Comprehending Swale Ecosystems

Research Synthesis and Analysis

Northern Shrike, Northeast Swale, Saskatoon, SK. Credit: Meghan Mickelson, 2018.

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The views presented in this report reflect those of the author.

GLOBAL WATER FUTURES

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Executive Summary

The purpose of this project was to identify current gaps in knowledge about the Northeast Swale and surrounding areas by reviewing existing research on the swales in north-east Saskatoon. A secondary purpose was to identify any major outstanding concerns that have not yet been addressed through prior research and assessment. The Swales offer an opportunity to observe how urban development and conservation interact.

As part of the City of Saskatoon's development process, natural area screenings are conducted to identify areas of high quality habitat, which are then flagged as a priority for conservation. Conversely, disturbed areas are lower priority for conservation, and are often seen as ideal for use in—or as land for—development. This classification involves evaluation against scientifically based criteria, as well as some professional judgement on the part of the assessor. This binary approach risks excluding the consideration of potential benefits and returns on investment from medium and large-scale restoration projects. Increasing the overall amount of conservation lands may provide more niche habitats for wildlife, but contiguous land is still key for long-term sustainability of the ecosystem and wildlife.

While there are risks to conservation associated with development, there are also opportunities to expand conservation. Agricultural lands adjacent to the Swales provide habitat, forage, and a corridor for wildlife. This provides an opportunity to broaden the 'core' boundary to include more upland areas, such as—but not only—the sharp-tailed grouse lek plateau. Restoring previously disturbed areas adjacent to high quality conservation areas would increase both the diversity and complexity of habitat, as well as provide opportunities to improve restoration science in a prairie context. This would also reduce the total amount of land seen as viable for suburban expansion, at least in the north.

The City could accommodate this by increasing density in the development, other developments, or by prioritizing higher-density in-fill for core neighbourhoods. In other words, generously buffer externally and make connections to other areas, rather than studiously buffer internally and create enclosure and fragmentation.

Observations of change should not be relegated to anecdote, since data are the foundation for future restoration, conservation, and development. Consistent monitoring and rigorous data collection are paramount to know if conservation goals are being met. Meewasin should continue to refine and expand their criteria for assessing progress according to their mandate, and potentially review how those indicators and criteria are weighted.

The City and Meewasin should collaborate further on developing indicators and measures of ecological change, including a thorough monitoring program and enhancement of citizen scientist involvement to ensure data are rigorously collected and publicly accessible.

Recommendations

If the Swales are to be managed as sustainable ecosystems, then the City must curb development in and around natural areas, and the Province must limit incursions into or through

those natural areas. Together with Meewasin, the public, and interested non-government organizations, strong protections and generous space must be given to the Swales. A rigorous monitoring and experimentation program would support conservation and restoration. A University-led collaborative research program would benefit: the City and its residents by providing accessible and biodiverse natural areas; the Province and its biodiversity and conservation targets; the University and its profile in prairie landscape management and plant sciences; and of course, the Swales and all of the plants and animals that breed, feed, or seed within.

Local and Regional Ecology

In conjunction with the UH III Field Natural Area Screening (2019) (potentially) studying the wildlife corridor(s) between the Swales, a comprehensive study of the full extent of the greater swale would provide decision-makers with a high-level understanding of importance of the Swales relative to other natural areas in and around the City. This would be best paired with a regional-scale ecological assessment, in order to understand the role of the swales in the sustainability of regional biodiversity by studying the movement of wildlife and plant genetic material. This is linked to an opportunity to improve regional and local ecotourism. Quantification of historical change and calculation of its rate (see below) would help put in to perspective the relative importance of remaining grasslands, including University Lands.

> **Recommendation:** In coordination and collaboration with R.M. Corman Park and possibly the University, comprehensively study and monitor the full extent of the greater swale, including regional wildlife corridors and movement of plant genetic material.
>
> **Recommendation:** That the University increase its profile in prairie restoration and conservation science. This would build off of the University's own lands, with more involvement in regional natural areas including activities such as tracking plant and animal genetics, distribution, population levels and health, and movement of plants and animals through corridors.

Knowledge of a development's potential ecological impacts can be achieved via an inventory, which will influence the selection of mitigation techniques, selection of compensatory scheme, or design elements in a neighbourhood plan. With appropriate parameters laid out to enhance the detection of wildlife and vegetation in future natural area assessments, natural areas should be more accurately delineated, species of management concern located, and potential impacts recognized.

> **Recommendation:** For the City of Saskatoon to continue to refine and adapt its natural area screening protocols, and encourage their use in regional partnerships, as appropriate for the context and scope of planning and management.

Missing is an understanding of the long-term impacts that this lack of knowledge has had on the surrounding natural areas of Saskatoon. Development remains relatively unquestioned,

and it may be difficult to argue for strict conservation without being able to provide some context for relative importance. While admittedly speculative, some modelling of prior habitat extent and species distribution (decadal; analysis potentially tied to waves of growth) would provide conservation arguments with a substantive basis to show overall land cover/land use change and highlight the importance of the remaining areas.

> **Recommendation:** Establish historical context for changes to natural areas all around the City in order to situate current changes to the Swales. This would include the use of historical air photos, descriptions, plans, and related documents to both locate and estimate previous extents of natural areas, and potentially their connectivity. Since many wetlands and other natural areas have likely been converted to residential or commercial/industrial, decision-makers and the public should be aware of the scale of impact on remaining.

Unless sufficient space is given, and connectivity protected, it wil further degrade until it is barren of wildlife and over-run by alien invasive species. Disturbance and connectivity are key to sustaining these natural areas. Range requirements vary by species, but to exclude some risks shifting the ecosystem baseline into a different, and possibly less 'valuable', state.

> **Recommendation:** That the City, Meewasin, and Province find ways to incorporate the Greater Swale into a broader conservation project, including adequate buffering and protection of wetlands in agricultural fields, and the generous (wide buffering) selection and restoration of disturbed areas adjacent to the Swales. This may involve conservation easements, purchasing as Crown land, or other land use controls that are available to municipalities.

Prairie Water Cycles

Blue water (surface and groundwater) and green water (water used by vegetation) are integral to the character and function of the Swales. In order to adaptively manage for future generations, further knowledge of how water cycles through these ecosystems, and how their plant and animal communities rely on—and change—surface and ground water regimes is required. With continued development and change from permeable to impermeable surfaces, there will be impacts to plants as well as hydrological function, and this understanding is lacking.

> **Recommendation:** Establish a research program to study blue and green water interactions in the context of native prairie, including projections of regional change predicted to occur with climate change.

Consistent and transparent monitoring is a fundamental component for management of the Swales. Henry (2012) notes that the City has not been monitoring the Silverspring wells since 2005 (the report includes data for 1993-2005), and urges them to resume. Further, test well decommissioning was not mentioned or otherwise indicated in previous reports, and recommends that this become standard, and that existing wells be properly decommissioned, or used in education/interpretation if they are on school grounds.

Recommendation: Resume monitoring and establish a portal for access to all hydrometric data collected by the City, similar to the provincial water monitoring and reporting websites.

Recommendation: Establish a protocol for well-decommissioning, if one does not exist, and review prior wells for decommissioning.

The University Containment Facility is another unknown in terms of impacts on groundwater, but very little information is available. More transparency on this issue would benefit the public, as it affects not only the management of lands within the City, but also potentially the water quality of a significant provincial waterway, with many downstream communities and ecosystems affected by upstream activities, contamination, and pollution.

Recommendation: For the Province to provide public access to information on the process and status of remediation, including groundwater quality monitoring.

Saskatoon Freeway Impacts

The lack of knowledge upon which development and corridor planning in the north-east has been based is a compelling reason to suspend current planning of the Freeway, especially considering current knowledge and growing environmental concern for, and value of, the area. Until such time as sufficient information on the relationship between the swales and the regional ecosystems to which they connect is made available, the true ecological impacts of the corridor remain uncertain and likely underestimated.

Recommendation: For the City and Province to acknowledge that building the Freeway within the current alignment and corridor would directly impact local ecosystems and wildlife, and both directly and indirectly place the broader ecosystem at risk of long-term decline.

With current knowledge of the Swales, as well as changes in City boundaries and regional development trajectories, continued construction of the Freeway risks preventable destruction of local habitat, and impairment of regional ecosystem health. Suspension of the Ministry of Highway and Infrastructure's (MHI) planning should be followed by a joint review of the placement of the corridor. With wetlands and grassland habitat now recognized as assets, and with tax payer money and Administration's time invested in their management and protection, the City, Meewasin, and the Province must find ways to protect the green infrastructure within City limits, and natural areas connected to those assets that are outside of City limits.

Recommendation: For the Ministry of Highways and Infrastructure to suspend planning until more information is available on the status of the Swales, including wildlife populations and corridors within and between the Swales, and between the Swales and other regional natural areas.

Planning and Governance

The majority of studies reviewed were geotechnical, ecological, hydrological, or heritage-focused. Only one social scientific study was found and reviewed (Sikorski and Gunn, 2013), though there is at least one other study currently underway (economic valuation survey of residents near the NES). There are no studies of the efficacy of the existing working group structure, nor any apparent assessment of others for their appropriateness. This indicates a gap in knowledge around values, democratic participation, and the transparency of decision-making.

> **Recommendation:** Development of a research program (2-3 graduate/honours students) to investigate the intersection of knowledge and politics in municipal decision-making. It could compare and contrast the 'public voice' represented in City Council and compare it to the 'public voice' within media. Included would be a review of council/sub committee minutes, video transcriptions, agendas, reports to Council Review media (social, traditional).
>
> For the Swale Watchers, a student could explore the institutional and social dynamics of a boundary organization through an ethnographic/institutional ethnographic lens. This could examine flows of knowledge, individual agency, and the role of social media in urban conservation.

Outreach and education of adults has also seemed to be lacking, or at least is untracked and uncertain. Current programming and interpretation is actively focused on youth and children, and only passively involves adults and residents adjacent to the NES. In this vein, the language the City and Meewasin use to communicate with residents is important. Within the reports and assessments, 'ecology' or the biodiversity within it are often framed as components of 'our natural heritage', yet the phrase 'natural heritage' may not be common currency for residents, and many of them (newcomers, non-specialists, retirees and youth, Indigenous peoples) may not immediately associate themselves with the community implied by 'our'. 'Natural heritage' may be suitable for institutional processes and technical or professional reports, but it may not carry the same meaning with average citizens.

> **Recommendation:** An assessment of current interpretation and outreach to ensure language and messaging from Meewasin and the City are consistent, inclusive, and accessible. Possible partnership with the University of Saskatchewan, especially to engage with knowledge mobilization specialists.

Document Structure

This report covers a wide range of information, from media articles to geotechnical investigations to scientific literature. Following the introduction, the document is organized into four parts:

Part I Media Scan. Given the breadth of potential issues and opportunities for research, a media scan was conducted to focus the document review on specific issues of interest to the public. This Part includes methods and both tabular and descriptive results. From 45 media articles, 11 keywords and concepts were identified. The four most frequently mentioned ones—boundaries, ecological value, ecological impacts, and roadways—were developed into themes, which informed both the Document Review and Research Synthesis by focusing them on issues of contemporary public concern.

Part II Document Review. Documents reviewed include summaries of wildlife and vegetation surveys, development plans, and technical reports. These are initially grouped either geographically as "Areas of Interest", or organizationally as "Institutional Plans and Policies". Each group and sub-group of documents is a discrete subset of the entire database (no overlap). The summaries are presented in the form of an annotated bibliography, but include comments on individual documents or their groups as a whole. As of April 17, 2019, the database includes 103 documents, of which 75 were fully and 9 partially reviewed. There are likely other studies and documents not in the database that are still relevant to the Swales that have not yet been identified.

"Areas of Interest" begins at a broad scale, moving from Regional studies to Meewasin, then to the North Sector, Swales, and finally Road Corridors. Institutional Plans and Policies include organizational and higher-level documents that are relevant to the Swales, grouped by scale: Provincial and Regional governance' City of Saskatoon; Meewasin Valley Authority; and the University of Saskatchewan. Where needed within those groups are further subgroupings to aide in the presentation of results.

Part III Research Synthesis. Presented in five sections, using the Media Scan themes to guide summary and commentary on the results of the Document Review. Each theme has a section, and an additional section included for Knowledge Gaps. The themes and gaps are discussed in greater detail, referencing the documents and summaries from Part II. Boundaries are discussed relative to ecosystem health, classifying land cover and land use, and the intersection of boundaries and jurisdiction in terms of governance. Corridors and Roads includes general discussion of corridor impacts, some elaboration on the process of planning the Saskatoon Freeway (formerly Perimeter Highway), and a discussion of some potential issues posed when provincial and municipal interests clash. Ecological impacts include documented and predicted impacts, as well as mitigation strategies and residual concerns. Ecological Value discusses the role of a shared vision, of classification in establishing value, and also the value of local connections to regional ecology. Knowledge gaps include water, information missing from previous natural area screenings, local and regional ecology, and a lack of social scientific study on planning and governance.

Although the four themes are discussed as discrete concepts, there is significant overlap and interconnection between them. For example, boundaries drawn around natural areas will influence not only the placement of roadways and neighbourhoods, but also our accounts of ecological health and identification of environmental impacts. Identification of potential impacts from roadways is often constrained to the proposed linear corridor, excluding direct, indirect, and cumulative effects at different scales, from micro-habitats to regional ecology. Assessments of ecological value also influence boundary lines, as human disturbance becomes

a deciding factor in delineating a the 'core' of a natural area.

Part IV Appendices. Three appendices close out the report: I. Accessing the document database (pending finalization); II. Media scan article dates and partial titles; and III. bibliography of documents in the database.

Introduction

> Additional efforts would be appropriate before future development of the Study Area which would better inform decision making by the City. (*University Heights Neighbourhood 3 - Natural Area Screening and Heritage Resource Impact Assessment* 2015)

This report covers a wide range of information, from media articles to geotechnical investigations to scientific literature. Building from an initial list of documents and following references within those and others, a database of documents relevant to regional development and conservation of the Swales was compiled.

There are a number of limitations to this report. Due to time constraints, not all documents could be reviewed and summarized, and so priority was given to primary material (studies and assessments) over summary material (plans), though flexibility was necessary where primary materials were not available. References for unread documents (whether for lack of time or lack of access to the document) are still included in the report and bibliography. The media scan used a search phrase for 'Northeast Swale', excluding media articles on related topics such as the freeway, parkway, and developments in the north-east. The document review and media scan did not include reports and recommendations that are internal to the City of Saskatoon (provided by City administration to Councillors and the Mayor for decision-making support in Council or committee meetings). These internal documents are often available online through the City's website, as attachments for Council meetings, as well as for standing committees of Council (Environment, Transportation, Environmental Advisory, Planning).

Part I

Media Scan of 'Public Interest' in the Northeast Swale

A media scan was conducted to provide a thematic framework through which the documents were to be interpreted and described. The purpose of the scan was to identify key themes within the public discourse on the swale. These themes provided guidance for the synthesis of existing research on the Swale and surrounding area. Given the diverse types of documents included in the database and focused purpose of the research, not all themes will overlap with the documents.

The media scan was conducted according to the three objectives below:

1. locate articles from the Star Phoenix that reference Swale issues;
2. record key issues found within the relevant articles;
3. thematically categorize the key issues identified.

1 Search Method

A search for the word "swale" was conducted on the Star Phoenix website; inclusion of search results required that they mention or discuss some aspect of the north-east, greater, or small swales. The final dataset of 45 items included articles from 2012 to 2018, and a range of types of articles, including opinion columns, letters to the editor, news, and an in-depth interview. A tabular description of the search results, identified themes, and frequency of theme by article type and year are included in the tables below.

Note that there are limitations to the search as conducted. There are articles related to activities occurring in or around the swale but do not include the word 'swale' in the text, thus excluding them from the scan. For example, an article reporting on the North Commuter Parkway in 2012 did not include the word 'swale'. A more thorough examination of would have iteratively searched for articles on specific urban and infrastructure projects adjacent to or in the swale.

A further limitation is the way in which the 'public interest' is constructed for the media scan. The dominant tone in the Star Phoenix was that of pro-conservation of the swale, yet the persistent development of the northeast sector indicates that the City is operating under a different understanding of the 'public interest'. A more rigorous construction of the 'public interest' would require analysis of materials from the City, such as committee and council agendas, public and administrative submissions to council and committees, and minutes from the discussions in council. Note that substantive minutes, beyond decisions, are not available. Some meetings have video recordings available. Transcription and analysis of the discussion within council and committee meetings would provide vital context for understanding what is—from the City's perspective—the 'public interest'. It would also provide insight into the ways in which knowledge about the swale influences decision-making.

2 Results

After reading a sampling of the items, a 'keyword' list was developed to assist with further article review. A presence/absence of these keywords was noted for each article; new keywords were developed when arising, and some existing ones merged and generalized. The thematic keywords are described below. Most of the items included multiple and overlapping themes or concerns related to the swale, with general concerns about biodiversity, light pollution, and a general commentary on development appearing alongside specific issues such as the North Commuter Parkway and the Perimeter Highway (now known as the Saskatoon Freeway, but Perimeter Highway is used in this Part due to its prevalence in the media items reviewed). The most frequently mentioned keywords varied by item type.

Four 'types' of articles were retrieved: letters to the editor, opinion pieces, news articles, and biographical interviews (Bridges). Various tabular representations of frequency results are presented below: Table 1 on page 13 shows the type of article by year; Table 2 on page 13 keyword by year; Table 3 on page 14 type by keyword; and Table 4 on page 14 keyword by type.

2.1 Thematic keyword descriptions

As mentioned above, the media scan items usually included a combination of general and specific concerns. While the keywords provide some level of generalization to inform the subsequent research synthesis, the following thematic descriptions are included to carry through the specificity and overlap in the media items. General themes are presented first, with specific themes following.

- 'ecological value' includes biodiversity (known and unknown threats, benefits, opportunity costs, valuation of ecological services), which includes considerations for the role of species (endangered, at risk, and secure), and habitat (grasslands, bush, water). Often includes 'sustainability' concepts.

- 'ecological impacts' includes effects suburban expansion and development, including effects of 'roadways' (collisions, dispersal, fragmentation, barriers), light pollution (affecting reproduction), water pollution (storm water management, pesticide run-off), and encroachment (habitat conversion, displacement, fragmentation, invasive species, pesticides, edge effects, encirclement). Impacts will only be known through various means of monitoring, which is tied to funding, and knowledge of those impacts must be dispersed through 'education'.

- 'roadways' includes the interrelationship between habitat fragmentation and animal crossings; concerns over animal crossings centre on collisions, but can be from a driver safety and/or animal mortality perspective; includes vehicle-induced dispersal of seeds from invasive plant species, as well as light and noise pollution; includes speed limits, which can be driver-oriented (convenience, efficiency, priority) or wildlife-oriented (collision avoidance, increased survivability, barriers). The Saskatoon Freeway and Lowe Road are given their own categories.

- 'education' includes knowledge translation and dissemination of impacts (monitoring, research), value (EGS, cost-benefit), and rationale for management practices (burning, grazing, buffers, zoning, monitoring, exclusions/fencing, mitigation). Related to 'funding' and enforcement.

- 'social values' include recreation and heritage (natural and social), as well as 'sustainability' in general.

- 'economic value' refers to costs of roadways (NCP and Freeway), and included questions of economic viability, lack of knowledge of value of ecological services, and of recreational value.

- 'boundaries' refers to the delineated borders of the swale, and the zoning/classification that is attached to it. Often discussed in conjunction with the greater swale and small swale, as a way to emphasize the need to address the broader ecosystem.

- 'funding' refers to the funding obligations laid out in the tripartite agreement (CoS, UoS, Province), and specifically to the implementation of Meewasin's core mandate.

Funding is required to implement the NESwale Plan, including for infrastructure and monitoring, but cannot be separated from funding concerns in general (e.g. staffing, maintenance, enforcement).

- 'politics' references decision-making processes and perceived conflicts of interest in City Hall.
- 'Saskatoon Freeway' includes discussion of the alignment, costs, impacts, and network integration of the future freeway/highway.
- 'Lowe Road' mentions speak to the decommissioning of Lowe Road.

2.2 Tabular Frequency Results

Table 1: Type by year

Year	Type	Count
2012	NEWS	1
		1
2015	LETTER	10
	NEWS	5
	OP	1
		16
2016	BRIDGES	1
	LETTER	1
	NEWS	4
	OP	1
		7
2017	NEWS	8
	OP	2
		10
2018	LETTER	3
	NEWS	8
		11
	Total	**45**

Table 2: Keyword by year

Year	Keyword	Count
2012	ecological value	1
	economic value	1
	roadways	1
2015	roadways	14
	ecological value	9
	ecological impacts	7
	economic value	3
	social values	3
	boundaries	2
	education	2
	funding	2
	Saskatoon Freeway	1
2016	funding	5
	ecological impacts	3
	ecological value	3
	education	2
	politics	1
2017	ecological impacts	8
	boundaries	6
	roadways	4
	education	3
	funding	3
	social values	3
	ecological value	2
	Lowe road	2
	Saskatoon Freeway	2
	politics	2
2018	roadways	9
	boundaries	8
	ecological value	7
	ecological impacts	4
	education	4
	funding	2
	Lowe road	2
	Saskatoon Freeway	1
	Total	**132**

Table 3: Type by keyword

Keyword	Type	Count
roadways	NEWS	14
	LETTER	11
	OP	3
		28
ecological impacts	NEWS	16
	OP	4
	BRIDGES	1
	LETTER	1
		22
ecological value	LETTER	10
	NEWS	10
	OP	2
		22
boundaries	NEWS	13
	LETTER	2
	OP	1
		16
funding	NEWS	9
	OP	2
	LETTER	1
		12
education	NEWS	9
	OP	2
		11
social values	LETTER	3
	NEWS	2
	OP	1
		6
economic value	LETTER	3
	NEWS	1
		4
Lowe road	NEWS	4
Saskatoon Freeway	NEWS	3
	OP	1
		4
politics	OP	2
	NEWS	1
		3
Total Result		132

Table 4: Keyword by type

Type	Keyword	Count
BRIDGES	ecological impacts	1
LETTER	roadways	11
	ecological value	10
	economic value	3
	social values	3
	boundaries	2
	ecological impacts	1
	funding	1
NEWS	ecological impacts	16
	roadways	14
	boundaries	13
	ecological value	10
	education	9
	funding	9
	Lowe road	4
	Perimeter highway	3
	social values	2
	economic value	1
	politics	1
OP	ecological impacts	4
	roadways	3
	ecological value	2
	education	2
	funding	2
	politics	2
	boundaries	1
	Perimeter highway	1
	social values	1
	Total	**132**

Part II

Document Review

Each group of documents below represents a discrete subset of the entire database of documents, and combined they cover the entirety of the database items. Although I followed references and requested documents where ever possible, this is not a comprehensive database. There are likely studies and documents that are relevant or pertinent to the Swales that have not yet been identified, and there will be more in the future.

As of April 17, 2019, there are 103 items in the database, of which 75 were reviewed. Some items do not have corresponding PDF files in the database. Some items are addenda to others and together comprise a single document, and some include appendices with items not recorded in the database. Two major groups were developed to organize the documents: "Areas of Interest", and "Institutional Plans and Policies":

- "Areas of Interest" is comprised of documents, reports, and assessments that are specific to a place or area. Groups are formed according to their specificity, e.g. Regional, Valley, Sector, Swales, Corridor. Subgroups are either more geographically specific within that Area (Swales -> Northeast Swale), or similar in the type or focus of the study (e.g. Geology and Water, Plans and Studies); and
- "Institutional Plans and Policies" is comprised of documents that are relevant to the institutional form and function of the organizations involved in managing the Swale, including plans, policies, and monitoring reports.

In the entries below, there are: first, a reference for the document, including author or organization, title, date, and related information; second, the reference 'key' for the item in the database; third, items with a corresponding file in the database include a line such as ":Journals/Esparrago2015.pdf:PDF"; and fourth, if the item was reviewed, a summary of the document.

1 Areas of Interest

Documents in various Areas of Interest are grouped based on the focus of the study or assessment, and ordered by the geographic extent of the "Area". There are documents that address broad areas, and some that are very narrow or small. Smaller areas are grouped into the larger areas of which they are a part, e.g.

various combinations of geographic, ecological, and political extents, e.g. Road Corridors are geographic, whereas North Sector is both geographic and political. Further grouping occurred according to the number of documents for the Area, either into more specific Areas of Interest

Here are various ways that the Valley has been explored. It is presented first by organization into three categories: the Meewasin Valley, as an assemblage of cultural and natural areas; the Regional Ecology, which places Meewasin and the Swale in a broader regional ecology; North Sector Development, for documents related to suburban development, sorted by scale and development phase; and Corridors, studies for which often include information for bits and pieces of the natural areas through which they run. Some older studies in the Meewasin Valley were focused either on vegetation and wildlife or cultural heritage; newer studies, often precursors to development, include natural and cultural components in one.

1.1 Regional Ecology

Javier Esparrago and Vladimir Kricsfalusy (2015-10). "Traditional grassland management and surrounding land use drive the abundance of a prairie plant species in urban areas". In: *Landscape and Urban Planning* 142, pp. 1–6. DOI: 10.1016/j.landurbplan.2015.04.006

Esparrago2015:Journals/Esparrago2015.pdf:PDF

Anton Sizo, Bram Noble, and Scott Bell (2015-01). "Futures Analysis of Urban Land Use and Wetland Change in Saskatoon, Canada: An Application in Strategic Environmental Assessment". In: *Sustainability* 7.1, pp. 811–830. DOI: 10.3390/su7010811

Sizo2015:Journals/Sizo2015.pdf:PDF

Green Infrastructure Strategy Baseline Inventory Report (2018). City of Saskatoon. Saskatoon, SK

CoS2018:Reports/CoS2018.pdf:PDF

The Inventory follows an approach to suburban expansion and development that attempts to systematically integrate the ecological functions of natural areas into an urban ecology. Implementation of the final Strategy will require amendments to the Official Community Plan, including the definition and 'recognition' of the concepts of natural assets, green infrastructure, and Environmental Reserve

designation; assess development for its impacts on areas defined as part of green infrastructure or natural assets; shift from the language of 'preservation' to that of 'conservation', including multi-use design; and 'Include[s] management of natural areas and assets as a key strategy.' Findings of the baseline inventory by category are outlined below:

Governance requires coordination within the City's organizational framework to support an integrated approach. It also requires enforceable, compatible, and up-to-date regulatory tools that can recognize and protect natural areas. Other needs include centralized data management to reduce conflicting or dispersed information; and the definition of service levels for non-park green spaces to ensure appropriate funding and resources are allocated. Federal and provincial legislation, and municipal by-laws that are relevant to the strategy are listed, as are various City initiatives that are, in some way, related to the Green Infrastructure Strategy. This includes the Natural Capital Asset Valuation and the P4G. Speaking on the P4G, 'The Regional Plan has established greater certainty and protection for environmental and cultural heritage assets in the region that are considered important from a sustainability and climate adaptation perspective.' A sampling of green strategies and similar initatives in other Canadian cities are summarized to provide comparative context for the Inventory.

Land allocation includes a desire for 'open lands' to be 'natural, walkable, and connected.' This would be achieved through appropriate protective designations and land use classifications, and the identification and protection of natural assets. Natural areas should not be carved out of the Municipal Reserve, but should be appropriately designated (e.g. as Environmental Reserves) and included in accounting for open space by appropriate land use classification; this helps to set appropriate allocative and distributive targets relative to other neighbourhood developments. Where natural areas overlap with multiple jurisdictions, coordination and cooperation in management is necessary. Other important targets include biodiversity, which requires habitat diversity within the network. Environmental Reserve designation is an as-yet unused tool in special area conservation, and can be a requirement imposed by the City or Rural Municipality.

The Green Network initiative includes measures of connectivity and fragmentation, as well as improvements to the natural area assessment process used in development planning. Physical and temporal boundaries are recognized as limiting the quality of the study, and the Strategy aims to expand data requirements to improve the knowledge used in decision-making. Site-specific management and tools are necessary to address the diverse components of the Strategy, as are the measurement and monitoring of impacts on natural areas/green spaces. Significant gaps exist in current knowledge of park features and 'natural assets' in the City, such as at-risk or indicator species; a similar dearth of information exists on the location and spread of invasive species in most natural areas in the City.

Storm water servicing includes considerations of raw and grey water use, but emphasizes low impact targets for development through site-appropriate design.

Existing examples within the City need to be inventoried and evaluated. The components of the City's green and urban storm water systems are explained and mapped, as well as the degree of permeability of parcels.

Heritage and culture makes reference to the Swale's 'natural prairie form' as a piece of 'Natural heritage' that is part of our collective and individual identities. The concept of a viewshed is introduced as a way to maintain a sense-of-place at specific cultural or heritage sites. This is already something that is recognized as an interest for Wanuskewin, but there are other instances where it has been mentioned, such as in Grismer (1989) with respect to SNG.

The Inventory provides some 'possibilities' for inclusion in the final Strategy. Relevant to the swales include development setbacks from environmental reserves (if a reserve is ever established), Natural Environment Park designation, and the reduction of fragmentation by greater integration of natural features into development.

1.2 Meewasin Valley and Local Natural Areas

1.2.1 Valley Wide

The Meewasin Valley Project: 100 Year Conceptual Master Plan (1979). Raymond Moriyama Architects and Planners. Toronto, ON

RMAP1979:`PlansPolicies/RMAP1979.pdf:PDF`

A long-term conceptual plan developed to guide development and use of the entire valley, leading to the creation of the Meewasin Valley Authority. The five 'general objectives' of the process were to further or improve: research and education, cultural arts, conservation of nature, recreation, and rural-urban relations (p. 39). From the outset, the document emphasizes that factors beyond the MVA's jurisdictional boundaries will influence the success of the MVA (it is embedded in broader socio-ecological contexts).

The Plan broadly recommends shifting the City's development northward, citing it's relatively more stable geology and opportunities to service existing rural communities. Within it's development nodes, the greater swale is encompassed by the Prairie Grass Terrace (Northeast Swale) and Cathedral Bluffs nodes. Common to these nodes were highlighted for potential conservation, research, education, and urban-rural relations; the Prairie Grass Terrace included recreation, while Cathedral Bluffs included cultural arts. Development in this area was intended to maintain 'natural amenities' by respecting nature throughout planning, design, and construction (p. 71). The plan calls for 'expansion and development of the City [to] be integrated with sloughs, creeks, coulees, river banks and terraces' (p. 79).

The swales are referred to as '[river] current channels and scars' in the northeast. Peturrson's Ravine, Clark's Crossing, and Coulees comprise the entirety

of the greater swale in this document. Near-surface aquifers within the swale are described as feeding the creek in Peterrson's Ravine with 'highly mineralized waters', and thereby providing for the ecology and morphology of the Ravine, though it is described as a radioactive dump site. The swales are also described as 'an integral part of the prairie surface drainage system,' functioning as 'oases on the prairie' supporting 'rich communities of plants and wildlife' (p. 36). The small swale was identified as a potential site for a 'major In-City Recreational Park.'

Knowledge gaps included calls for: geotechnical evaluations to ascertain groundwater flows, aquifer location and connectivity to surface waters, aggregate (mineral) resources, and stability; heritage surveys; transportation studies, including arterial roads and corridors as well as recreational, public, and active transportation infrastructure; inventories of 'flora, fauna, and geological materials' (p. 79); and wildlife management priorities.

Ernest G. Walker (1983-10). *Saskatoon perimeter archaeological resource assessment.* 83-17. City of Saskatoon. Saskatoon, SK

Walker1983:`Reports/Walker1983.pdf`:`PDF`

An archaeological study covering a number of areas across the City of Saskatoon that were slated for development, including areas near/adjacent to the NES. Using primary resources, the author reports on typical animals in the 'study area', but does not explicitly address animals within or near the swales. The report does not dwell on the Northeast Swale explicitly, and does not identify any archaeological sites in that area worthy of continued excavation. The report does, however, provide a method and set of questions to evaluate or assess the archaeological merit of individual sites. As the original study was not comprehensive, it did not include mention of the tipi rings found near the river, in the vicinity of the swales.

B. L. McCann (1992-12). *Meewasin Valley soil survey.* Saskatchewan Institute of Pedology, University of Saskatchewan. Saskatoon, SK

McCann1992:`Reports/McCann1992.pdf`:`PDF`

This report is 'an inventory of the soil resource of the natural sites within Meewasin valley' (p. 1). Descriptions of soils in areas adjacent/in close proximity to the North East Swale include Silverspring (and potentially the Silversprings Prairie Preserve; PDF pp. 34-5) and Wanuskewin (PDF pp. 39-40). Most useful for context might be the notes, which in some cases partially describe the landscape, such as land use or disturbances within the area of study. Otherwise, not much content directly relevant to the NE Swale.

Note that 'Old Channel (OC) soils' (p. 3-4) are found *within* the river valley, they are not located in the Swale area. Different soil types support different

vegetative communities, and will respond and interact uniquely with changes in water regimes and climate.

The soils identified in the Silverspring area likely extend into the swales. Some specific information on these soils is provided below. Within the study area, '[u]ndulating landscapes with very gentle to moderate slopes'–such as the swale–may have Asquith, Bradwell, or Elstow soils, though Elstow is mostly associated with seeps along the river bank. Asquith and Bradwell are usually found with other soils in a complex, and their location on slopes varies according to the soils it appears with. Weyburn soils are typical stony knolls found in the swale, while Wetland soils have formed in the centre of sloughs or low-lying depressions along with gleyed (sticky blue clay) or eluviated (minerals leached by water) soils (Asquith and Bradwell groups). Riparian areas have Hillslope and Slump classes, and disturbed areas have either Fill or Typical Disturbed soils.

The following descriptions are included as they may help interpret patterns of vegetation distribution or spread of invasive species. It is also helpful to keep soil in mind when considering changes in climate and precipitation patterns.

Weyburn (WR) soils 'formed on...calcareous glacial till...[are] moderately to extremely stony; usually occur on undulating or hummocky landscapes with slopes ranging from gentle to strong'; when they are in complexes with other soils, 'usually occur on mid- to upper slopes,' and include: Orthic Dark Brown, well-drained on mid- to upper slopes or stony knolls; and Calcareous Dark Brown, well-drained and 'on locally dry upper slopes and knolls' with very good run-off and limited water infiltration.

Asquith (AQ) soils were found on lower slopes when formed on glacial till in complexes with other soils, and include (for Silverspring): Eluviated Dark Brown, occurring 'on lower slopes and depressions that receive runoff water from upper slopes;' and Gleyed Dark Brown, which is imperfectly drained and influenced by groundwater discharge. Within the study areas, Eluviated Dark Brown occurs mostly in the Silverspring area.

Bradwell (BR) soils were found on upper slopes if present with fine-textured acustrine materials, or lower slopes with glacial material, and include (for Silverspring): Orthic Dark Brown, well-drained soil on gentle slopes above the river valley; Eluviated Dark Brown, on lower slopes and depressions receiving runoff; Gleyed Dark Brown, in shallow depressions and imperfectly drained; and Gleyed Eluviated Dark Brown Chernozem, in sloughs and shallow depressions and imperfectly drained. Within the study areas, Bradwell soils occur mostly in Silverspring and/or Wanuskewin.

Wetland (WZ) soils include Humic Luvic Gleysol and Gleyed Eluviated Dark Brown Chernozem, and occur 'in the bottom of sloughs or low-lying depressions...supporting willow shrub and sedge grass' (3-7).

Soils closer to the riparian southwest extent of the swale are related to seeps in the river bank: Elstow (EW) soils usually 'occur on undulating landscapes with

very gentle to moderate slopes,' on upper slopes if present with fine-textured lacustrine material, and on lower slopes with fluvial material or glacial till, and include Orthic Dark Brown and Gleyed Rego Dark Brown, mostly adjacent to the Silverspring area seeps. Seep (SE) soils include Rego Humic Gleysol and Gleyed Dark Brown Chernozem; occuring in the Silverspring area, they are fed by the Forestry Farm aquifer.

Other riparian soils include: Hillslope (HS) soils, with a variety of sub-types distributed across the study area, developing 'on till material in the Wanuskewin, Silverwood, Silverspring, and CPR Bridge areas'; Gleyed Dark Brown Chernozem in the HS class is found 'near zones of groundwater discharge'; and Slump (SL) soils, of which Orthic Regosol was found in active slumping areas in Silverspring.

Disturbances of soil profiles are noted in Silverspring by the presence of: Typical disturbed (DT) soils, where the soil profile no longer exists due to shallow excavation or farm site abandonment, with the largest areas of disturbance 'in the Silverspring and Wanuskewin areas'; and Fill (FI) soils, specifically Orthic Regosol, with the largest area found in the 'Silverspring area on the abandoned dump site.'

Bert Weichel (1992-12). *An inventory of natural areas remaining in the vicinity of Saskatoon.* Johnson and Weichel Consultants. Saskatoon, SK

Weichel1992:`Reports/Weichel1992.pdf`:PDF

A technical report identifying sites and areas for heritage protection, adopting an approach that values ecosystems based on ecological, academic, cultural and aesthetic, economic, and stewardship values. Part of the Natural Areas Inventory project (Saskatoon Natural History Society, 1990-2). Explicitly refers to the swale as the Northeast Swale.

Natural areas in either the river valley or upland terrain were surveyed. Most sites in the upland portion were found to be small and fragmented, with the exception of swale areas (NE and small). Six out of the ten Category 1 (priority protection; larger extent) sites were in the northeast, including grasslands and swale complexes (sites 1, 3, 6, 9, 10, 11). Category 2 areas were not explicitly identified in the text, were mostly smaller sites throughout the MVA area, but did include parts of the swales' wetlands and grasslands.

Use of effective zoning and bylaws by Corman Park RM and Saskatoon are identified as key mechanisms to support conservation efforts, as is collaboration and political/individual commitment. Recommendations of the report are for the City of Saskatoon and Corman Park RM formally recognize the 'importance and benefits of natural heritage protection'; for the province, local governments, and MVA to establish communication and coordinate protection policies, integrating them with land use planning and development processes; natural area inventories continue in collaboration with conservation groups, in support of future evidence-based decision-making; and that landowners be encouraged and assisted to protect heritage resources.

John H. Hudson (1993). *1993 Natural areas Survey.* Saskatoon Natural History Society. Saskatoon, SK

Hudson1993:`Reports/Hudson1993.pdf`:`PDF`

Part of the Natural Areas Inventory project (Saskatoon Natural History Society, 1990-2). From the inventory, areas 9 (SNG), 10 (NES), and 11 (small swale) are relevant to the swales; the swales were the largest areas in the survey.

Within the NE Swale (area 10), three traverses were conducted through the middle (tract 10A), northern (beyond MVA limits; 10B), and southern (10C) portions of the NE Swale; all three were classified 'interesting'. Traverse 10C was noted as being overgrazed but still with relatively high species diversity due to the variety of habitats and environments within the area. Oblong-leaved Gentian and White Sneezewort Aster were noted.

Through the small swale (area 11), five traverses were conducted, with two (B, E) being classified as 'very interesting', and the other three (A, C, D) traverses as 'interesting'. Traverse B included rare species: Crawe's sedge and red club-rush. Traverse E included the 'rare cinquefoil Potentilla finitima'. Traverses A, C, and D were noted as being similar in either topography (all three) or in composition: A and C share many species, including those associated with groundwater seepage, but with C being 'weedier'; traverse D was 'Couplandian mixed prairie' in good shape, but without 'unusual' species. Traverse E included fescue grassland with invasion of brome and quack grasses (60% cover), with the rare cinquefoil (Potentilla finitima) in the sandy south portion; the northern portion was again Couplandian prairie (Stipa-Agropyron) in good shape; Pink flowered onion was also found, which is unusual as it is 'uncommon this far west and south' (p. 4).

Maurice J. Lineman (1992-12). *A botanical inventory of some natural areas in the South Saskatchewan River Valley in and near Saskatoon - Part I.* I. Saskatoon Natural History Society. Saskatoon, SK

Lineman1992:`Reports/Lineman1992.pdf`:`PDF`

Part of the Natural Areas Inventory project (Saskatoon Natural History Society, 1990-2). An inventory of 'vegetation and flora' at eleven study sites in eight locations (map on page 30). Sites were selected with the help of local experts, with selections based on the naturalness of the area, as assessed by level of disturbance. None of these sites are adjacent or otherwise relevant to the NE Swale. This document is most useful as a reference for environmental change, and for potentially understanding ecological connectivity in terms of animal-plant communities.

; Maurice J. Lineman (1993-12). *A botanical inventory of some natural areas in the South Saskatchewan River Valley in and near Saskatoon - Part II.* II. Saskatoon Natural History Society. Saskatoon, SK

Lineman1993:Reports/Lineman1993.pdf:PDF

Part of the Natural Areas Inventory project (Saskatoon Natural History Society, 1990-2). The inventory extends Lineman (1992) to eight more locations, describing the locations by flood plain, lower slope, mid-slope, upper slope, and bluff summit zones. Of the additional locations, numbers 9 (northern extent of Small Swale), 11 (just south of the snow dump), and 12 (Peturrson's Ravine) are relevant to the swales; of the five most diverse and least disturbed, 9 and 11 are the best, with 12 being the worst. While no provincially rare species were found in these studies, three were found that are considered 'borderline': striped coralroot, Menzie's catchfly, and bristle-leaved sedge.

Site 9 is a seep bank at the northern extent of the small swale. The lower slope (zone 2) was moderate to poorly drained; mid-slope (zone 3) was good to moderately drained, with prior grazing by cattle as the 'greatest disturbance' for both zones 2 and 3. The upper slope (zone 4) was wooded, with notable species of Fragile Fern (cystopteris fagilis) and Menzie's Catchfly (Silene mensiesii) (p. 8). The bluff summit (zone 5) is 'grass dominated', with disturbance limited to cattle grazing; herbs include hairy golden aster, pasture sage, and crocus anemone; graminoids include needle-and-thread spear-grass, northern wheatgrass, and blue grama grass.

Site 11 is a seep bank in the 'Riddell' area, south of the Peggy McKercher property. The upper slope and bluff summit zones were combined due to limited bluff area. The upper slope was forested, and the bluff area grassy and shrubby. The bluff summit included low shrubs (western snowberry), forbs (pasture sage, northern bedstraw, common bearberry), graminoids (needle-and-thread spear-grass, june grass, northern wheat grass), and of note Louisiana broom-rape and striated coralroot. This is identified in the 2015 NE Swale management plan (MVA 2015, p. 15) as a 'paleontological site' with research-grade fossils.

Site 12 is Peturrson's Ravine (Pyschiatric Centre ravine), and marks the southwestern extent of the greater swale. Human recreation is the greatest disturbance in the flood plain, lower slope, mid-slope, and upper slope; limited human recreation occurs in the bluff summit, and is typical constrained to border paths. Species of note in the upper slope are Fringed gentian, saline shootingstar, and grass-of-Parnassus.

Other resources for documentation of species in upland areas near the NE Swale include Silversprings Prairie (Harms 1991) and Kernen Prairie (Pylypec 1986). Neither are included in this database.

; Maurice J. Lineman (1995-12). *A botanical inventory of some natural areas in the South Saskatchewan River Valley in and near Saskatoon - Part III*. III. Saskatoon Natural History Society. Saskatoon, SK

Lineman1995:Reports/Lineman1995.pdf:PDF

Part of the Natural Areas Inventory project (Saskatoon Natural History Society, 1990-2). Prior research is extended by another 7 sites (Silverwood, Agra Road riverbank, Meewasin Park, River Park, University South, Cosmopolitian Park south, and Gabriel Dumont Park). Only Agra Road is of relevance to the Swale, as this zone would provide a habitat 'island', from and to which energy, genetic material, plants, and animals would move in connection to the swale and other (large) habitats. No explicit connection between the site near Agra Road and the NE Swale was made in the report.

; Maurice Lineman (2000). "A survey of the natural vegetation and flora along the South Saskatchewan River Valley within and near Saskatoon, Saskatchewan". mscthesis. Saskatoon, SK. URL: https://harvest.usask.ca/bitstream/handle/10388/etd-05302012-092530/Lineman_Maurice_J_2000_sec.pdf

Lineman2000:Reports/Lineman2000.pdf:PDF

A study to determine the extent of riparian habitat deterioration along the South Saskatchewan River. Vegetation was surveyed during 1995 and 1996 in 10 locations, supplementing previous studies by Lineman (1992, 1993, 1995). Also in the thesis is a methodological assessment of 'qualitative zonation as a tool for classifying riparian slope plant communities' (p. iii). The only site relevant to the NE Swale is site 9 (Riddel to Agra; this combines sites 11 and 18 from Lineman (1995) due to their proximity and contiguity/similarity). As this is predominantly an inventory of riparian areas, the bluff-summit zone (plot 43) is most directly relevant to the NE Swale, though specific locations (e.g. Agra) are relevant due to their connectivity to the swales, ecologically and geographically.

The description of communities for site 9 is based on data from prior studies, and there is little additional information of interest for the Swale. The Riddel/Agra location showed relatively low values (a good thing) for % total exotics introduced relative to total species found (9%), which is an average of the herbs and low shrubs (7%) and tall shrubs and trees (14%). These values indicate that the quality of the grasslands at the southwest extent of the swale complex is still in relatively good condition, at least in terms of introduced species coverage.

Diana Bizecki Robson and Jason V. Nelson (1998-12). *Vegetation inventory of Saskatoon and area*. Addendum added April 2001. Nelson Dynes and Associates Inc. Saskatoon, SK

Robson1998:Reports/Robson1998.pdf:PDF

Vegetation inventory of areas along the South Saskatchewan area, using predetermined polygons for detailed field work. Documentation included plant community information (landform and vegetation types, dominant cover), dominance of exotics, and level of disturbance. Of potential relevance to the NE Swale could be the upland (442 polygons total), escarpment (39 polygons), and abandoned channels (10) communities. There is no map indicating the polygon locations, making it difficult to assess degree of relevance to the NE Swale, though the

report mentions shallow sloughs and aspen bluffs in upland areas, grasslands in escarpments, and rocks in disturbed areas in the north end of the city. The report concludes that 'Some of the best chunks of native grassland occurred on the east side of the river, north of the city. There were several large polygons that contained hummocky, shrubby grassland in fairly good condition,' suggesting that the swale(s) were likely included in this survey.

Luc Delanoy (2001b-04). *Vegetation inventory of Saskatoon and area - update to Robson & Nelson (1998).* Meewasin Valley Authority. Saskatoon, SK

Delanoy2001a:`Reports/Delanoy2001a.pdf:PDF`

An updated inventory from the Nelson-Dynes inventory (Robson1998). Without having the relevant maps, it is difficult to identify which ones are relevant to the swales. MVA may have the original map, but it would be archived.

1.2.2 St. Joseph's High School

Saint Joseph High School landscape management plan (1996-10). Meewasin Valley Authority. Saskatoon, SK

MVA1996:`PlansPolicies/MVA1996.pdf:PDF`

Documentation for a naturalization project, including design and construction methodology along with a long-term management plan. Includes appendices summarizing restoration efforts at Wanuskewin, Preston Trail, and SNG; educational materials and examples from other schools. Staff and students of the high school are responsible for maintenance. Prairie potholes are retained as wetlands, with appropriate species planted/re-seeded and monitored over time.

The area of interest was divided into four zones with subunits. This with grassland components include: the Entry Area, which includes transplanted native prairie (salvaged from suburban development); seeded wildflowers and grasses, and plugs; and the grasslands zone, whose subunits include seeded native and sodded exotic grass areas. The seeded units in the grasslands zone used a Ducks Unlimited mix for 'migratory bird and other wildlife' habitat, and follow different combinations of pre- and post-seeding treatments (nurse/no nurse crop; mow frequency/no mow) to control weed growth. Interpretation should include consideration of the costs of lawn vs mixed grass dryland prairie, and the ecological benefits and value estimates attached to them.

Saint Joseph High School: Schedule B List of vascular plant species (2000-08). Tech. rep. Meewasin Valley Authority. Saskatoon, SK

MVA2000:`Reports/MVA2000.pdf:PDF`

Baseline inventory of vascular plants for St. Joseph's High School, dated August 29, 2000. Four areas inventoried: prairie sod in front of school; dry seeded grassland south and west of school; wetland at SW corner; tree and shrub beds.

1.2.3 Kernen Prairie

Contact Eric Lamb, USask Plant Biology.

1.3 North Sector Development

This subsection includes the North-west Natural area Screening, but not Marquis and other development studies west of the river. There was some overlap between the NW screening and the NC/NE screening.

Some studies cover a broad area, but only parcels or pieces of land within that area are reported on in the various studies. This is due to incremental study and development, which leads to fragmentation of knowledge in time, space, and by species.

1.3.1 Sector-Wide Studies

See also Clifton Associates (2013) in North Commuter Parkway

Geology of the forestry farm area, Saskatoon (1980-08). 0040-002. Clifton Associates Ltd. Saskatoon, SK

> CliftonAssociates1980:`Reports/CliftonAssociates1980.pdf:PDF`
>
> A stratigraphic study of the Forestry Farm area to establish the type and extent of geological underlay in the northeast region of and near Saskatoon, dealing 'mainly with the stratigraphy of the Saskatoon Group of deposits, particularly the Forestry Farm Aquifer.' The report does not provide a comprehensive account of connectivity between and within layers across the full extent of the study area. A specific legal land description of the study area is given in section 1.2 (p. 1), with a map on p. 2. The processes that formed and influenced the geology of the Forestry Farm area are descriped on pages 11-20. A partial geologic history is described on pages 20-22, with further information referenced in Christiansen (1979b).
>
> Christiansen describes the Saskatoon Group as being 'divided into the Floral and Battleford Formations and Surficial Stratified Drift.' Joints (connections) in the Floral Formation, Sutherland Group, Surficial Silt and Clay layers 'will facilitate groundwater recharge into the Forestry Farm Aquifer.' Spring sapping [discussed as piping or piping failures in more recent documents] occurs in various places 'along the eastern side of the South Saskatchewan River north of Sutherland,' such as Peturrson's Ravine and Riddell Seep. The Floral formation is further divided into Lower Till (10m thick; mostly in northern section), Lower Sand (6m; mostly in northern section), Middle Till (5-9m), Upper Sand (16m), Sutherland Valley Fill (0-20m), and Upper Till (25m); the Forestry Farm aquifer includes the Lower Sand, Middle Till, and Upper Sand layers.

Quoting the report at length for groundwater considerations: 'If more groundwater recharge takes place during development, present sloughs will enlarge and the spring discharge will increase causing flooding and slope instability, respectively. As the water table rises in the Forestry Farm Area, it will cause the water table to rise to the east which may cause saline soils to develop between the Forestry Farm Area and the Strawberry Hills' (p. 24).

If more information is required on groundwater, the study identifies Christiansen (1967, 1970) and Meneley (1970; 'Physical environment of Saskatoon'), Meneley et al (1979) as sources. The extent of the aquifer is detailed in Christiansen (1979a). None of these resources are included in this database.

Northeast Background Study (1985). UMA

UMA1985

Could not locate copy to review.

Stage 1 Geotechnical investigation proposed northeast sector truck sewers and subdivision development (1985-12). S85-COS92. BBT Geotechnical Consultants Ltd. Saskatoon, SK

BBT1985:`Reports/BBT1985.pdf:PDF`

A geotechnical investigation focused on the construction of storm and sanitary sewer services in northeast Saskatoon, including an outfall into the South Saskatchewan River for stormwater runoff. Land use was slated for residential and light industrial. The originally proposed trunk route (map p. 93) bisected permanent swale wetlands and would have placed the outfall within Peturrson's Ravine (p. 6). The outflow at Peturrson's was abandoned due to technical feasibility and costs of controlling existing seepage, which is a 'very high' volume of water; no mention was made of any ecological considerations.

Geomorphology of the study area is classified as uplands and riverbank. The upland area includes the Northeast and Small Swales. The swales are described as 'very rough with localized relief in some areas of up to 8 m and disordered drainage.' The boulders are residuals of a 'boulder lag between the Floral and Battleford tills.' River bank seepage from the Forestry Farm aquifer occurs 'almost continuously up to the midpoint of Sec. 13 where the [southern extent of the] northern current scar [or small swale] intersects the bank.' Slope failure along the river bank may expose the aquifer where it is currently not seeping.

An airphoto mosaic (PDF page 38) shows the extent of the aquifer, and indicates that the Aquifer is 'exposed' in the depressions within the greater swale, but drilling from this study indicates the aquifer does not extend to all parts of the small swale. Soil thickness is not uniform, decreasing 'from southeast to northwest,' and the aquifer varies in thickness 'from 5 to 10m within the study area.' Groundwater is more of a factor in sewer construction than the unconfined aquifer, with a general drop in groundwater levels from the southest to

northwest, roughly following the contour of the river and without impact from surface topography. Open-trench test excavations showed significant sloughing. Groundwater is recharged to the east, flows through the sand, and is discharged along the river.

; *Stage 2 Geotechnical investigation proposed northeast sector truck sewers and subdivision development* (1986-10). S85-COS92A. BBT Geotechnical Consultants Ltd. Saskatoon, SK

BBT1986:`Reports/BBT1986.pdf`:`PDF`

This study evaluates design changes to the trunk system made in response to BBT (1985). An investigation into the use of ponds in the swale to manage storm water, and proposed stormwater alignments and outfalls for lands to the south of the greater swale and lands between the Small Swale and NES. Includes a chemical water quality analysis up and downstream of the University dump site from 1984 (p. 23-4; location is NW1/4-12-37-5-W3).

The storm water retention ponds are addressed in Section 8, pages 30-2). For the stormwater surge ponds, test hole drilling was conducted only for Pond A (and only along a section line due to access), since 'it was not critical that this [Pond B] maintain a minimum water level' (p. 7). Pond A (between Agra and Fedoruk Rds) was desired to be a 'permanent reservoir.' This would require excavation through approximately 0.5m of aquifer sand, which was seen as sufficient thickness to minimize seepage. Over-excavation and replacement of sand with till was seen as a possible solution to sand exposure in undrilled portions of the pond.

It was suspected that Pond B was directly connected to the Forestry Farm Aquifer sands, such that stormwater put into Pond B could potentially affect groundwater 'downstream.' Analysis of a proxy outfall suggested that impacts to groundwater will only be significant in the case of a toxic chemical spill in the subdivision.

A map of the proposed routing and outflows is included on PDF page 59. [See objective 4, page 4. The proposed outfall between piping failures A and B was constructed in 2011-2012, located at the SE corner of SE1/4-14-37-5-W3, just west of a sand/gravel pit.]

North/northwest natural area screening study, City of Saskatoon (2012-09). 113253776. Stantec Consulting. Saskatoon, SK

StantecConsulting2012:`Reports/StantecConsulting2012.pdf`:`PDF`

A report following the Natural Area Screening process, as part of the Official Community Plan Bylaw No. 8769 (Section 9.2), triggered by the presence of 'important natural areas, features, or archaeological sites.' For a regional perspective and information on wetlands, prior reports cited include the Marquis/Silverwood Industrial Area screening report (AMEC 2002 - not included); North Industrial Sector screening (Stantec, 2006 - not included); Saskatoon Wetland Policy Study (Stantec, 2009). This is relevant to the Northeast Swale in terms of ecological

connectivity across the river. Plants (genes and materials) and animals (specifically birds and with birds as vectors) in the Northwest region may move through to the Northeast.

The vegetation survey for the swale conducted by AMEC in 2002 was done in winter, precluding a search for rare species. Historical occurrences of rare species date back to 1965-6 (Engelmann's spike-rush; Chaffweed), but one the quarters in which they were found has since been developed. The wildlife observations emphasize birds, and the SKCDC at that time had 'no records of rare wildlife species within the study area' (s. 2.2.5).

Provincially listed species were found in 7 locations (5 total: narrow-leaved water plantain (S3); meadow pussytoes (S1), Engelmann's spikerush (S2), northern blue-eyed grass (S3?), narrow-leaved cattail (S1?)). Three of the species were found in the west-side North Swale, including 'two locations of narrow leaved cattails and one location of narrow leaved water plantain.' Transplantation and seed collection are considered sufficient as mitigation techniques, but only for S1 and S2 species. For wildlife species, three federally-listed species were found: Spragues Pipit (SARA and COSEWIC), and Bobolink and Barn Swallow (COSEWIC). The most significant concern is timing of activity, specifically vegetation clearing, to ensure it does not affect nesting, but does not preclude conversion of land cover. Having no federal lands, the study area is not eleigible for designation under the Wildlife Habitat Protection Act (2010, Ch. 36). Habitat area is described as poor, with natural areas highly disturbed and adjacent agriculture allowing for alien species invasion and decreasing biodiversity. Some areas do provide good quality habitat. The *North Industrial Sector Plan Natural Areas Screening - Resource Overview Report* attributed ecological significance to North Swale, with observations of white pelicans (ranked S3B), yellow-headed blackbirds, grebes, geese, ducks, sandpipers and shorebirds

A Functional Assessment was completed for a number of wetlands, including classification, vegetation inventory (cover class by species, quality of zone, disturbance level), functional assessment, water depth measurement, water quality (temperature, EC, pH, DO), sediment quality (texture, metals, BTEX/F1 to F4 hydrocarbons). Classification results in three types of management classes: Preserve (high quality for humans and habitat, hydrology), Manage 1 (high quality for human and hydrology, moderate for ecology), and Manage 2 (medium for human, low for ecology). Of the 10 identified wetlands targeted for functional assessment, only 8 were studied (two had no access). Of the eight studied, four were classified as preserve, and four as Manage 1. Only two wetlands studied had 'exceptional' vegetative diversity and wetland water quality; all others had high vegetative diversity. Deep and shallow marsh zones are highest quality for vegetation, with wet meadow and low prairie having lower vegetative quality due to noxious and nuisance species from disturbance and agriculture.

No provincially listed wildlife species were observed, but as mentioned previously, the study was conducted outside of the window where vegetation could be iden-

tified. Two provincially listed plant species were found (narrow-leaved cattail, narrow-leaved water plantain).

The heritage assessment described areas with known or potential heritage resources, and delineated areas with no areas of concern (PDF page 62).

North Central/North East Natural Area Screening Study, City of Saskatoon (2013-11). Stantec Consulting. Saskatoon, SK

Stantec2013a:`Reports/Stantec2013a.pdf:PDF`

Conducted in conjunction with the North Commuter Parkway (NCP) study (Stantec 2013). Five Areas of Interest were identified in total, four by the City of Saskatoon (Northeast Swale, Small Swale, Opimihaw Creek, South Sask River), and an additional one by Stantec (Wetland Complex A, assumed to drain into the NE Swale). The document notes that any development will change surface water regimes, and is highly likely to change groundwater regimes; further study of groundwater-wetland functions would be required prior to further development. Wetlands in the swales are influenced by the Forestry Farm aquifer and local drainage; their extent and boundaries will change over time, as will their vegetative communities. Some wetlands in agricultural areas are unbuffered, and thus degraded in terms of habitat quality. Large, unbuffered wetlands in agricultural fields still achieved higih functional scores due to quality of vegetation. The screening study recommends contact with the SK MoE in order to develop mitigation plans. [Uncertain if this has been followed up].

The screening study recommends that specific components of the NE Swale Development Guidelines be extended to the greater swale in its entirety (such as the 'boundary' extending beyond City limits; see PDF p. 30 for more detail on the extension recommendations). Boundary-related guidelines discussed in Stantec (2012) should be applied to the Small Swale (with signage, fencing, and a resource management plan developed); a greenway design should be adapted and adopted; stormwater modelling conducted; and fluctuation in wetland water levels expected. No mention is made of using planning tools to protect the Small Swale (reserve designation etc).

For the Small Swale, all surveyed wetlands are classed as 'Preserve' due to 'presence of the northern leopard frog, a tracked species, or because of a high score in another function.' The Small Swale's ecological boundaries include disturbed areas in order to maintain connectivity to the river, unlike the boundary for the NE Swale. Vegetative 'species of concern in the Small Swale are the western red lily, red club rush, Crawe's sedge, and few flowered aster.' Wildlife species of concern include the NLP, migratory and breeding birds, and possibly the western tiger salamander.

Wetland Complex A is highly influenced by surface water runoff, filtering precipitation through grasslands and recharging groundwater. There are some uncultivated areas in the complex with high ecological function, but most of the wetlands

do not have vegetative buffers, decreasing their function. Some wetlands had been cultivated through within the last 10 years, and were not classified. Hydrological function is the main consideration for this complex, but a vegetation corridor for storm water management and trails (and incidental ecological function) to the NE Swale is also recommended.

Vegetative surveys were conducted in 39 upland natural areas. Remnant patches of native prairie are communities of needle-and-thread - western wheat grass - KBG. Some shrub/hardwood areas occur throughout the study area. Provincially-ranked species found include: Pursh's milkvetch (S2; west bank of SSR), narrow-leaf water plantain (S3; wetlands 9205 and 9251 in wetland complex A), and western red lily (S3S4; Opimihaw Crk, Small Swale, NE Swale). Nine nuisance or noxious weeds were found in all but one surveyed areas (absinthe, nodding thistle, Canada thistle, quackgrass, foxtail barley, prickly lettuce, blue lettuce, perennial sow-thistle, dandelion).

From initial desktop classification of 541 wetlands, 39 were potentially high quality habitat. The number of field surveyed wetlands and total number identified, by wetland classification, are: (II) Temporary - 4/292; (III) Seasonal - 17/192; (IV) Semi-permanent - 18/56; (V) Permanent - 0/1, was constructed.

Of 48 bird species identified during dedicated bird observation field work, the COSEWIC-listed horned grebe and Baird's sparrow (special concern) and barn swallow (threatened) were identified, as were two black tern colonies, which are protected by a 400m development setback (buffer) in effect from May to mid-July. Incidental observations during other field work adds 56 bird species, 'four of which are tracked': barn swallows, American white pelicans, a turkey vulture, and a great blue heron (S3B; in the small swale, likely foraging) were observed in the area. Only six mammals were observed during field surveys, 'none of which are tracked species'.

Amphibians and reptiles found during field work included incidental sightings of the plains garter snake, boreal chorus frog, wood frog, and northern leopard frog (S3 and federally Special Concern (SARA, COSEWIC)). The NLP were also observed throughout Small Swale; require grasslands for forage, semi-permanent and well-oxygenated wetlands without fish, abundant vegetation for breeding, and wetland that does not fully freeze).

North sector swale hydrogeological, geotechnical, and wetland evaluation (2015-11). ENVH2O03096-01. Tetra Tech EBA. Saskatoon, SK

TetraTechEBA2015:`Reports/TetraTechEBA2015.pdf`:`PDF`

A drilling report and wetland functional assesssment for ground and surface water, to inform the design of infrastructure for industrial development in the swale area. A total of 15 boreholes were drilled from 6.1m to 21.3m depths, with water monitoring in all but one (15BH002). Six wells were in sand that is assumed to be the Upper Floral Aquifer (Forestry Farm; wells 15BH00{1,3,4,5,8,9}). Four

sets of ground water measurements were made at 13 wells in total, and three sets at Well #7 (destroyed during construction, prior to final measurement). Well 13 was dry throughout, whereas over a six month period, Wells 1,4,5,8,9 were artesian (flowing under pressure) at depths less than 1.5m.

Wildlife observations during the assessment include a horned grebe (wetland #5057) and a black tern (#5049). The wetland evaluation was conducted on June 23 and 24, during 'hot and dry weather'. A total of 18 wetlands were identified for further study; 10 within the proposed development boundary, and an additional 8 within the 'optional' boundary, excluding the west-side 'North swale' (see the North/Northwest NAS, Stantec 2012). Of the 18 wetlands, ten were reclassified from Class III to Class II due to 'disturbance', and were not assessed. The remaining eight included five Class III and three Class IV wetlands, which were then graded as Preserve (5048, 5049, 5059, 5859) and Manage 1 (5050, 5057, 5867, 5945).

The conclusion is that infrastructure servicing is viable. Horizontal drilling is recommended due to water, rock, and also to reduce wetland disturbance. Long-term monitoring is recommended, including a permanent well near the former location of well #7. Well #1 should be extended, and three additional wells drilled near by.

1.3.2 University Heights (UH) Plans and Studies

University Heights Sector Plan (2013-06). 2nd ed. City of Saskatoon. Saskatoon, SK: City of Saskatoon

CoS2013:`PlansPolicies/CoS2013.pdf:PDF`

A high-level plan to guide neighbourhood planning and development. It notes that natural area screening, conducted in accordance with S. 9 of the OCP, has the potential to reduce the 'gross developable area' if 'important natural areas' are identified and delineated. The threshold for 'importance' is not discussed in this document. The North Commuter Parkway and Saskatoon Freeway/Perimeter Highway are briefly mentioned.

The Sector plan identifies NES Development Guidelines as a means of 'integrating natural areas into urban development areas' while simultaneously recognizing the importance of the swale for its fescue component, considering how little fescue grassland remains in the province. Portions of the guidelines are referenced throughout as design considerations for areas of the Sector near the NES, and for storm water management.

The Environmental Reserve designation is mentioned, but only in general terms: no specific areas are recommended or identified as ERs. However, the Plan notes 'developers are required to protect natural features and enhance these features by incorporating them into the layout of the neighbourhood open space.'

The Small Swale is discussed, though only the portion within City limits. Whereas the 2007 Sector plan slated the area for development due to prior disturbance, the 2013 amendment places the small swale 'under review' for further study prior to development. It tentatively recommends storm water retention and native vegetation restoration. Also discussed are NE-24-37-5-W3M and SE-25-37-5-W3M, with reference to rare plant species Crawe's sedge and red bulrush/club rush, as well as western red lily.

Other MVA-related interests mentioned in the plan include Peturrson's Ravine, Crocus Prairie, SNG, Peggy McKercher Conservation Area, and St Joseph's High School Conservation Easement.

UH I - Silverspring No neighbourhood plan is available for review: "The Silverspring neighbourhood was developed before we did formal neighbourhood concept plans like we do today." (K. Grant, planner at City of Saskatoon, pers. comm., April).

UH II - Evergreen and Aspen Ridge *Evergreen neighbourhood concept plan* (2009-06). Saskatoon, SK

CoS2009a:`PlansPolicies/CoS2009a.pdf:PDF`

A conceptual plan that is influenced by the City's (then) Development Plan (no. 7799), as well as seeks to be an 'environmentally sustainable' village; implements environmental design for crime prevention; offers a variety of lifestyle amenities, choices, and economic opportunities; and has a sense of place. This sense of place includes the swale, which is 'a valued amenity and marketing feature for this neighbourhood...[that] will provide opportunities for interesting pedestrian linkages to the Meewasin Valley river trail system.' Sustainability focuses on human dimensions, exclusive of biodiversity and wildlife interactions on roadways, neither of which are mentioned in the plan

Only the northwest corner of the plan area was noted as having 'native vegetation' dominant. ¡b¿Viewing the topography and boundary line on the map in figure 2 (PDF page 33), it is clear that this northwest area extends to the mid-point of the "channel scar"¡/b¿. White-tail and mule deer were known to frequent the area, and burrow holes for badgers, skunks, ground squirrels, and garter snakes were identified; within the plan area, 'no rare or endangered plant or animal species' were recorded in the SK CDC database.

The original hydro-geological study by Clifton/Christiansen (1980) recommended follow-up study at the time of development. ¡b¿ A Phase II analysis is referenced in the plan, but not included.¡/b¿ To deal with topographic variation, the development includes surface (storm) water drainage connected to an underground drainage system: on-street, at the backs of lots, and of linear parks. This water drains into a settling pond within the NE Swale boundaries, with spill-over being

discharged 'slowly' into the South Saskatchewan River. During spring, meltwater from road-side and median snow storage moves through the system, with absorption and settling rates varying by thaw.

The neighbourhood plan area covers 265 ha, with 17 ha of neighbourhood parks (7.8 ha core; 8 ha linear; 0.75 pocket; 0.40 village square) and 4.86 ha of District Parks, and projects a maximum population of 12,622 people in 5712 units (2021 single units, 3691 multi-units) at a higher density (8.7 units/acre) than City Park (8.5) and Nutana (7.5). The plan cites a 'strong demand' for housing as a rationale for "orderly growth" into surrounding natural and agricultural lands.

Relevant planning instruments include the Development Plan, Zoning Bylaw, UH Sector Plan, and the MVA Development Zone regulations. The MVA Board approved the NCP on Oct 3, 2008.

Exhibits an interpretation of the landscape and land as a blank slate: a homogenous space where land use can be efficiently and/or optimally allocated and relocated, in order to produce common goods for 'the public'.

J. L. Henry (2012-03). *Soil and Groundwater Conditions University Heights II Subdivison, City of Saskatoon.* Saskatoon, SK

Henry2012:`Reports/Henry2012.pdf`:`PDF`

A desktop-based geotechnical report to inform planning of subdivision University Heights II (UHII; Evergreen). The goal of the study is to inform building guidelines of local conditions, with the purpose of 'allow[ing] housing development so that dry basements will occur.' The report suggests dry basements will obtain unless persistently wet weather cycles swell the aquifer and increase its 'piezometric surface.' The author describes how the aquifer has changed as a result of 'excessive snow and rain events since 2005' (til 2012) charging up the aquifer and causing it to become 'confined' and raising water levels as a result. A test well operated by the Sask Watershed Authority/Sask Research Council, located near the highest point of elevation in the study area, has monitored groundwater levels since 1967, with a 5m rise recorded from 2005 to 2011 during the 'wet cycle.'

Surface drainage to the river is described as 'excellent' due to topography, excepting for 'a few small [enclosed] sloughs in the centre of section 17 and one significant slough in SW16' that do not drain to the river via surface flows. Significant boulder deposits were identified as 'a hazard to development,' while subsurface fractures down to the aquifer allow for good 'internal' drainage. There is a recognized hydrogeological connection between UH II and the Swale.

Sloughs are of interest to the study primarily for potential use as storm water retential ponds. Air photos (irregular coverage; from 1956 to 2011) and township survey maps were studied to document change in water surface area, relative to the size of the depression, and the presence of a salt ring. These measurements

would be useful in interpreting and predicting changes in wildlife and vegetation species compositions.

The report notes that the City has not been monitoring the Silverspring wells since 2005 (report includes data for 1993-2005), and urges them to resume. Further, test well decommissioning was not mentioned or otherwise indicated in previous reports, and recommends that this become standard, and that existing wells be properly decommissioned, or used in education/interpretation if they are on school grounds.

The report also urges a comprehensive hydrogeological study that is not bounded by sections or neighourhoods. The previous 'piecemeal approach' has been ineffecient and unnecessarily constrained, as it would make more sense to study the aquifer as a whole than as a reaction to subdivision build-out.

Geotechnical Investigation Proposed UH II Forebay Structure University Heights II Neighborhood Saskatoon, Saskatchewan (2013-01). SX04195. AMEC Environment & Infrastructure. Saskatoon, SK

AMEC2013:`Reports/AMEC2013.pdf`:`PDF`

A report on three boreholes drilled in 2013 at the edge of the NES. Includes borehole: depth, depth to slough/water, and water level on 16 Jan 2013, if detected.

'...the proposed Forebay structure would require significant excavation of water bearing sand soils or soft clays, up to 3.5m below the 16 Jan 2013 recorded water level (assuming a minimum water depth of 2.5m)'

Due to the significant work required to ensure separation between the stormwater forebay and the forestry farm aquifer, an alternative location was 'strongly' recommended.

Location is NE-18-37-4-W3M, west side of road across from farmsite.

University Heights II Development Impact on the North East Swale Stormwater System (2013-02). City of Saskatoon. Saskatoon, SK

CoS2013c:`Reports/CoS2013c.pdf`:`PDF`

A technical document that indicates how the NES is connected to other wetland complexes within different channel scars to the west and north-west. The study area relates to the development of Aspen Ridge. The document also provides some useful terminology for discussing other wetland complexes within the watershed. Stormwater flow modelling of surface and subsurface water suggests that the NES would experience 'minimal' impacts on water level and flows, though a 'noticeable increase in a small portion of the central wet land west of range road 3045' as a result of road decommissioning. Culverts for range road 374 are proposed to mitigate impacts of the road by 'improv[ing] the storm flow conveyance

through the NES'. Range road 3045 impedes flow, modeled to flood at 25-year frequency event levels as a result of the rapid run-off from UHII into a small portion of a wetland divided by the road. Flow is constrained by insufficient drainage.

Three 'branches' of the swale system are described: south (minimal contribution), centre (most significant contributor), and north (minimal contribution, only spills in storm events). The southernmost portion of the swale (south of the 'south' branch) would not connect even at a 500-year event; otherwise, general flow within the NES is to the north. No connection is made between the swale and the river until ¿10-year frequency events. Overall, the UHII 'area [is] small relative to the total catchment area of the NES.'

Precipitation (intensity duration frequency curves) was modeled for 2, 5, 25, and 100-year return periods. Three iterative land use scenarios were modeled: current conditions; development of 270 ha at an average of 35% imperviousness; and the 'opening up' of range road 3045, which currently acts as a dam and holds back a significant amount of water from flowing to the River. This modeling is limited by not integrating groundwater, evaporation, or snow melt, and not being of a 'continuous' type of simulation of 'the complete cycle of hydrology.'

Aspen Ridge neighbourhood concept plan (2014). 1st ed. City of Saskatoon. Saskatoon, SK: City of Saskatoon

CoS2014:`PlansPolicies/CoS2014.pdf:PDF`

Aspen Ridge Development Area Geotechnical Investigation for Roadways (2018). 18-2327. Pinter & Associates. Saskatoon, SK

Pinter2018:`Reports/Pinter2018.pdf:PDF`

Borehole logs and analysis for future road development in Aspen Ridge, and McOrmond and 8th area. The three boreholes closest to the Swale also had piezometers installed (map on PDF pages 18-19).

The logs for deep boreholes (10m) BH10{0,1,2} show the soil profile, as well as water levels (PDF pages 50-2). Shallow bores (2m) BH{5,6,7,8} are also in close proximity to the swale, but do not reach water or sand.

UH III *University Heights Neighbourhood 3 - Natural Area Screening and Heritage Resource Impact Assessment* (2015-04). 1132-53910. Stantec Consulting Ltd. Saskatoon, SK

Stantec2015:`Reports/Stantec2015.pdf:PDF`

A preliminary report for development of UH III, preceded by the North Commuter Parkway study (Stantec 2013) and North Central/North East screening (Stantec 2013a). This NAS extends to areas that are predominantly cultivated

lands, but also includes the snow dump, half of the small swale, and extends to the northern extent of the NES. The small swale is approx 162 ha, including connections to the river. Of that, 83 ha was in the study area; this represented seventeen percent of the study area being composed of the small swale. Eleven quarter sections were assessed for wildlife habitat suitability, with incidental wildlife sightings documented. Land use/cover is predominantly cultivated (235 ha), native vegetation (144), developed (48), hayland (41.3; includes farms), wetland (18), and tame pasture (11.6).

The study is limited in time and space, and should not be read as 'representative' of future [or current] conditions. Vegetation, wetland, and wildlife surveys took place from Sept 30 to Oct 3, 2014, which is outside of the timing window for rare plant surveys [this window should be reviewed for previous studies; also, multi-temporal within the window]. Weather conditions also affected wildlife observations (limited migratory bird observations, VES inconclusive, likely too cold).

Twenty-one of 25 classified wetlands were surveyed for further data collection on habitat quality. Those 21 were classified as: II - Temporary (Total: 9, surveyed: 9); III - Seasonal (14, 12); IV - Semi-permanent (2, 0); and V - Permanent (0, 0). Functional assessments were undertaken for a diversity of wetlands in the Small Swale, including 'natural areas and a select number of highly disturbed wetlands and small isolated wetlands in cultivated fields.' For the Small Swale, five wetlands are in the Preserve Class, due to the presence of NLF, SOMC, or for functionality. Of those 5, one is in a cultivated field (#3031; NLP) and one near a road and modified (#9055; sufficiently inundated with water for NLP habitat). Wetlands associated with the snow dump are either Manage 1 (#3034; indirectly affected by the snow dump) or Manage 2 (#7188, #7189; directly affected).

For the eleven quarter sections assessed, areas of high suitability for wildlife habitat were found across a number of dimensions, including for amphibians, tree-nesting raptors, loggerhead shrike, and for general connectivity to the river. Nine quarter sections were asessed for dominant vegetation. Some of the wetlands in cultivated fields were ground truthed for status (which was assumed to be poor due to lack of buffer); wetlands in natural areas were also examined and classified as in previous studies.

Wildlife database queries (Sept 26, 2014; SKCDC) showed no species of management concern previously identified in the Study Area, though this does not preclude their existence or use. No breeding bird survey was conducted (due to timing), so only incidental observations were recorded. Of the incidental observations, 13 common waterfowl and waterbird species were noted, with most observations occurring during work in the Small Swale. Nesting cavities were also observed in multiple quarter sections, but no species identification took place. For mammals, only white-tailed deer were directly observed, but a beaver lodge was found in one quarter. For amphibians, but specifically northern leopard frogs, two VES studies were conducted. They were inconclusive, as no sightings were

made, and the temperature was below recommended guidelines for VES (4 deg C vs 8 deg C). Two wetlands (#3027 and #3029) are potential over-wintering habitat for NLF(depth greater than 1.5m).

The study recommends restoring connectivity in areas of cultivation and in the snow dump. Wetlands in the Preserve class should have a 30m buffer for nutrient reduction. More study is needed to understand the ground and surface water hydrology in the small swale. It also recommends early and late rare plant surveys for uplands and wetlands, and wildlife surveys including breeding bird surveys, nocturnal spring amphibian surveys, amphibian fall VES, in accordance with provincial survey protocols. Wildlife documentation did involve an 'amphibian fall visual encounter survey' to identify potential overwintering habitat. Provincial setback guidelines exist for overwintering habitat.

For plant communities, native prairie communities are found only in remnant patches (healthy with problems or healthy; in the Small Swale or NES), with the communities in the rest of the area 'not yet described' due to non-native species invasion or encroachment. Nuisance and noxious weeds abound. Approximately 123 individual western red lily plans were observed in the Study Area, with two found in the Small Swale within the study area.

Potential infrastructure crossings through the small swale were chosen to 'reduce habitat fragmentation' and avoid 'disruption of wetland function'. Crossings are proposed either for the snow dump, or through a Preserve classed wetland in a cultivated field with Northern Leopard Frog habitat (#3031). The crossing (S1) is narrowed from previous studies, and is said to cross 'at the lower quality habitat in the Small Swale', leading to narrowed corridor having the 'smallest effect to [the] wetland.' Crossing S5 goes through the snow dump, an area of low quality habitat but still hydrologically functional.

City of Saskatoon Hydrogeological Study of a Former Snow Dump University Heights III (2015-07). 15-6116-E. Concentric Associates International

ConcentricAssoc2015

No file, not reviewed.

Added 2019-04-17

Hydrogeological investigation at UH III, Saskatoon, SK (2015-03). 14-1685. Pinter & Associates. Saskatoon, SK

Pinter2015

No file, not reviewed.

Added 2019-04-17

UH3 RFQ - Field Natural Area Screening (2019-01). 19-0116. City of Saskatoon. Saskatoon, SK

CoS2019:Reports/CoS2019.pdf:PDF

A request for quotes to conduct Natural Area Screening for the UHIII neighbourhood. Of most interest is Appendix D, which details the deliverables and outlines the changes in Natural Area Screening process discussed in the Green Infrastructure Strategy (CoS 2018).

Objectives of the study are to obtain a current, 'complete and accurate' survey of plants and animals, 'exact' delineation of swale boundaries (NES and SS; include any new wetlands as needed), and identification of any wildlife corridors that may exist 'between the two swales.' Potential effects of development must be described, and a monitoring regiment proposed for monitoring before and during development.

The timing for this contract is more open-ended compared to prior assessments, such that best practices and protocols for detection can be followed 'during appropriate times of the year.' Vegetation communities, noxious and nuisance weeds (early and late surveys for upland and wetlands); wildlife communities (birds, mammals, fish, reptiles, invertebrates, micro-organisms; breeding bird survey, amphibian visual and auditory surveys); additional wetland classification; assess the ecological health of the riparian area difference between the OCP's 92m and the Sector Plan's 150m; study in greater detail the sharp-tailed grouse Lek (location, population, health, mitigation).

A list of optional 'Assessments and monitoring' is also included (flora and fauna, site specific areas, hydrological review, roadways review), but would need to be justified in the proposal. For flora and fauna, a second year of vegetation and wildlife monitoring, and fish and fish habitat assessment are suggested.

For site-specific areas of interest, a review of the existing greenway design for application to UHIII, best management practices (BMPs) to protect the Riddell site, and recommendations and BMPs to improve integration of natural areas into urban landscapes while still incorporating regulatory setbacks for natural areas and sensitive species.

For hydrology, connectivity of the Small Swale wetlands, impacts of use of the swales for storm water retention, classification and identification of wetlands to incorporate into UHIII and recommendations for a mitigation plan if necessary.

For roadways, review the need for and siting of the industrial road connecting UH3 and UH Business Park, describe best practices for a future road crossing of the Small Swale, review current impacts of Lowe road and projected impacts of an upgraded road with best practices for a crossing of the NES, describe mitigation measures for small-medium animals including a count of collisions during the project, review implementation of existing mitigation.

; *UH3 RFQ - Field NAS - Addendum 1 - Q & A* (2019-01). 19-0116-A1. City of Saskatoon. Saskatoon, SK

CoS2019A1:Reports/CoS2019A1.pdf:PDF

A list of questions from applicants and answers from the City, clarifying details on the initial release of the RFQ.

Q7 asks about wildlife connectivity between the swales, with the City requesting a determination of whether or not a connection exists.

Q8 asks about potential areas of ecological interest, which the City clarifies are 'predominantly [in] the Small Swale and along the North edge of the Northeast Swale,' but leaves arguments for further investigation up to the respondent.

Q9 references hydrological connectivity of the Small Swale given the disturbance created by McOrmond. The City clarifies that they want to know the current status of connectivity in the event that additional roads are 'needed' to cross the swale, or 'additional forebays...added for Neighbourhood No. 3.'

; *UH3 RFQ - Field NAS - Annex C - Study Area* (2019-01). 19-0116-AnnexC. City of Saskatoon. Saskatoon, SK

CoS2019c:`Reports/CoS2019c.pdf:PDF`

A map depicting the study area, areas of potential ecological interest, and the grouse lek in the NES (but not the small swale, though a lek was identified in the Green Strategy Appendix 4 (CoS2018a)).

; *UH3 RFQ - Field NAS - Annex D - Roadways* (2019-01). 19-0116-AnnexD. City of Saskatoon. Saskatoon, SK

CoS2019d:`Reports/CoS2019d.pdf:PDF`

A map depicting roadways in the NE sector, as well as future interchanges.

1.4 Small, Northeast, and Greater Swales

The areas of interest presented below are within the currently recognized 'swale' boundaries, and ordered chronologically by the earliest document for that specific area or site. Research that has documented multiple sites in a single study is included above if in the Meewasin Valley, or below, if regional in scope.

1.4.1 Saskatoon Natural Grasslands

Both the SNG and Peturrson's ravine were originally identified in a natural areas inventory program (1969-72), and the Moriyama 100-year plan called for their conservation. The City purchased the land where both sites are located from the University of Saskatchewan, and began to develop the Silverspring subdivision without concern for preserving the area's natural heritage. Eventually, facing pressure from local environmental specialists and a variety of ENGO groups, 11.5 hectares of the grassland was 'sold' to Meewasin for a dollar (Harms 1993).

The area is often miss-classified as fescue prairie, when it is actually mixed-grass prairie with some fescue, or a mixed prairie/fescue prairie ecotone (Harms 1993, p. 7).See also Hudson (1993), Area 9 (in section 1.2).

Glen Grismer (1989-01). *Conserving fescue prairie in the northeast section, version III.* Meewasin Valley Authority. Saskatoon, SK

Grismer1989:`Reports/Grismer1989.pdf`:`PDF`

An MVA report that seeks to pre-emptively protect a 'pristine remnant' of native fescue prairie (northwest of the Forestry Farm; now Saskatoon Natural Grasslands) from the development of Silverspring and adjacent neighbourhoods. Native prairie near the NES is described as being overall 'rich in vegetative diversity,' while the variation in the landscape itself is identified as providing diversity of habitat and vegetative communities. Also included in the document appendices are: commentary from Romo and Driver on the multiple values in and of preserving this piece of prairie; an MVA memorandum on the interpretive plan for the fescue prairie; a submission from Stan Rowe on the importance of conserving the fescue prairie; and a conference paper on the "significance of natural areas" by Stan Rowe.

Recommendations specific to the SNG include remediation and restoration activities (minor invasives encroachment, debris from the old Sutherland dump and from rock/mineral mining, and vehicle trails. A potential link to the Prairie Conservation Action Plan was identified (p. 4). Critiera for conservation include intrinsic value, practical value (relevance to the MVA mandate for education, conservation, development), and the feasibility of management (balancing 'resource' values with costs of conservation). An 'optimal' balance of conservation and development is proposed, giving 'space' for representative landscape features and plant communities to change over time.

Vernon L. Harms (1993a-05). *Vascular plants of the 'Silversprings Prairie Preserve', Saskatoon, Saskatchewan.* Saskatoon Nature Society. Saskatoon, SK

Harms1993:`Reports/Harms1993.pdf`:`PDF`

This report provides a study of the Silversprings Prairie (Saskatoon Natural Grasslands), providing some background on its establishment and a rationale for saving native prairie. Four vegetation communities are described (grasslands, shrublands, aspen groves, open disturbed trailsides and fencerows). Non-native plants vary in their distribution and dominance, but include Kentucky blue-grass and weedy forbs such as Yellow Goat's-beard and Narrow-leaved Hawk's-beard. The frequency of floral species within the prairie preserve are found to be similar to the Kernen Prairie Research Area, but Silverspring showing more diversity (as mixed-grass, with introduced or weedy species, and having aspen groves and shrublands).

In tune with Grismer, Harms asserts that the size of land set aside is far from sufficient for a self-sustaining grassland ecosystem, as it leads to disconnection

from other, nearby grassland sites. A larger area improves the likelihood of long-term viability of the land as a preserve. Without connection and with insufficient space, the area may not survive as a representative native grassland. An area five times larger would have grater potential for sustainability; ideally, 180 acres with connection to Peturrson's ravine and other grassland area. Connectivity is a concern for the movement of genetic material between the parts and the whole.

Vernon L. Harms (1993b). *Vascular plants of the 'Silversprings Prairie Preserve', Saskatoon, Saskatchewan: Plant list*. Saskatoon Nature Society. Saskatoon, SK

Harms1993a:`Reports/Harms1993a.pdf:PDF`

An updated and re-organized list of the plant species described in Harms (1993).

Saskatoon Natural Grasslands (1994-03). 15-1602-A-00. Delcan Western. Saskatoon, SK

DelcanWestern1994:`PlansPolicies/DelcanWestern1994.pdf:PDF`

Resource Management Plan for the Saskatoon Natural Grasslands, commissioned May 1993, after ownership transfer of the SNG from the City to MVA was completed (approved by Council Feb 15, 1993). The purpose of the plan was to articulate an 'optimum management approach' for implementation, and focuses on three broad goals:

1) Preserving ecological integrity of the site–one remnant amongst others–as embedded in a 'larger prairie ecosystem'; preservation here emphasizes biodiversity (gene pool). Note that in Harms (1993), the small size of the preserve is critiqued for its ability to self-sustain into the future.

2) Living laboratory for education and interpretation.

3) Recreational use and enjoyment by connection to schools, parks, trails, the Forestry Farm and Peturrson's ravine.

The document has multiple appendices; of potential interest are: vascular plant list for SNG; unpublished inventories of birds, butterflies, and lichens and moss; 'review of management, administration, and interpretation of selected grassland reserves' (Conducted by Jo-Anne Joyce for the SRC); responses to a public meeting questionnaire (PDF pages 174-95); and the City's official comments.

The plan includes a Vegetation Management Strategy (natural biodiversity; restoration; fire suppression) and a Physical Development Plan. Data includes documentation on vegetation and a limited wildlife inventory, an ecological assessment, identification of potential impacts, a discussion of vegetation management strategies, and a discussion of the interpretive potential of the site. It notes that prior research included at the site included soils, vascular flora, and bird species, but limited research was available for 'lichens and mosses, butterflies, and mammals' (p. 1). In the 'blue grass grassland' area of the SNG, Kentucky bluegrass (KBG) appears to be displacing the fescue component of mixed prairie.

The Vegetation Management (VM) literature review includes a discussion of management approaches and actions from other grassland reserves, and the VM Strategy (VMS) include an inventory, problem identification, management objectives, and actions. Specific issues include alien species control, reclamation, control of aspen expansion, fire suppression, and reducing human traffic impacts. The VMS prescribes, by species, the priority for treatments, rationale, areas to target, and methods of control. It also identifies areas targeted for restoration, preservation, protection from human impact, fire suppression, and monitoring, along with their priority, rationale, and methods.

Bob Godwin and Jeff Thorpe (2004b-02). *Ten-year vegetation changes at Saskatoon Natural Grassland*. 11658-1E04. Saskatchewan Research Council. Saskatoon, SK

SRC2004b:`Reports/SRC2004b.pdf`:`PDF`

A technical report on the impacts of prescribed burning on the species composition (stem counts, mass) and distribution in the Saskatoon Natural Grasslands. Results have implications for future management of the swales. Overall, 'shrub cover and the percentage of Kentucky blue grass increased significantly, while species diversity declined' (SRC 2004a, p. 14) The sampling shows an increase in number of shrub species and decrease in herbaceous, forb and grass-like species, indicating a transition from grassland to shrubland. Total species variety, averaged across all sampled community types, declined; shrub and herbaceous cover increased relative to 1993, and clubmoss decreased. Species extent significantly changed towards dominance by shrubs (wolf-willow) and Kentucky blue grass (KBG); invasives increased extent significantly while native flowers and grasses decreased.

Development not only introduced the species, but also altered microclimatic conditions, improving the habitat for KBG to spread; development around the swale may also alter microclimatic conditions, with impacts on the resilience of grassland communities. A lack of disturbance was noted as a factor in the spread of KBG. Recommendations for burning were based on research from warm-season grasslands; there is uncertainty as to the most effective management regime (fire/grazing) to control KBG in this region. Statistical analysis shows that a single burning event over 10 years was able to reduce the spread of KBG, and reduce loss of grass-like species, though sampling issues (difference in community mix) introduces uncertainty. The report recommends further study, with a finer-grained experimental design and monitoring.

Bob Godwin and Jeff Thorpe (2004a-02). *Analysis of prescribed burning experiments at Saskatoon Natural Grassland*. 11904-1E04. Saskatchewan Research Council. Saskatoon, SK

SRC2004a:`Reports/SRC2004a.pdf`:`PDF`

A follow-up to previous prescribed burns (1994, 1996), focusing on two plant communities in the SNG: blue grass grassland, and open snowberry. Of interest

in the report was 'shrub cover, percentage of Kentucky blue grass (KBG), and herbaceous species richness' (p. 3). Burning had little apparent effect in terms of shrub cover in either community, but led to a small decrease in the rate of spread of KBG in the open snowberry community. These results are seen as contrasting with Godwin & Thorpe (SRC2004b), where burns resulted in significant differences between sites.

Sample size was identified as a likely factor for the inconsistency within and between the studies. Increased sampling rates within each quadrat will increase the likelihood of finding statistically significant differences, and is recommended for future research. Increased frequency of burning is recommended as a way to improve control of the spread of KBG: litter (ground cover) is a key variable in species composition change by increasing soil moisture. Litter can be controlled by grazing or burning, though burning requires the presence of some amount of litter in order to spread. More frequent burning is still the preferred option for further experimentation in control of KGB, even if grazing is implemented.

J. Thorpe, B. Godwin, and W. Sumners (2005-12). *Monitoring transects for burning and grazing treatments at Saskatoon Natural Grasslands*. 12028-1E05. Saskatchewan Resarch Council. Saskatoon, SK

SRC2005:`Reports/SRC2005.pdf`:`PDF`

A study of the experimental burns established to control Kentucky bluegrass (KBG) in the Saskatoon Natural Grasslands (SNG), 'document[ing] the establishment of monitoring transects that will form the basis for future evaluations of the effects of grazing and burning treatments at SNG.' Experimental control through burning was recommended in Delcan Western (1994), and conducted in 1996 and 1999. Findings from follow-up surveys (Godwin and Thorpe 2004a,b) showed no significant effects on contorlling KBG, but did affect shrub encroachment in one vegetation community. Repeated burning at increased frequency was recommended, as was grazing: annual burns if litter supports it, or every two years if not; and sheep grazing yearly, targeting consumption of half of available forage.

Burning is prescribed in two vegetation types in the southern area, with control transects in the same vegetation types within the central area. This study added 10 sample points for each existing transect; additional transects added for the Mixed Grassland vegetation type; and transects to measure grazing impacts were added in the northern part.

Patchy disturbance is important for habitat diversity and plant community health. Burning is an effective way to manage invasive species; lessons from testing burning and grazing techniques and monitoring the effects at SNG can inform the management of mixed grasslands in the swales, which 'tends to be found on upper slopes and knolls in the gently rolling terrain.' Concern about shrubs and KBG expansion in the swale is a concern for 'diverse communities of the knolls.'

Saskatoon's Natural Grassland Education Guide (2005). Meewasin Valley Authority. Saskatoon, SK

MVA2005:`GuidesEducation/MVA2005.pdf:PDF`

An elementary-level education guide developed by the MVA for experiential, outdoor-based education in the Saskatoon Natural Grasslands. The goals of the guide and lessons are to 'Rouse interest,' encourage children to 'Relate" with nature, and 'Reflect' on their experience in nature. The modeling of appreciative behaviour by adults/educators is emphasized as a necessary component of the education. Four thematic sections each include a philosophical theme, curriculum chart, and lesson plans for all grades. Content focuses on: Awaken to Diversity (recognition of bio and physical diversity, by visual observation); Appreciate Nature's Symphony (recognition of grassland ecology and the role of humans in supporting biodiversity, by aural [sound] observation); Experience the Mystery (increase connection to the environment through senses other than sight); and Tread Softly (encouraging deeper connections through empathy, and identifying strategies for conservation and care).

Bob Godwin and Jeff Thorpe (2011-01). *Limited report: Grazing experiments at Saskatoon Natural Grassland, 2010 monitoring.* 13010-1E11. Saskatchewan Research Council. Saskatoon, SK

SRC2011:`Reports/SRC2011.pdf:PDF`

A study of vegetative change in Saskatoon Natural Grasslands (SNG) as a result of five years of grazing. Builds on SRC (2004a,b;2005). Grazed and ungrazed transects were documented in three vegetation types: Mixed Grassland, Blue Grass Grassland, and Open Snowberry.

For Mixed Grassland (relevant to the swale), Kentucky bluegrass was less extensive in grazed areas, with Northern wheatgrass and other native species benefiting, and overall improvements in species richness. For Blue Grass Grassland and Open Snowberry, grazing controlled short shrub encroachment into grassland, with herbaceous cover increasing for one of the two. Further control of KBG in the Mixed Grassland areas is still necessary, with season-long grazing suggested for efficacy.

1.4.2 Peturrson's Ravine, Riddell Seep, and Peggy McKercher

Peturrson's Ravine and Riddell seep comprise the 'Sutherland Bogs', with geochemically unique seeps fed by the Forestry Farm aquifer, which is recharged in the Strawberry Hills east of Saskatoon. The aquifer also has connections to various wetlands in the swales. Peturrson's moist habitat supports a number of rare species. Geotechnical and hydrogeological studies describing the aquifer are in the North Sector Development section. See also Lineman (1993) sites 11 and 12 in Meewasin Valley and Local Natural Areas.

Joan Champ (1991-09). *The Pioneer Lime Kilns: North of Peturrson's Ravine, Saskatoon, Saskatchewan.* City of Saskatoon. Saskatoon, SK

Champ1991:`Reports/Champ1991.pdf`:`PDF`

Two kilns, side by side, northeast of Peturrson's Ravine. Though they sustained some damage, in 1991 MVA covered the kilns with plastic sheets and sand in an attempt to preserve them. The known history of the kilns is limited to an estimated of construction date in the 1880s; the land was originally Crown land. The document provides some cultural history of settlement: stone was used in place of wood where possible, due to the poor quality of lumber available locally or by import. The kilns may have been used to produce quicklime for buildings in Saskatoon, including landmarks such as the Queens Hotel.

Report on Peturrson's Ravine resource management plan (1995-05). 942-6267. Golder Associates. Saskatoon, SK

GolderAssociates1995:`PlansPolicies/GolderAssociates1995.pdf`:`PDF`

Resource Management Plan (RMP) for Peturrson's Ravine, largely reacting to suburban development on or near the area. A landscape element rating scheme for an ecological valuation of habitat (Baschak 1994), and connectivity was evaluated by a Network Assessment, with ratings of 12 and 6, respectively, matching those of some of Meewasin's other natural sites. During the background studies, there was a confirmed sighting of a Cooper's hawk (COSCEWIC (1994) listed), with loggerhead shrike and Baird's sparrow identified as possibly making use of the habitats.

The plan is used as rationale for the 'designation of significant portions of the ravine property under Meewasin's Natural Areas Protection Policy' (NAP; p. 1). The NAP prescribes the topics that Meewasin's resource management plans must address, including review of the planning and policy framework; natural/cultural resource inventories and analyses; public consultation and deliberation; landowner consensus on designation and management; and a proposal for implementation.

Peturrson's geomorphology is aquifer-driven by surface water infiltration in the Strawberry Hills east of Saskatoon (near Hwy 5 + RR 3040?), and groundwater outflow through the northeast portion of the ravine. Later in the document (26), the Sutherland Aquifer is named as contributing seepage into the Ravine. Development is expected to result in 'a general increase in ground water flows,' although surface flows from the swale will be diverted to the river (p. 27).

The report does not identify hydrological connectivity between the swale and the ravine, an important consideration for storm water management from surrounding neighbourhoods. This connection is detailed in subsequent geotechnical studies.

Peturrson's Ravine species list (1995-03). Meewasin Valley Authority. Saskatoon, SK

MVA1995:`Reports/MVA1995.pdf:PDF`

A master list/table of species at Peturrson's Ravine, dated March 1995. No text aside from the table.

Vernon L. Harms (2001). *Vascular plants of the Peturrson ravine area, along the South Saskatchewan River, in Saskatoon, SK.* Nature Saskatchewan. Saskatoon, SK

Harms2001:`Reports/Harms2001.pdf:PDF`

A short description of Peturrson's Ravine, along with an extensive species list of vascular plants found in the ravine area. Peturrson's Ravine is a complex of three ravines at the south-west extent of the greater swale: Peturrson North - the main ravine; Peturrson Middle - smaller ravine to the south; Peturrson South - west of the Psychiatric centre and southernmost (see Lineman 1993). Together with the Riddell seep further north, 'these constitute the Sutherland bogs...referred to...by Fraser [1944], Hudson [1951-1987, unpublished] and others.'

The distinct chemistry of the groundwater seeps at these ravines supports 'unusual botanical assemblages' as well as provincially rare species (Red Bulrush, Dwarf Bulrush, Marsh Felwort). Remnants of mixed-grass prairie were found in upland areas, with disturbed areas exhibiting exotic encroachment by the usual blend (KBG, smooth brome, crested wheatgrass, alfalfa, sweet-clover, perrenial sow-thistle) in open areas, and European buckthorn in woods and shrublands, and finally perennial sow-thistle and Canada thiscle in marshes.

Grazing, gravel extraction, and dumping constitute the majority of prior disturbances. Despite this, the area has 'a surprisingly high number of nearly 300 native vascular plant species.'

Maryville [Peggy McKercher] restoration and resource management plan (2008-08). Meewasin Valley Authority. Saskatoon, SK

MVA2008:`PlansPolicies/MVA2008.pdf:PDF`

This document is a Restoration and Resource Management Plan, describing site features, restoration plan, and operational plan for 'managing the special natural and cultural heritage resources found at that location.' Formerly an old hunting lodge, Maryville is now the Peggy McKercher Conservation Area (28 acres). It includes 'a section of the Meewasin Trail and provides connectivity from the Small Swale to the South Saskatchewan River' (NE Swale Master Plan, MVA2015). Prior to purchase by the MVA, it was zoned for future urban development.

An environmental site assessment (ESA; Phase 1) was completed by AMEC in order to identify actual or potential contamination on-site (22 April 2008; Appendix B in the PDF). The ESA includes historical aerial photos (1944, 1961, 1972, 1981, 1989, 1993, 2007) that overlap with the small swale; those, or adjacent, photos may have a broader coverage to show historical land cover in the area.

Ecological features include 13 vegetation patches (balsam poplar forest, yellow willow seep, flood plain, open Ash, mixed grass prairie, tall mixed shrub-ravine, exotic grasses, upland wolf willow, yellow willow dogwood seep, low mixed shrub, caragana, snowberry, mixed open forest, former grounds) across diverse topographic features (level upland dominated by mixed grass prairie; steep riverbank; and narrow floodplain), as well as 'two significant groundwater seeps (springs)'. General groundwater flow is suspected to be towards the northwest, but a hydrogeologic connection to the Forestry Farm Aquifer is not explicitly asserted. Local groundwater flow is considered variable and uncertain.

No formal observations were made for wildlife, birds, butterflies, lichen, or moss, though '[w]ildlife movement and habitat on the site is evident throughout.' No recommendations are made to collect wildlife, bird, butterfly, or lichen and moss data. Extensive exotic invasion and alien invasives, remnants of buildings, debris and a garbage pit are identified as 'ecological challenges' for the site's restoration.

Informal observations of wildlife and birds included: deer (beds and browsing); House Wren, Cedar Waxwing, Song Sparrow, Bonaparte's Gull Chipping Sparrow, American Goldfinch, Catbird, Eastern King Bird, Brown Thrasher, Robin, Towhee, Yellow Warbler. Nodding Thistle and Absinthe (noxious weeds) were found, as were crocuses (part of the prairie).

The planning process included a (cultural) Heritage Resources Impact Assessment (HRIA; Stantec, April 2008; Appendix C), which revealed, amongst other features, trails to the on-site spring that may be linked to the Moose Woods Trail (Saskatoon-Batoche). At the time of the assessment, the site was 'too young' to be considered for a 'Borden' designation that would be accompanied by stronger protection; any protection at this point is voluntary.

1.4.3 Regional Psychiatric Centre, Crocus Prairie, and the University Containment Facility

See BBT (1986) for water quality testing up and downstream from the Containment area (North Sector Development).

Luc Delanoy (1996). *Vegetation survey of natural riverbank lands north and west of the regional psychiatric centre*. Meewasin Valley Authority. Saskatoon, SK

Delanoy1996`:Reports/Delanoy1996.pdf:PDF`

A background document for a resource management plan, quantitatively documenting vegetative species diversity and distribution near the Regional Psychiatric Centre (RPC). It does not address mitigation of impacts from suburban development. This site is in close proximity to other Meewasin sites: west of the SNG, south of Peturrson's Ravine, and southwest of the NE Swale.

Most of the site is upland, with high quality, natural mixed grassland prairie. Compared to SNG, the RPC has less shrub cover but more crested wheatgrass;

for both sites, Northern wheatgrass is dominant, with KBG and Western porcupine grass as co-dominants. It is suspected that RPC is dryer than SNG, which improves stability (resistance to encroachment) of the 'higher drier portion' specifically, but the grassland in general as well: invasives need more moisture to compete. Two management priorities were identified for the bluff grasslands areas: introducing disturbance (high priority) and removal of crested wheat grass by wick/spray or by mowing.

Luc Delanoy (2004-03). *Vegetation survey of the University chemical landfill remediation site and adjacent City of Saskatoon buffer lands.* Meewasin Valley Authority. Saskatoon, SK

Delanoy2004:`Reports/Delanoy2004.pdf`:`PDF`

A 7 page vegetation survey report dated March 31, 2004, based on field data collected in 1997. The digitization and analysis of the 1997 data completes Meewasin's overall vegetation survey of 'a relatively large block of natural lands in the Northeast of Saskatoon.' The area in the report (17.9 ha; lat/long 52.1664, -106.5957) is bounded on the north(east) by the swale, south-east by SNG and the Forestry Farm, south by the Silverspring neighbourhood, and west by Peturrson's Ravine. This area is part of a 'larger block of land [that] measures over 200 ha[,] making it one of the largest urban grassland reserves in Canada.' Recommendations include adequate and strategic seeding of disturbed areas, combined with control of exotics, and a focus on other sites to allow shrubbery and trees to grow on City lands, producing cover, habitat, and food for wildlife. Since completion of the report, the land has been remediated to the point of supporting non-contact recreation (e.g. trails; see CoS 2013 - UH Sector Plan, 5.5.4, p. 15 in 1.3.2).

The University land (Chemical landfill remediation site) is highly disturbed and exhibits high exotic herb encroachment (non-woody vegetation; grasses, e.g. quackgrass, smooth bromegrass; and broadleaf, e.g. sweet-clover, alfalfa, Canada thistle, absinthe, baby's breath). City-owned buffer lands (3 parcels) are 'relatively undisturbed,' but the report states that 'it is probably that the abundance of exotic vegetation is somewhat higher on the City Buffer Lands than on nearby natural areas.'

The vegetation survey identified 85 species, of which 15 (18%) are exotic; overall exotics account for approximately 56% of all vegetation, but only 38.6% when considering City lands exclusively. The University lands have very little woody cover, whereas the City land is approximately 2/3 woody cover (70% western snowberry), with 'an equal mix of herbaceous cover including Exotic, Native/Exotic, and Native.' Northern wheatgrass is the most common native plant overall (5%) and in City lands (7.6%). For good quality prairie, northern wheatgrass would be dominant, but even on undisturbed City lands, it is sub dominant to KBG and smooth brome grass. The report describes exotic cover as 'more severe' than the encroachment in other surveyed sites. Shrub cover is also noted as increasing rapidly.

1.4.4 Northeast Swale

An aerial photo in BBT (1986; page 59 in the PDF) shows the landscape prior to the development of the Silverspring and Evergreen neighbourhoods. See also 1.4.4 on page 59.

Northeast Swale master plan (2013). Meewasin Valley Authority. Saskatoon, Sk

MVA2013:`PlansPolicies/MVA2013.pdf:PDF`

Northeast Swale resource management plan (2015). Meewasin Valley Authority. Saskatoon, Sk

MVA2015:`PlansPolicies/MVA2015.pdf:PDF`

Vegetation and wildlife

Luc Delanoy (2001a). *Vegetation and wildlife survey of the Northeast Swale near Saskatoon.* Meewasin Valley Authority. Saskatoon, SK

Delanoy2001:`Reports/Delanoy2001.pdf:PDF`

A Meewasin report on the vegetation (primarily) and wildlife of the Northeast Swale, based on field data collected in summer 2000; the study area includes part of the small swale. The report is 'a quantitative assessment of the vegetation and qualitative information on wildlife.' According to the report, prior research on the swale presented only qualitative information on vegetation (lists), and Delanoy states that quantification of wildlife is necessary for future management. Variation in topography, connectivity to the river, and groundwater chemistry provide for diverse habitats (woodland, prairie, springs, meadows, wetlands), leading to high plant and bird species identifications (206 and 181 respective). It does not address heritage or paleontological resources 'although several features are known in the area' (p. 4). Management actions emphasize the importance of diversity, including in the pattern and frequency of disturbance to achieve a mosaic of even-aged aspen stands, mechanically or by fire, with snags (standing dead trees) retained. The summary is good for those who are just learning about the swale, as it provides some physical description and then lays out some initial concerns that have reverberated through subsequent developments and reports.

Issues include over grazing, developments, disturbed areas and debris, and weeds. Goals include testing of land management practices, control of exotics, and use of disturbance that is 'random in space and season', and with a frequency and type appropriate to the dominant vegetation in order to restore and maintain healthy vegetative communities. Nearly half of the study area was native prairie habitat (305 ha); three of five quarters were overgrazed, while ungrazed areas had good relative coverage of fescue (13%). Kentucky bluegrass and smooth bromegrass are key weed species to tackle due to their displacement of rough fescue. One location had leafy spurge, and was treated with beetles.

Connection to the river increases the wildlife habitat value of the Swale, which is also of benefit to certain types of human interaction with the swale, but not all (e.g. driving through the swale). Relative to animal movement and roads, white tailed deer prefer tree cover in the south and west edges, whereas mule deer prefer rugged topography in the swale. The deer population is year-round and healthy. Roadways must be designed to emphasize visibility of wildlife for drivers, and deterrance of browsing through planting of native grasses in ditches. Fragmentation by roadways is acknowledged, and an underpass 'would help overcome fragmentation' but this is not strongly worded as a recommendation. Roadways generally are a source of weed seeds; to reduce both fragmentation and susceptibility to edge effects and seed dispersal from roadways, future road crossings should be minimized and existing vehicle access and roadways should be decomissioned.

Other recommendations in the summary include: for the aspen and grassland vegetation communities alike, removal of cattle; set aside largest portion of natural vegetation and ensure its connectivity to the river; minimizing storm pond footprint while discouraging bird populations and optimize alignment for green space; keep roadway crossings down, preferentially construct on exotic vegetation, do not plant/allow shrubs near roadways, and plant with native seed to avoid attracting deer; introduce moderate disturbance to facilitate flora and fauna diversity in natural areas; site- and species-specific aggressive restoration treatments.

Vegetation and Wildlife Survey of the Northeast Swale (2009). Meewasin Valley Authority. Saskatoon, SK

MVA2009:`Reports/MVA2009.pdf`:`PDF`

The study informed the NES Master Plan (MVA 2013) and NES Resource Management Plan (MVA 2015). The Plans are seen as necessary to address 'pressures from land-use, recreation, and weak stewardship enforcement.' The study was funded by the Habitat Stewardship Program, builds on Delanoy (2001) and others. This survey did not find any species at risk, but follow up studies had positive identifications. Subsequent studies include birds (Shadick 2009; Jensen 2009 - missing; Jensen 2012; MVA 2012), an ecoblitz (MVA 2011), a Natural Area Screening study (Stantec 2012) and updated development guidelines (Stantec 2012a). As with most studies of the NE Swale, it is constrained to lands already designated as areas of interest and within City or Meewasin boundaries, but does not extend through the greater swale (private land in RM Corman Park) or the small swale.

The bird survey component of this study is limited by its narrow temporal coverage. Prior studies amassed observations over many years, whereas this study took place over a short period of time (six periods–3 from sunset, 3 from sundown, four hours each), and thus did not necessarily include migratory or nesting species.

Conservation goals are discussed as either natural/ecological (integrity of wetlands and upland mixed-grass prairie; restoration and conservation of ripar-

ian area; decommission and restore roadways; resource management through burning, grazing, and weeding; reduce impacts of interpretive activities) or cultural/historical/archaeological (integrity of components; restoration and conservation; interpretation). Conservation requires effective enforcement of bylaws (as well as signage and fencing), and the decommissioning of roadways (specifically Agra and Lowe Roads) to reduce 'wildlife-vehicle collisions and the spread of weeds along the road right-of-way.' Residential development poses a significant threat to the swale in terms of alien invasives (leafy spurge, european buckthorn, bird's foot trefoil) from residential development.

Using a GIS, data from prior reports was combined with additional field work to classify land in the conservation zone based on presence of native vegetation, rare plant species, potential for native plant species (in unsurveyed areas), naturalized (undisturbed) vegetation, and disturbed or developed (thoroughly converted or built up). Disturbed land accounts for only 6% of the study area, while 144 hectares (40%) is primarily native vegetation, and 107 hectares (54%) of vegetation communities with rare plant species. Native vegetation cover is estimated at 205.8 ha (79%), exotic/invasives at 46.8 ha (18%), and disturbed at 8.1 ha (3%).

Stan Shadick (2009-06). *Northeast Swale bird survey report - June 11 2009*. Saskatoon Nature Society. Saskatoon, SK

Shadick2009:`Reports/Shadick2009.pdf`:`PDF`

A three page report on a bird survey conducted June 11, 2009 at five road-side locations. Observations lasted five minutes at each location, and included visual and auditory identification. Counts were constrained to roadways within the typical 'NE Swale' boundaries. During the survey, 29 species were identified, with 2 others identified beyond the survey times. Unexpected species included two non-nesting Tundra Swans and two Great Blue Herons, both pairs flying over the area of interest. All observation sites were within grassland habitat, mostly with shrubs and/or aspen, and two with sloughs.

Meewasin ecoblitz 2011 summary report (2011). Meewasin Valley Authority. Saskatoon, SK

MVA2011:`Reports/MVA2011.pdf`:`PDF`

An evocative yet succinct description of the Swale's evolution, and the MVA's mandate in relation to the Swale. The report pertains to an ecoblitz, an initiative to collect data, outreach, education, and community engagement prior to the development of the Swale's Resource Management Plan (MVA 2015). Data collection centred on 'ecology and habitat in addition to species.' The event is well documented in terms of event structure, media exposure, data collection, and educational activities. Includes some descriptions of the area used in outreach and educational materials.

Crowfoot violet (Rare) was found [possibly for the first time], as was rough fescue; the area also includes crocus, wild rose, and western red lily, which are the 'floral

emblems of the three Prairie Provinces'; it also includes sweet grass, possibly of interest to indigenous peoples in the area. The common nighthawk, a threatened (still?) species, and abundant waterfowl (40-50 nests) at the large slough in SE-18 were documented during the blitz. Poor weather is said to account for low insect and mammal counts. Collation and analysis of insect and aquatic invertebrate counts were not available by the time of publication.

Bird survey for Northeast Swale within Meewasin Valley (2012). Jensen Ecosystems Services. Saskatoon, SK

JES2012:`Reports/JES2012.pdf`:PDF

A bird survey (May 1 - June 2, 2012) conducted to capture spring breeding and migration, and includes commentary on 'habitat(s) that are vulnerable or critical to the species observed.' Observations were 'limited to the native grassland, water bodies and woody vegetation...[on lands] owned by the City and within the Meewasin Conservation Zone.' Observations were made by walking the land over 3-4 hours, with eight walks in the morning and four in the evening, and on different days (no morning + evening on the same day). Recorded nesting site observations were incidental. Further investigation of habitat for nesting species, including surveys for nesting sites, and additional observations at a later time of day (for waterfowl nesting) are recommended.

Species of interest include common nighthawk, horned grebe, barn and tree swallows: '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.' Barn swallows were present, but nest instead in adjacent farm buildings. Though not observed, loggerhead shrikes could nest in the swale as it does provide appropriate habitat; their numbers across the province are low, so it is not expected to find them, but providing habitat is critical for their survival. Sprague's pipits require patchy, grazed grass and the grazers as well; owls could also use the Swale, if local populations were to increase.

Common nighthawk, loggerhead shrike, Sprague's pipit and Baird's sparrow are not considered to be annual species for the NES. Even if not for nesting, the NES provides critical foraging habitat (crows, magpies, merlins, peregrine falcon, Cooper's hawk; red fox, coyote); the lek is also hypothesized to exist, but timing was suboptimal for observation.

Meghan Kelly (2013). "Assessing the Status of Invasive Exotic Plant Species in the Northeast Swale, Saskatoon". MSEM project. Saskatoon, SK

Kelly2013:`Reports/Kelly2013.pdf`:PDF

An assay of the 'spread and degree of infestation of exotic invasive species occurring within the Northeast Swale,' along with recommendations for management strategies and priority. Data were collected from transects (10m apart) of 135

sites (50x50m), from June 10 to July 12, 2013: 'Vegetation community type, disturbance, and vegetation percent cover' were recorded. Sites were categorized based on 'the number of species, their extent and percent cover, and the category' of the species. The study included a survey to map locations and determine severity of infestation. Whereas weeds are usually classified as noxious or nuisance, the study adds a third category of exotics that are potentially invasive but not designated as weeds by the provincial government (Ministry of Agriculture). This in itself is an important consideration, as it indicates an emphasis on weed classification as pertains to agricultural interests.

While invasive species are found within the swale, the most susceptible areas are those within 100-150m of roads, or that have seen significant human modification (e.g. grading). Accuracy of the study is susceptible to missed or mis-identification due to lack of experience and familiarity with species identification. Furthermore, plant maturation was not complete, and double-counting is possible. As the author states, it is likely that errors decreased towards the end of the study, as the author gained familiarity and experience in identification.

Table 1 provides a summary of 45 invasive plant species (weeds) previously identified in the Northeast Swale, including their latin and common names, as well as the status and associated rank (nuisance = 1, invasive species = 2, noxious = 3, early detection = 4). This study found 28 of those previously identified, and 3 additional species (toadflax, rapeseed, foxtail barley). Seven species are categorized as very high priority, four as high, 13 as medium, and seven as low priority. Early detection species (not yet classified by the province as 'weeds') found in the south west of the Swale included vetch and chickpea milkvetch. Of special interest for wetlands is the potential for broadleaf cattail to hybridize with exotic invasive narrow-leaf cattail. The narrow-leave and hybrid species outcompete the native species 'by forming dense strans dominating wetlands, ditches, and storm water basins'.

The most cost effective and environmentally friendly way to control of most of the invasive species in the Swale is hand-pulling. Extensive infestations would require mowing or grazing, but over-grazing can increase the spread of certain species. Along roadways, burning or grazing can facilitate the spread of invasives. Due to the extent of spread of some species in certain areas, mowing or herbicide application might be more feasible. However, herbicide use should be minimal and done with caution due to unintended consequences to other plant species (e.g. glyphosate can kill beneficial nitrogen-forming bacteria), as well as the potential for contamination of water.

Nicholas Howitt (2013-08). "Assessing the Status of Sensitive Plant Species Prairie Crocus (pulsatilla Patens L.) in Response to Fragmentation in the Northeast Swale, Saskatoon". MSEM project. Saskatoon, SK

Howitt2013:`Reports/Howitt2013.pdf`:`PDF`

An examination of the factors that influence the distribution and population health of prairie crocus in the Northeast Swale. Builds on regional scale studies of prairie crocus distribution (Esperrago & Kricfalusy, 2015; referenced as 2013 in this report), but also engages with rangeland management literature. Howitt emphasizes plant communities as appropriate management units and proposes a number of management practices that maintain heterogeneity.

The study adopts a scalar approach to understand how landscape and community-scale processes such as changes in edges (perimeter to area ratio), habitat loss, or habitat isolation affects population density. Observation units are 50x50m, with sub-units (10x10m) and sub-sub-units (5x5m) used to analyze distribution and density in terms of scale. Field study occurred over 45 days, but only over one season, which constrains temporal analysis.

The prairie crocus is noted as an effective 'indicator species for disturbance,' and has experienced significant decline as a result of agriculture and suburban expansion. Also discussed are the effects of grazing and burning disturbances on population health, both of which are management techniques used by MVA. Aside from disturbance, this research looks to understand the role of fragmentation on population health. Internally, natural fragmentation exists as a complex mosaic, including variation in soil moisture, chemical composition, and structure; topography; and wind exposure. Uncertainty about why prairie crocus prefers certain plant communities remains, with possible reasons being 'light availability, competition for nutrients, reproductive success [, and] differences or shared preferences in soil type.'

Aspect (direction of slope face) is a significant factor for plant presence and density: north and northeast slopes are preferred by the plants. However, variation in topography left the aspect of some sub-units 'indeterminate' (ridges, troughs, significant variation) or 'level'. Units with aspects of north, northeast, indeterminate, and south were highest for relative density, though the amount of land surveyed at different aspects varies significantly as well.

Plant communities matter, such that mixed natural grasslands and semi-natural grasslands host the most prairie crocuses found (53%), so long as native species account for more than 50% of grassland species and less than 25% shrub cover. Natural and semi-natural thickets with shrub cover greater than 25% accounted for 46% of observed prairie crocuses. In general, higher native grass cover leads to more crocus stems, unless wholly covered by inasive grasses. Maintenance and protection of natural species in grasslands and thickets will be key to conserving prairie crocus.

Prescribed burns had a small but measurable positive correlation with increased prairie crocus density, as measured on a presence/absence of fire at the sub-unit (10x10m) scale. The author notes that the literature supports a stronger positive relationship between burns and plant density, but (in)accuracy of burned area identification in this study constrains strong conclusions.

Planning and management

Breanna C. Sikorski and Jill A.E. Gunn (2013-04). *Urban Development Pressures and Biophysical Effects to the Northeast Swale, Saskatoon, Canada*. University of Saskatchewan. Saskatoon, SK

Sikorski2013:`Reports/Sikorski2013.pdf`:`PDF`

A baseline report based on interviews and document review to determine the perceived relationship between development pressures and cumulative effects in the Northeast Swale. Cumulative effects are understood as those that combine non-linear human and ecological responses to environmental changes, which can lead to 'devastating levels of change in valued ecosystem components.'

Interview participants identified a number of existing and potential issues that are still issues, or have come to fruition (e.g. new roads or upgrading of existing ones leading to further fragmentation; off-leash dogs impacting nesting birds [no direct evidence of disturbance, but off-leash dogs have been photographed outside of the recreational zone of the NES]; speed limit issues; stranding of the NES as an 'island' in a sea of urban development; continued and elevated mortality [since the NCP has opened to traffic, multiple deer have been killed on the roadway]; changes in animal behaviour as a result of human/urban presence [noise, lighting, road barriers, pet disturbances/hunting]).

The concepts of Environmental Assessment introduced in this report is helpful in providing a language to discuss development around, and environmental change in, the swales. Different actions or developments (drivers) interact in varied ways, and have different cumulative effects on the environment, individually or combined. Cumulative effects can be additive (incremental, repetitive, piecemeal); interactive (combinatory and accumulative); or synergistic (repetitive, but with accelerating depletion).

Delineation of the Swale's spatial boundaries is uncertain, contestable, and varies based on perceptions of what are considered the most significant factors (e.g. hydrologic function and connectivity, vegetation, topography) and parameters (e.g. ratio of wetland to upland, distance of light pollution control) for habitat function.

Prior to urban development pressure, over-grazing was likely the most significant impact on the grassland ecosystem, reducing levels of smooth brome. Cultivation-related effects at the edges include invasion/encroachment of weeds, and a lack of surface water filtration due to loss of wetland buffer.

Other infrastructure considerations, such as downhill flow of wastewater to the treatment plant, also influence the rate and spread of development in the NE sector. Development near the NES does not support the maintenance of the Downtown sector as a core business district, which was noted as a key goal for the City.

Lack of municipal coordination with Corman Park is also seen as aggravating the NES situation, as country residential development south of the City has left

little land for suburban expansion in that direction. It is likely that the 100-Year plan also influenced this: as early as the 100-Year plan (RMAP 1979), and even up until the Future Growth Study (2000), the NE was seen as a viable and recommended area for residential expansion and the south for conservation. A boom cycle of resource extraction is also tied to these pressures, along with suburban development and province-wide population growth, and low interest rates for mortgages.

Design Charrette - Northeast Swale Master Plan (2014-04). Meewasin Valley Authority. Saskatoon, SK

MVA2014:`Reports/MVA2014.pdf:PDF`

Rong Shen (2015-12). "Evaluation of Grassland Management in the Northeast Swale, Saskatoon". MSEM project. Saskatoon, SK

Shen2015:`Reports/Shen2015.pdf:PDF`

Meewasin Valley Authority Northeast Swale mitigation planning (2016-03). 2287. Canada North Environmental Services Limited Partnership [CanNorth]. Saskatoon, SK

CanNorth2016:`Reports/CanNorth2016.pdf:PDF`

An assessment of mitigation techniques recommended to reduce development impacts on MVA property in the NES, and likely transferrable to the Small Swale and other MVA properties. Provides a catalogue of ecological impacts from suburban development on wildlife and plant communities in similar contexts: habitat loss and fragmentation, reduced habitat quality, reduced connectivity, direct mortality, and altered behaviour. The NES is described as having 'increasingly rare habitat', and also 'relatively unfragmented' connectivity between other landscape habitat patches. Main habitat types include open grassland, aspen shrubland, wetland and riparian habitat. 'Species movement, recruitment, and dispersal' are but some of the ecological functions provided by the Swale.

Recommendations are made with assumptions about long-term viability of the ecosystem habitat. Unavoidable effects of development include direct habitat loss, reduced patch sizes, and increased human presence. Development affects groups of animal species differently, with evolutionary adaptations for different habitats leading to high sensitivity to alteration or loss of habitat. Upland species may require even more habitat to have sustainable populations (e.g. 2 ha for bobolinks and '150 ha of shortgrass prairie for Sprague's pipit'; coyote home ranges average nearly 7600 ha; badgers range from 1200 to 9700 ha, and like to eat roadkill). It is noted that agricultural lands are likely also used by wildlife, and its conversion to residential developments will leave the Swale unable to support large mammal populations, even with mitigation measures. Large mammals (deer) are seen as potential nuisances, so their retention in the area is not seen as

desirable. Small to medium sized mammals, amphibians, and birds have smaller range requirements; the uptake of effective mitigation measures is more likely to sustain their populations compared to larger mammals. Any mitigation measure requires monitoring to assess its efficacy.

A lack of 'legally binding protection' of the NES is noted, with recommendations including designation as a Municipal Heritage Site, Environmental Reserve designation, or through conservation easements.

The report also considers the impacts of the Saskatoon Freeway in general, lacking specific details about design: 'it has the potential to significantly alter hydrological flows throughout the Swale and reduce habitat connectivity.' If an open span bridge (over land) is not chosen, mitigation techniques identifed for other roadways through the Swale must be adopted. The open span bridge (extended bridge/viaduct) reduces impact on surrounding areas and spans sensitive areas, but can be very costly; dry and wet passage should be included, with mixed use acceptable but not if it is primarily for humans, as they do not suffice as wildlife passage.

Light and sound are considered deterrents, and the degree to which a roadway exhibits barrier effects is commensurate with traffic (2,500 vehicles per day can have minimal effect, but 10,000 vpd is a complete barrier, though some species may be affected regardless of volume). Lighting should be avoided where possible; if lighting is required, it should be 'Dark Sky Friendly'.

Reduced speed limits are cited as effective for reducing sound, as well as instances of direct mortality and collision; salt avoidance is also important for water and wildlife. Amphibian and small mammal fencing and crossings are recommended every 50m, with temporary evening closure of Lowe road during peak breeding seasons. Speed limits matter when reducing collision rates; breeding seasons reduce animal caution near roadways and photoradar enforcement of speed limits during those times will help reduce collisions. Speed limit enforcement has 'minimal costs' but is not effective at mitigating barrier effects in high traffic areas. It is also often a flash-point for city administration, councillors, and the road-using public who cry foul over 'speed traps'.

Renny Grilz and Eryn Tomlinson (2017-02). "Case Study: "Restoring" a Stormwater Pond at the Meewasin Northeast Swale". In: *Native Prairie Restoration and Reclamation Workshop*. Native Prairie Restoration and Reclamation Workshop. Regina, SK: Prairie Conservation Action Plan

Grilz2017:`Reports/Grilz2017.pdf`:`PDF`

A presentation and workshop assignment related to stormwater management, set in the NES. Includes an array of maps that depict the full extent of the greater swale, grasslands and wetlands in the region (grassland data from year 2000 land cover), Meewasin sites in the northeast, extent and year of prescribed burns and grazing, and the locations and extent of invasive species.

Rong Shen et al. (2019). "A GIS-based model of ecosystem services for the Northeast Swale in Saskatoon, Saskatchewan". In: *Spatial Knowledge and Information Canada* 7.1, p. 7

Shen2019:Journals/Shen2019.pdf:PDF

Development Guidelines

Development guidelines and the Northeast Swale (2002-03). First. 132-52317.01. Stantec Consulting. Saskatoon, SK

StantecConsulting2002:PlansPolicies/StantecConsulting2002.pdf:PDF

The first integrated analysis of the NES, providing guidelines to reduce future development pressures on the Northeast Swale, 'an important natural prairie remnant.' This document, and the study upon which it is based, are aa response to section 9.3 of the City's Development Plan (Conservation of Natural Areas and Archaeological Sites).

The study was to establish a transition zone between development and ecological boundaries by delineating boundaries for a core swale zone. Specifically, the study was to 'identify, describe and map the ecological and heritage resources associated with the northeast swale and adjacent area,' and to 'provide recommendations and develop guidelines' for utility and road corridors, storm water management, and neighbourhood boundaries to protect or mitigate impacts on ecological and heritage resources.

The study boundaries are listed on p. 9 in the PDF, with a disclaimer that ecological and geotechnical boundaries are not aligned. Residential development and modification of wetlands for storm water management have already occurred in part of the swale originally delineated by Weichel (1992).

Delineation of the final 'core' boundary was based on: geotechnical boundaries, with a minimum 6m of soil cover over the Forestry Farm aquifer; distribution of wetlands; distribution of native and altered vegetation, connection between the swale and the river, and heritage character. The 'core' area has only a thin and inconsistent layer of soil between the surface and the Forestry Farm aquifer. It is considered unservicable, as water and sewer would be too difficult to install without significantly disturbing the aquifer and wetlands. In later studies, horizontal drilling is proposed as a way to avoid disturbances.

The development guidelines include two perspectives: ecological, and transportation and development.

Ecological considerations (table 4.1) included connectivity, enhancement of water retention areas, development/enhancement of existing disturbed areas, maintain wetlands for groundwater regime, reduce speed and traffic through the natural area, use natural species for planting, and consider human and animal crossings across corridors, and consider road re-alignment.

Transportation and development perspectives (table 4.2) are discussed in three categories: Transportation, Land Development, and Water and Sewer. Transportation included the 'required' Central and McOrmond extensions (for subdivision access; speed of 60km/h); arterial routes (E/W or NE/SW; Fedoruk Drive); and the Perimeter Highway/Saskatoon Freeway along Blackley Road (4 lanes, 100km/h; 'extreme northeast corner of the swale study area,' but not of the swale itself). Land Development identified neighbourhoods north, south, and northeast of the swale; geotechnical and ecological 'constraints' are to be balanced against economic feasibility of development size and location. Water and Sewer must also consider geotechnical constraints, stormwater management, and the phasing of build-out; locating the connections to new neighbourhoods must be done in a way that 'protect[s] the core area of the Northeast Swale'.

Three classes of development issues are identified: ecological, heritage, and recreation.

Ecologically, the swale has experienced impacts from overgrazing, industrial and residential development, storm water management, mineral extraction, and road corridors. This theme emphasizes ecological connectivity, even though it may lead to conflict with development: increased traffic will be of particular danger to mammals as a result of 'their daily and/or seasonal movements through this area. Their crossing of busy roadways puts them at risk' (p. 3.2). Wildlife abundance is a result of habitat diversity and connectivity to large blocks of non-residential areas, such as the Forestry Farm Park and the river's riparian zone. Wildlife movement is noted as being facilitated by this diversity of connected habitats, as well as the limited number of road crossings and limited traffic on those that exist.

Although animal under/overpasses are effective in preserving functional connectivity, the cost of construction is weighted against the relatively small extent of the swale, and low numbers of animals that may be affected. Residential development was/is expected to eventually reduce or displace the white-tailed deer population, perhaps leaving a small local population. Regardless, the report does identify potential 'cost effective' guidelines: level crossings, line-of-site, right-of-way vegetation, reduced speed limits, and reduced road crossings.

The vegetation section defers to Delanoy (2001), which is mentioned only in support of delineating the core boundary. The Surface and Groundwater section references BBT (1985, 1986) and emphasizes the swale's connectivity to the Forestry Farm aquifer, and thus to Peturrson's Ravine, as well as the ecological communities (wildlife, vegetation, insect) associated with wetlands.

The use of storm water management ponds (dry detention ponds as temporary surface water management areas, typically more susceptible to pollution; wet retention ponds as year-round wetlands with aquatic vegetation, less susceptible) in the swale is recognized as potentially introducing pollutants into the aquifer, but not necessarily uniform; e.g. wet/dry ponds will interact differently with the aquifer. Areas of disturbance (borrow pits and dug-outs) are identified as ideal

for storm water management pond construction. Even with the knowledge of hydrogeologic connectivity, wetland conservation targeted only one 'large wetland in the southwest corner of Section 18,' with adjacent and dispersed sites being integrated into storm water management or reclaimed for habitat enhancement.

Heritage resources are documented in Walker (1983; perimeter assessment, included lands in Sec.s 13-37-5 and 18,7-7-37-4 W3M) and Stantec (1999, 2001; N 12-37-5 W3M; Batoche Trail remnants, limestone quarrying late 1800s).

Recreation and Trail Linkages section describes current use of the swale (at the time) as non-recreational. It acknowledges further residential growth 'north and south of the swale', and posits that the swale could be part of a pedestrian/multimodal active transportation corridor, mimicing its existence as a wildlife corridor. Just as for wildlife, humans crossing Central Ave is noted as a consideration for safe and efficient connectivity.

Development guidelines and the Northeast Swale (2012-10). Second. Saskatoon, SK

StantecConsulting2012a:`Reports/StantecConsulting2012a.pdf:PDF`

Draws substantively on an unpublished report: Stantec Consulting Ltd. 2012. Wetlands in the Northeast Swale. This is not included in the database.

Updated guidelines for development in and around the Swale (Stantec (2002) was the first set of guidelines). Greater detail is provided on the boundary of the Swale, it's ecological significance (wetlands and ecological characteristics such as flora and fauna), 'road crossings, and issues related to stormwater management,' and reliminary design details for the Greenway buffer between the core area and new neighbourhoods. Protection of the swale is based on its 'hydrological and ecological importance,' with the guidelines offered as a way to achieve management and development objectives.

The guidelines focus on establishing a boundary, providing separation from surrounding land use, locating transportation and utility corridors, and managing stormwater to reduce negative impacts. The northern boundary 'generally follows a line between more highly cultivated lands and the more native and less disturbed Swale lands.' Some high quality prairie is found outside of the boundaries, and a no-net-loss approach is recommended. The boundary is 'a compromise that protects...ecological character...and provides lands...for development adjacent to the Swale.'

The location for North Commuter Parkway ('recommended east transportation' road crossing #1) was established acknowledging its proximity to the Saskatoon Freeway North corridor (Perimeter Highway). This recommendation was made with the assumption that RR 3045 would be decommisioned and rehabilitated, though portions may be kept to assist in interpretation activities. The guidelines comment on uncertainty about how the Freeway will affect wetland water levels in the swale, specifically with water flow moving east of RR 3045.

Although individual rare species are found in the Swale, the guidelines note that it is the assemblages that are most important, especially because of the habitat they provide. Further, the guidelines document reports that, although federally protected northern leopard frogs have been found in the swale, no purposeful reptile or amphibian studies have been completed within the Swale.

The swale contains habitat for the common nighthawk, loggerhead shrike, and horned grebe (federally listed species at risk; observed but no nests known), and counts of observed bird species are at least 186, with 61 species known to nest in the Swale. Provincially-ranked vegetative species are also located in upland areas (crowfoot violet, western red lily, narrow-leaved water plantain).

Education of residents about swale ecology, resource management objectives and boundaries, and backyard management is seen as a joint MVA and City task.

1.4.5 Northern extent to Clark's Crossing

Kim Weinbender and D. G. Irvine (2001-09). *Clark's Crossing*. Saskatoon, SK

Weinbender2001:`Reports/Weinbender2001.pdf:PDF`

A report on materials related to Clark's Crossing, collected by the late Dr. Donald G. Irvine. Of particular interest to Dr. Irvine were the role of Clark's Crossing in the Northwest/Riel Rebellion, and its precise location.

The crossing is located at the CNR rail bridge (lat/long 52.3042, -106.4625 DD; or along the shared edge of 26-38-04 W3 and 35-38-04 W3), approximately 1.7km SSW of the current Warman Ferry. In relation to the greater swale, it is approximately 20km NNE of Peturrson's Ravine and 6km SSW of the northern terminus. The crossing is buffered from agricultural cropping (though not necessarily grazing), and from a cursory look at relatively recent satellite imagery, appears to be surrounded mostly by prairie but with cultivation nearby.

The report identifies quartersections for which homestead entries exist, as well as historic trails and tracks that connected to other heritage sites in the region. The Crossing has an historic component as playing a part in moving troops in response to the Red River uprising, and includes aerial photos with markings to show how the area was laid out and utilized.

Kim Weinbender (2002-08). *Clark's Crossing 2002*. Meewasin Valley Authority. Saskatoon, SK

Weinbender2002:`Reports/Weinbender2002.pdf:PDF`

Luc Delanoy (2003-03). *Vegetation and wildlife inventory of Clark's Crossing*. Meewasin Valley Authority. Saskatoon, SK

Delanoy2003:`Reports/Delanoy2003.pdf:PDF`

A report completed under the Museums Assitance Program, funded by the federal Department of Canadian Heritage. This adds to prior research in the area (Weinbender 2001, 2002), providing a 'qualitative assessment of the natural vegetation cover' and incidental wildlife reports. No distinction was made between breeding or migratory use of the site by birds. The area is part of the greater swale wildlife corridor, connecting the northeast end of the swale back to the river. The report aims to bring awareness of the land's 'intrinsic value' in terms of local landowners and communities. The number of vegetative species recorded totals 209, with 133 broad-leafed, 45 of grass or grass-like, 31 woody species, and 31 (15%) exotics total. These values are consistent with other natural sites in the region.

Minimal woody exotics encroachment was identified, with controls recommended for European Buckthorn along the river bank as well as in the 'Mansuy and Wiebe/Peters coulee lands.' Herbaceous encroachment from agriculture and river flows affects most significantly the 'small natural parcels' along the river's edge or field edges, while larger parcels are 'expected to remain intact in the future' barring any disturbance. Overgrazing was evident in some areas within the study, though grazing would need to be part of a longer-term management plan. Toad-flax (noxious weed) was found along the rail lines and noted for control, and garbage was also found in need of cleaning up.

Of the private lands, the Wiebe/Peters property includes prairie and woodland with moderate grazing and exotics encroachment; the Mansuy land is mostly wooded or shrubs, but 'a few open patches of good quality native prairie' exist with exotics encroaching along the edges; the Peters land is grazed to the rivers' edge and shows some damage from cattle; the Nichol land is wooded or shrubs in the north, and moderately grazed prairie and 'broken land' for forage in the south, toad-flax patches 'were found near the railway bridge'; the Hutterite land showed a 'simpler mix of plants' due to heavier grazing, though good prairie still exists in patches, this land is the northern extent of a potential ecological corridor, and grazing should be managed to improve forage for cattle and habitat for wildlife.

Typical wildlife includes white-tailed deer (forage in agricultural fields, cover in natural areas), sharp-tailed grouse (winter cover in trees and tall shrub), beaver, mink, and muskrat on the river's edge, and raptors (e.g. red-tailed hawk) nesting in trees. The report notes that heavy grazing can alter the character of grassland areas, shifting it's suitability of it as habitat in favour of different species, perhaps most notably for birds (more details on p. 4).

1.4.6 Small Swale (conservation designation pending review)

Also referred to as the "North Swale" in some documents, though there is also a "North Swale" on the west side. See also Hudson (1993), discussion of area 11.

The 'Small Swale' Resource Overview (2003). 132-52599.01. Stantec Consulting. Saskatoon, SK

StantecConsulting2003:Reports/StantecConsulting2003.pdf:PDF

A preliminary report from the Natural Areas Screening process, describing natural and cultural (archaeological) heritage features and the ecology of the small swale. It also makes recommendations on development and further study. Prior human disturbances include gravel extraction and landscape modification, cultivation, grazing and overgrazing, localized rock extraction and large rock piles. A single 1/2 section was identified as in a relatively natural state with some minor disturbances. In general, the report writers interpret much of the landscape as incapable or unlikely to provide harbour for plants and animals.

Four 'Resource sites' were identified: a potential heritage site (homesteading buildings) worthy of a site visit for data collection; potential teepee rings that should be the subject of a heritage resource impact assessment; the gravel pit, with little ecological value and no perceived concerns about future development; and the southern half of section 25, with minimal ecological value and no perceived concerns about future development. Only the lands within Section 30 are identified as a potential environmental reserve, though it is admittedly fragmented and isolated from upland natural areas other than the river valley.

Saskatoon's Green Strategy: Appendix 4 - The Small Swale (2018). City of Saskatoon. Saskatoon, SK

CoS2018a:Reports/CoS2018a.pdf:PDF

A good primer for the small swale. In a way, it models 'what could have been' with the NES.

The document is a succinct and accessible summary of prior assessments and investigations of the small swale (Weichel 1992, Hudson 1993, Stantec 2003, Stantec 2013a). Includes aerial photos and a list of potential species occurrences given the habitats in the small swale. The swale's wetland complex is mostly classified as Preserve, which requires that a mitigation plan be developed for development or amendment of an Area Concept Plan, and leaves the mitigation plan discretionary for any other development requiring City approval. The wetland policy states that wetland complexes are high priority for 'protection and preservation'.

1.5 Road Corridors

1.5.1 North Commuter Parkway

Business Case to PPP Canada - North Commuter Parkway Project and the Traffic Bridge Replacement Project (2013). City of Saskatoon. Saskatoon, SK

CoS2013a:Reports/CoS2013a.pdf:PDF

A technical analysis of the 'value-for-money' of P3 partnership models for the North Commuter Parkway construction and Traffic Bridge replacement. Emphasis is on procedural aspects of the RFQ and RFP. The document notes that the NCP road crossing location was determined after consultations with 'the City, environmental engineers, scientists, and the Meewasin Valley Authority,' and will need to comply with the NES development guidelines.

The Public Communications platform identifies mostly government and non-government agencies as external stakeholders, with the only civic body being 'commuters and road users'; excluded are residents and environmentalists, who are likely considered to be a 'public' represented by government.

North Commuter Parkway Functional Planning Study (2013-05). City of Saskatoon - Transportation. Saskatoon, SK

CoS2013b:Reports/CoS2013b.pdf:PDF

This study focuses on traffic system performance, considering the impacts of alignment on performance in different scenarios. The North Commuter Bridge is said to be 'required' (p. 5) infrastructure to support a population of 500,000. It connects the west-side industrial area with east-side residential, diverts traffic from Circle Drive bridge, but is not a truck route. Projections of traffic (average daily traffic) volumes were 14,600 - 21,700 vehicles/day. A summary of public consultation is included from p. 28: no mention of ecology or conservation, but '5 comments were submitted indicating a preference for Perimeter Highway instead of the proposed North Commuter Bridge.'

A basic assessment of impacts on the NES, in the form of 'yes/no', was included in calculating the 'relative merits' of four different crossings: Pinehouse Drive (no), Lenore Dr. (no), Marquis Dr. (yes), Perimeter Hwy (yes). A single page addresses the NES crossing (p. 16): it is the shortest (quickest) route; a trade-off in alignment was made to 'preserve the largest continuous blocks of grasslands and wetlands'; and the crossing would comply with guidelines and the resource management plan. The NES is also mentioned in reference to pedestrian/bike pathways. Finally, the swale appears in the recommendations: 'McOrmond Drive through the Northeast Swale should be constructed as a narrow arterial roadway with special considerations for reducing the impact on wildlife and the natural resources along the crossing through the swale.'

Ecological, Environmental, and Heritage Review of the North Bridge Corridor (2013-07). 1617. Canada North Environmental Services. Saskatoon, SK

CanNorth2013:Reports/CanNorth2013.pdf:PDF

A literature review and database search of ecological, environmental, and heritage assessments of the area through which the North Commuter Parkway (NCP)

was (to be) built. It summarizes prior research, identifies knowledge gaps, and 'recommends environmental and heritage work' required for project approvals. Precedes and provides a framework of study for Stantec (2013). Lack of study in the Small Swale is noted as a source of uncertainty on its status as an ecologically sensitive area (having habitat for upland and wetland plant and wildlife species).

The authors note that species database submissions are voluntary and not comprehensive, may not be dated or located, and 'often [do] not represent full lists of species found in an area.' To compensate for this uncertainty, the study adopted a 30-km radius for searches of the species databases (SKCDC, Herbarium, eBird, SK Bird Atlas Database from map unit 73b02), giving a more 'representative' rather than 'comprehensive' result. Similarly, aquatic studies (7 total reports, publications, articles) were site-specific and also extended to 100-km from Saskatoon, while the terrestrial literature review (12 reports) was site-specific. No fish or fish habitat studies were found for wetlands along the road corridor.

For impacts, the modification of the river bed and shore–incidental to bridge construction–may improve fish and/or aquatic invertebrate habitat and spawning areas. Modification of terrestrial habitats does not offer the same outcomes. MoE terrestrial field survey guidelines require multi-temporal (seasonal) surveys 'to increase detection of rare species.' Of significant concern is the fact that '[t]he studies presented in this [CanNorth] literature review were conducted only once during the growing season.'

The only habitat classification completed at the time of writing was for wetlands, as part of the Northeast Swale Development Guidelines (Stantec 2012). However, not all wetlands were classified or studied, and no studies exist on the potential for upland habitats in other parts of the study area (e.g. Small Swale) to support rare species or species at risk. This report identifies Crawe's sedge (Carex crawei; S1), and red club-rush (Scirpus rufus; S2; called red bulrush (Blysmopsis rufa) in CanNorth), whereas Hudson (1993) also found sandhill cinquefoil (Potentilla finitima, or Potentilla lasiodonta) in the Small Swale.

Short-eared owls, a federally listed species of Special Concern (SARA Sched. I) and provincially rare to uncommon (S3B, S2N), have been found in the NE Swale, including an active nest in 2000. Piping plover (Sch. 1; endangered), yellow rails (Sch. 1; special concern) and horned grebes (no sched; spcial concern) have been documented in the study area, as well as other 'rare or sensitive waterbird species' (western, red-necked, eared, and pied-billed grebes; American bittern; black tern; Bonaparte's and Franklin's gulls; American white pelican; double-crested cormorant). Declines in grassland habitat within and beyond the study area have affected numerous passerine (perching bird) species: chestnut-collared longspur and Sprague's pipit (Provincial - Threatened); Baird's sparrow and loggerhead shrike (Provincial - Special Concern); common nighthawk, bobolink, barn swallow (Federal - Threatened); red knots (Federal - Endangered - migratory habitat); Canada warbler and rusty blackbird (Federal - Threatened and Special Concern - migratory habitat).

Evidence of badgers and olive-backed pocket mouse has been found in the project area; both are federally (COSEWIC) ranked as threatened, and provincially as rare.

Western tiger salamander (no sched) and northern leopard frog (Sched 1) are both special concern federally (COSEWIC) and provincially rare, but beyond one wetland in the NE Swale, 'studies in other parts of the project area are lacking.'

The report suggests that a 'comprehensive baseline terrestrial assessment' include a wetland classification outside of the NE Swale; a rangeland health assessment, with specific attention to habitat used by species at risk; multi-temporal rare plant surveys; visual and auditory amphibian surveys; waterbird surveys (occurrence, nesting, abundance and distribution); marsh bird surveys for yellow rails; breeding bird point count surveys (including for loggerhead shrikes); avian fall migration surveys (three times over the migratory period, at wetlands and bridge location); live trapping for presence and abundance of olive-backed pocket mice; badger burrow surveys; acoustic bat surveys.

North Commuter Parkway - baseline terrestrial and aquatic field studies, and heritage resource impact assessment (2013-10). 11325813. Stantec Consulting. Saskatoon, SK

Stantec2013:`Reports/Stantec2013.pdf`:`PDF`

Baseline studies and an HRIA according to recommendations in Canada North Environmental Services (2013) scoping review and database search for the NCP (North Bridge Corridor). Builds off of the Small Swale resource overview (Stantec 2003), NE Swale Development Guidelines (Stantec 2012), and draws on data from the North Central/Northeast Natural Area Screening (Stantec 2013a). Extent of the study is constrained to the proposed Right of Way, and does not include a multi-temporal migratory bird survey, which was recommended in CanNorth (2013). 'Soil and terrain' are not considered at this point, 'pending the detailed design.' Wetlands in the small swale were classified in the same manner as those in the NE Swale. Vegetation composition and percent cover in eight areas of interest were recorded along 28 transects; locations of provincially and federally tracked species were recorded. The wetlands in the small swale through which the Right of Way crosses were classified as 'Preserve' due to hydrological function and presence of the northern leopard frog.

Eight Areas of Interest (AoI) were delineated for study and ranked according to habitat quality, environmental sensitivity, and specific management issues (PDF page 44). Two of the AoI are in the NE Swale (#6 is through a wetland, high quality wet meadow and deep marsh vegetation community; #8 is near Peturrson's Ravine, low quality buckbrush and KBG). Three AoI are in or adjacent to the Small Swale: #5 crosses a wetland with moderate quality shallow and deep marsh; and #7 is east of the snow dump, with low quality smooth brome, Saskatoon berry bushes, trembling aspen, and hawthorn; and #4 is east of Central Ave, with low quality KBG and smooth brome.

A habitat suitability assessment was also conducted. For the NE Swale, #6 is high suitability for waterfowl, yellow rail nesting; breeding ground for northern leopard frog, Canadian toad, great plans toad, western tiger salamander; moderate habitat for short-eared own south of the RoW; #8 is moderate suitability for waterfowl in buckbrush, and low for loggerhead shrike in the caragana. For the Small Swale, #4 is moderate for waterfowl in tall grass and buckbrush, low for loggerhead shrike in thorny buffaloberry, and moderate for short-eared owl; #5 is high for waterfowl nesting and northern leopard frog, Canadian toad, and great plains toad breeding, moderate for yellow rail nesting, tree-nesting raptors, and short-eared owl, and low for loggerhead shrike in thorny buffaloberry; #7 is moderate for tree-nesting raptors in an aspen grove, moderate for loggerhead shrike in hawthorn, and low for waterfowl and sharptailed grouse in buckbrush and grasslands.

The selection of three breeding bird survey locations (five minutes each) favoured loggerhead shrike habitat, with the assertion that the study area is not suitable for Sprague's pipit and burrowing owls. Water bird surveys took place on three days (20 minutes each), with incidental wildlife observations also noted. Of 48 bird species identified, three sensitive water-bird species were observed at the NE Swale (eared grebe, pie-billed grebe, and black tern); and 'a flock of 29' of Franklin's gulls...were observed at the Small Swale'. Additionally, a great blue heron was observed in the small swale (reported in Stantec 2013a).

Geotechnical Report - North Commuter Bridge - Saskatoon, Saskatchewan (2013-07). S1913. Clifton Associates. Saskatoon, SK

CliftonAssociates2013:`Reports/CliftonAssociates2013.pdf:PDF`

A geotechnical study of the bridge component of the North Commuter Parkway (now the Chief Mistawasis Bridge). See also North Sector Development. A graph is presented to show the correlation between preciptation (recorded at the airport) and water levels in the Forestry Farm aquifer (Figure 3.2, PDF p. 27). The graph indicates a delay in response (increase) after high precipitation years, but a more rapid response (decline) that may even precede the onset of extended dry periods. This provides some insight into the effects that surface water management (e.g. use of the swales in storm water management) may have on groundwater, and also on wetlands under directly influence of groundwater: 'The water in the ponds within the swales is controlled by the groundwater elevation within the Forestry Farm Aquifer' (p. 9).

From construction, seepage water is expected and managed by redirection through piping to the river. Selenium and uranium levels exceed surface water quality objectives, and the Water Security Agency was to be engaged to ensure that seepage water can be safely discharged into the river.

GolderAssociates2014d; *Geotechnical Investigation - North Commuter Parkway* (2014-06). 13-1362-0061. Golder Associates. Saskatoon, SK

GolderAssociates2014:Reports/GolderAssociates2014.pdf:PDF

A geotechnical study for the North Commuter Parkway (NCP) project, focusing on roadways but including some commentary on bridges. Preceded by Clifton (2013), and supplemented by Golder (2014a,b) for limitations and groundwater measurements, respectively. Comprised predominantly by borehole reports on soil and subsoil components, as well as water levels and quality. Boreholes are distributed across the range of the proposed roadway, including in the Small and NE Swales.

; *Geotechnical Investigation - North Commuter Parkway - Tech Memo - Groundwater measurements* (2014-06). 13-1362-0061/814/1. Golder Associates. Saskatoon, SK

GolderAssociates2014a:Reports/GolderAssociates2014a.pdf:PDF

Supplementary to Golder (2014). Provides groundwater levels for some of the piezometers in Golder (2014), as measured on April 29, 2015.

; *Geotechnical Investigation - North Commuter Parkway - Tech Memo - Limitations* (2014-06). 13-1362-0061/814/. Golder Associates. Saskatoon, SK

GolderAssociates2014b:Reports/GolderAssociates2014b.pdf:PDF

Supplementary to Golder (2014). Provides groundwater levels for piezometers 003-015, 019-020, as measured on May 26, 2015.

NCP Ministerial Declaration (2014). Saskatchewan Ministry of Environment. Regina, SK

SKMoE2014:Reports/SKMoE2014.pdf:PDF

The NCP received a Ministerial Determination that it did not require an environmental impact assessment due to the design, monitoring and mitigation strategies included in the application. Additional studies were required as part of the Determination (rare plants in undisturbed areas and northern leopard frogs).

North Commuter Parkway revised fish habitat offset plan (2017-07). Canada North Environmental Services Limited Partnership. Saskatoon, SK

CanNorth2017:Reports/CanNorth2017.pdf:PDF

1.5.2 Saskatoon Freeway

Preliminary geotechnical analysis: proposed Saskatoon perimeter road north bridge crossing (2004-08). M442-350003. UMA & MDH. Saskatoon, SK

UMA2004:Reports/UMA2004.pdf:PDF

East perimeter highway functional planning study (2005). UMA & AECOM. Saskatoon, SK

UMA-AECOM2005:`Reports/UMA-AECOM2005.pdf:PDF`

To be re-read; originally had a truncated version of the file, now have the full copy.

A summary of key findings from AECOM's 'Environmental, and Heritage Screening for the City of Saskatoon Perimeter Highway Functional Planning Study' [missing]. Briefly addresses land use, designated areas, terrain, soils, native vegetation, sensitive plants, wildlife fisheries, and heritage resources. In the conclusion, only two sites are discussed as needing to be avoided (Tipperary Creek and Kernen Prairie, which are listed as 'designated areas'); the rest of the corridor is deemed to be essentially barren, with 'little native vegetation remaining.' The summary is not specific about wildlife and vegetative species, especially those at risk; new species may have been listed since the report, and different species have been found since. Further, the potential 'designation' of the Swale (e.g. environmental reserve or heritage) could mean the swale should also 'be avoided'.

2 Institutional Plans and Policies

2.1 Provincial and Regional Scope

Federal acts, policies, and legislation that may be triggered by, or could constrain, development: Federal Policy on Wetland Conservation, Canada in general and Crown lands specifically; Species at Risk Act, preventing extirpation/extinction of {special concern, endangered, threatened} animals by protecting the 'species and any existing critical habitats, including wetlands'; Migratory Birds Convention Act, controlling disturbance of nesting sites or habitat 'during active nesting and rearing stages', but not during forage, mating, or migration; Fisheries Act, protecting fish habitat and water quality, including for wetlands; Canadian Environmental Protection Act, mostly to control discharge of pollution (unclear if stormwater is pollution).

Provincial acts, policies, and legislation implicated include: *Saskatchewan Wetland Policy* (1995), encouraging sustainable management to maintain function and production of benefits, conservation for species or function, and restoration or rehabilitation of significantly altered and degraded wetlands; *Wildlife Act*, protecting wild plants, animals, and other organisms by providing designation {extirpated, endangered, threatened, vulnerable} of species and subsequent planning and implementation of a recovery plan; *Provincial Lands Act*, establishing Crown ownership and grants/transfers of beds and shores of water ways, wetlands, etc; *Saskatchewan Watershed Authority Act* [Now the Water Security Agency Act], claiming Crown rights to surface and groundwater and thus regulation of extraction, use, or drainage but not applying to drainage that remains in the City boundaries; *The Planning and Development Act*, providing for Environmental Reserve designation of land (ravine, coulee, swamp, wetland, sensitive wildlife habitat, unstable or flooding lands, or land adjacent to water bodies if that land is to be used for flood control) during subdivision; *Environmental Assessment Act*, which articulates triggers and the process for an environmental assessment, including impacts on 'unique, rare or endangered feature[s] of the environment'; E*nvironmental Management and Protection Act*, controlling pollution discharges, regulating shoreline alteration such as gravel or vegetation extraction. *The Wildlife Habitat Protection Act* applies only to Crown land, of which there is none in the Swale. Regulation of industry activity to protect vertebrate species exists under the Wildlife Act; no mention of invertebrates in the overview.

Municipal by-laws and policies include: *Corman Park-Saskatoon Planning District OCP Bylaw* (2010, No. 8844), of which Section 4 promotes proactive agricultural environmental stewardship, and Section 10 promotes 'conservation and management of significant environmental and heritage resources', looking to integrate 'natural features and landscapes' or re-use or restore 'designated Municipal Heritage properties during development'; and *Corman Park OCP* (8/94), which is similar in objectives to the *District OCP*. See also the Green Infrastructure Strategy under 1.1 on page 16 regarding regional environmental protection.

Saskatoon North Partnership for Growth Regional Plan (2017-05). Saskatoon Parternship for Growth. Saskatoon, SK

P4G2017:`PlansPolicies/P4G2017.pdf:PDF`

Saskatoon North Partnership for Growth Regional Plan: Regional Governance and Implementation Strategy (2017-05). Saskatoon Parternship for Growth. Saskatoon, SK

P4G2017a:`PlansPolicies/P4G2017a.pdf:PDF`

Saskatoon North Partnership for Growth Regional Plan: Regional Servicing Strategy (2017-05). Saskatoon Parternship for Growth. Saskatoon, SK

P4G2017b:`PlansPolicies/P4G2017b.pdf:PDF`

2.2 City of Saskatoon

City of Saskatoon Official Community Plan (2009-01). City of Saskatoon. Saskatoon, SK

CoS2009:`PlansPolicies/CoS2009.pdf:PDF`

This is a key document for guiding development within City limits, and has been amended through bylaw changes over time. Further revisions are planned, see the Green Infrastructure Strategy (under Regional Ecology) for recommended changes to the OCP. A revision process for the OCP was initiated in 2018/9. The following subsections of the plan are relevant to the swales and natural areas in general:

9.5 - Wetlands Conservation and Management - added provisions regarding wetlands management and conservation.

9.2 - Conservation of Natural Areas and Archaeological Sites

15.0 - Heritage - amended text to improve upon the success of the City of Saskatoon's (City) Heritage Conservation Program based on recommendations outlined in the Heritage Policy and Program Review.

16.0 - No Constraints to Development - wetlands or natural areas are not seen as constraints on development in this version of the OCP.

Saskatoon Wetland policy study (2009). Stantec. Saskatoon, SK

Stantec2009:`Reports/Stantec2009.pdf:PDF`

Hard copy, but images of selected pages are included in a PDF; accessed at the City of Saskatoon.

An inventory of wetlands around the city, and a sampling of wetland policies from other municipalities in the prairie pothole region. This document recommends the use of the Stewart and Kantrud system for wetland assessment; prior to this document, the City did not have a formal approach to identifying wetlands of significant wildlife and habitat value. Policy recommendations include 'no-net loss' for lower function or value wetlands (mitigate or compensate), and

protect or enhance for high function or value. It also calls for the City to conduct an economic valuation 'to determine the net value of wetlands...[and] their changing value...over time' (E. 2). The policy review suggests that preservation requires: legal mechanisms; incentives to retain and enhance wetlands and implement buffers with clear calculations for compensation; and the adoption of a watershed approach to wetland management, rather than at an individual, site-level.

The wetland policy needs integration with the Official Community Plan to incorporate language on zoning (environmental reserves), buffers, and appropriate land use in and around wetlands. It also suggests that the Natural Area Screening process be amended to include an assessment tool specific to wetlands (habitat, physical setting, water and sediment quality, wetland hydrology, biodiversity and heritage potential). The Minnesota Routeine Assessment Method, recommended here, was adopted in the City's 2013 Wetland Policy.

Wetland Policy (2013). C09-041. City of Saskatoon. Saskatoon, SK

CoS2013d:`Reports/CoS2013d.pdf:PDF`

Stipulates the method to be used when assessing wetland function and classifying of wetlands for City-commissioned assessments. The policy mentions the possibility of compensatory mitigation measures (3.2 e)) and identifies departments implicated in wetland management, and how funding for that management is to be allocated. The Minnesota Routine Assessment Method is adopted to assess the level of quantity of wetland function (s. 2.12), and the Stewart & Kantrud system for level of management classification (s. 3.1.b).

Area Concept Plans must include a wetland mitigation plan in compliance with this policy, and must have a 'reasonable balance' between development impacts and mitigation measures (s. 3.2.b).'Significant' wetlands (high functioning, of a certain class, with habitat or wildlife present) are priorities for preservation; 'unavoidable impacts' are still permitted, but would require mitigation through 'compensation' (s. 3.2.c). Natural and constructed wetlands are to 'be integrated [where possible] into the City's parks system and managed as Naturalized Parks' (s. 3.4).

2.3 Meewasin Valley Authority

Meewasin Strategic Plan 2014-2024 (2014). Meewasin Valley Authority. Saskatoon, SK

MVA2014a:`PlansPolicies/MVA2014a.pdf:PDF`

Meewasin valley-wide resource management plan (2017-03). Meewasin Valley Authority. Saskatoon, SK

MVA2017:`PlansPolicies/MVA2017.pdf:PDF`

2.3.1 Policy

Northeast Policy (1987). 1st ed. Meewasin Valley Authority. Saskatoon, SK

MVA1987:`PlansPolicies/MVA1987.pdf:PDF`

The digital document is missing the maps, which would be helpful for interpretation where the text discusses the areas and types of improvements within that are exempted from the Development Review.

Definition of Heritage resource sets cultural (archeo/paleo history), environmental, and scientific on equal footing as historic buildings and routes. 'The Northeast Policy will be used by Meewasin to guide it in the preparation of more detailed plans and in subdivision and development review.' For development and planning beyond the core mandated area (river valley, 'the MVA's role in planning and development matters has evolved into one that emphasizes co-operation, encouragement and minimal intervention" (p. 5).

With respect to the 100-year Plan, 'there is a need to more clearly define the MVA's interests in the [northeast] area's future planning and development... [specifically] how it will apply its subdivision review powers over public land, and its development review powers' (p. 6). This is limited, however, as '[p]ursuant to Section 44(2)(c) of The MVA Act, the Authority shall not undertake any further review of any instrument affecting public land intended for residential purposes and concerning which a plan subdivision is filed in the Land Titles Office,' but any such 'instrument' can be reviewed if it is not yet filed with the LTO.

Goals and objectives in the policy include the protection of groundwater from inappropriate development, with a special concern for the 'channel scars,' and the minimization of impacts from stormwater runoff combined with the enhancement of open space linkages resulting from increased runoff (drainage). Other objectives include the inclusion of experimentation in development plans, focusing on planning (relationship between prairie society and prairie environment), ecology (relationships between urban and prairie environments), and research at the University of Saskatchewan.

Northeast Policy (2015-06). 2nd ed. Meewasin Valley Authority. Saskatoon, SK

MVA2015a:`PlansPolicies/MVA2015a.pdf:PDF`

2.3.2 State of the Valley

The *State of the Valley* report is a five-year progress report, assessing Meewasin's progress towards goals from the 100-Year plan (*The Meewasin Valley Project: 100 Year Conceptual Master Plan* 1979). The reports use indicators and criteria grouped into themes arising from their mission statement. Themes and indicators have changed over time, according to

advances in measurement and classification of ecosystems, as well as in language and understanding of ecological relationships. The 2013 report assesses: Health of the valley, in terms of wildlife habitat, protected land, ecological integrity or conservation of nature, and source water protection; Fit, in terms of public support for Meewasin's mandate as well as development and interpretation; Balance including public access, trails, and land use mix; and Vibrancy for green space, continuum of uses, and community capacity. Recommendations for additional future indicators include measures of biodiversity and habitat connectivity, as well as information on public perceptions of accessibility or ability to experience natural areas, and appreciate of natural and cultural heritage resources.

State of the Valley (2003). Meewasin Valley Authority. Saskatoon, SK

MVA2003:`Reports/MVA2003.pdf:PDF`

Habitat loss (31ha) from the Swale occurred due to Silverspring expansion (northern portion; east of Peturrson's Ravine, south of the south-western end of the Northeast Swale). The City's 1997 Proposed Growth Concept plan targeted expansion into the northeast, excluding some areas of the swale due to serviceability constraints. The report warns about 'sub-urban and country residential development' leading to the loss of habitat and species, especially with further fragmentation of habitat into smaller parcels. Meewasin sees this as 'unavoidable', unless it can acquire more land to compensate for fragmentation and reduced parcel size; the north-east parcels are identified as most vulnerable to 'urban development pressure.' Even though the proportion of development to conservation land use was seen as 'balanced', dispersed fragmentation of habitat, shrinking sizes of individual parcels, and their distribution leaves the report ambivalent to pessimistic about the long-term health of the north-east swale.

State of the Valley (2009). Meewasin Valley Authority. Saskatoon, SK

MVA2009a:`Reports/MVA2009a.pdf:PDF`

The assessment reports an overall rating of 'good'. Only two indicators did not meet or exceed expectations: Health - No net loss of habitat, and Vibrancy - green space.

Future Assessment indicators were proposed for the next assessment, including some that would be directly relevant to some of the public discussion about the NE Swale: Value (in dollars) of ecological services provided by habitat to region; limits of acceptable change in land use; measures of stability and resilience within dynamic systems; scored assessments for wildlife corridors, habitat balance; quality of life indicators (visual, spiritual, real connections); natural heritage.

State of the Valley (2013). Meewasin Valley Authority. Saskatoon, SK

MVA2013a:`Reports/MVA2013a.pdf:PDF`

Health needs improvement for no-net loss of habitat, increases in acres under public protection, and meets expectations for ecological integrity or conservation. Across the valley, the total area of land use classes has changed since 1998 (pct, ha): river, (+1.2, 86 ha); developed or disturbed, (+1.7, 117 ha); actual or potential habitat, (-2.9, 194 ha). Variation in land cover extents between reporting years is due to the absence of satellite imagery coverage, improved detail of the classification, and variation in the inclusion or exclusion of certain areas from analysis due to changes in Meewasin boundaries.

While some habitat loss occurred, greater concern is placed on the loss of 'sustainable' habitat (¿50 acres), which has seen a slight decrease. Areas of habitat, urban, and institutional classes were reclassified as green space. Protected Lands within the Valley cover 6696 ha, with an additional 28 ha beyond. Total land increased due to the addition of Chappel Marsh (conservation zone) in 2011. Within the Valley, 1344 ha were procedurally exempted from further review by Meewasin.

Ecological integrity and conservation classifications, for lands within the valley and a 2km buffer, are changed from 2008 and 2003 due to different boundaries being used for MVA calculations (p. 4). There have been increases in extents of: native habitat (0.4, 1614 ha); perennial (3.2, 1562 ha); potential for native plant species, (2.3, 1279 ha). Decreases occured for: native vegetation with rare species (0.6, 49 ha); river (0.1, 539 ha); and disturbed or developed (5.2, 5089 ha). In aggregate, more land is now classified as native, native with rare plants, or potential for native species (+2, 2943 ha). In total, 89% of all habitat (1249 ha) meets criteria for connectivity and sufficiency of size, down 3% from 2008.

Parts of Crocus Prairie and SNG were grazed in 2009, and the NES in 2013. Parts of Crocus Prairie and NES were burned (prescribed) in 2009, 2010; and the NES again in 2011, and 2013. Wildfire burned some of the SNG in 2010. No native plant restorations have taken place in the NES or surrounding areas.

Fit meets expectations, with positive and consistent results for trust, quality of life, tourist attraction, and return on investment of tax dollars.

Balance meets expectations for public shoreline, but access points needs improvement. Trails meed expectations, as does land use mix. However, land use mix indicators show concerning trends. The proportion of land-in-habitat has changed within 500m of the valley (-36% from 1998) and within 1km of the valley (-29%); within 2km, there is no change. Encroaching development consumed 810 ha of habitat, while 1465 ha of land (within 2km but beyond the valley) was re-classified from disturbed or developed to 'undeveloped'.

Vibrancy meets expectations for green space and trail, continuum of uses, and community capacity.

Quality and sustainability of habitat have improved, but overall wildlife habitat has declined (absolute number of acres declined 87 hectares over 10 years, from 1446 to 1359 hectares of habtitat). Number of parcels ¿50 acres has increased from 12 to 23, and connectivity between parcels has improved.

2.4 University of Saskatchewan

2.4.1 Kernen Prairie

2.4.2 University Containment Facility

Part III

Research Synthesis

The four keywords (or themes) most frequently mentioned in the media scan were those of roadways, ecological impacts, ecological value, and boundaries. Although presented here discretely, there is significant overlap and interconnection between these four themes. For example, boundaries drawn around natural areas will influence not only the placement of roadways and neighbourhoods, but also our accounts of ecological health and identification of environmental impacts. Identification of potential impacts from roadways is often constrained to the proposed linear corridor, excluding direct, indirect, and cumulative effects at different scales, from micro-habitats to regional ecology. Assessments of ecological value also influence boundary lines, as human disturbance becomes a deciding factor in delineating a the 'core' of a natural area. Each of the four key themes mentioned above is discussed in individual sections below, using context from the document review. A fifth section identifies knowledge gaps and suggests future research directions.

1 Boundaries

> In 1883, government surveyors had originally mapped out the area into 'long, narrow Red River lots (seigneurial)', but it was soon resurveyed into square sections (Weinbender 2001). Imagine that the entire region, including the Swales, could have looked significantly different if long lots had prevailed. The lines we draw on maps today will reverberate well into the future, in ways we do not always recognize or understand in the present.

The process of establishing boundaries around the Swales has been coupled with neighbourhood and corridor planning and development. A suite of studies, including geotechnical, hydrological, ecological, human heritage, and environmental waste assessments, are conducted according to the context. These assessments and investigations are typically constrained to a specific area, either due to technical scoping, modelling of infrastructure and servicing, land ownership, economics, or jurisdiction.This approach may at first appear to be administratively and economically efficient, but it is not without criticism. Discussing development in the north-east sector as part of a geotechnical study, Henry (2012) urged a comprehensive hydrogeological study that is not bounded by sections or neighbourhoods. The 'piecemeal approach' has been inefficient and unnecessarily constrained, as it would make more sense to study the sector's hydrogeology as a whole than as a reaction to subdivision build-out. The same can be said for prior Natural Area Screenings.

For the swales, geological and hydrological landscape components have dominated boundary delineations: the swales exist within ancient Channel Scars, with rocky and thin soil making it undesirable as cropland, but passable for grazing. A high water table, connectivity to an aquifer, and large subsoil boulders in some areas limit suburban development. Ecology, if considered, follows economic and technical feasibility.But the swales are more than just a conjunction of physical landscape features. Diverse communities of plants, wildlife, soil, water, and humans have evolved on the landscape, thriving on diversity of the landscape within the swales, and between the swales and nearby natural areas.

Contiguous and diverse natural areas need to be of a sufficient size to be sustainable, yet the economics of development around Saskatoon have continually trumped this need. Since the first mobilization of people to protect the Silverspring Prairie (Saskatoon Natural Grasslands), conservationists and environmentalists have been struggling to increase the 'core' area of the Swales, recognizing the importance of connectivity in any sort of sustainable future for these natural areas (Grismer, 1989; Harms, 1993). This requires protecting not only 'high quality' habitat, but also those areas that are degraded but still provide passage and habitat for species, or could potentially as restored habitat. Additionally, disturbed areas may offer habitat or function as a corridor for wildlife species. This is recognized in the initial delineation of the Small Swale's ecological boundaries, which includes disturbed areas in order to maintain connectivity to the river (*North Central/North East Natural Area Screening Study, City of Saskatoon* 2013).

The boundaries of natural areas are typically drawn tightly to a 'core', around which a buffer is created to transition between 'urban' and 'natural' lands. The buffer can be internal

(subtracting from the core), or external (extending from the core). Setbacks are a type of buffer, but are less permanent and more permissive. For example, setbacks from the nests or nesting grounds of at-risk species offer protection during key times during that specie's life cycle, but do not restrict all activities in and near the site outside of those times. It is very much a technical, species-specific and narrow conception of conservation. While it protects an identified nesting site, it does not take into account how adjacent land cover or land use change can affect that animal's behaviour directly or indirectly through changed behaviours of other animals.

These interconnections between species through time (such as responses to changes in behaviour of other species, or as consumer-producer plant-animal communities), and the relationships between habitat and wildlife-plant communities are not protected by setbacks. Individual wetlands (high quality or with endangered species) require vegetative buffers to maintain function within agricultural lands or in urban settings; so too do the 'scars' in their entirety require buffers in an urban-industrial-agricultural landscape. This is not simply an internal buffering, but one that identifies and protects connectivity between natural areas (such as with the Green Infrastructure Strategy and the preliminary bounding of the Small Swale's ecological boundaries in the North Central/North East Study (2013). Both are forms of integration, but internal buffers are for 'easing in' to natural areas, where external buffers would serve to 'give space' for natural areas.

1.1 Regional Ecosystem Health

Much of the land around Saskatoon has been converted to agriculture, leaving only fragments of natural areas in pockets of Crown land, conservation lands (private and public), and areas of marginal utility for agriculture or suburban sprawl (rocks, sand, and/or water prevent use). Given Saskatoon's function as a regional hub, it is growing, along with vehicle and truck traffic in and through the region. Combined with the car-centric focus of suburban design, natural areas in the north-east have become internally fragmented, enclosed by development, and subject to multiple pressures from residential and regional vehicle traffic. Internal fragmentation of the Swales has occurred through the construction of wide, high-speed roadways (Sikorski and Gunn, 2013); roadways also introduce edges into natural areas, aiding in the dispersal of seeds from alien invasive species. Although the Northeast Swale (NES) is not yet enclosed, adjacent development is starting the process and threatens to disconnect the Swales from regional ecosystems.

In the *Green Infrastructure Strategy Baseline Inventory Report* (2018), the noted potential amendments to the City of Saskatoon's Official Community Plan (OCP) reveal part of the reason for the lack of concerted effort to generously conserve the Swales. There has been no direction given by Council to Administration (and thus no direction to planners, designers, and developers) to consider natural areas beyond tightly constrained Areas of Interest or corridors. Even then, development was not to be assessed against its impacts on the whole (swale), but only mitigation for potential impacts on the part (being developed or encroached upon). The City as a collective entity interprets the environment through the OCP. In the OCP, 'natural' and 'urban areas' are defined and redefined according to contemporary scientific and planning practices, technical ability, and economic modelling.

Through time, the screening reports for development around the swales gradually incorporated more language about ecological connectivity, habitat fragmentation, and endangered species. However,the City's interpretation of space, as set out in the Official Community Plan (OCP), has lagged behind: it was receiving information that did not fit inside of its developmental framework, and thus that information has been occluded from upper level decision-making process. The result is that development will happen (growth is good; suburbia is what the people want), and mitigation for site-level effects will suffice (long-term build out will mean loss of ecology, but we will offer some token concessions).

But the City and Meewasin should not be the only ones held accountable for management of natural areas and important habitat. Private land ownership of much of the greater swale continues to impact grassland ecosystem and wetland health due to cultivation and cattle grazing (Sikorski and Gunn, 2013). This has already been recognized in prior studies: during wetland classification in the Stantec (2013) study, wetlands in agricultural fields were found to be home to northern leopard frogs, or have suitable habitat.Farmers can become 'point source polluters' of individual wetlands if there are no buffers (with nutrients through run-off, and pollution through spread of invasive species); there is also a loss of biodiversity associated with industrial agriculture and monocrop cultivation. According to Stantec (2013), the Ministry of Environment should be consulted about these wetlands, so that a mitigation plan can be developed. There is potential to ally with private landowners by finding ways to share or encourage stewardship; regulatory enforcement is also important and should be effectively (if sparingly) used to support conservation.

1.2 Legislation & Classification

Provincial legislation regulates Environmental Reserve status (Planning and Development Act, s. 192(1)), conservation easements, and Wildlife Habitat (Wildlife Habitat Protection Act). Designation as an Environmental Reserve first requires subdivision, which initiates a process of planning and development that includes natural area screening. Environmental reserves are not meant to replace municipal reserves (parks) in the planning phase, and represents a potential loss of income for the City (selling land, property taxes) and developer (selling houses). This forces the City to balance protection of the environment against revenue: development 'earns', while conservation and management 'costs'.

The use of environmental reserve status was discussed for Peturrson's Ravine in *Report on Peturrson's Ravine resource management plan* (1995). While the reserve status would provide further 'protection' of the Swales, its designation is embedded in a development process that inevitably introduces stressors adjacent to (edge effects), around (making islands and isolating), and through (fragmentation by roadway corridors) the natural area. Further, the City's natural area screening process is constrained to areas that it has jurisdiction over, or to areas with multi-jurisdictional collaborative planning processes (e.g. P4G, Saskatoon and Corman Park). Most often the screenings are bounded by parcels within City limits, meaning that the processes that enable environmental reserve status place natural areas at risk of: being inaccurately delineated as separate from its local context; partially described without integration into a broader ecology; and immediate and long-term impacts on wildlife,

plant communities, water, and habitat. Finally, ownership of the Swales would have to remain Municipal, rather than under Meewasin, the implications of which would need to be investigated or discussed at a technical level.

Environmental reserves are set aside during development. To avoid subdivision as a requisite for protection, a more appropriate classification might be as wildlife habitat under the province's Wildlife Habitat Protection Act. However, that designation only applies to Crown land, again introducing issues of jurisdiction and ownership.

The City's Administration has been looking in to designation options, and an internal report to Council or a Committee might be available. If it is preferred or required that Meewasin retain ownership, then inquiries could be made as to possible changes to both Acts to allow for non-government ownership.

1.3 Governance

Meewasin's ability to give voice to regional ecology and promote avoidance of impacts prior to neighbourhood or sector development is laid out in the Northeast Policy, which definitionally limits Meewasin guidance to general statements on the project. This is an advisory role; a more collaborative approach would require meaningful inclusion in the design phase, before the plan is filed with the Land Titles Office. The NES Development Guidelines are further 'controls' on certain aspects of design, but these are typically mitigation-based rather than avoidance-based.

In the North Commuter Parkway (NCP) proposal, Meewasin is recognized as a stakeholder, with a limited role of reviewing various project components "prior to and during the procurement process." Meewasin's role is diluted further, as "The City anticipates that Meewasin's main involvement will relate to the Project's connections with pedestrian trails," leaving little space for input on ecological impacts (City of Saskatoon, Business Case to PPP Canada 2013). Meewasin lacks a strong role in governance, as City Council is authorized to over-rule any objections that either Meewasin or Crime Prevention Through Environmental Design committee may raise. Evident with setting the speed limit on the section of the North Commuter Parkway through the small swale, politics and 'perceptions' over-ruled the recommendations to adopt and implement the NES guidelines for the Small Swale.

Grismer (1989) describes the relationship between the City and Meewasin as one where they must work together for "linkage and other planning issues. Outside of a 'conservation zone', however, Meewasin's input is constrained to the "design and development of public open space"(*Report on Peturrson's Ravine resource management plan* 1995), which are the spaces left over after lots are allocated in accordance with development and economic criteria.[1] The author suggests that identifying key habitat or ecosystems prior to development planning will allow Meewasin to claim it as conservation space, and thus force the City to plan the neighbourhoods around the space, mitigating or avoiding impacts.

[1]Meewasin's jurisdiction to review is limited "only [to] improvements outside of the approved residential area (i.e. in the natural areas and parks)" (Golder 1995) and not in terms of what happens inside those discrete 'blocks'.

Where the City has a desire to develop on lands within the conservation zone, it can request an exemption from Meewasin review of land development through MVA By-law. For example, By-law 003 exempted lands south of the NES, and between the Small and NE Swales; these lands are slated for industrial/commercial and residential development, and no longer subject to Meewasin review. Meewasin is able to comment only on the 'open spaces' rather than design or acceptability of the neighbourhood as a whole in terms of ecological impact.

Governance issues also exist between Meewasin, the City, the Swale Watchers, and the Province. While participation in the technical working group by the City, Meewasin, and the Swale Watchers for the current iteration of planning on the Saskatoon Freeway is important, that process is attending only to technical considerations in alignment, rather than appropriateness of the corridor. Effective protection by the City and Meewasin will require standing up for the public interest in biodiversity and ecological connectivity outside of prescribed and narrowly defined stakeholder consultations.

2 Corridors and Roads

Of most apparent concern for corridors through the Swales are the roadways. A 'new era' of post-World War II road building "places an emphasis on wider, more voluminous transportation corridors combined with less permeable neighbourhood road patterns" (Sikorski and Gunn, 2013, p. 17). Sikorski and Gunn suggest that the use of 'inefficient' curvilinear streets for local neighbourhood road design is at the root of justifications for wide, high traffic corridors through the Swales. Additionally, country residential acreage development in Corman Park on the outskirts of the City have elevated traffic on grid roads through and near the Northeast Swale.

Corridors are designed or conceptualized around linear features (roads or infrastructure). Less often is there a focus on, or recognition of impacts to, animal corridors. For example, Northern leopard frogs need an ecological and physical corridor to travel from riparian habitat along the river to their grassland and wetland foraging habitats in the Small Swale. For many species, the Swales are wildlife corridors in and of themselves (Stantec2015), and for more mobile species, also part of a broader migratory habitat. The 2019 UH III Field natural area screening RfQ includes an optional component to identify animal corridors between the Swales, showing potential for more comprehensive study of wildlife in the area, but it is still not required. Any study such as this will not be indefinitely conclusive, as behaviours and patterns will change over time with fluxes in population and climate, and in response to existing and future development.

Roadways through the Swale are designed to connect commercial/industrial and residential nodes: traffic modelling for the North Commuter Parkway (NCP) and Saskatoon Freeway did not incorporate potential impacts on wildlife crossings on traffic flows, nor the safety issues that such crossings create. While a section of the NCP was narrowed through the swale to 'encourage' speed reductions, the same was not done through the Small Swale, with no mention of the Small Swale made in the NCP Functional Study. Similarly, the section of road through the NES has a lower speed limit (50km/h; *North Commuter Parkway Functional*

Planning Study 2013), whereas in 2018, City Councillors voted in favour of a higher speed limit through the Small Swale (70km/h), even after a recommendation was made for adopting the NES guidelines in the Small Swale (50km/h) and subsequent agreement between the Swale Watchers and City administration to accept 60km/h. The swale will be demarcated by 'Wildlife' signage, but no other mention of wildlife appears in the NCP proposal.

Connectivity of the NE Swale is emphasized throughout the *North Central/North East Natural Area Screening* (*North Central/North East Natural Area Screening Study, City of Saskatoon* 2013) and other studies--internally for wildlife and water, and externally from the swale to the river at both ends. Yet development continues to interrupt ecological connectivity and continuity by way of road or infrastructure crossings. At a site-level, efforts to minimize disturbance mean prioritizing development on previously degraded lands, but there is no discussion of how those crossings contradict the principle of ecological connectivity, or consideration of how those degraded lands are actually used by wildlife.

In the transportation section of the NE Sector FS (2004, s. 2.5), the authors re-evaluated the traffic modelling used in the 2001 functional planning study, stating that unrealistic growth patterns had been used originally, but otherwise without any "major internal constraints" or concerns found with the model. In essence, they took a model of the existing transportation network, updated with planned improvements from an internal City of Saskatoon map, and selected a traffic flow that worked best for that model. No consideration was given to carbon emissions, wildlife mortality at different speeds, nor the degree of barrier effect produced at different traffic volumes.Even when recognizing that one routing would avoid environmental impacts, it was not the recommended route as it would not carry traffic as efficiently as the other two (p. 4.11).

2.1 Corridor Boundaries and Impacts

The issues of bounding are particularly relevant for corridors, most specifically when establishing a 'corridor' for a final road alignment. Often, the project area (corridor) is described in terms of land use or cover. For example, in the *East perimeter highway functional planning study* (2005), most of the "study corridor is comprised of a cultivated landscape or otherwise modified for agriculture purposes. There is little native vegetation remaining" (*East perimeter highway functional planning study* 2005). Similarly, for the North Commuter Parkway, the corridor was described as having a significant amount of 'disturbed' (42%) or 'modified grasslands' (36%) where introduced species dominate (*NCP Ministerial Declaration* 2014).

One outcome of viewing impacts through such a tightly constrained area of interest is known as the modifiable areal unit problem: minor changes to the alignment and width of the corridor can radically alter the relative distribution of landscape features within the corridor. Since the corridor crosses natural areas at a relatively perpendicular angle, the amount of native vegetation *in the broader area* is under-represented. Sensitive plants in the *project area* face a similar outcome of non-recognition, as provincially-listed species are not found *within* the corridor. Such an approach to assessment de-emphasizes habitat connectivity by focusing on site- and species-specific effects in a non-cumulative manner.

Focusing on previously disturbed lands, emphasizing the relatively small amount of high quality natural area within a corridor, and leveraging fragmented knowledge from prior assessments in support of development, the City then produces more fragmented knowledge by of incremental assessments of natural areas that intersect with the corridor. This occludes the fact that the corridor is embedded in a broader ecological context that is less disturbed, and also ignores cumulative impacts of the roadway on that broader context.

2.2 Saskatoon Freeway

While the North Commuter Parkway remains a point of contention between those who advocate for the NES and the City, the Saskatoon Freeway presents the potential for even greater impacts on the local environment due to the scale of the project, and speed and volume of traffic. For clarity, where I use the term corridor, I refer to the wider extent considered for routing; the term alignment refers to placement of the road within the corridor, of which there are usually alternatives that are evaluated across a number of criteria for their suitability.

The general corridor was originally established in the *Saskatoon long term transportation planning study* (2001) and refined in the *North East Sector Feasibility Study* (2004, hard-copy accessed at City of Saskatoon). The corridor and subsequent proposed alignments were established based on limited research on the swales: the 2001 transportation study was completed prior initial documentation of the swales was published (Delanoy 2001, Stantec 2002, Stantec 2003). It is telling that for the 2005 Functional Planning Study, the rare plant survey and wildlife species assessment are proposed for *after* route selection, indicating the priority that environmental constraints have in relation to geotechnical and economic considerations.[2] There is no mention of either swales in the constraints that guided development of alternate routes for Section 2 (north-east), nor in the list of key findings from evaluation of the alternatives. The swales were not recognized in the study, but their profile and relative importance has since changed, and the current routing is no longer appropriate for the long-term goals of the City.

There are also important considerations other than knowledge of wildlife that have not been incorporated in the selection of the current corridor. Significant change has taken place in and around Saskatoon since the early to mid 2000's, especially in the north-east in the context of jurisdiction and municipal boundaries. In 2010, the City expanded its boundary to encompass more of the swales, including most, if not all, of the original corridor routing through both swales. Similarly, Meewasin's management interests have extended into the swales, leading to more thorough study and thus more data. This means that there are both new and refined stakeholder interests that have not been considered by the proposed Freeway alignment, let alone the corridor as a whole (e.g. Meewasin as a new stakeholder with the swales; City of Saskatoon's Green Infrastructure Strategy; the P4G's regional environmental interests; Wanuskewin's view-shed). Much of the natural area (and habitat and

[2]'No further significant environmental or heritage issues were identified that would preclude development of this highway. However, a formal heritage resources review will be required on select locations once the route is finalized. Further, a sensitive wildlife species and rare plant survey may be required by Saskatchewan Environment in advance of the highway development.'

ecology) through which the corridor is currently routed is of significant interest to the City, Meewasin, neighbouring municipalities, and residents of the City. The environmental and public consultation findings in the previous studies (2001, 2003, 2005) that established the corridor, should not be relied upon to support the current alignment, let alone the corridor.

2.2.1 2001 Long-Term Transportation Planning Study

The 2001 Study considers a number of routes for the Saskatoon Freeway. Minimal discussion of environmental impacts, studies upon which are deferred to the narrowing of the corridor to a proposed alignment. Includes a letter from Saskatchewan Environment (May 30, 2000), who express 'concern over the general destruction of native grasslands,' though this concern is tied only to the area through which the road would be constructed (alignment), rather than effects on the ecosystem and wildlife.

A relatively small public consultation session (30-35 people) included two comments on environmental impacts: 'concerned that the plan may encourage growth along Central Avenue. This is one of the few areas in the city that remains natural prairie'; and 'Roadway plans should consider preservation of the ecosystem in the area north of Circle Drive on the east side of the river.' Neither of those concerns are addressed in this study.

2.2.2 2004 North East Sector Feasibility Study

The steering committee guiding this study decided that the most critical constraints are the Northeast Swale, Kernen Prairie, and Agricultural Research lands, as well as a small number of small prairie habitat and heritage sites, and the gravel resources and boulder lag of the western portion of the area. No mention of field work dates are given in the wildlife/vegetation section, though the authors do mention the importance of timing "biological field work during appropriate parts of the growing season." Elsewhere in the report, the influence of seasonality (as explained in the ecological resources investigation) "led to slight revisions to the site plans", but not significant change.

Traffic modelling in the 2001 Study above was found to rely on unrealistic growth patterns, but was otherwise without any "major internal constraints" on traffic. In essence, the authors took the existing transportation network, updated with planned improvements from an internal City of Saskatoon map, and selected a traffic model that worked best for that flow. Three alignment options were considered "from a transportation perspective," including the first explicit mention of environmental impacts: Options 1 and 3, with "an arterial link through the swale to an interchange at the Perimeter Highway" would have had the highest impacts, whereas "Option 2 has the least environmental impact in that transportation linkages do not extend west of the swale." The final recommendation was for either Option 1 or 3.

No consideration was given to carbon emissions, wildlife mortality at different speeds, nor the degree of barrier effect produced at different traffic volumes. Environmental impacts were, however, more explicitly attended to in terms of storm water (s. 4.2.3), but the focus was on the use of disturbed (wet)lands that can be used for storm water infrastructure. The study

predicts that more water will move into and through the swale as development continues to establish impermeable surfaces. This is an important consideration for environmental impacts, since surface and internal drainage are important for prairie and seep ecosystem health: "good surface drainage and clay soils mean that the natural prairie grass was able to consume essentially all precipitation that entered the soil," leaving little for recharge (Henry, 2012). The classification and subsequent use of 'degraded' or 'low quality' wetlands, as mentioned above, can result in unintended selection of plant and animal species: "Three participants and Native Plant Solutions (2012) specifically cautioned that excess run off from paved and/or impervious surfaces may affect the necessary 'dry period' needed for some seeds to be activated" (Sikorski, p. 37).

2.2.3 2005 Functional Planning Study

The 2005 Functional Planning Study asserts that "The recommended alignment was established to accommodate future City of Saskatoon growth sectors, provide for growth in both city traffic and highway traffic while acknowledging the interests of the various stakeholders within the study corridor and recognizing environmental and heritage resources," yet there is no substantive mention of 'environmental resources' such as the Northeast Swale's wetlands or grasslands. The Study recognized only Wanuskewin, Tipperary Creek, and Kernen Prairie as important ecological areas to be considered in the evaluation of alternative routes, even though the 2003 Study above included the NES as an important ecological area. Stakeholder consultations included 'two open houses and a series of correspondence letters mailed during the study.'

The document notes that 'Another key environmental concern was that the project route may impact rare or endangered wildlife or plant species or their habitats,' but does not specify or elaborate on those potential impacts. How the 2005 study assessed or collected data on wildlife and vegetation in the study corridor is not discussed: if just a review, it suffers from similar issues as previous natural area assessments, in that the field studies may not have followed appropriate protocols for detection/observation; if a study was conducted to verify, no details are given on study methods or protocols.

Stakeholder consultations included 'two open houses and a series of correspondence letters mailed during the study.' For the alignment through the swales, five alternatives were considered for the section of Freeway from Hwy 16E to Blackley Road north of Hwy 5; Kernen Prairie was to be avoided, with minimal 'severance' of other lands owned by the University. The recommended alignment does avoid Kernen Prairie, but still results in fragmentation of the research farm, and by following the alignment in the North East Sector Plan, is expected to have 'minimal impact' on lands between Highway 41 and the River. From Blackley Road to Wanuskewin Road, heritage interests at Tipperary Creek (with a 500 metre minimum buffer) and First Nations Treaty Entitlement Land designation were decisive for alignment selection. The buffer for Tipperary Creek appears to differ from the buffer recognized above for the purposes of the City's development activities.

At the time of the Functional Study, the lands under consideration through the swales were in R.M. of Corman Park. However, from 2010 those lands were annexed, effectively changing the

relationship between the Ministry of Highways and Infrastructure and the City of Saskatoon with respect to land control in the corridor.[3] Meewasin, with responsibility for lands in the swale and interests in the management of surrounding lands, was not originally considered to be a stakeholder, and so their concerns were either indirectly represented through the City or landowners, or not represented at all.

2.3 Competing Interests

> There is nevertheless reason to believe that major infrastructure investments [such as the Saskatoon Freeway] still tend to 'drive' changes to the urban landscape as well as affect comprehensive sector planning. (Sikorski and Gunn, 2013)

It is important to be aware of the politics involved in decisions about development. In the Public Communications platform component of the North Commuter Parkway proposal (*Business Case to PPP Canada - North Commuter Parkway Project and the Traffic Bridge Replacement Project* 2013), the list of stakeholders are predominantly government and non-government agencies, with the civic body being 'commuters and road users'. Excluded are residents and environmentalists, whose interests are not considered germane to such a development. An environmental assessment may help document interests and impacts more broadly, but they are not a panacea, nor are they biased towards conservation.

The Highways and Transportation Act does not mention any requirements for environmental assessments, and the EA act does not appear to be triggered by developments the province deems to be a 'public improvement.' Conversely, the Act (in s. 16) is strongly worded in support of expropriation and gives the Ministry wide discretion in conducting studies and collecting data in a way that it deems to be appropriate. It also presumes that all highways are 'public improvements', without considering the degradation that highways cause to public and common goods such as clean air, clean water, and genetic and species diversity of plants and animals.

Ultimately, the Ministry of Highways and Infrastructure is empowered to build infrastructure that is in the 'public interest'. Yet it is also in the 'public interest' to maintain biodiversity and access to natural areas. City Council and the Meewasin board should strongly consider ways in which they can get the Province to take seriously their (City and Meewasin's) interests in biodiversity, as it is a public interest, a public they are meant to represent. For the City and Meewasin, the rationale is laid out above. For the Province, there are other provincial 'public interests' that need to be considered. The Statements of Provincial Interests regulations (section 6.2) discusses biodiversity and natural ecosystems: "[t]he province has an interest in conserving Saskatchewan's biodiversity, unique landscapes and ecosystems for present and future generations." Rather than attempting to use a partial and biased

[3]'On August 1, 2010, the City boundary was altered to include the remainder of the Sector and the future Provincial Perimeter Highway (Perimeter Highway) alignment in the north-east quadrant. A total of 997 hectares (2,464 acres) or 15.5 quarter sections in the north-east were brought into the City's boundary' (2013 UH Sector Plan). This is interesting considering the concern voiced at the 2004/5 Perimeter Highway/Saskatoon Freeway consultations, specifically about land development within the corridor

knowledge base to establish technical solutions for mitigation, the Province needs to assess the potential for regional impacts from this major piece of infrastructure. A strategic environmental assessment, conducted in conjunction with the P4G, might be an appropriate mechanism to achieve this state of knowledge.

3 Ecological Impacts

> As human habitation in a place continues, vegetation changes are evident by a "relative increase in introduced species with respect to native species" (Lineman, 2000, p. 108-9).
>
> "[H]abitat modification, deterioration or total destruction" will increase pressure on species at risk or threatened, and possibly drive others into those categories. (*Bird survey for Northeast Swale within Meewasin Valley* 2012)

Throughout many of the documents reviewed, there is often a discussion of impacts in conceptual terms of edges, islands (or isolation), fragmentation, and barrier effects. Multiple impacts may be associated with a single project (roadway as fragmentary and also a barrier), or as a result of cumulative development. Or, multiple projects can aggravate and amplify one impact, such as isolation resulting from suburban development surrounding a natural area (e.g. SNG). Edge effects are stronger relative to physical boundaries such as wetlands, roads, or cultivation, and less apparent with 'jurisdictional' boundaries that govern the application of management techniques or exclude certain activities (Howitt, 2013).

Choosing what to look for will alter our detection and measurement of ecological change. The prairie crocus, for instance, is noted as an effective 'indicator species for disturbance,' and has experienced significant provincial and regional decline as a result of agriculture and suburban expansion (Howitt, 2013). Sometimes, what we look for is highly influenced by tradition and the economy. For example, whereas the Province regulates vegetation by classifying species as either noxious or nuisance, those decisions are often focused on how the species interacts with dominant land use (i.e. agriculture). A third category of species should also be tracked, exotics that are potentially invasive but not (yet) designated as weeds by the appropriate provincial authority (Kelly, 2013).

Knowledge of the swale, as well as surrounding natural areas, is fragmented in space and time. The CanNorth (*Ecological, Environmental, and Heritage Review of the North Bridge Corridor* 2013) study consistently identifies a lack of knowledge of the 'project area' as a whole, commenting on the degree to which prior studies focused on specific and highly isolated sites. Stantec's (2015) UH3 natural area screening cautioned about the timing of the contract, noting that wildlife and vegetation observations were not conducted at an appropriate time. While administratively efficient to fit in annual budgets, this incremental approach has likely led to losses of land that could have been set aside for conservation, or even to the incorrect classification and subsequent alteration of wetlands.

As a result, assumptions of the presence/absence of species become implicit rather than explicit: a sighting of a rare species within a certain habitat in 1992 is often not verified in

2015, but neither the assessment parameters (different time of year/day), nor the methods the same. Climate change, combined with continued land use/land cover change in the region, has changed habitats and plant communities and will likely continue to do so over time. Without consistent monitoring across multiple domains and in a variety of habitats, Council and planners will continue to make decisions based on insufficient knowledge.

With the City's *UH3 RFQ - Field Natural Area Screening* (2019), the City has dramatically improved its criteria for natural area assessments, emphasizing best practices and Provincial protocols for improving observations of wildlife and plant species. The potential exists to increase lands considered worthy of conservation. Combined with the integration of principles from the Green Strategy into the Official Community Plan, it is possible that greater awareness of ecological realities will increase conservation-oriented decisions in the City. It is also possible that this inventory will not stop development, and only force the City to require more technically complex mitigation techniques.

3.1 Documented Impacts

> Unfortunately, SNG has experienced a significant reduction in natural vegetative cover, reportedly because it is small area and spatially enclosed by urban development (a potential harbinger for the NES). (Sikorski and Gunn, 2013, p. 41)
>
> "[D]ozens of bird species have ceased to be present in the NES over the span of just 12 years. Whereas 188 bird species were recorded in the NES in 2000, by the year 2012, just 103 species were observed," with Sprague's pipit and burrowing owls most notably absent. (Sikorski and Gunn, 2013, p. 38-9)

Empirical documentation of impacts can only be accomplished by comparing the status of habitat or wildlife population pre and post development. This presents a challenge to effective management of the Swales, since prior documentation is fragmented in time and space (see section 5.3). The original *Development guidelines and the Northeast Swale* (2002) documented impacts on the Northeast Swale, including overgrazing, industrial and residential development, storm water management, mineral extraction, and road corridors. But by framing impacts regionally, we can predict how the Swales will respond to development. For example, in *Report on Peturrson's Ravine resource management plan* (1995, p. 31), consultants noted that "ecological linkage has not been an operative principle in the planning of the Northeast Sector to date; only functional linkage for trails has been achieved." As a result, Peturrson's management plan notes, Central Ave effectively cuts the Ravine off from inland sites such as the Forestry Farm, SNG, and the wetlands in the Northeast Swale. With enclosure and continued fragmentation, the Swales seem similarly destined.

3.1.1 University Containment Facility

Beyond data from water quality testing in 1984 (*Stage 2 Geotechnical investigation proposed northeast sector truck sewers and subdivision development* 1986), there is little to no publicly

accessible information about the University Containment Facility. Inquiries through the University resulted in this information:

> The Land [and related containment unit] is co-managed by the City and the University by a Trust committee. The containment facility is licensed by Saskatchewan Environment. Saskatchewan Environment receives the annual monitoring data. The Trust Committee is currently working with Sask Environment regarding the licensed facility. The committee would like to explore options for use of the site as part of the larger Swale lands. (B. Barnstable, pers. comm, April 15, 2019)

3.2 Predicted Impacts

> The biggest impact is yet to come with incorporation into the urban environment. (Delanoy, 2003, p. 7)

Understanding impacts requires baseline data and monitoring; biodiversity can be used as an indicator of functional health for the Swale (Sikorski and Gunn, 2013, p. 44), but still requires baseline data and monitoring. *Meewasin Valley Authority Northeast Swale mitigation planning* (2016) catalogued ecological impacts on wildlife and plant communities in similar contexts of suburban development. Common impacts include habitat loss and fragmentation, reduced habitat quality, reduced connectivity, direct mortality, and altered behaviour.

Using longer-established local natural areas and similar ecosystem contexts and processes as proxies can help to identify potential impacts and responses. Saskatoon Natural Grasslands provides a very close study that includes edge effects (spread of alien invasive species), isolation (due to adjacent residential/industrial development), and roadways (as fragmentation, and as a barrier and through direct wildlife mortality).

3.2.1 SNG

From the start, SNG was recognized as an incomplete 'ecological unit' due to the absence of fauna that are associated with its plant communities and dominant vegetation (Grismer, 1989). The ecological unit concept has currency for the Swales. Wildlife behaviour will be influenced by roadways through the swales, and in response to enclosure by neighbourhoods and industrial areas. If key wildlife species are driven out or otherwise excluded, the swale ecosystems will no longer be complete, with subsequent shifts in the types, dispersion, and dominance of native species. Grismer and others have recognized the need for connectivity to broader ecosystems to support the continued health of the SNG, and the Swales, in terms of biodiversity as fescue prairie, moist mixed grasslands, and prairie wetlands.

In the *Saskatoon Natural Grasslands* (1994) resource management plan, a number of ecological impacts were predicted:

- A decline in the total number of birds in the SNG is predicted to be larger than the difference between prior inventories and the 'peak visitor' inventory conducted for the plan.

- The cause most attributed to overall and species-specific declines (large birds, white-tailed deer) is the enclosure of the SNG by housing and its disconnection from nearby remnant grassland patches.
    - A similar decline can be envisioned for the NE Swale, but with a different trajectory and from other sources of impacts (roadways, light, edge effects, storm water drainage).
- Changes in vegetative land cover is linked to grazing, fire suppression, and mechanical disturbance, with different effects evident in extent and type of of woody cover, as well as introduced species in different areas.
    - The source of the Kentucky blue grass (KBG) (local/introduced) in moist areas has implications for management actions to either control it or not; the same might be true for the NE Swale.
- The effects of trampling, linked to interpretation and recreational use, are discussed, with evidence indicating that medium and heavily used trails (200-400 passes) would require more than one growing season to recover.

Kentucky bluegrass is recognized as being able to spread rapidly and into most areas in SNG (Bob Godwin and Jeff Thorpe, 2004b); this would be similar to pressures faced by the Swales. Development has not only introduced the species, but has also altered climatic conditions, creating habitat for KBG to spread; development around the swale may also alter microclimatic conditions, with impacts on the resilience of grassland communities. Burning is an effective way to manage invasive species such as KBG; lessons from testing burning and grazing techniques and monitoring the effects at SNG can inform the management of mixed grasslands in the swales, which 'tends to be found on upper slopes and knolls in the gently rolling terrain.' Concern about shrubs and KBG expansion in the swale is a concern for 'diverse communities of the knolls' (J. Thorpe, B. Godwin, and Sumners, 2005). Given the likely need for frequent burning, Meewasin and the City should seriously consider the ability of Meewasin to conduct these practices in the swales given the current and future levels of urban development nearby. Disturbances can also include grazing, with patchy disturbance being key to maintain habitat diversity and plant community health.

3.3 Considerations and Mitigation

> [We recommend that] a joint strategic cumulative effects assessment be undertaken by the Province of Saskatchewan, the City of Saskatoon, and the Meewasin Valley Authority to identify a preferred urban development scenario for the NES area, with its sustainability as a top priority. This exercise should engage the public fully, particularly the Swale Watchers group. (Sikorski and Gunn, 2013, p. 46)

From *Geology of the forestry farm area, Saskatoon* (1980), we know that the location and nature of joints or cracks in and between the geologic layers will be important considerations

for development, especially for storm water management that makes use of constructed fore bays and existing depressions or sloughs. These joints are entry points for pollutants, and changes in the surface-ground water regime may change groundwater chemistry in a way that impacts water quality in ravines fed by water seeping from the river banks. This has implications for the management of provincially and federally rare species, such as at Peturrson's Ravine. The University Containment Facility may be a significant consideration for current and future groundwater quality, but as mentioned above, little information is available. Typically, however, geotechnical studies have been conducted thoroughly, although in a fragmented and inefficient manner (Henry, 2012).

In the current *Development guidelines and the Northeast Swale* (2012) document,and across most other development-related documents, there is often discussion about the need to avoid certain areas during nesting times, but no mention is made of the potential that development may drive birds away from nesting or mating in the Swale. An assumption is made that the birds have either limited discernment for habitat quality or surrounding land use change: they will return, find the habitat essentially the same as prior, and continue their reproductive cycle undisturbed. This also assumes that interactions between species will not change, i.e. that there are no cumulative impacts where shifts or movement of some affected specie has no impact on other species.

In their review of mitigation measures, Canada North (*Meewasin Valley Authority Northeast Swale mitigation planning* 2016) provides some general information about mitigating the impacts of roadways. Overpasses are better than underpasses, and landscape bridges (wider) better than wildlife overpasses (narrower), if designed for more than just large ungulates; however they can be costly and require disturbance of a large area in order to provide sufficient slope. These types of measures are only effective in areas where surrounding or adjacent habitat is protected, and where animal (large mammal) populations are sufficiently large.

Generally, reducing spread of invasive species in the NE Swale will require reducing soil exposure and implementing a disturbance regime that supports desired plant communities. Preventing spread would require avoiding the creation of new edges, enclosure/isolation, and fragmentation. Management techniques such as burning and grazing have been evaluated by by the Saskatchewan Research Council (Bob Godwin and Jeff Thorpe, 2004a; Bob Godwin and Jeff Thorpe, 2004b; J. Thorpe, B. Godwin, and Sumners, 2005; Bob Godwin and Jeff Thorpe, 2011). Graduate students working with Vladimir Kricsfalusy (University of Saskatchewan) have also studied management (Shen, 2015), fragmentation (Howitt, 2013), and spread of invasive vegetation (Kelly, 2013).

4 Ecological Value

By imagining and valuing the environment as discrete 'resources', management by component parts rather than as an integral whole becomes naturalized. This type of thinking manifests in terms of restoration involving the 'transplanting of sod from prairie areas slated for development' into areas slated for conservation (City of Saskatoon 2018, p. 4). Whether

such an 'opportunity' for restoration is serendipitous or ironic is up to the reader. The value of landscapes, plants, and wildlife has received little attention in the City's calculus, though improved methods of valuation should help improve the ability of Administration to incorporate environmental goods and services in its calculus. Triple Bottom Line and Natural Area Valuation are two models that the City has discussed. The City of Saskatoon's 2018 Green Infrastructure Strategy Baseline Inventory makes mention of Natural Capital Asset Valuation, a project that will be of significance for future natural area conservation. The valuation aims to provide a basis from which planners and decision-makers can assess costs and benefits when it comes to residential, industrial, and roadway development, but the results may not be available soon enough to limit further impacts on the swale.

Statements of Provincial Interest are relevant in this context, specifically section 6.2 on Biodiversity and Natural Ecosystems. The Provincial Planning Handbook describes these as 'valuable, priceless commodities', with high quality habitat worthy of designation as Environmental Reserves under provincial legislation. Note, however, that the 'commodity' perspective is not uncontested, as there are spiritual and aesthetic aspects to both biodiversity and landscapes. People hold many values for natural areas in and around the city, but the City has not been equipped with data or techniques to account for them all.

This lack of accounting creates a bias towards development. Delanoy (2001) highlights the contradictory actions and interests of the City in recognizing the NE Swale as an 'important natural prairie remnant,' but continuing to develop in to and around the Swale in such a way that imperils the survival of the area as an 'important natural prairie remnant.' Combined with loss of natural prairie to agriculture and infrastructure, having a natural remnant close to the city becomes much more unique and valuable.

In *The Meewasin Valley Project: 100 Year Conceptual Master Plan* (1979), the swales are described as "an integral part of the prairie surface drainage system... [functioning as] oases on the prairie... [and supporting] rich communities of plants and wildlife" (p. 36). Yet in the *Saskatoon Natural Grasslands* (1994) management plan, the City suggests residential drainage management be conducted within the grasslands, claiming that adjusting residential elevations during development, and alterations post-sale, may not be feasible. Where mentioned in the documents reviewed, a consistent theme in ecological valuation is the primacy of humans, to the detriment of wildlife and native habitat.

The 100-Year plan called for research into and discussion of wildlife management priorities. Meewasin conducts ecological surveys, the City's commissioning of natural area screenings contributes to knowledge of wildlife, and citizen scientists and students have also added to the body of knowledge around wildlife in the Swales. However, the discussion of wildlife management priorities has been a missing piece, except for some bird-related concessions enforced by provincial and federal regulations. Instead, development has been allowed to continue in a way that knowingly pushes out large mammals (deer), and with mitigation measures (of uncertain efficacy) for smaller wildlife.

Reflecting on these documents, there is never talk of large restoration projects, only of mitigation and sacrifice of previously disturbed lands. Degradation does not need to be permanent, the landscape and habitats will change.

4.1 Vision

Visioning involves forward thinking. Citing the 1992 Round Table on Environment and Economy's 'Conservation Strategy for Sustainable Development in Saskatchewan', Weichel (1992) argues for:the protection of habitat of high biodiversity, especially when endemic species are present; preservation and conservation of biodiversity are to be "considered when approving developments," and the reform of legislation to avoid conflicting outcomes in terms of "maintaining biological diversity" (p. 5).

From the 100-Year Plan to the UH Sector plan, integration of nature and urban development has been an overarching goal. The *University Heights Sector Plan* (2013) identifies NES Development Guidelines (2012) as a means of 'integrating natural areas into urban development areas.' At the same time, the Plan recognizes the importance of the NES for its fescue component, relative to the scant remaining fescue grassland in the province. However, the NES is mixed grassland with some fescue, not fescue-dominant like Kernen Prairie. Development places the entire grassland ecosystem at risk, not just one of the species within it.

Vision also involves a shared sense of place, which is important for understanding how people vary in their valuing of the Swales. In the *Evergreen neighbourhood concept plan* (2009), this sense of place includes the NES, which is 'a valued amenity and marketing feature for this neighbourhood...[that] will provide opportunities for interesting pedestrian linkages to the Meewasin Valley river trail system.' Again, sustainability and integration prioritize human dimensions, exclusive of biodiversity and wildlife interactions on roadways, which are not mentioned in the plan.

4.2 Classification and Value

> 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. (*Bird survey for Northeast Swale within Meewasin Valley* 2012)

Throughout the reports, the value of the local ecology and landscape features are most often discussed in terms of human wants and needs. There is an implied value to conservation by way of acceptability of costs to the public. Under Meewasin's Natural Areas Protection Policy, 'a site only has to be seen by the public as an important ecological area to warrant designation. Peturrson's Ravine and other associated areas, has been documented repeatedly as an ecological priority to the public' (Golder 1995, p. 21). So, with enough political pressure, an area becomes valued at how ever much 'the public' is willing to pay for at some given level of management. Yet even as an ecological priority to the public, costs and technical feasibility ultimately curtailed the use of the Ravine as a storm water outfall, but with no mention of the public outcry or ecological impacts as driving or even influencing that decision (BBT 1985). As with most of the studies conducted on behalf of the City, the *North Central/North East Natural Area Screening Study, City of Saskatoon* (2013) is part of a development process that assumes mitigation techniques will suffice to protect

the environment, and often rationalizes further alteration due to prior 'disturbance'. One example is seen in the use of wetlands as part of stormwater management system. By presuming the inevitability of development, conservation is seen as a matter of mitigation and technique rather than avoidance.

Though without a specific economic value, the Swales are still culturally relevant. In the Meewasin 2011 Bioblitz, (*Meewasin ecoblitz 2011 summary report* 2011)Crowfoot violet (Rare) was found [possibly for the first time], as was rough fescue; the area also includes crocus, wild rose, and western red lily, which are the 'floral emblems of the three Prairie Provinces'; it also includes sweet grass, possibly of interest to indigenous peoples in the area.

Stantec's (2003) initial review of the Swale shows some potential heritage value, yet none of the 'site's of interest' within the small swale are seen as impediments to future development. By interpreting the results of human disturbance as leaving 'no concerns about or impediments to' future suburban development, the writers leave out the possibility of remediation; their evaluation precluded reclamation options and restoration values entirely, focusing instead on a binary of develop/protect.

For SNG, the goal was not preservation of the entire grassland area, but of 'enough' to provide a certain interpretative 'experience' (Grismer, 1989). Peturrson's Ravine is noted as 'geotechnically, very sensitive to urban development adjacent to it, and ecologically sensitive to intensive use or abuse' (*Northeast Policy* 1987, p. 24). Even though the the channel scars are also ecologically sensitive and connected to groundwater, their relative geotechnical 'stability' means they are more easily subject to alteration.

Ecological value in the NES has been based on vegetation type, where the presence of undisturbed native plant communities and areas which contain rare plant species have a higher ecological value compared to disturbed or anthropogenic plant communities (*Vegetation and Wildlife Survey of the Northeast Swale* 2009). Further, the NE Swale is consistently described as significant—of value—due to its size (ability to sustain ecosystem health and diversity), connectivity (internally, and externally to the river and other natural areas), biodiversity and habitat diversity, use by wildlife, and cultural heritage assets. The size and intactness of the NES makes it stand out from similar but smaller grassland preserves in the Saskatoon area as well as the broader region. It's fescue community also differentiates it from other Meewasin properties. On the other hand, much of the swale is unserviceable for development and thus becomes a conserve by default.

While the overall landscape is expected to change over time (climate, aquifer level, development), it is the diversity of habitat within and near the swales that provides for their rich species abundance. However, it is necessary to be aware of how systemic decisions influence the environment over time. Take for example wetland classification: the classification system used by the City includes temporary and (semi) permanent classifications. Only certain classes of wetlands are subject to detailed functional and habitat assessments, the results of which determine the level of management selected for that wetland. By considering only certain (and few) wetlands for preservation or light management, the rest are subject to alteration, typically for use in storm water systems. Without a diversity of wetlands, the diversity of habitat within those areas changes, as the landscape tends towards homogeneity. In readily classifying modified habitats as 'disturbed' and thus amenable for development,

the City's planning process seems to interpret the landscape and land as a blank slate: a homogeneous space where land use can be efficiently and/or optimally allocated and relocated, in order to produce common goods for 'the public'.

4.3 Regional Connections and Ecosystem Health

> See also Corridors and Roads, since Connections and Health are threatened by fragmentation and isolation, reducing the ability of natural areas to contribute to and benefit from regional ecosystems. Mitigation costs can act as another implicit valuation for conservation.

The NES is located in a transitional zone between the Moist Mixed Grassland Ecoregion and the Aspen Parkland Ecoregion; regional transition zones such as these are known for providing diverse habitats, being home to many species, and also as drivers of evolution. Diversity of habitat within the swale, as well as between the swale and connected natural areas, provides food, shelter, and mating/nesting grounds for many animal species, both resident and migratory (*Vegetation and Wildlife Survey of the Northeast Swale* 2009). The Northeast Swale is part of a 'larger block of land [that] measures over 200 ha[,] making it one of the largest urban grassland reserves in Canada' (Delanoy, 2004).

Although the Swales include 'important natural prairie remnant[s]', the City continues to grow in to and around the Swales in such a way that imperils the survival of these 'important natural prairie remnants.' Combined with loss of natural prairie to agriculture and infrastructure, having a natural remnant close to the city becomes much more unique and valuable.Unique to the swale, in comparison to SNG and Kernen Prairie, are its ecological function as a corridor between 'the river...[and] uplands and wetlands to the northeast' (*Development guidelines and the Northeast Swale* 2002, s. 3.2); its greater habitat diversity due to the presence of wetlands; and its hydrogeological connection to the Forestry Farm aquifer and other natural areas along the river bank.

'Disturbed' and 'cultivated' lands are seen as having low ecological value, though they may still play a significant role in regional connectivity. *Meewasin Valley Authority Northeast Swale mitigation planning* (2016) notes that adjacent and near-by agricultural lands are likely also used by wildlife, and its conversion to residential developments will leave the Swale unable to support large mammal populations, even with mitigation measures. Large mammals (deer) are seen as potential nuisances, so their retention in the area is not seen as desirable. Small to medium sized mammals, amphibians, and birds have smaller range requirements and are thus likely to maintain populations given the uptake of effective mitigation measures. This seems to be the extent of discussion on wildlife management priorities, which was called for in the 100-Year plan (1979).

When it comes to conservation, the City's classification of the ancient scars as 'unserviceable land...does not guarantee conservation of the natural resources,' but only excludes certain land uses (Delanoy, 2001, p. 3). Those land uses can influence the distribution and health of regional genetic diversity. In Delanoy's study, no rare plants were identified within the study area; a more recent (2017; personal communication) survey did find crowfoot violet

(Viola pedatifida)--S3 Rare/Vulnerable--in the ecological core. There are also rare plants nearby (e.g. small swale), and in habitats influenced by their hydrogeologic connection to the swale through the Forestry Farm aquifer (Riddell seep, Peturrson's). There may also be other rare species in the region and area that have not yet been observed.

5 Knowledge Gaps

5.1 Local and Regional Ecology

In conjunction with the UH III Field Natural Area Screening (2019) (potentially) studying the wildlife corridor(s) between the Swales, a comprehensive study of the full extent of the greater swale would provide decision-makers with a high-level understanding of importance of the Swales relative to other natural areas in and around the City. This would be best paired with a regional-scale ecological assessment, in order to understand the role of the swales in the sustainability of regional biodiversity by studying the movement of wildlife and plant genetic material. This is linked to an opportunity to improve regional and local ecotourism. Quantification of historical change and calculation of its rate (see below) would help put in to perspective the relative importance of remaining grasslands, including University Lands.

> **Recommendation:** In coordination and collaboration with R.M. Corman Park and possibly the University, comprehensively study and monitor the full extent of the greater swale, including regional wildlife corridors and movement of plant genetic material.
>
> **Recommendation:** That the University increase its profile in prairie restoration and conservation science. This would build off of the University's own lands, with more involvement in regional natural areas including activities such as tracking plant and animal genetics, distribution, population levels and health, and movement of plants and animals through corridors.

Knowledge of a development's potential ecological impacts can be achieved via an inventory, which will influence the selection of mitigation techniques, selection of compensatory scheme, or design elements in a neighbourhood plan. With appropriate parameters laid out to enhance the detection of wildlife and vegetation in future natural area assessments, natural areas should be more accurately delineated, species of management concern located, and potential impacts recognized.

> **Recommendation:** For the City of Saskatoon to continue to refine and adapt its natural area screening protocols, and encourage their use in regional partnerships, as appropriate for the context and scope of planning and management.

Missing is an understanding of the long-term impacts that this lack of knowledge has had on the surrounding natural areas of Saskatoon. Development remains relatively unquestioned, and it may be difficult to argue for strict conservation without being able to provide some

context for relative importance. While the NES has received a lot of attention, there have been other wetland areas, sloughs, and scars that have been developed on or over; these areas could potentially have had similar plant and animal communities that were either not yet assessed, or missed due to assessment parameters. While admittedly speculative, some modelling of prior habitat extent and species distribution (decadal; analysis potentially tied to waves of growth) would provide conservation arguments with a substantive basis to show overall land cover/land use change and highlight the importance of the remaining areas.

> **Recommendation:** Establish historical context for changes to natural areas all around the City in order to situate current changes to the Swales. This would include the use of historical air photos, descriptions, plans, and related documents to both locate and estimate previous extents of natural areas, and potentially their connectivity. Since many wetlands and other natural areas have likely been converted to residential or commercial/industrial, decision-makers and the public should be aware of the scale of impact on remaining.

Unless sufficient space is given, and connectivity protected, it wil further degrade until it is barren of wildlife and over-run by alien invasive species. Disturbance and connectivity are key to sustaining these natural areas. Range requirements vary by species, but to exclude some risks shifting the ecosystem baseline into a different, and possibly less 'valuable', state.

> **Recommendation:** That the City, Meewasin, and Province find ways to incorporate the Greater Swale into a broader conservation project, including adequate buffering and protection of wetlands in agricultural fields, and the generous (wide buffering) selection and restoration of disturbed areas adjacent to the Swales. This may involve conservation easements, purchasing as Crown land, or other land use controls that are available to municipalities.

5.2 Prairie Water Cycles

Blue water (surface and groundwater) and green water (water used by vegetation) are integral to the character and function of the Swales. In order to adaptively manage for future generations, further knowledge of how water cycles through these ecosystems, and how their plant and animal communities rely on—and change—the water regime is required. This includes knowledge of aquifer extent and subsurface flows, as well as a better understanding of how the various soils and plant communities intercept surface flows and prevent them from becoming groundwater. With continued development and change from permeable to impermeable surfaces, there will be impacts to plants as well as hydrological function, and this understanding is lacking.

> **Recommendation:** Establish a research program to study blue and green water interactions in the context of native prairie, including projections of regional change predicted to occur with climate change.

Consistent and transparent monitoring is a fundamental component for management of the Swales. Henry (2012) notes that the City has not been monitoring the Silverspring wells since 2005 (the report includes data for 1993-2005), and urges them to resume. Further, test well decommissioning was not mentioned or otherwise indicated in previous reports, and recommends that this become standard, and that existing wells be properly decommissioned, or used in education/interpretation if they are on school grounds.

> **Recommendation:** Resume monitoring and establish a portal for access to all hydrometric data collected by the City, similar to the provincial water monitoring and reporting websites.
>
> **Recommendation:** Establish a protocol for well-decommissioning, if one does not exist, and review prior wells for decommissioning.

The University Containment Facility is another unknown in terms of impacts on groundwater, but very little information is available. More transparency on this issue would benefit the public, as it affects not only the management of lands within the City, but also potentially the water quality of a significant provincial waterway, with many downstream communities and ecosystems affected by upstream activities, contamination, and pollution.

> **Recommendation:** For the Province to provide public access to information on the process and status of remediation, including groundwater quality monitoring.

5.3 Saskatoon Freeway Impacts

From at least 2001—and likely prior—until the most recent 2019 University Heights (UH) III Request for Quotes for a field natural area screening, the City's knowledge of the swales has relied on natural area screenings that are now considered insufficient in scope and breadth. The City has known about this methodological issue at least since a 2013 report from CanNorth. In the CanNorth literature review of research of the swales dating from 1992 to 2012, "[t]he [vegetation] studies. . . were conducted only once during the growing season." Provincial protocols, which do change from time to time, now require multiple samplings throughout the year, for some species throughout the day or by season, habitat, etc. These protocols reflect scientific best practices and their use is only a requirement for provincially-commissioned data collection or where known wildlife habitat will be disturbed by a 'project' as defined by the Environmental Assessment Act(as per the 2016 Wildlife Regulations, a permit is required); otherwise the use of the protocols is optional.

This is not a stale issue: as recently as 2015, wildlife and vegetation observations as part of the UHIII natural area screening were conducted only once (October), well outside of the growing season for vegetation, as well as nesting, mating, and migratory seasons for birds (not to mention detection protocols for amphibians and macroinvertebrates). Their report does qualify field work findings, noting that species and habitat observations are not representative of the area's extant ecology. In other words, for a long time the City has been making decisions based on snapshots of the swale(s) that are not representative of reality.

For the Freeway corridor, and also for neighbourhood planning and development, natural area screening studies are confined not only in time, but also in space. This leads to serious occlusions that compromise the credibility of decisions that rely on the data. Focusing only on the corridor right-of-way reproduces a fundamental issue in geospatial analysis: the modifiable areal unit problem, where changes in the shape and scale of the 'area of interest' can lead to drastically different statistical outcomes in terms of species presence and relative diversity, and relative extent of different types of habitat. For corridor studies, natural areas and impacts upon them are discussed in terms of their presence within the corridor, rather than the impacts of the corridor on the entirety of the natural area, and especially not on the broader regional ecology.

The lack of knowledge upon which development and corridor planning in the north-east has been based is a compelling reason to suspend current planning of the Freeway, especially considering current knowledge and growing environmental concern for, and value of, the area. Until such time as sufficient information on the relationship between the swales and the regional ecosystems to which they connect is made available, the true ecological impacts of the corridor remain uncertain and likely underestimated.

> **Recommendation:** For the City and Province to acknowledge that building the Freeway within the current alignment and corridor would directly impact local ecosystems and wildlife, and both directly and indirectly place the broader ecosystem at risk of long-term decline.

With current knowledge of the Swales, as well as changes in City boundaries and regional development trajectories, continued construction of the Freeway risks preventable destruction of local habitat, and impairment of regional ecosystem health. Suspension of the Ministry of Highway and Infrastructure's (MHI) planning should be followed by a joint review of the placement of the corridor. With wetlands and grassland habitat now recognized as assets, and with tax payer money and Administration's time invested in their management and protection, the City, Meewasin, and the Province must find ways to protect the green infrastructure within City limits, and natural areas connected to those assets that are outside of City limits. The Freeway will only further fragment what has previously been called 'one of the largest urban grassland[s]...in Canada' (Delanoy 2004).[4]

> **Recommendation:** For the Ministry of Highways and Infrastructure to suspend planning until more information is available on the status of the Swales, including wildlife corridors within and between the Swales, and between the Swales and other regional natural areas.

5.4 Planning and Governance

The majority of studies reviewed were geotechnical, ecological, hydrological, or heritage-focused. Only one social scientific study was found and reviewed (Sikorski and Gunn, 2013),

[4]The full quote is "one of the largest urban grassland reserves in Canada," but I omit the word 'reserve' because it implies both protection and management; procedural hurdles are not protection.

though there is at least one other study currently underway (economic valuation survey of residents near the NES). There are no studies of the efficacy of the existing working group structure, nor any apparent assessment of others for their appropriateness. This indicates a gap in knowledge around values, democratic participation, and the transparency of decision-making. Does the City assess it's partnerships, and if so, by what criteria? How do Administration and Council balance environmental outcomes against procedural efficiency, and given a dearth of valuation for ecological goods and services and intangible values, how should the environment be weighted in those decisions?

Similarly, how do the Swale Watchers (as a group and as individuals) assess the efficacy of their participation as a stakeholder in City planning? Is there a better model? What tools might be needed to improve the standing and power of residents in Administrative and political decision-making?

> **Recommendation:** Development of a research program (2-3 graduate/honours students) to investigate the intersection of knowledge and politics in municipal decision-making. It could compare and contrast the 'public voice' represented in City Council and compare it to the 'public voice' within media. Included would be a review of council/sub committee minutes, video transcriptions, agendas, reports to Council Review media (social, traditional).
>
> For the Swale Watchers, a student could explore the institutional and social dynamics of a boundary organization through an ethnographic/institutional ethnographic lens. This could examine flows of knowledge, individual agency, and the role of social media in urban conservation.

Outreach and education of adults has also seemed to be lacking, or at least is untracked and uncertain. Current programming and interpretation is actively focused on youth and children, and only passively involves adults and residents adjacent to the NES. In this vein, the language the City and Meewasin use to communicate with residents is important. Within the reports and assessments, 'ecology' or the biodiversity within it are often framed as components of 'our natural heritage', yet the phrase 'natural heritage' may not be common currency for residents, and many of them (especially newcomers) may not immediately associate themselves with the community implied by 'our'. 'Natural heritage' may be suitable for institutional processes and technical or professional reports, but it may not carry the same meaning with average citizens.

> **Recommendation:** A formal or informal survey could inform either a change in language, or development and implementation of educational materials or programs that aim to inform people about natural heritage in an inclusive way.

Part IV

Appendices

1 Accessing the Document Library and Database

The document database includes information about documents in the library (folder). PDF files in the library are named with a key that corresponds to an entry in the database. The database is stored in Bibtex format, and can be accessed using different programs, including JabRef, Mendeley, and others.

Only digital documents are included in the library; there are no physical copies accompanying this report. In some cases, only hard copies of documents were available. These were reviewed in person, and with permission, selected photos were taken of sections or pages. These were then converted to PDF and text added through optical character recognition.

Distribution of the library and database has not yet been finalized. The instructions will be updated once this has been established.

2 Media Scan File List

BRIDGES-2016-02-16-Huziak_Light_pollution.pdf

LETTER-2015-07-30-Precious_swale.pdf

LETTER-2015-08-16-Groups_preserve_swale-RESP_20150730_Precious.pdf

LETTER-2015-10-01-Pause_consider_future.pdf

LETTER-2015-10-05-Damage_cannot_undone.pdf

LETTER-2015-10-08-Highway_through_our_swale.pdf

LETTER-2015-11-12-Caution_needed-RESP_LETTER_20151001_Pause.pdf

LETTER-2015-11-12-Conserve_swale-RESP_LETTER_20151001_Pause.pdf

LETTER-2015-11-12-Protect_nature-RESP_LETTER_20151001_Pause.pdf

LETTER-2015-11-12-Start_at_home.pdf

LETTER-2015-12-19-Swale_natural_heritage.pdf

LETTER-2016-06-23-MVA_funding.pdf

LETTER-2018-09-21-Mistawasis_speed_limit.pdf

LETTER-2018-10-04-Heed_speed-RESP_NEWS_20180901.pdf

LETTER-2018-11-14-Speed_changes.pdf

NEWS-2012-11-30-North_commuter_bridge_project.pdf

NEWS-2015-10-02-Swale_Plan_cost_14m.pdf

NEWS-2015-10-06-Activists_say.pdf

NEWS-2015-10-28-Status_of_swale.pdf

NEWS-2015-11-27-Animal_bridge.pdf

NEWS-2015-12-12-Saving_the_swale.pdf

NEWS-2016-02-07-Buffer_design.pdf

NEWS-2016-06-01-Funding_Province_urban_park.pdf

NEWS-2016-10-26-Councillor_election_positions-swale_mention.pdf

NEWS-2016-12-01-Budget_competition_Swale_Plan.pdf

NEWS-2017-02-03-Keep_up_fight.pdf

NEWS-2017-02-03-Parcel_Y_condo_MVA_commuter_bridge_approval.pdf

NEWS-2017-03-17-EnhancedProtection.pdf

NEWS-2017-05-19-Freeway_preferred_route.pdf

NEWS-2017-07-15-Trail_work.pdf

NEWS-2017-10-26-Banning_dogs.pdf

NEWS-2017-12-11-SPCoT_speed_limit_changes.pdf

NEWS-2017-12-15-Provincial_leadership_MVA_funding.pdf

NEWS-2018-04-12-Highway_route_established.pdf

NEWS-2018-08-09-Sheep_grazing.pdf

NEWS-2018-08-10-CEO_hiring.pdf

NEWS-2018-08-13-Speed_limit_closed_road.pdf

NEWS-2018-08-28-Speed_trap_concern.pdf

NEWS-2018-09-01-Heed_the_speed.pdf

NEWS-2018-09-18-Grouse_mating_lek_protection.pdf

NEWS-2018-09-24-Mistawasis_speed_limit.pdf

OP-2015-12-03-Hanley_Save_the_swale.pdf

OP-2016-01-28-Hanley_Swale_citizen_science.pdf

OP-2017-03-13-Tank_Glacial_pace.pdf

OP-2017-05-29-Tank_Freeway_no_scrutiny.pdf

3 Document Bibliography

References

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