and cedar waxwings nest late July to early August thus no nesting or defensive observations. Brewer's blackbirds were observed carrying nesting materials. A majority of the duck species, especially "dabbling ducks" and at least three "diving ducks" (canvasback, redhead and ruddy duck) are probably nesting in the wetland cattails or grass uplands with three duck species' nests found in the native grass uplands. A count of ducklings by species could determine what species were at least successfully nesting in the

swale. Given the aerial avian and terrestrial predators in the area, black-billed magpie, common raven, American crow, ring-billed gull, red fox and coyote, not all upland nesters will succeed in hatching their respective eggs.

Two species of fowl were observed in the swale: gray partridge once as a pair; sharp-tailed grouse, as many as five birds, mostly pairs or three's were observed during six surveys in the prairie uplands. There may even be a lek on a rocky prairie knoll but this survey started too late to observe any mating dance activity by sharp-tailed grouse.

Three avian predators would appear to be regularly foraging in the swale: great horned owl, red-tailed and Swainson's hawks. No young great horned owls were observed in the treed areas of the swale in early May. This species nesting depends upon available stick nest constructed by other raptors, black-billed magpie, American crow and recently common raven. There are less than 10 available nesting sites for great horned owls currently in the swale. The two hawk species, red-tail and Swainson's, prefer larger trees to construct their respective nests than were available within the swale. There were numerous large trees outside of the swale for nesting. These two hawk species were observed flying over the swale included 5 red-tailed occurrences and 4 Swainson's occurrences, presumably hunting.

Three additional raptors were observed once within the swale: peregrine falcon, merlin and Cooper's hawk. Merlin has been documented, "*In late summer immature Merlins were often seen hunting singly in the fields north of the University and in Saskatoon itself (hawking dragonflies)*" by Lynn Oliphant (1974), to forage outside of their city nesting locations. The peregrine falcon may be doing the same as the merlin. There is presently a nesting pair of peregrine falcon within the city limits. Cooper's hawk is a year round resident of Saskatoon, possibly nesting in heavily treed areas along the river.

CRITICAL HABITATS

Part of this survey was to determine which habitat(s) were more critical. Considering the 62 species that may breed or use the swale as a part of their respective foraging habitats, all the habitats within the swale are occupied by at least one species. Prairie grassland species are under represented because this habitat type is the least abundant. Thus the species abundance is low, i.e. burrowing owl, Sprague's pipit and Baird's sparrow for example. Should the aquatic habitats or limited treed habitats be compromised in the NE Swale, species like the horned grebe and tree swallow will no longer be represented resulting in a move along the continuum of more species on the "species of interest" list due to habitat modification, deterioration or total destruction. **All the NE Swale habitats are of value to different species. The significance of a native grassland uplands and associated wetland/pothole complex can not be overstated close to or within an urban environment**.

FURTHER STUDIES RECOMMENDED

Confirmation of nesting species, not within the parameters of this survey and report, requires intense observation by a number of observers and a dog trained to search would be very useful.

Additional field trips prior to July 31 concentrating on young of the year waterfowl would be useful to help determine those waterfowl (duck, geese and grebes) that successfully nested in the swale study area.

Habitat(s) for species of interest (common nighthawk, loggerhead shrike and yellow rail) most probably to nest within the swale study area could be identified and geo located with further field work.

ACKNOWLEDGEMENTS

I would like to thank Amber Jones and Luc Delanoy of the Meewasin Valley Authority for the opportunity to conduct this birding survey on the lands with in the Meewasin Conservation Zone. I appreciate the efforts of earlier surveyors whom provided background for this survey.

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Appendix E.
Prescribed Burn Proposal
Prescribed Burn Complexity Rating Guide

Prescribed Burn Proposal

This form should be completed by the Resource Management Officer and signed off by the Resource Planner and the C.E.O. This form is a summary of a proposed prescribed burn and approval in principle of it.

Project Date:

Project Location:

Project Name/Number:

Who is advocating this burn?

General Intent of the Project.

Rationale

Objectives of the Burn.

Site Description, Size and Location

Site History.

Methodology for Inventory, Sampling and Monitoring Prescribed Burn

Proposed Burn Dates

Preliminary Ignition and Control Plan

Smoke Management

Operational Concerns

Pre Burn Site Preparation

Affected Stakeholders

Stakeholder Consultation and Information Plan

Other Concerns:

Signed and approved in principle:

Res Mgmt Officer_____ Date_____

Resource Planner _____ Date_____

C. E. O. _____ Date_____

Post Burn Summary of Observations and Recommendations

Prescribed Burn Complexity Rating Guide

Basic Prescribed Fire	16 to 104 points
Complex Prescribed Fire	105 to 208 points

It is recommended that a complexity score of 156 points be the upper most limit of a prescribed burn. If your score is higher than this, then cancellation of the burn is recommended until conditions improve.

Score	Complexity Indicators	Complexity Points												
		1	2	3	4	5	6	7	8	9	10	11	12	13
2	Firing Techniques	Burn Out			Stripping			Back Fire				Aerial Ignition		
4	FBP Fuel Model Outside Unit	D1	01a		01b	M 2	M3			C3	C1, C4	S1		C2
2	Burn Block Shape	Uniform			Non-Uniform					Fragmented		Very Fragmented		
4	FBP Fuel Model of Burn Area	D1		01a	01b	M 2	M1	S1			C3	C1,C4		C2
1	Unit Size in Hectares	<2		2-5		6-10		10-40			40-100		>100	
9	Days Since Last Rain 2mm or more	1-3	4	5	6	7	8-9	10	11 -15		16 – 20		>20	
11	Season of Year (Grassland)	June			May		July	March-April			August		Sept-Nov	
12	Primary Types of Control Lines	Natural			Black Lines			Plowed Lines				Wet Lines/ Foam Lines		
11	Outside Burn Values at Risk	Grass/ Brush Nothing			Timber Values/ Minor Values			Private Property, Timber Values High Values						
12	FFMC	<80			81-85			86-90				91-96		
7	Relative Humidity	>60		50 -40		35-30			29-25		24-21		<20	
11	Wind Speed (10 meters) km/hr	<5	6 – 9					10 – 14		15 – 19			> 20	
9	Temperature	5 - 9			10 - 14		15 - 19		20-24		25-29	30-35		>35
8	Time of Day	2000	1000		1100	1800/1900		1200		1700	1600	1500	1300-1400	
104	Total Score													

Appendix F.
Process and Consultations

Process and Consultation

Consultations on the RMP began in earnest in late September, 2012. Members of the public with an interest in the swale, nature, Meewasin, and the future direction of the City were consulted to inform the process. Some important feedback included:

- The concept of "controlled access" in the ecological core
- The importance of the swale for research and partnerships with the U of S
- Limiting recreation to passive uses in the swale
- Considering cumulative effects
- Restoration of disturbed areas
- Connection to future schools for programing in the swale, concept of a "living classroom"
- Value of ecosystem services provided by the swale

Approximately 25 to 30 people attended the Public open house, those attending included City of Saskatoon staff and councilors, swale watchers and other naturalists, Silverspring residents, Meewasin staff and committee members, and other members of the community. Meewasin presented the components of the Resource Management Plan, and facilitated questions and discussion. City of Saskatoon staff attended to respond to questions. Key discussion points and recommendations included:

- Timeline and funding for implementation
- Funding for the recommendations
- Rational behind burning and grazing
- Wildlife mortality rates on roadways
- Placement of road corridors
- Striving for perfection, how close does this plan get
- Constriction of the wildlife corridor, especially at Central Avenue, option of an overpass
- Designing roads to reduce wildlife mortality
- Storm water management
- Change from 2002 Guidelines
- University of Saskatchewan Reclamation Site and adjacent lands
- Legal designation and status

Consultation Sessions:

- Technical Steering Committee – May 8, July 25, August 20, September 25, and November 26, 2012
- Meewasin Education Advisory Committee - October 2, 2012
- Swale Watchers – October 3, 2012
- Meewasin Valley Authority Management – October 6, 2012
- Meewasin All Committees meeting - October 11, 2012
- University of Saskatchewan – School of Environment and Sustainability – October 15, 2012
- Department of Geography and Planning Class, University of Saskatchewan – October 16, 2012

- Saskatoon Nature Society – October 18, 2012
- Partners for Saskatchewan River Basin Conference – October 18, 2012
- City of Saskatoon Land Branch – October 30, 2012
- City of Saskatoon Senior Management Team – November 6, 2012
- Public Open House – November 14, 2012