Analysis of Urban Wildland Boundaries in Shaw Wilderness Park – A Path Forward to Shaping Urban Planning Perspectives

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Section Picture 1

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Scott Inman, 2021

Section Picture: 1

Executive Summary

The purpose of this study is to investigate the relationship between the boundaries of the natural and the built environment, as the progression of development systems continues to grow. The centralized focus is on a new protected area located in Halifax, Nova Scotia, named the Shaw Wilderness Park Area. This area comprises Williams Lake, Colpitt Lake, mixed forest stands, and several other unique ecosystem features (see map 1).

The study specifically looks at the Urban Wildland boundaries around the park and the paths contained within those boundaries. The baseline data gathered in this study will help provide greater insight and understanding into the relationships between the natural ecosystem and human interactions contained within this park.

The main objective of this baseline data, accompanied by a policy review of existing Federal, Provincial, and Municipal urban-wildland management plans, is to aid in future urban-wildland planning control systems for the HRM while contributing to further landscape ecology studies and overall management purposes of the park. Moreover, it will help to highlight the contrasting interactions between the natural and the urban environments forming around it.
This includes the creation, implementation, and monitoring of urban policies and buffers. This type of continuing research will ensure that responsible, ethical, and informed planning decisions can be made in the future. Moreover, this type of planning is a catalyst to the creation of reliable infrastructure, safe communities, and healthy natural environments that everyone can enjoy.

Keywords: Urban Trail Management, Urban Parks, Wildland Management, Wildland boundaries.

Section Picture: 2

Introduction

This project was conducted on the grounds of supporting planning policies and tools for managing ecological impacts and maintaining biodiversity, along the boundaries, trails, and paths within the Shaw Wilderness Park and contiguous public lands.
The creation of these policies and tools is important from a planning perspective because Urban Parks are a complex and fragile set of individual ecosystems. As urban development expands, those ecosystems start to recede which, in turn, creates larger and better-defined boundaries around the exterior of the park. Those boundaries act as a type of transition zone between the urban and natural environment.

As these borders continue to expand deeper into the natural environment of the park, they are effectively disrupting the ecological services needed for a healthy and productive ecosystem, further illustrating the effects of mixing current urban practices with the natural mechanisms of wildland areas. As the race for urban development continues, these parks stand as the last bastions of the natural wilderness areas that existed in the times of reduced settlement in Canada (Gallo et al., 2017).

Newton's third law, the law of action and reaction, is relatively easy to envision in regards to the result of, for example, two vehicles colliding; however, this law also applies to any disturbance within an ecological area. The results of, or reaction to, the action of a disturbance is both an important mechanism for change within that landscape, and often far more challenging to project than the vehicular collision example. Both natural and anthropogenic disturbances can be the catalyst causing a reaction. A reaction that may have a positive and/or a negative effect on the landscape. It is not only difficult to ascertain which one it will be at the time of the disturbance, but also how far the impact will travel throughout the system. This cause-and-effect factor becomes especially difficult to quantify when observed over short periods. Therefore, for this project, it is important to recognize that disturbances and changes were recorded over only a short period, and were used to offer a brief perspective/insight into the ecological workings of the Shaw Wilderness Park.

Anthropogenic edges and boundaries can be seen everywhere. For example: roads, the frontier edges of privately developed properties, or urban parks within a city. Moreover, landscape ecology can be very complex. Therefore, it is extremely difficult to see the ripples that will be

caused by any impacting human force. Reactions caused by natural impacts are also extremely important ecological functions that have a profound effect on the spatial heterogeneity and health of ecosystems within the landscape. This means it is extremely difficult to know when to interfere or when to only observe.

Shaw Wilderness Park

Halifax Regional Municipality (HRM) in conjunction with the Province of Nova Scotia, the Nature Conservancy of Canada (NCC), and the Nova Scotia Nature Trust have been dutiful in working towards the goal of setting aside large parcels of government/privately-owned land around the province. In 2019, The Shaw Wilderness Area became one of those protected sites *(see figure 1)*.

Figure. 1: Shaw Wilderness Area - (Inman, 2021)

The Shaw Wilderness Park was designated as a protected area through a legal agreement between the HRM and NCC. The 154 hectares, or 380 acres, were purchased from the Shaw Group in April 2019 for $6.6 million by the HRM and NCC. A portion of the park was purchased outright, the rest operates on a 99-year lease; however, the HRM is responsible for managing and maintaining the entire park *(Gorman, 2017; Conservation Partnership, 2020.).* These protected areas are becoming an important consideration for planners and government as they search for new ways to manage and promote these essential features within a

community. As we progress, planning for adequate separation between private land and naturalized protected areas is crucial. Estimates vary, however, it is generally believed that between 65 - 75% of the province, and 85% of its coastline, are privately owned *(NSNT, n.d.)*. This is one of the highest rates of private ownership in Canada! As such, it is important not only to protect private and public infrastructure but also to ensure healthy and ethically based environmental stewardship in the future. The Shaw Wilderness Park was chosen as a specific case study on this topic not only due to the recency of its creation, but also its broad ecological structure. It includes Williams Lake, Colpitt Lake, several feeder streams, ponds, and wetlands. It has a mix of native Acadian deciduous and coniferous tree stands, that comprise mostly of early to mid-succession rates, with several distinct areas.

The Park has several marked and unmarked entrances/trails, including many ‘unofficial’ trails formed by hikers and deer. In addition, in the summer of 2019, a parking lot and gravel walking path were constructed as part of the sale agreement: Clayton Developments Limited, a division of The Shaw Group, were required to construct the parking lot/path to aid in the accessibility of the park. This path starts from the parking lot directly across from the Royal Nova Scotia Yacht Squadron on Purcells Cove Road. It winds in a Northerly direction to the South end of Williams Lake, at which point it ends and a surveyed trail begins marked with red reflective tabs *(HRM Planning Department, 2021).*

When speaking with the HRM Planning department, I asked if they had any plans in the future of expanding this path any further around Williams Lake. They communicated that there was no intent to expand the formal path for a multitude of reasons, with the main reason being that the end of the path where it meets the trail, delineates the line between the ‘development zone’ and ‘easement zone’. This means that they were able to build the path structure along the development zone that was established at the time of sale, however, the HRM was not able to infringe on the easement zone, so at this point the gravel path turns into a marked surveyed trail system. Another important aspect of this path is that the NCC audits, and will continue to audit/monitor this path into the future, however, the maintenance aspect will be conducted by the HRM.

Background

Research on the effects of development on spatial distribution and edge effect has been increasing since the early 1980s. Largely possible due to advancements in, and accessibility of, computing technologies, such as remotely sensed satellite/aerial imagery, GIS (geographic information systems), ArcInfo (geographic information system), and advancements in spatial statistical methods (Fortin & Dale 2005). This has helped ecologists to easily and effectively observe and analyze spatial heterogeneity. As a result, it opened up a new way to explore landscapes, ranging from local habitats to entire continents (Clark, 2010).

Principals of Landscape Ecology

Landscape ecology is a discipline that is concerned with the analysis of interactions between ecosystems within a designated study area. It studies the effects those interactions have on biotic[1] and abiotic[2] components within these ecosystems.

A formal definition of a landscape is best described by Thomas G. Barnes, an Extension Wildlife Specialist at the University of Kentucky. He defines it as “a heterogeneous area composed of a cluster of interacting ecosystems that are repeated in various sizes, shapes, and spatial relationships throughout the landscape.” (*Barnes, 2000*). In other words, a landscape is a mosaic of connections between habitat patches, edges, and corridors within the matrix, in which organisms move, settle, reproduce, eventually die, then return to the soil.

Common terms used in the study of landscape ecology are: The **matrix** is a portion of the landscape in which habitat patches and corridors are interspersed; **patches** are areas of a habitat that are distinctly different than its surroundings in a landscape; **corridors** are thin strips of habitat that connect separated patches within the matrix. **Ecosystem boundaries** can be areas that exhibit grades of change in abiotic or biotic factors, and; **edge effect** is the correlating response of two habitats that meet.

An important note on the topic of the ‘edge effect’ is that it becomes an undesirable condition when it supersedes that area's ability to cope with the stresses placed upon it by the composition of the adjacent areas. When an area is unable to cope, conditions may promote the migration of opportunistic species from adjacent habitats and this has the potential to disrupt the delicate ecological balance within the landscape. (*Fonseca, 2008*).

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1 living things; e.g. plants and animals

2 non-living things; e.g. weather, nutrients/minerals, and soil

The Importance of Corridors.

Wildlife corridors are normally categorized by width (among other factors). They are Regional, Sub-regional, and Local in scale. Inside these corridors, they can be further categorized by their continuity, for example being continuous or broken up in patches.

Natural or manmade corridors are important for many reasons. They increase the biodiversity of species inside separate patches within the matrix, and they increase colonization, promote migration, and reduce interbreeding. Understanding these connections is key to decreasing the amount of stress that is placed on these ecosystems. Furthermore, it is hard to ignore the impacts caused specifically by human disturbances that create greater fragmentation of the natural landscape.

These disturbances are leading to smaller patches of natural habitats, increased edge effect, and breaking the link between target patches by destroying natural corridors. The Shaw Wilderness Park is no exception to this occurrence, it exists within a system that has now been fractured by human interference.

Disturbance Regimes

Other important factors that affect ecosystems within a landscape are disturbance regimes and natural succession. In a forest, some examples of natural disturbances are: fire, wind, and erosion. Examples of human disturbance factors are: the creation of roads, logging, trails/paths, and the accumulation of garbage (Clark, 2010).

Natural succession is the process in which a landscape transforms after a disturbance or the process of renewal. There are two types of succession: Primary and Secondary. Primary succession *(see figure 2)* starts at a stage of bare rock ending in a late climax forest stand,

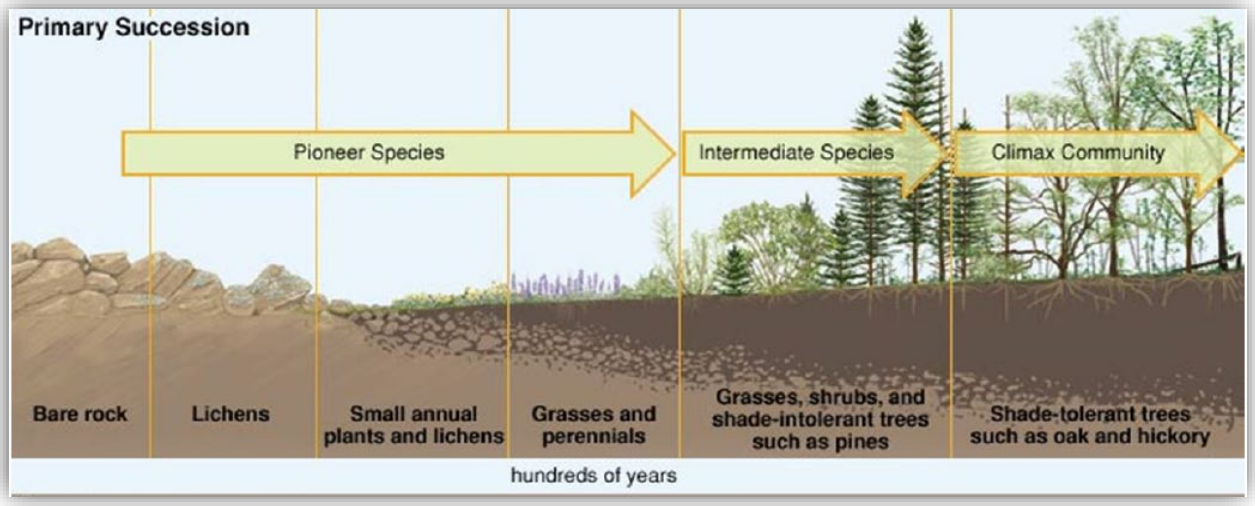

Figure. 2: Primary Succession, (Encylepedia Britanica Inc, 2006.)

comprised primarily of 'late-successional' tree species such as *Tsuga canadensis* (Canadian Hemlock). This process happens over hundreds of years.

Secondary succession *(see figure 4)* can be initiated by natural or human disturbances and happens over a much shorter period. A good example of secondary succession is after a forest

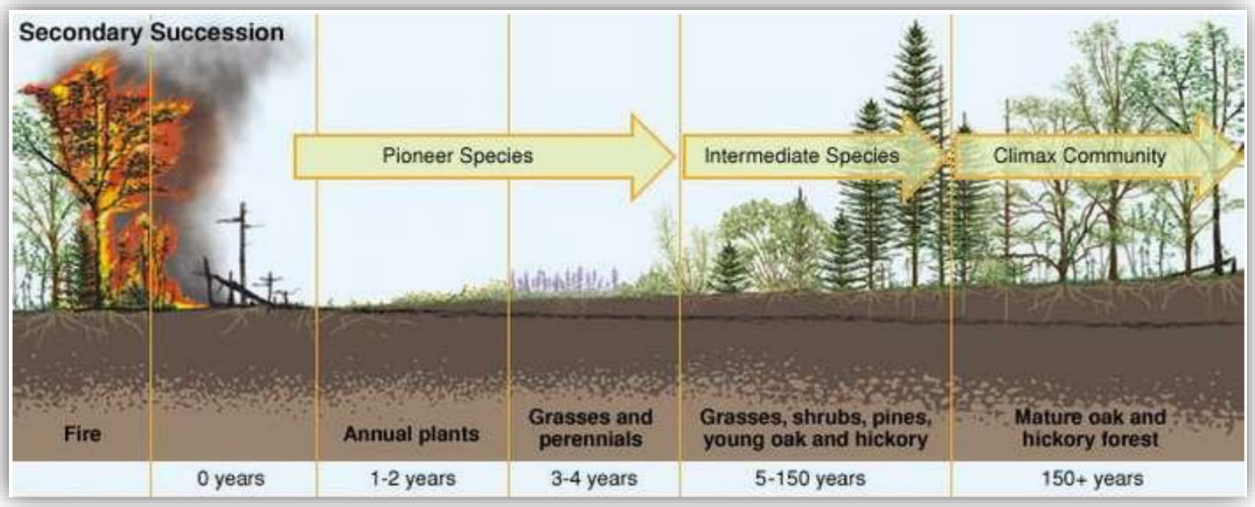

Figure. 3: Secondary Succession, (Encylepedia Britanica Inc, 2006.)

fire. Forest fires can be loosely categorized by frequency and intensity. Low-intensity fires are more frequent than high-intensity fires. One reason for a higher frequency of low-intensity fires is because they do not burn all the available fuel and the fire burns through the lower brush without affecting the higher canopy of the Forest. Therefore, the forest can regenerate faster and the cycle starts again. High-intensity fires are infrequent but burn most, if not all, of the forest organic matter, therefore the cycle takes longer to reset (Ward, 2021).

Fires are part of the natural ecosystem process in a forest and are needed to revitalize/regenerate. As a basic principle, they eliminate dead and decaying wood debris, control the growth of the understory, and reduce competition.

Why is all of this important?

The relationships between disturbances, succession, and the connections between habitat patches, edges, and corridors within the matrix are important to sustain spatial homogeneousness[3]. Disturbances can in certain cases, serve to fracture the matrix and increase the overall edge effect, however, the other factors can have as much, if not more impact on the result than the disturbance itself. For example, the relative arrangement of

3 The difference or diversity in the arrangement of component elements in a landscape.

elements plays a larger role in differentiating heterogeneity from that of diversity. It is how corridors are positioned relative to the patches that ultimately can dictate the degree of fracturing in the natural landscape (Abson, 2017; Gallo et al., 2017).

As urban areas continue to grow, they can create a stark contrast between wildland areas and developing urban environments. Unless they are managed properly this contrast will only increase until the urban environment overshadows and takes over. The beginning can be seen in the form of distinct boundaries around urban parks and protected wildland areas. This can lead to, among other effects, the creation of new corridors and the enlargement or destruction of existing ones.

Management Strategies Review

The research into the literature surrounding this project was two-fold: (1) A selective list of Federal, Provincial, and Municipal management strategies focused on those dealing with Urban Parks and Wildland boundaries located in Cities or managing Towns inside of National Parks. (2) Review of previous studies for contextual information regarding landscape ecology studies. This provided a place to start, gain a better understanding of similar projects, and streamline the data collection/processing.

HRM Parks Naturalization Strategy

On January 29, 2019, the HRM Council approved a report that gave direction to expand upon naturalization efforts within the HRM (*Halifax Regional*, 2019). It was titled the '*HRM Park Naturalization Strategy Recommendation Report'.* This report outlined directions for a two-year pilot project with the support of volunteers for the naturalization of rights-of-way and parks that have been difficult to maintain in the past.

The HRM has had several isolated projects in the past aimed towards this goal; however, it was not until the 2019 report, that a coordinated and combined effort was put forth. This was an important step forward towards developing management plans for wildland parks. Although it is not specifically aimed towards the Shaw Wilderness Park, many of these remediation strategies and methods outlined in the report can be used to properly manage this park in the future (*Halifax Regional*, 2019).

The HRM has been creating many similar initiatives regarding ecological protection for both private and public lands. Some of these initiatives include HalifACT which is a region-wide

naturalization policy/plan to address issues such as climate change, ecological resilience, and biodiversity for the next 30 years.

There is also 'The Pollution Source Control Study for Lake Banook & Lake Micmac'. This was a study approved in September 2020 that deals directly with stormwater management and erosion control surrounding these lakes. Moreover, the HRM has created a page on their website that explains why naturalization is important (*HRM Naturalization Website*, 2021).

This webpage uses a GIS map that shows current and future naturalization projects within HRM. While scrolling around this map, projects can be pulled up for information and area descriptions of the 26 individual areas listed. This is a very useful tool for creating community engagement, encouraging public curiosity and garnering public support.

Province of Nova Scotia

In 2011, the Province of Nova Scotia released "*The Path We Share, A Natural Resources Strategy for Nova Scotia, 2011-2020"* (*Provincial Parks Strategy* | *Novascotia.Ca*, 2021). Outlined in this strategy are 3 initial phases: (1) consultations with Government Departments, NGOs, and Recreational Organizations; (2) facilitate community engagement sessions for Municipalities, local groups, and the general public; (3) research into how these parks are being used (*Provincial Parks Strategy* | *Novascotia.Ca*, 2021). The Nova Scotia Department of Lands and Forestry is responsible for 300 provincial parks and park reserves. The Path We Share Strategy identifies five important goals for success: "Shared Stewardship; Far-sighted Planning; Protection; Education; and Recreation" (*Provincial Parks Strategy* | *Novascotia.Ca*, 2021). These initiatives are centred around public involvement with the Department of Natural Resources, setting public consultation as a priority.

Province of Alberta

The Provincial Government of Alberta has moved away from a localized management regime to instead adopt a new strategy of connected landscape management systems. A recent project analyzing land use impacts was titled "The Landscape Patterns project" (*Landscape Patterns Project*, n.d.). It was in collaboration with Western Canada, Northwestern United States, and Alberta (*Landscape Patterns Project*, n.d.).

They assessed the overall connectivity of management areas, versus using an individual approach to conservation and protected areas. This enabled the Alberta Government to analyze and create a Region-based plan that addresses the needs of these areas while ensuring the relationship support provided by adjacent landscapes and their connectivity would not be lost.

The project was conducted in two phases: (1) anthropogenic land-use effects research in North America and Alberta and; (2) using that research to design strategies to manage and mitigate negative environmental impacts (*Landscape Patterns Project*, n.d.).

United States Federal Trail Management

The United States Department of Agriculture Forest Services has a “Trails Management Tool” located on their website. It includes such sections as “Trail Fundamentals and Trail Management Objectives” (*Trail Management Tools*, 2018). It is a comprehensive list of information regarding trails for land management purposes. This is an example of providing knowledge in a trickle-down system. It empowers Organizations, Municipalities, and States or Provinces by providing reliable information in which to design proper management strategies. This simple, yet effective tool, can be used on many levels. On a large scale, it can be used Federally to assist Provincial/Municipal Governments, since Federal agencies have access to greater resources and larger budgets. On a small scale, a tool like this can be tailored to create public or organizational stewardship with the passage of reliable and accurate information.

Management Strategies Observations and Conclusions.

The salient points regarding the three levels of Governmental strategies, involving nature conservation and ecological Parks management, have mandated that public engagement is a top priority in implementing short and long-term approach systems. This indicates that public interest and engagement have been identified as crucial elements of success in the management process.

As these parks are transforming from the pressure exerted by urban development, park usage and public needs are also having a profound effect on this transformation.
These are important tools in the management process as they promote public stewardship, forge partnerships with outside organizations, and create benchmarks for which to measure and control management systems.

Published Journals

The two Journal studies that stood out in the process of this review were set in Eastern Asia and Northern Canada. One looked specifically at the effects of power line corridors and the other was recording the effects of seismic line disturbances in the Canadian Boreal Forests of Northern Alberta.

Evaluating Forest Clear-cuts as Alternative Grassland

The title of this study is “Evaluating forest clear-cuts as alternative grassland habitats for plants and butterflies”. The research centred around the risk of invasive non-native species and the creation of negative biological effects as a result of a high degree of cleared areas. This type of disturbance has adverse effects on plant species, specifically trees, when edges at the borders of wilderness patches and corridors are created through the natural landscape.
Determining the main factors affecting the landscape's ecology in those cleared areas and contrasting borders is important. This ranges from plants and insects to the complex relationships between predators and prey; however, for this review, the focus is on trees. Finally, this review also examines the use of clear-cutting as a viable substitute for the creation of semi-naturalized grasslands, in an attempt to offset the receding natural grasslands in Europe and Eastern Asia. This is used as a comparison to create a balanced introspection into the topic of human intervention. Many reports contain the narrative that development can only be a disruption to natural functions; however, this study looks at whether development may also be planned in conjunction with natural factors to positively influence the surrounding ecosystem (Ohwaki et al., 2018).

Edge influence of low-impact seismic lines

This study is titled: “Edge influence of low-impact seismic lines for oil exploration on upland forest vegetation in northern Alberta (Canada)”. This study is centred around low-impact seismic exploration in Northern Alberta. Seismic is a tool used to find and manage oil and natural gas deposits in the energy trade. There have been multiple studies into the edge effect of seismic paths cut through Canadian forests, especially in Northwestern Alberta and the Northwest Territories (Dabros et al., 2018). Many of these studies have been sponsored by energy companies, showing due diligence towards environmental management/sustainability.

Originally seismic paths were created by deploying heavy equipment to cut large cleared paths through the forest up to 20 feet in width, scraping deep into the soil horizon to permit vehicle

access (Finnegan et al., 2018). Once those paths have been used, in most cases for only one winter season, they would be covered over and left to regenerate (Finnegan et al., 2018). This technique has an extreme effect on understory growth and soil conditions even years after the reclamation process has been initiated.

Cleared paths continue to be required for equipment access, however, companies have started to employ new methods that limit the environmental impact/footprint, such as cutting only 3-meter-wide trails and placing skid feet on the bottom of the cutting blades to reduce soil disruption. However, this still has direct impacts on the foraging capability of animal species that rely on this vegetation and creates further fragmentation and disruption to the landscape (Finnegan et al., 2018; Dabros et al., 2018; MacDonald et al., 2020). These types of disturbances also create an unnatural movement of flora and fauna. Specifically, they add areas of open ground with very little natural competition to invasive species that tend to thrive in these types of environments (Dabros et al., 2018; Çoban et al., 2019). Moreover, as the landscape becomes more fragmented, it, in turn, isolates plant and animal species which creates a lack of genetic diversity, increased interactions with humans, and higher amounts of exposed edges (Pearson, 2013).

The main similarities found in the research methods were the usage of: (a) transects to track change from different types of disturbances, (b) GIS mapping, and (c) Multivariate Analysis of Ecological Data using software such as CANOCO 5 (Clark, 2010; Çoban et al., 2019). However, the size of the study areas differed considerably, ranging from trails that were 20m to 600m (+) in length and areas from 1 km^2 to 300 km^2. Other key differences found between the studies on seismic lines and power corridors, were the times of year the studies took place and whether or not soil samples were taken. This is an important factor, as the health of the soil as a result of disturbance can be drastically affected, including its ability to hold/release water, its level of compaction, or its ability to decrease latent heat loss. Only one study, (Dabros et al., 2018) listed the importance of taking soil samples to reinforce their conclusions. However, the ultimate common question asked, in the end, was: “do they return to a naturalized state post-remediation?” (Dabros et al., 2018; MacDonald et al., 2020).

Section Picture: 3

Project Purpose

The purpose of this research is to support the development of HRM planning policies, physical design, and intervention tools for environmentally sensitive areas. This will ensure adequate protection for both urban wildlands and the adjacent communities, while creating a baseline data set as a monitoring tool. This will enable future research to quantitatively measure the progression of human interaction and general use of the park.

Project Scope

The scope of this project is to assess the impact of change caused by urban interactions; along the surveyed, developed (paths), and naturalized trails (animal/human) that exist in and around this park. The area covered by this research extended from the South contiguous urban/conservation lands that surround Colpitt Lake, Northeast in a circular pattern to where the park meets Purcell's Cove Road and the Southern end of Williams Lake *(see figure 4)*, around the border until a complete circle of the park was completed.

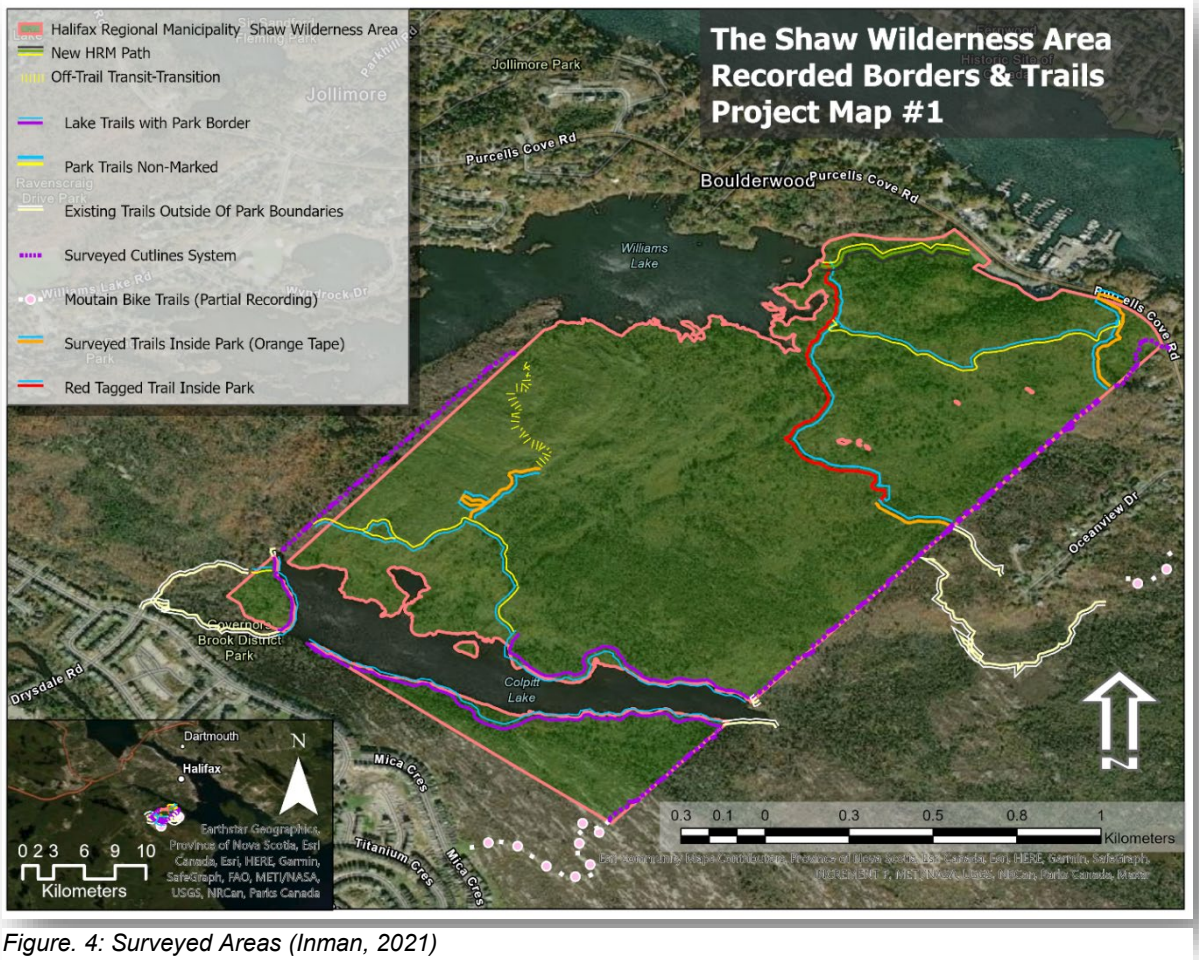

Figure. 4: Surveyed Areas (Inman, 2021)

The Shaw Wilderness Area has many trails that spider throughout the interior of the Park and surrounding area, they range from trails with flagging tape to barely noticeable deer trails. Therefore, not all of the trails that exist inside and around the park were recorded in this study

Objectives

- Define and characterize the boundaries around the park.
- Identify types and the extent of impacts along these boundaries.
- Identify edge management policies and tools used in other jurisdictions with potential relevance to the HRM and case study area.
- Identify HRM policies and tools for managing the urban-wilderness interface including protection, maintenance, and buffering for these areas.
- Create a data baseline as a tool for future research and management.
- Recommending additional tools for managing the edge environments of the Shaw Wilderness Park and Colpitt Lake area

Research Questions

- What are the effect of human interaction on this park to date?
- What types of disturbances have been created both naturally and by human interaction?
- Is there a greater impact by humans on marked and unmarked trails versus formally constructed paths?

Project Methods

The research began in early September 2021 and consisted of two phases *(see figure 2 for flow chart)*. Phase one: the collection of data consisted of assessing the changes in the composition of tree species, disease, level of succession, erosion, windthrow, and any other noticeable impacts on the environment, such as garbage, firepits, and camps. This analysis will further define geographical points to broaden the identity of edge development characteristics and trail formational impacts as it relates to the park boundaries.

To accomplish this a collection of ground and aerial reconnaissance to define and measure the set boundaries of the park was recorded on a paper checklist at 50-meter intervals. These sheets formed a dataset baseline, created a framework, and set parameters in which to operate this study. The spatial analysis with the use of ArcGIS further defined these boundaries and

paths, as they are a mix of difficult to distinguish boundaries on some trails, and more defined boundaries, such as surveyed cutlines where the park meets hardscaping and private lots.

Phase two: consisted of a review of HRM policies and guidelines regarding planning interventions. More specifically: the HRM Green Network plan, HaliFACT, and individual land-use bylaws. These are centred around public infrastructure, privately owned properties, and other Federal/Provincial wildland management policy and planning tools.
Looking at all three levels of park planning from a top-down perspective was an important step in this process, it allowed for a complete picture of management styles, needs, and perspectives. The size and scope are different between all three levels of Government; however, many of the principles remained constant.

Sources of Data Collection

- Review of literature for contextual analysis and examples of management/policy tools.
- GPS (Global Positioning System) and Paper Checklist
- Unmanned Aerial Vehicle (UAV).
    - The use of a UAV will be used to collect aerial photography and reconnaissance when conditions are suitable for use.
- GIS (Geographical Information System).
- Municipal Survey Maps and Most Current Topographical Maps.

Main Data Collection Source

The primary data collection for this study was obtained from the 50-meter interval checklists *(see table 2)*. This process involved the use of a handheld GPS unit and a paper checklist recording sheet. The sheets comprised four sections and 25 sub-sections. The four main sections were: the composition of the border, trail, or path; types of ecosystem characteristics and; the types of natural disturbances or anthropogenic disturbances. Sub-sections under each of these main sections helped further define that section with details such as predominant tree type, terrain, understory thickness, and garbage. Each interval was categorized and logged based on this criteria, with new intervals repeated every 50-meters for the 19.8 km of trails, paths, and cutlines that were surveyed on this project.

Data Collection Notes

This study took place over several months during the Fall resulting in possible inconsistencies in tree identification due to factors such as falling leaves, light conditions, and haste. There are little to no errors in tree genus identification, however, some species of tree within the genus may have varying degrees of deviation. For example, Maples, genus (Acer), are identified correctly, whereas there may be some discrepancy in the species (Red, Sugar, Mountain Maple). Moreover, there was also the added issue of accuracy in determining the rate of succession, terrain, and consistency identifying disease, for the sake of expediency. Therefore, it was decided that some information would not be included in the main sections of the report. This data would still be included in the appendix (see the appendix for additional information) as it will still allow future researchers who are looking to catalogue specific landscape features or characteristics the ability to narrow their initial search results and shorten the overall time spent on the initial project location planning.

Since many of these areas have stunted tree stands due to fire and windthrow, no trees were recorded under four-five feet in height. This criterion is not perfect since some of these areas are changing in forest composition from natural disturbances which have reset the natural succession rate. However, it was an important control measure so as to not inappropriately miss-identify an area with non-consistent results, e.g. seedlings that will not reach maturity or some that might be missed in the counting process.

ArcGIS

Several geospatial layers are created showing a record of travel throughout the park and surrounding landscape, both from the checklist and non-recorded travel. The non-recorded Geo-points were set at approximately 15m intervals on the GPS, those shorter track intervals show a finer scale of the surveyed paths, cutline borders, and several of the vast network of unofficial trails located in the park

Section Picture: 4

Results

What is the Effect of Human Interaction on this Park to Date?

The human recreation activities are heavily concentrated in distinct sections of the park, while the center seems to be largely free from the impact of human activity. There are small, isolated areas that have had heavy impacts from anthropogenic disturbances such as firepits and campsites but these mainly have a small footprint in relation to the park size. However, the impacts from these disturbances will continue to expand if left unchecked.

One of the first recorded impacts in this study came from the newly built path leading from the parking lot to the South end of Williams Lake (see figure 5). There seems to be strong evidence of a correlation between greater human impacts/disturbances on the marked trails versus the newly constructed path *(see figure 6 & 7)*. The trails that start at the end of the newly constructed path are marked with small red reflectors *(trail denoted in red, see figure 5)*. Roughly, this trail travels from the end of the new path, through the land area East of the Park center, where it transacts with the middle of the South cutline (this becomes a junction of orange and red survey taped trails spreading in multiple directions).

During this study, the newly constructed path showed no signs of garbage, firepits, or any other human disturbances, other than what had been created by the construction process.

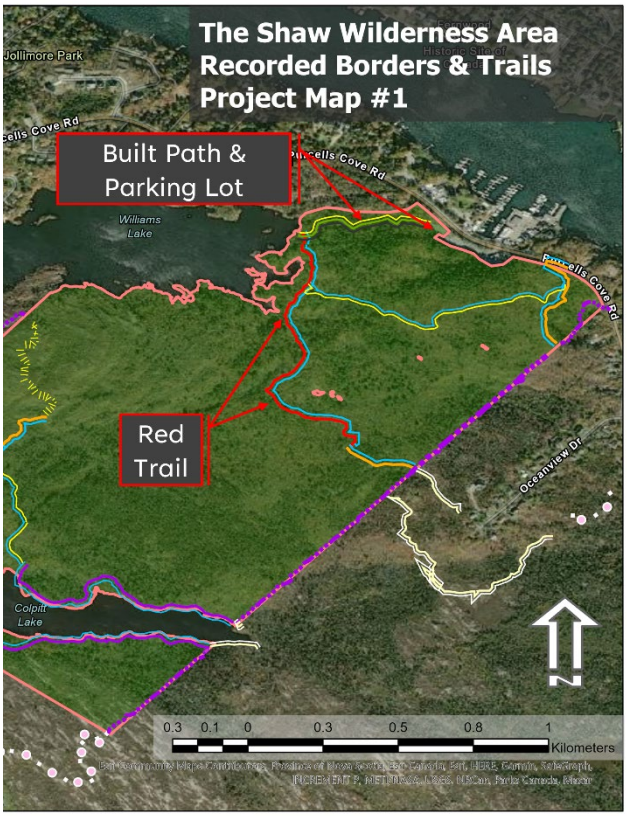

Figure. 5: Red Trail & Built Path - (Inman, 2021)

When compared on paper, the built path would have a larger footprint of disturbance, combined with a higher and more diverse concentration of use. Therefore, from that single matrix criteria, it would have higher frequencies and severity rates of disturbance. However, the data shows that the marked trail has higher rates of anthropogenic disturbances versus the formally constructed path.

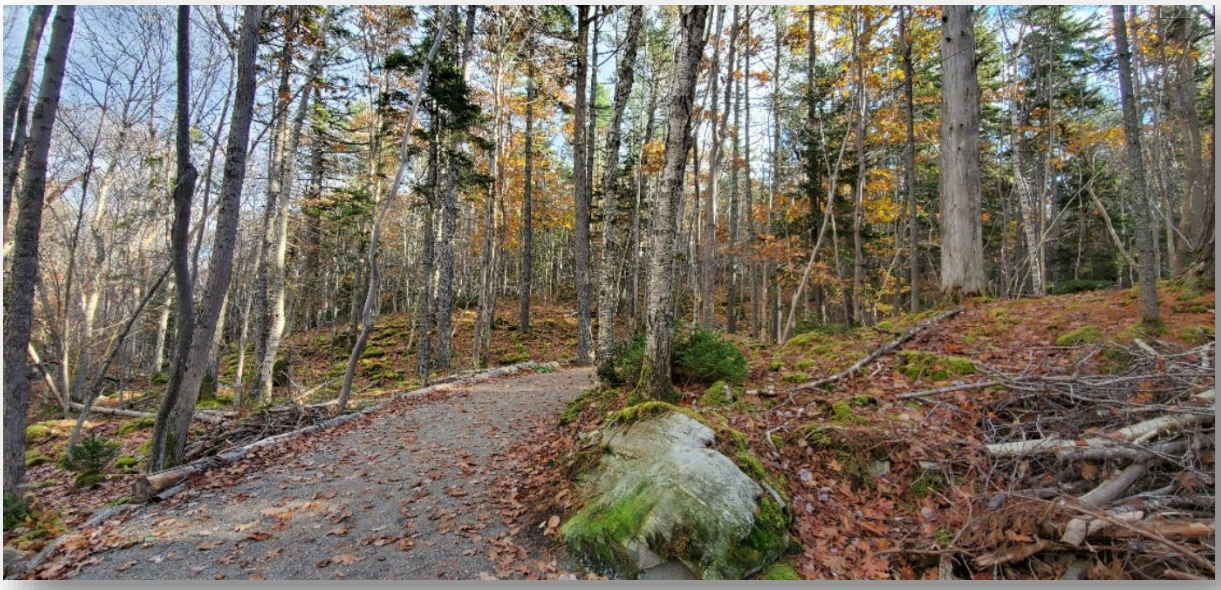

Figure. 6: Built Path Perspective - (Inman, 2021)

This is likely caused by many factors, such as time of year, age of construction or previous impacts prior to the formal path being constructed. However, I believe the main factor is due to human sociology, in which people tend to choose the path of least resistance when travelling through an area. This phenomenon is often seen in urban parks when the form of the designed paths/sidewalks traverse through grass or naturalized areas contradicts the function desired by the population (the shortest path between point A and point B). The result, in most cases, is new trails being blazed between paths/sidewalks, born through a desire for efficiency.

Case in point, what has been witnessed by this principle, is that it has made the marked trail, which is 2-3 feet wide, considerably wider in terms of impact than the 8-foot wide formally built path. As a result, in many places along the red marked trail, there are numerous offshoots running parallel to the primary, all reconvening hundreds of feet away to create a single trail again.

Figure. 7: Red Trail Disturbance - (Inman, 2021)

Upon closer inspection, it shows a trend of people trying to avoid a low-lying area that has become flooded or a tree fallen from storm damage that is blocking the original trail. Due to this, the imprint from the marked trail is, in certain cases, 2-3 x wider than the formally built path. This, in essence, equates to a higher rate of disturbance on the natural ecosystem along the trail versus the path. However, it is very difficult to compare these two straight across the board. The 8-foot wide crusher dust/gravel built path has a high contrasting footprint from the surrounding environment, but the disturbances are uniform on the path and will likely not expand over time. The marked trail blends into the surrounding environment; however, it will continue to fluctuate, growing in size or moving into other areas and then receding.

What types of disturbances have been created both naturally and by human interaction?

This park has had many disturbance impacts over recent history. The landscape is pocked with areas of natural disturbances such as forest fire, flooding, windthrow, and erosion. However, there are also signs of human settlement from the 1800's, such as mining for granite and Military activity (Groat, 2016). The more recent activity is in the form of campsites, firepits, trail making (bridges, cut trees, soil compaction). Several of the surveyed cutlines have had multiple surveys in the recent past which has destroyed understory and forest growth each time a new survey was conducted.

The Southern corner of the park *(see figure 8)* has been heavily scarred by human activity (e.g. mountain bike trails) and affected by previous forest fires *(see figure 9)*. The concentration of urban development lies outside of the

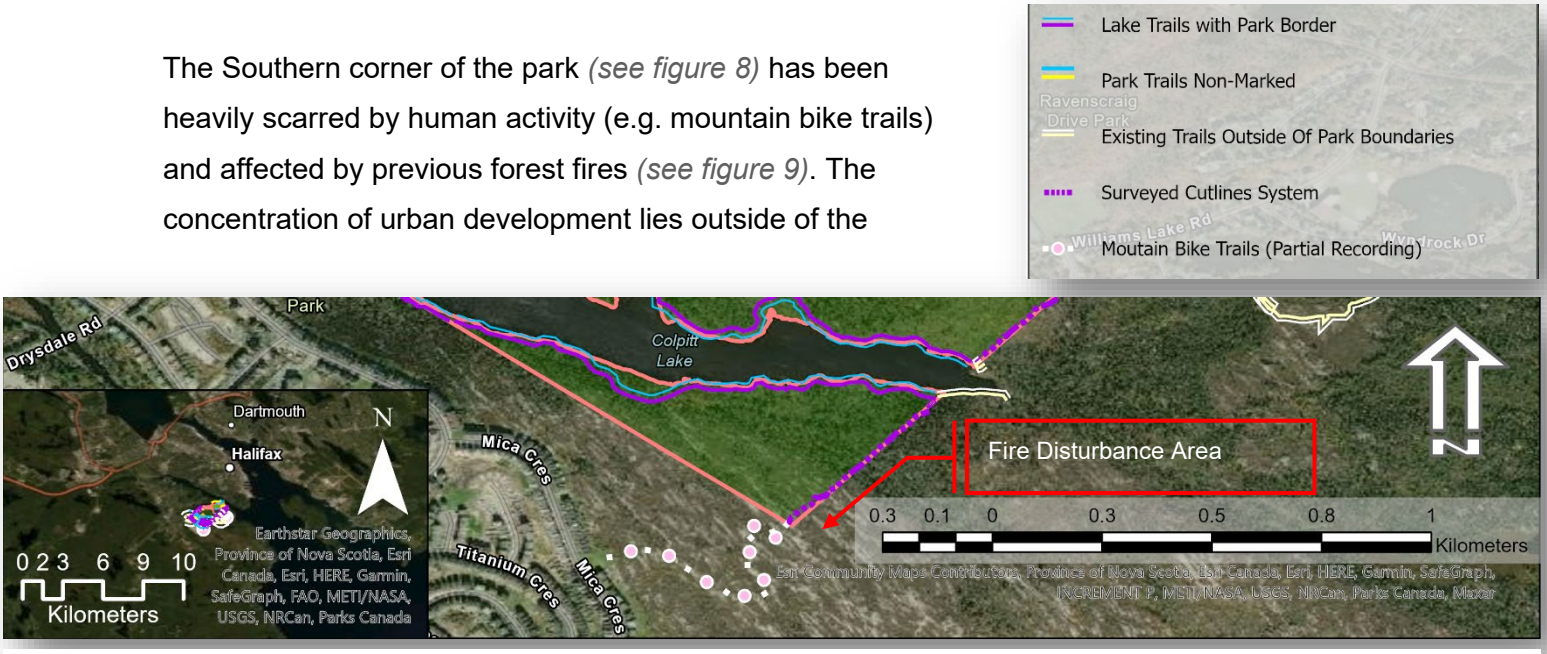

Figure. 8: South Cutline & HRM Conservation Area (Inman, 2021)

boundaries of this park, and therefore not within the scope of this study; however, it is important to note that the contrasting urban settlement (relatively new sub-division) borders another

conservation area in the HRM (The Backlands Conservation Area) which is connected to the Shaw Wilderness Park.

Figure. 9: Fire Disturbance, End of Park, South Border - (Inman, 2021)

It is this section of the Backlands and Park that is adjacent to the highest degree of both urbanization and contrast between borders, as well as features sensitive to ecological disruption. Moreover, this southern section of the Park extends into a large area covered by previous forest fires.

Many of the landscape patches have reverted to a state of early succession, where a large portion of bare bedrock has become exposed. Between these areas of exposed bedrock are deeply furrowed transitions that contain microhabitats with features such as wetlands, swamps, lichens, pioneer grasses, and unique voids where animals create dens.

Moving through this area it becomes apparent that even the smallest amount of foot traffic into these microhabitats would have large and lasting effects on the ecology of this rejuvenating landscape.

This area is also significant for the sheer volume of mountain bike trails, winding throughout, creating a network of trails in Backlands that border the Park limits. This extensive network is a hotspot for human activity. Frequently while transitioning through this area within one-hour periods, numerous biker/hikers were witnessed moving throughout these trails. In some cases

(myself included) moving between trails, trying to wayfind/reconnect back onto the passage of a marked trail. The sheer concentration of exposed bedrock in this area and the lack of forest makes for greater ease of movement; however, marking and ensuring public stay on the marked trails is extremely difficult

The Northwest section of the park *(see figure 10)*, like the Southern section, has suffered from previous fire disturbances but has a smaller degree of human impact versus the South section. This is the advantage of very limited access (roughly one-kilometre distance from vehicle parking), less foot traffic and being buffered from the urban environments by lakes on two sides. Furthermore, many of the trails in this area have small loops or become dead-ends as they travel towards the center of the park. This forces hikers to backtrack or circle back to their starting point as there are no direct routes to the other side of the park or surrounding urban environment.

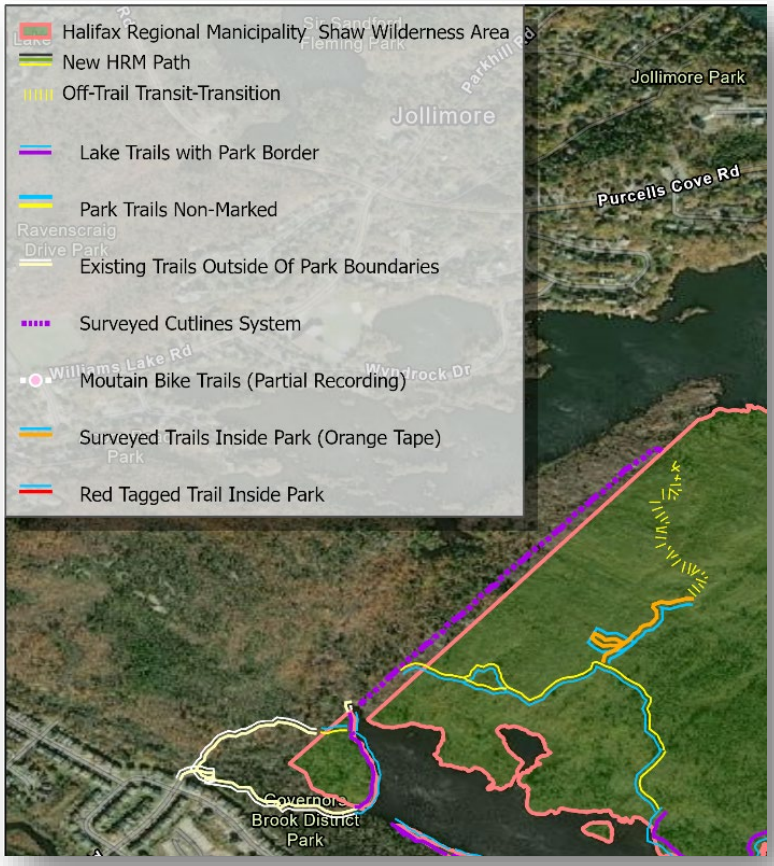

Figure. 10: Northwest Cutline - (Inman, 2021)

As outlined above, this contrasts the South corner of the Park where a multitude of trails link entrances along the urban corridors/borders and diverge on each other. This means access in and out of the park in the Southern section is quick and easy but the North section takes some planning/commitment.

Other important features to note in this Northern area were the size of fire pits and the surveyed cutline. The fire pits were found along the surveyed cutline and were 3 to 4 times the size of others found within the park. In some cases, 5-foot-long sections of trees were burnt in circular fire pits. In one instance there was a tree fort found 100 feet from the largest pit, just outside the cutline marking the edge of the Park.

Is there a greater impact by humans on marked and unmarked trails versus formally constructed paths?

There is evidence which points to a greater impact on marked and unmarked trails throughout the park; however, since the formal gravel path is relatively new in construction, further observation and recording is needed to make a definitive conclusion.

As stated previously, there was less human impact from garbage, firepits, and campsites along the formally built path. Another possible factor affecting this hypothesis is a greater rate of surveillance along the formally built path. The term surveillance is not referring to remote cameras or the presence of security personnel, but rather to the higher rate of foot traffic along the new path, versus the trails that spider throughout the park. On the 20+ trips made to this park during the study, there were a minimum of 3 vehicles in this parking lot at any given time, whereas days could go by before seeing someone, on any of the trails or cutline (in some cases never seeing anyone), but the evidence of recent human activity was still strongly evident despite their absence. The higher rate of visitorship born from better vehicle access and a greater degree of accessibility for everyone, acts as a surveillance system because it encourages people to act within certain social norms. It is posited that this may also be a reason behind the larger human disturbances (fire pits, camps) observed in the more remote Northern area of the park. If there is a lower chance of being observed, there is less drive to adhere to those social norms[4].

Shown in *figure 11* are the recorded Human disturbances denoted as red circles on the map.

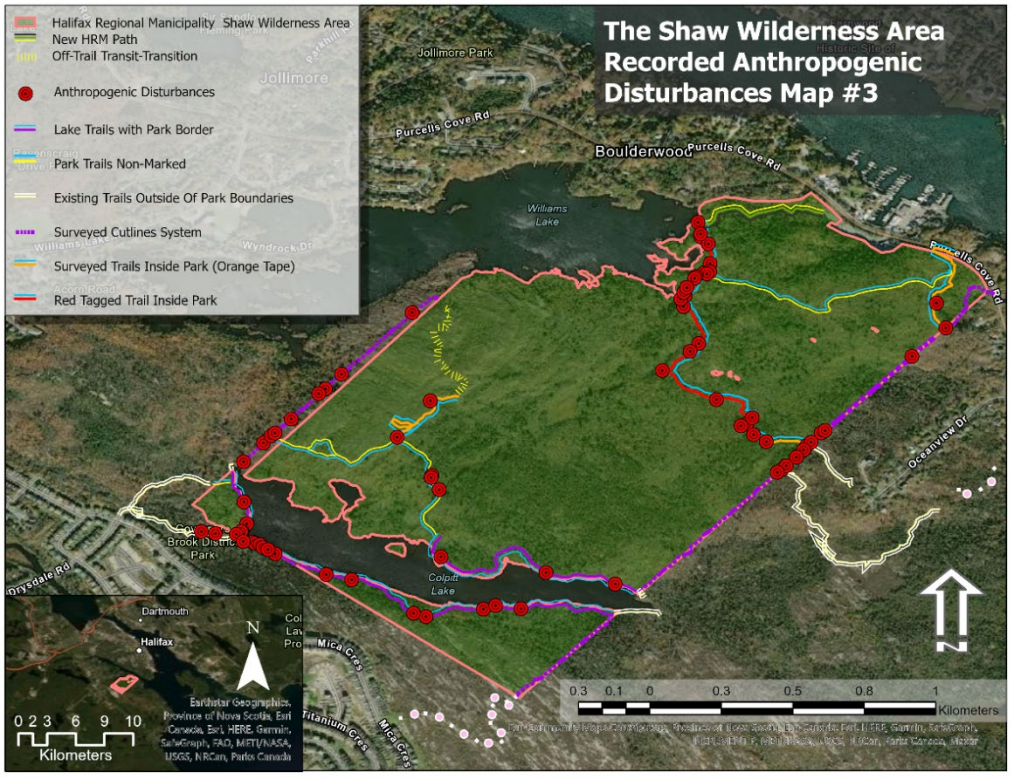

Figure. 11: Anthropogenic Disturbances - (Inman, 2021)

[4] Social norms, the informal rules that govern behavior in groups and societies (Bicchieri et al., 2018)

Figure 12, shows the recorded natural disturbances found during this study.

Figure 13 shows the relationship between Human and Natural disturbances. This data suggests that there is a connection. When this data is compared side by side, it shows a higher degree of natural disturbances within the highest concentration of anthropogenic disturbances. Furthermore, it also defines the link of disturbance regimes with the proximity to ingress and egress locations (larger example photo located in the appendix).

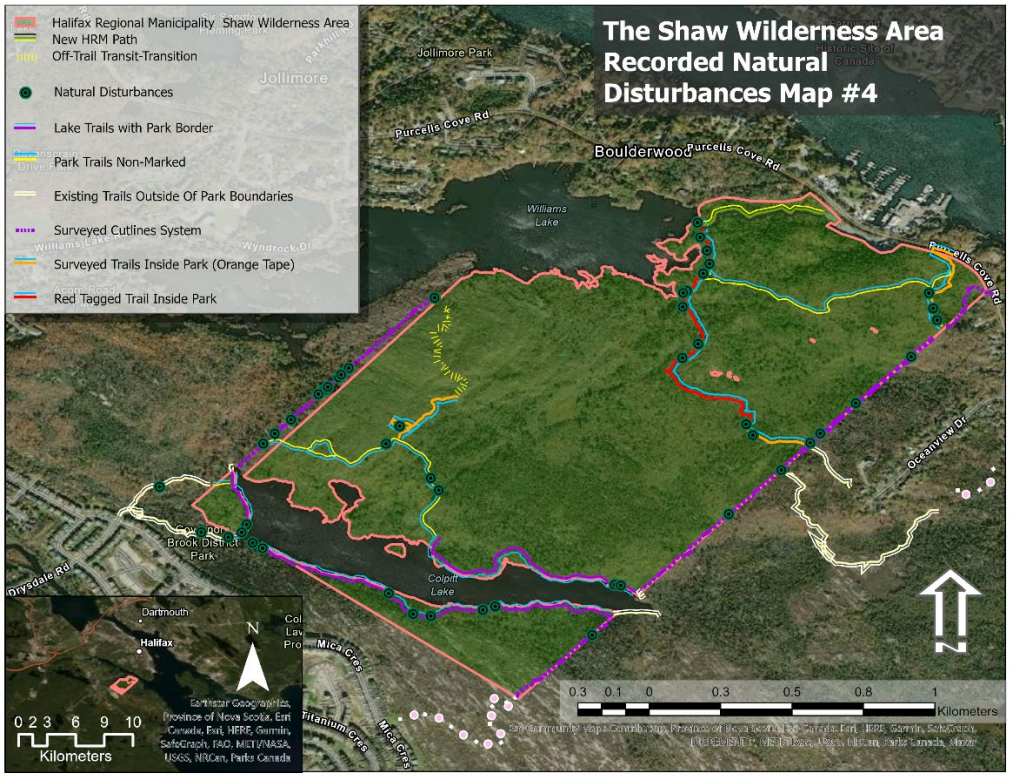

Figure. 12: Natural Disturbances - (Inman, 2021)

Figure. 13: Disturbance Connections - (Inman, 2021)

Figure 14 shows the total amount of disturbances recorded, broken down by individual category.

Anthropogenic Disturbances Recorded								Natural Disturbances Recorded						
Human Trail Crossings	Garbage	Firepits	Domestic Animal Waste	Campsite	Trees Cut For Trail Maintenance	Soil Compaction	Total Disturbances	Windthrow	Issues Related To Drainage	Deer Crossings	Fire Disturbances (Not Lrg Area Fires)	Major Errosion	Flooding	Total Disturbances
36	40	8	2	2	5	31	124	24	5	13	9	15	5	71

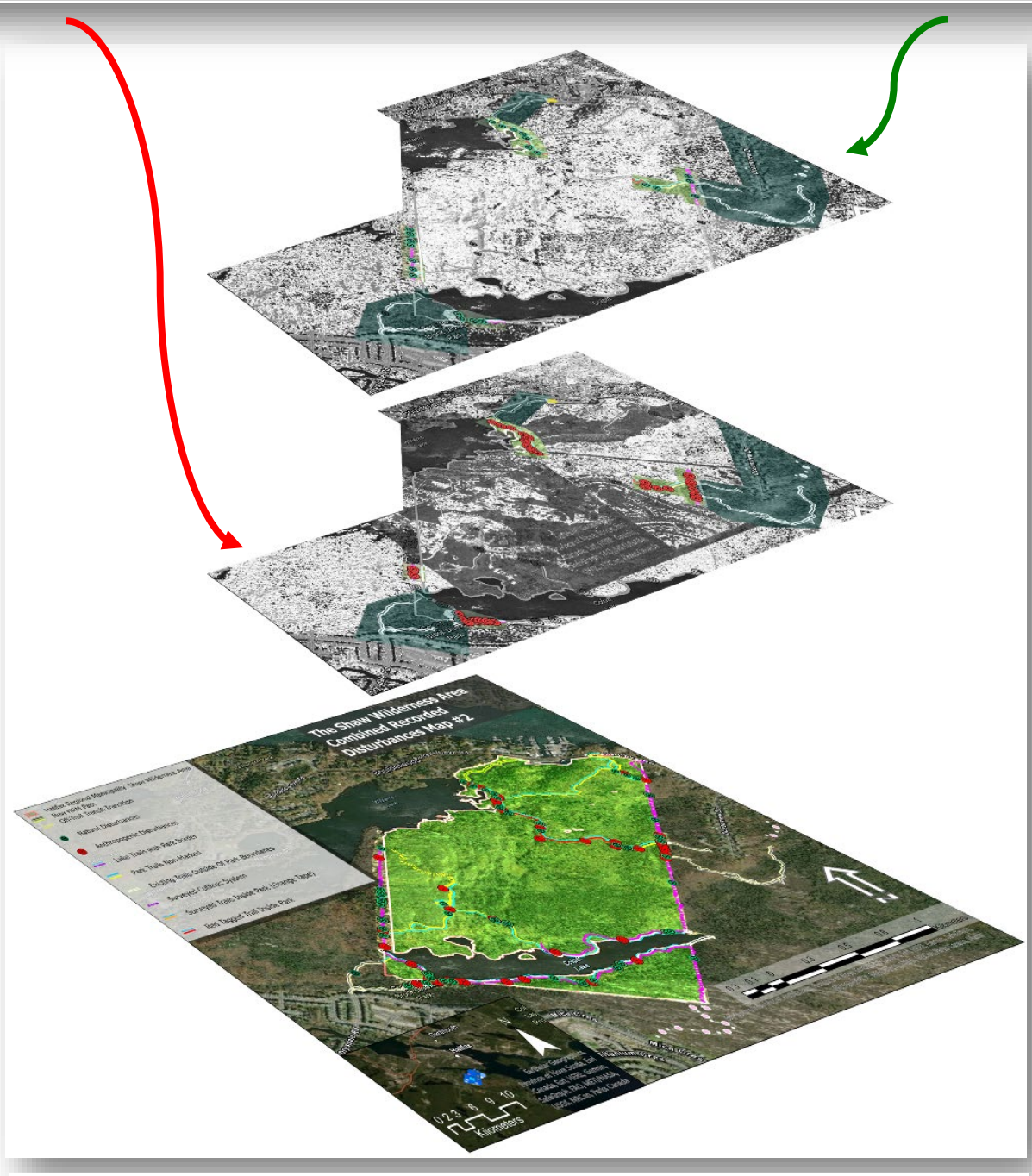

Figure. 14: Disturbance Tally - (Inman, 2021)

Discussion

It took a process of many weeks of trial and error to fine-tune the data recording sheet to be usable in GIS, finally resulting in converting to a mostly binary recording system to allow for proper representation in GIS laying systems. Once this was accomplished, the results became easier to decipher. In the end, the average time per 500-meters distance while recording was approximately 55 minutes. This may seem like a short period but when factoring in the length of day and temperature in the Fall, it created an ever-shrinking window of data collection time. Some windows suitable for the collection of data were as short as 4-hour per day and only two days a week (due to heavy rain and/or winds).

OBSERVATIONS

This list is comprised of the more notable observations based upon the data and general perceptions during the study recording process.

Path Versus Trail

The ultimate question becomes: will those areas that are in the fluctuation zone of the trail return to a state of normality, or continue to be scarred after the trail increases or recedes? An analogy of this situation may be the effects of ocean tides along a beach, when the tide comes in it changes the land composition, and when it recedes, it leaves organic material and garbage in its wake.

The best long-term solution to mitigate disturbance factors would be to know what will be the resulting severity of the impact and where it will occur. Planning and knowing where that disturbance is going to be (since it does not fluctuate), could be conducive to a long-term management strategy. Compared to a fluctuating trail that moves through sensitive areas. Meaning the path is still a large disturbance but it is uniform and predictable and therefore, manageable.

Remoteness of Trails

Having more public trails will force people to obey societal norms; however, this type of ‘passive public surveillance’ will not solve some issues, especially the more serious ones. Moreover, the social obligations felt by individual users will tend to impose restrictions on less serious offences such as littering, fires, and the consumption of alcohol, etc. Generally, society does not condone this type of behaviour publically, especially with the recent green conservation revolution.

This obligation forces individual users of the Park to think twice about leaving used dog waste bags along the trail, throwing out food packaging, giving up easily when looking for a miss-thrown dog toy, and preventing dangerous homemade firepits. Whereas, without this surveillance on the more naturalized trails, as a result, there is less accountability for the actions of users. This leads to graffiti, high rates of littering, overnight camps, firepits, the senseless destruction of the landscape, and any otherwise damaging acts as a result of human use. Arguably, there are not very many people that set out with the intent to destroy or disrupt these natural environments. Many users have the 'best intentions' at heart and do not want to see these areas be disrupted, however, with increased activity, every small impact collects and makes up a concentrated problem, and this concentrated problem is creating lasting impacts.

Southern Border

Marking trails in this area is not the same as in the wooded areas of the park, in the wooded areas you can simply place markers at eye level and there is a contrasting edge on trails to guide people between those markers. In this area filled with bare bedrock and nothing over 10 feet high, trail marking consists of placing 4 foot high posts with trailhead markers and spray painting arrows on rocks, but between posts (some more than roughly 200 feet apart) there are little to no signs that you are on a trail at all.

Furthermore, the network of mountain bike trails continues through the Backlands parallelling the Southwestern border of the Park, while continuing to fracture as it transitions from the firescape into forest cover.

This area becomes a natural choke point because of the topography/angle of Colpitt Lake and the urban boundary. Moving in a Northwesterly direction these angles start to converge. This sandwiches the Backlands between the urban environment and Colpitt Lake which serves to concentrate many mixed-use trails to the point of heavy human disturbance. It is not uncommon in this area to walk no more than 30 feet in any direction without stumbling along heavily urbanized walking/mountain bike trails, large amounts of garbage and graffiti, evidence of recreational swimming (swimwear left behind), firepits, and transient campsites.

Therefore, this is another example of conditions seen on the red marked trail in the park and yet another example of trail identification being at the heart of limiting human disturbance impacts.

Northwest Border

One of the more puzzling discoveries during the gathering of data was along the surveyed cutline along the Northwest border, as it showed signs of acting as a fire break. Fire breaks are commonly used in control areas across Canada, such as Canadian Forces Bases or National Parks, and generally consist of a large trench (much wider than deep) that is filled with sand to stop fires from jumping to adjacent areas. However, this cutline is not wide enough to create a break in the fire, nor is it composed of any noncombustible material, such as sand. Instead it is merely a cutline marking the edge of the Park property, no more than several feet in width, and covered by normal forest ground cover. Currently, I have no explanation for why the fire stopped along this line and shows no sign of scorched earth directly adjacent to this cutline.

Recommendations

Presently, the HRM has set forth numerous planning initiatives/policies towards future conservation, naturalization, and green connectivity e.g. the HalifACT. These strategies are a progressive step forward and will act as an umbrella for the ecological protection of this park. It is also an important step towards unifying urban park planning. All too often, at all levels of government, conservation and green planning do not leave sufficient overlap between individual plans, or lack consistency and standardization over large areas of landscape planning.

For example, the City of Vancouver, British Columbia has a vast network of city-owned parks that have been cobbled together over time, lacking strategy or common direction. This has created many issues and has resulted in a very complex relationship between the parks and urban areas, especially now that land has become a premium in the city (Takyi & Seidel, 2017).

The HRM is growing rapidly and, due to geographical limitations/restrictions, urban expansion can only grow in certain areas. The Northwest Arm, Halifax Harbor/Peninsula, and terrain are a few examples of these restrictions.

The Shaw Wilderness Park is in the middle of a possible growth corridor for Halifax and Spryfields routes of urban expansion. Moreover, as we look to the future of this Park in the HRM, along with many others to come, the rate of increased visitorship and the pressure from urban growth is only going to increase. Therefore, it is important to design strategies to address the increased frequency and severity of human disturbance rates as they will be in lock-step with the increasing popularity of this Park

Recommended Management Strategy

Taking a fine-scale approach to creating a management plan that is specific to the needs of both the public and the identified areas of concern. The management plan should include possible future connections of surrounding conservation and newly acquired land areas. All areas should be categorized by their susceptibility to human disturbance impacts, trail characteristics, and intended use structures.

Shown in *figure 15* (below), is an overview of the suggested planning matrix followed by a detailed list of planning elements.

Figure. 15: Recomondations Overview - (Inman, 2021)

The plan would consist of 4 phases:

(1) **Inventory:** A complete inventory of areas, features, and trails within the park. Trails should be broken down into class, usage frequency, and level of disturbance. Areas/features should be identified by specific ecosystem characteristics, level of sensitivity to disturbances, terrain type, and location to current/future urban development;

(2) **Goals and Directives:** Set clear goals and directives for the future urban expansion and strategies for areas of non-development of the Park (area naturalization and maintaining wildland initiatives);

(3) **Implementation:** Continue to strengthen relationships with groups such as the WLCC and NCC, while holding public engagement sessions to solidify usage objectives and goals. Plan for future connectivity of surrounding patches within the matrix, continuing to manage and create natural corridors connecting this park to the other naturalized area. This will strengthen the Park's ability to cope with higher rates and frequencies of disturbance while creating milestones, and;

(4) **Monitoring**: Established on the initial baseline results and the planned objectives, set up regular monitoring intervals to ensure milestones are being hit and that plan objectives are still feasible. This will determine whether ongoing efforts are meeting objective parameters, the needs of the public, and ecological concerns.

Recommendations Continued Park Ecological Mitigation Strategies for the Future needs of public use.

For the future needs of public use, a planned forced disturbance should be considered based on the ecological and public use planning objectives. An ecological mitigation strategy for the future needs of the Park is to plan a forced human disturbance now. This will allow areas that have been disturbed previously and areas that could be developed the ability to recover without the harassment of heavy public use in the future. This can be accomplished by building paths along the main surveyed routes where there are already human impacts from people moving through the area. If done correctly, mechanical interventions such as raised boardwalks in wetlands and bridges could be set in place to deal with high traffic rates, water crossings, and ecologically sensitive areas.

Moreover, this will increase the ease of access for the required monitoring/maintenance phases. This will increase overall accessibility through the Park while ensuring the right to public access in the future.

This has the added advantages of increasing public interest and commitment to conservation, controlling the vast majority of disturbances (both frequency/severity), and spreading public surveillance into the more remote areas of the park.

In the end, it will be a deeply contrasting solution; however, from a pragmatic perspective, the impacts will be contained to a 4-8 foot wide gravel path versus an ever-increasing number of smaller informal trails with unpredictable impacts in the future.

Project Limitations

Many small limitations resulted in not being able to collect as much data as was initially projected, this hindered the ability to identify the entire trail system within the Park. Without this complete and fully encompassing picture, some questions were left unanswered, necessitating further trail mapping in the future.

The main limitation stemmed from weather conditions that impacted every facet of this project in different ways. The weather limitations delays extended across the creation of flight plans, landscape characteristic identification, terrain suitability, an abundance of ticks, and the data collection schedule.

Flight Plans

In the planning stages of this project, the use of a drone referred to as an RPAS (Remotely Piloted Aircraft System) by Transport Canada was intended be utilized for pictures and aerial reconnaissance (Transport Canada, 2021). During the operation phase, one flight took place on the Southeastern border of the Park collecting several panoramic pictures. This area, based upon independent flight planning software, was deemed to be outside of the Transport Canada Class ‘D’ controlled airspace that extends from Canadian Forces Base (CFB) Shearwater Heliport (see map 2). This meant that necessitating a Special Flight Operation Certificate (SFOP) from CFB Shearwater was not required. While practicing due diligence as the project progressed, the knowledge of a new NAVCanada flight planning map became apparent (see map 3). Upon further flight planning using this map, it was deemed that this park does reside on/within the actual border of the Class ‘D’ airspace in accordance with the CARs (Canadian Aviation Regulation), SOR/2019-11 directive, section 903.03 (Transport Canada, 2021). With

this new information confirmed, in order to continue flying in this area, an upgrade to an Advanced Drone Pilot's Licence would be required, along with an SFOC from CFB Shearwater for each day of scheduled use. Due to scheduled time requirements, this limitation on aerial access effectively ceased any further photographs and reconnaissance that could be conducted via drone flights for the purposes of this project.

Landscape Characteristics

As the days continued to progress through Fall, the cold temperatures at night started to affect the foliage of trees. Slowly, during data collection, the leaves began to fall, making tree identification more difficult. Instead of relying on the leafing structures of trees which is one of the easiest/quickest methods, the identification process now relied on the composition of bark, buds, and branching characteristics, in conjunction with (where possible) the leaves that had fallen to the ground nearby. This also had the compounding effect of obscuring the ground floor of the forested areas, making ground characteristics (soil, garbage, and drainage issues etc.) more challenging to discern.

Terrain Suitability and The Abundance of Ticks

The terrain was a limiting factor as some areas were eroded and steep, and, with any recent rainfall, became slippery and difficult to negotiate. There were also issues with low-lying areas prone to flooding that required crossing, creating a loss of efficiency and slowing general progress.

Navigating through the study area, ticks became a major limiting factor, although they are very small in size they made up for this in numbers. This caused many delays pre-excursions to don extra clothing/repellent, during data collection to avoid more tick prone foliage/remove any found, and post-excursions to ensure all insects had been removed. Around mid-October, the number found on clothing during/post-excursions rose sharply, after which point, considerable time needed to be spent stopping to remove the accumulation of ticks during data collection, greatly slowing the process. It should be noted that this is referring to excursions into the lesser used trails and borders, not the built path, or even large portions of the marked trail where dense foliage does not encroach on a person’s body while hiking. Mitigation/control protocols utilized included: wearing clothing tucked in at the waist and ankles with repellent treated gaiters, several applications of tick specific repellant, careful checking of clothing before entering both the vehicle and house, and a large clear plastic storage box to place clothes in at

home (any insect remaining on the clothing will tend to not remain once the body heat is removed. In a clear container they can be easily observed and caught).

Between the combined issues surrounding terrain suitability, ticks, and the order in which trails were selected (nearing the end of the field collection time), I was not able to record the Northern border of the Park, where it meets Williams Lake. This border was observed to require lengthy travel through high levels of understory growth and low-wet ground. Therefore, it was decided in the field that this border would not be recorded.

Data Collection Schedules

As stated previously in the discussion section, scheduling of field data collection became challenging over the course of this project. Bad weather days increased in frequency as November approached, causing delays for factors such as ground conditions, and the warmth needed to sustain long periods of hand exposure (writing notes and checklists) and daylight hours. These factors contributed to an ever-shrinking window of time for the large amount of data to be collected, especially considering the amount of time allocated for the project as a whole.

Section Picture: 5

Conclusion

Natural landscapes are under constant assault from many different factors, both natural and anthropogenic; however, nature is resilient with an amazing ability to adapt and change. Where this becomes an issue is when the anthropogenic disturbances reach a level with which nature is no longer able to cope. This is why creating/designating more wilderness areas and parks within an urban region to reduce the frequency of stress on existing areas is so important.

The contrast that is seen from urban borders and edges on the natural environment is one of the largest negative contributing factors to the edge effect in urban-wildland areas and needs to be managed properly (Andrieu et al., 2018).

The rate and frequencies of disturbances in the Shaw Wilderness Park are creating an edge effect resulting in high contrast between the Wildland boundary and the progression of urban development.

The objective of this report is not to imply that any human interaction with nature has a negative connotation; in many scenarios, human disturbances are not the single driving factor for overwhelming disturbances within an ecosystem. In these situations, disruptions can exist within the natural cycles and can be due to multiple simultaneous factors. Some cause factors are natural, such as disturbances from forest fires or windthrow from storms, and are perfectly natural causes of succession. However, when human disturbance factors are introduced into the natural order of disturbance regimes it has an exacerbating effect. These human follow-on effects become the issue.

Nature exists in a balance, and sometimes humans unknowingly remove parts of the structure that make up this balance, effectively disrupting it. When pieces of that balance are removed there are severe adverse effects on the function of ecosystems; it causes fragmentation within the matrix and severely disrupts the overall landscape ecology (Gallo et al., 2017).

Research into the Urban Wildland border is important because it creates a better understanding of how humans are using and influencing the landscape around them. This understanding will improve land-use planning, while managing the influence of the physical and spatial distribution of the landscape form. Over time, this more balanced and stronger approach to landscape ecology will pay dividends. Furthermore, it will strengthen the overall relationship between the natural environment and the built form.

Future Research

There is the potential to add further data to this GIS planning tool, which will aid in planning, management aspects, and usability in future research projects. Moreover, it will also lend a snapshot in time for measuring the effectiveness of previously implemented management policy tools and mitigation strategies. One of the hurdles I encountered on this project came from the limitations of baseline data since this Park is relatively new. Therefore, I believe this database will be an important step in building a robust dataset and catalogue on which to build upon for the future.

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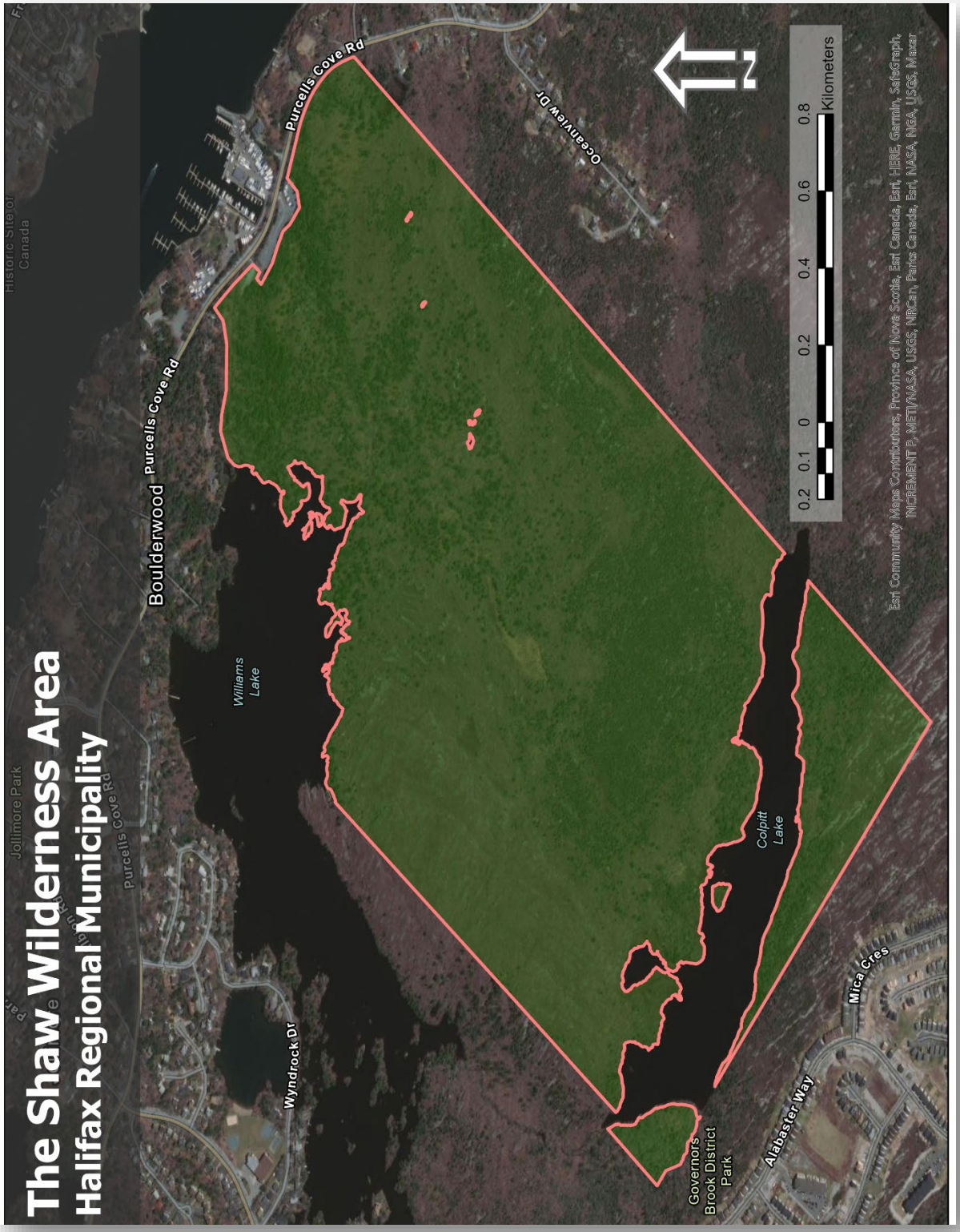
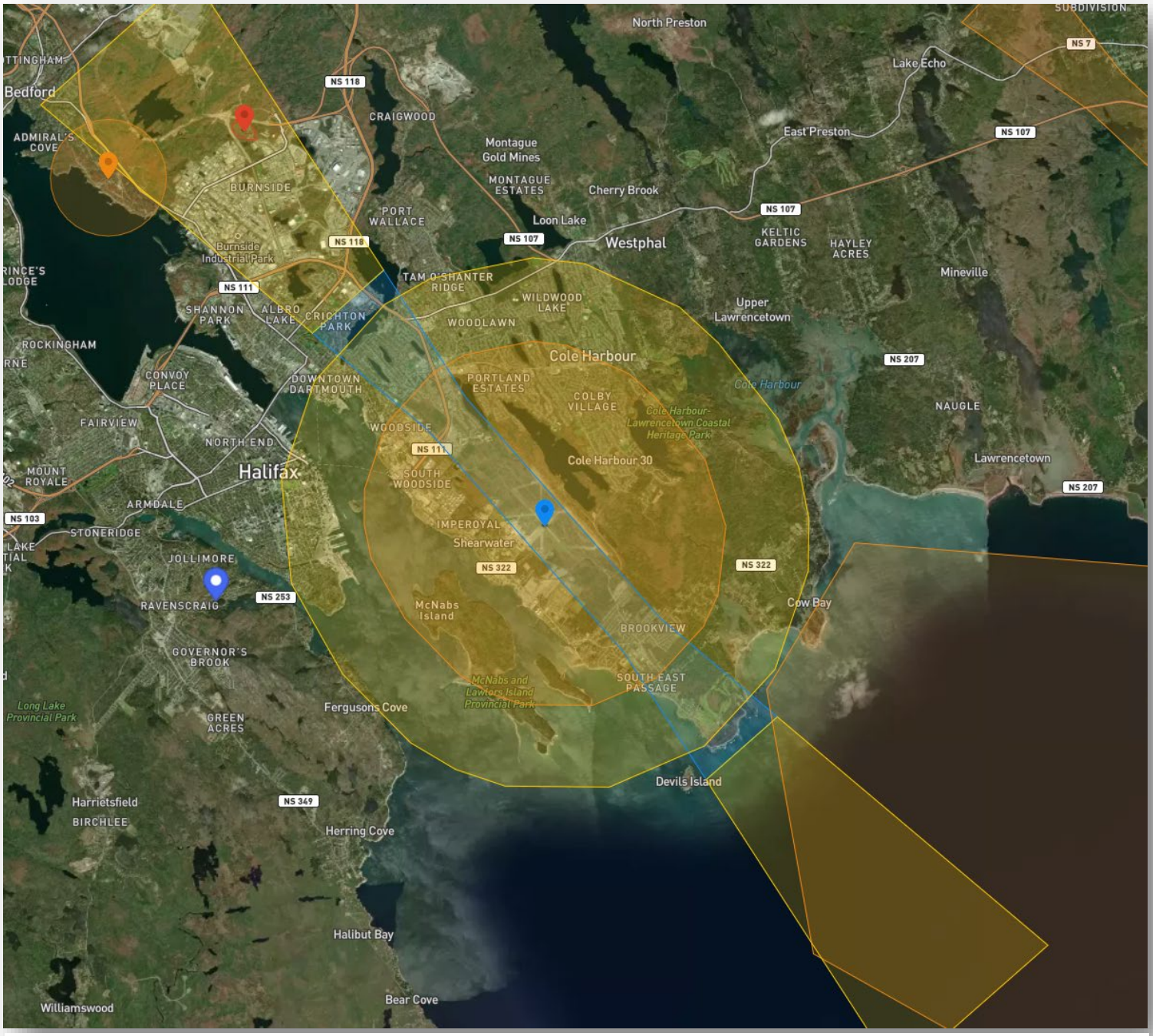
Maps & Tables

Map 1. Park Borders – Sourced From HRM GIS File:



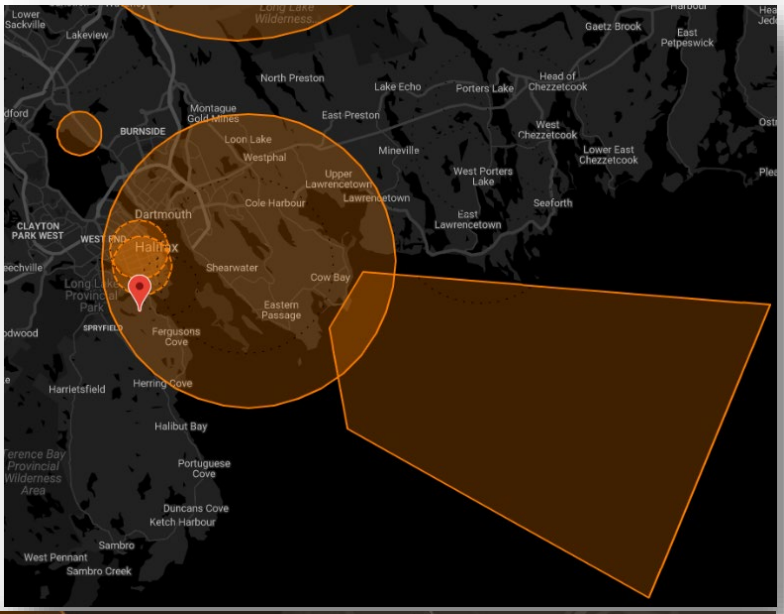
Maps 1: (ArcGIS - Prepaired by Scott Inman, 2021)

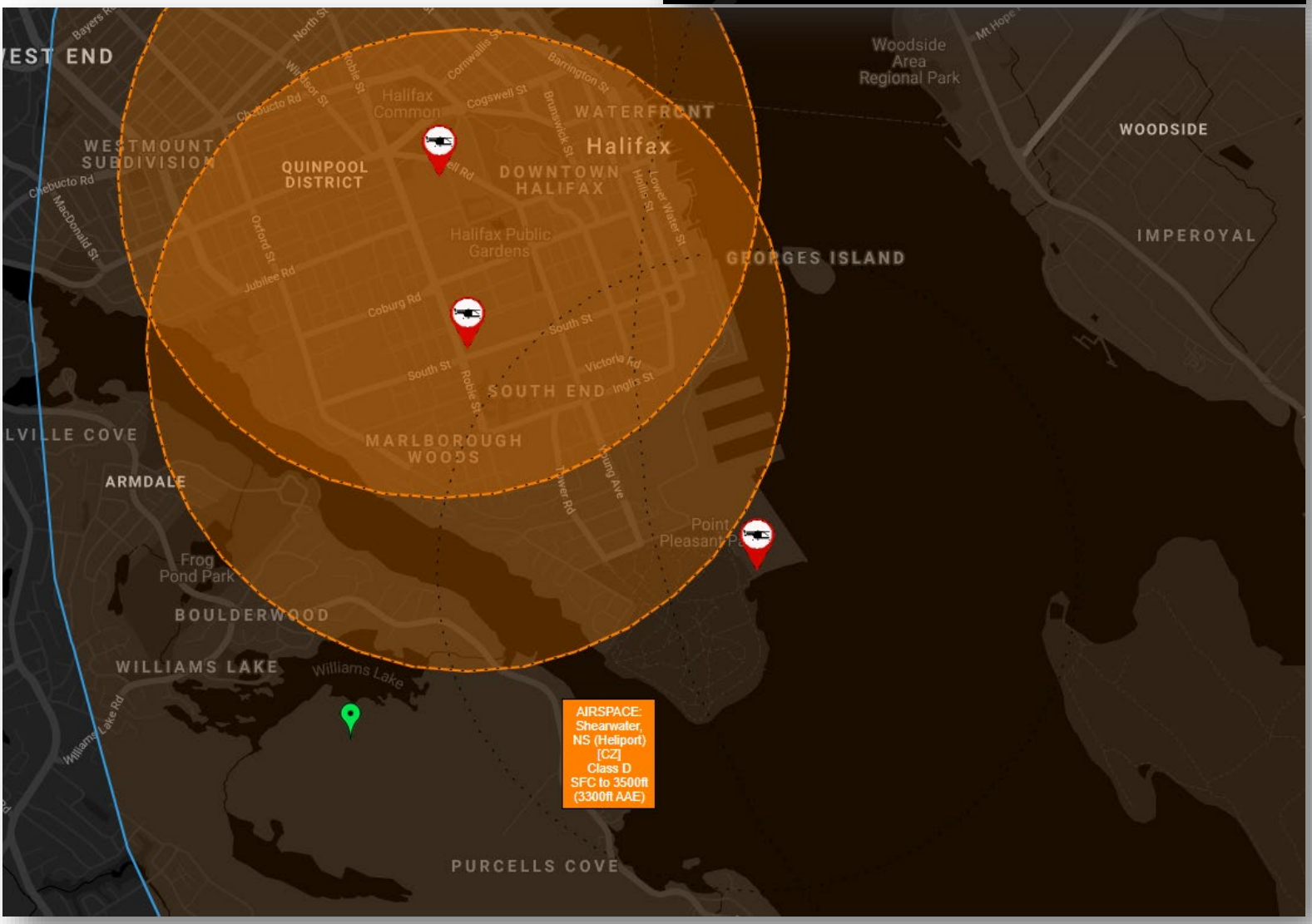
Map 2. DGI Flight Restrictions Map



Maps 2: (Geo Zone Map - Fly Safe - DJI, 2021)

Map 3. NAV Canada Flight Restrictions





Maps 3: (NAVCanada - WhereToFly Map View, 2021)

Table 1.- Methods Flow Chart:

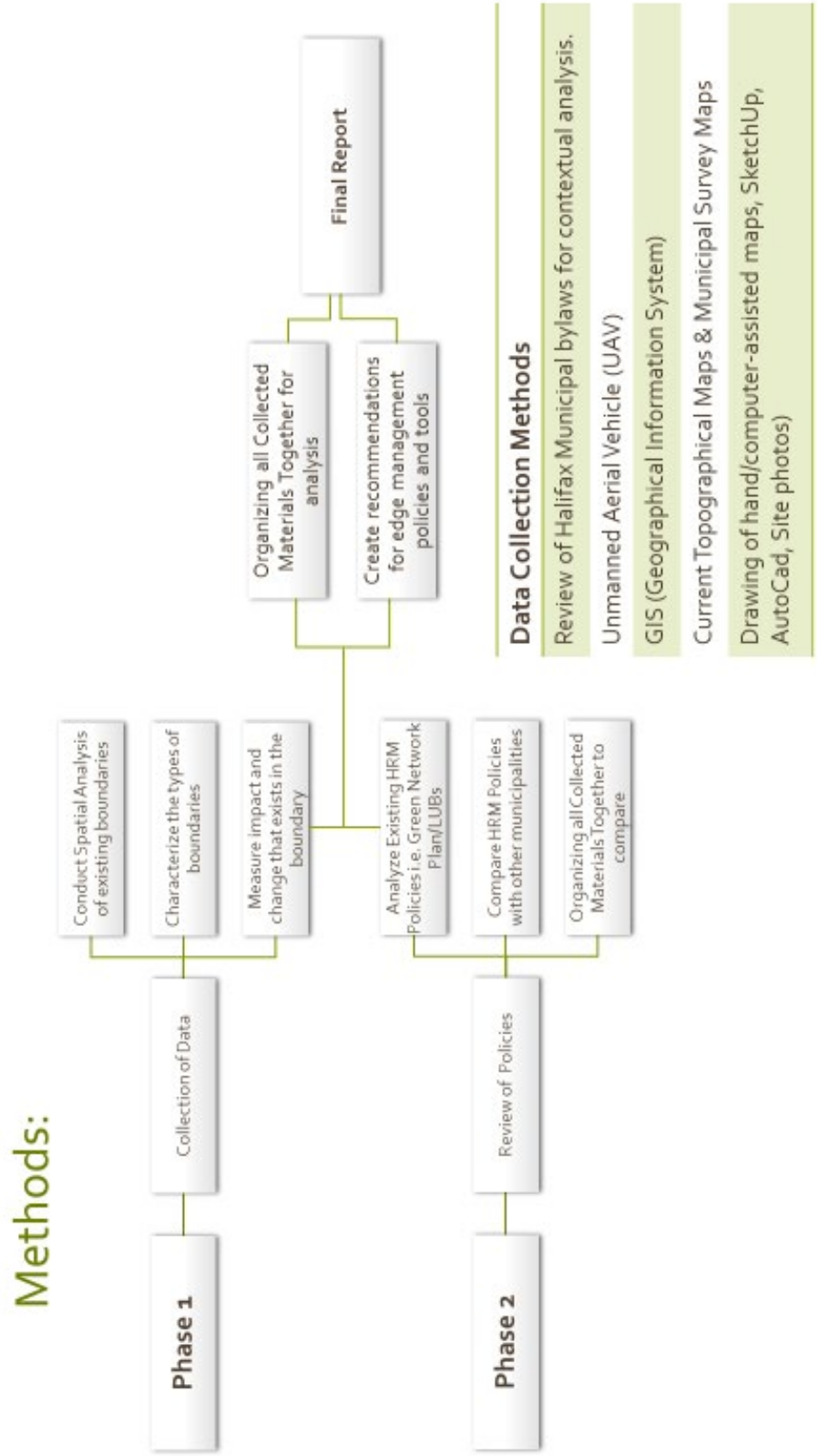


Table 1: Prepaired by Inman, 2021

Table 2.- Example of Paper Recording Checklist

Path / Border

(Circle One)

Date: _____2021 / Sheet Series_____, Sheet #___of___ Time In: _____ Time Out: _____

Interval # (Point #) (Boundary / Path are 50m Long Intervals X 3m Wide O/C)											
Mark-Mark #											
Disturbance(**G**arbage, **F**irepit, **O**ther, **D**omestic animal waste, **C**ampsite)											
Picture											
Direction of disturbance from path (**N**orth, **S**outh, **E**ast, **W**est, on **T**rail)											
Trail (**M**arked = 1 / **U**nmarked = 2)											
Type of Ecosystem / Characteristics	Wetland										
	Open Clearing										
	Water (**L**ake, **C**reek, **M**arsh)										
	Water crossings										
	Predominate Soil - **C**lay, **SA**nd, **S**ilt, **B**edrock or **H**eavy **O**rganic										
	Steep Slopes										
	Tree Succession X Severity (**E**1,2,3 or **M**1,2,3 or **L**1,2,3)										
	Tree Stand Health (**1** = good / **2** = fair / **3** = poor)										
	Understory Thickness (**1** = light, **2** = moderate, **3** = heavy)										
	Soft - **W**hite+**R**ed+**J**ack **P**ine, **TA**Marack, **R**ed+**B**lack+**W**hite **S**pruce, **HEM**lock, **B**alsam **F**ir, **C**edar, **L**arch										
	Hard - **T**rembling+**L**argetooth **A**spen, **B**alsam+**W**hite **P**oplar, **W**illow, **Y**ellow+**W**hite+**G**rey **B**irch, **I**ronwood, **S**peckled **A**lder, **B**eech, **R**ed **O**ak, **W**hite **E**lm, **M**ountain **A**sh, **S**taghorn **S**umac, **SU**gar+**MO**utain+**S**ilver+**M**oose+ +Red+**MA**nitoba+**N**orway **M**aple										
	Predominate Tree in Stand										
Disturbance Features (If Any to Note)											
Natural	Wind Row, Cutline Exposure										
	Drainage Issues										
	Animal activity i.e. Beavers, Deer Trails or Laydowns										
	Fire										
	Major Erosion										
	Flooding										
Anthropogenic	Soil Compaction / Bent Grass / Broken Branches										
	Unusual Odor										
	Noise Pollution in Db._____ Baseline Db. _____										
	Invasive Species (Pets or Plants)										
	Sawdust / Tree Cuts										
	Other:										

Notes_____

_____

_____

_____ Scott Inman 2021

Table 2: Prepaired by Inman, 2021

Table 3.- Planning Cycle Overview

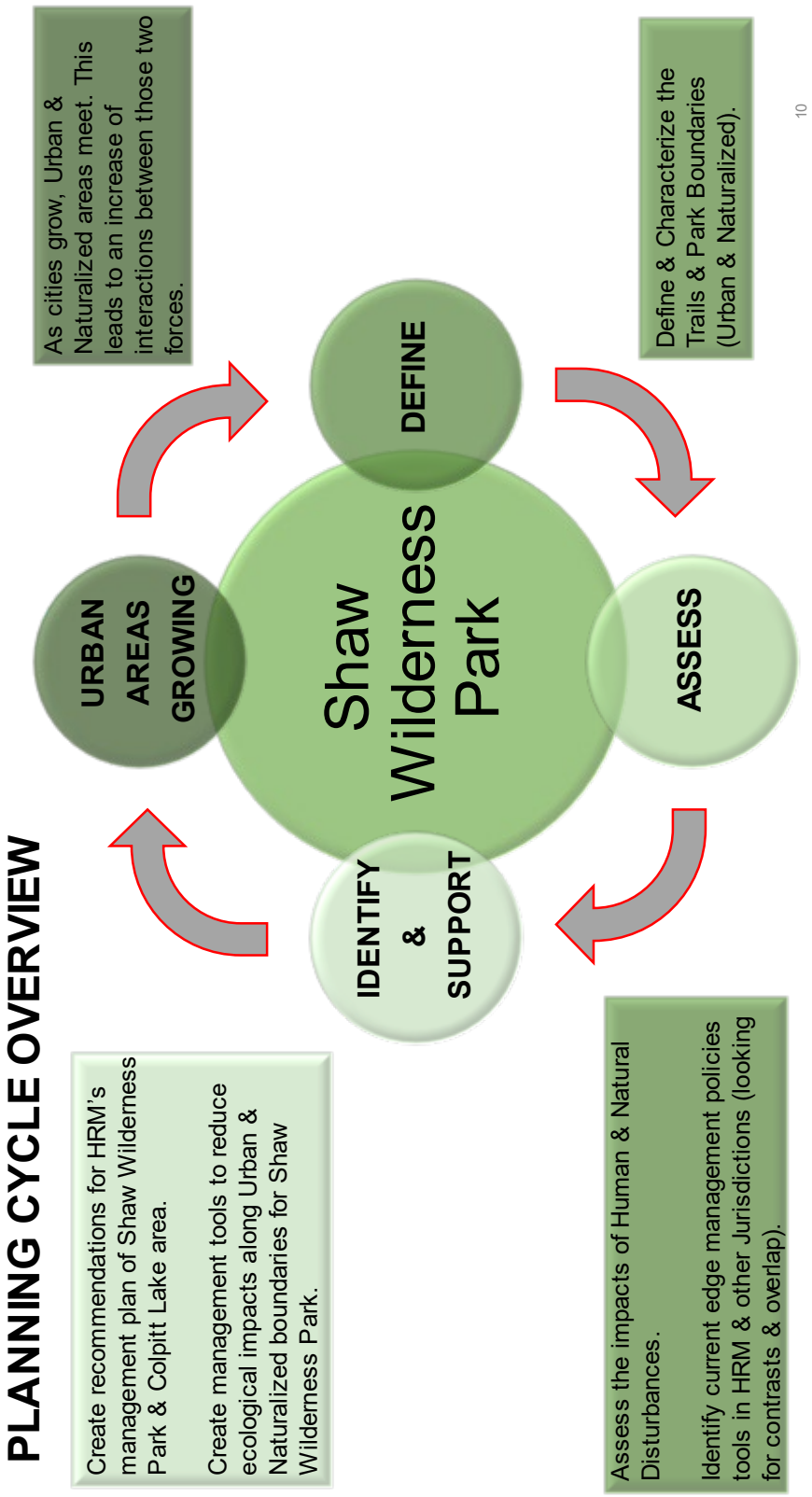


Table 3: Prepaired by Inman, 2021

Table 4.- Recorded Disturbance Spreadsheet

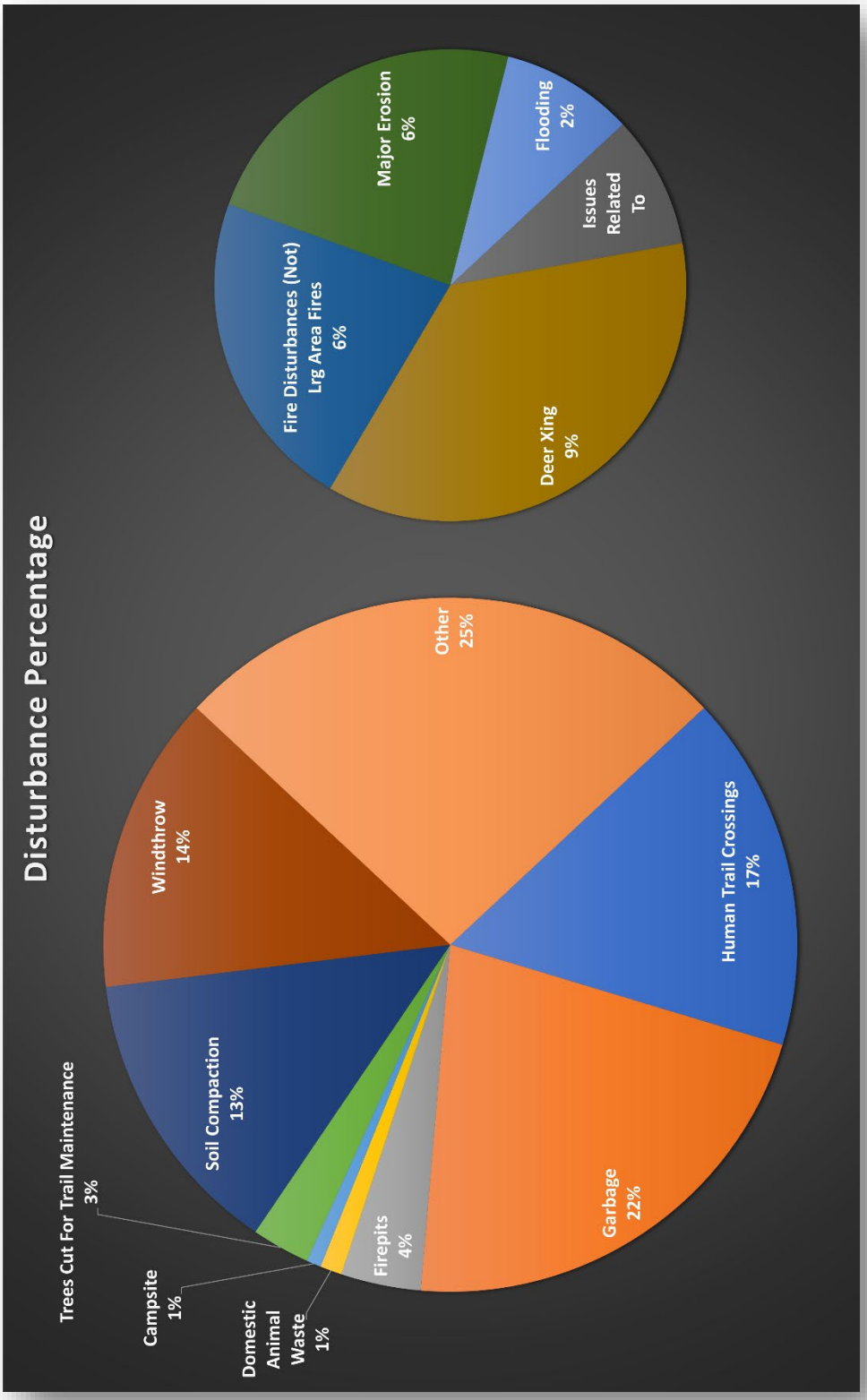


Table 4: Prepaired by Inman, 2021

Table 5.- Recorded Disturbance Spreadsheet.

Marker ID	Zulu Time (Summer + 3hrs Winter+4hrs)	Interval (Yes or No) YY = Yes & Rec. Disturbance	Trail Type 1 = Marked 2 = Unmarked 3 = Path 4 = Cutline	Identity Description	Anthropogenic Disturbances Recorded								Natural Disturbances Recorded						
					Human Trail Crossings	Garbage	Firepits	Domestic Animal Waste	Campsite	Trees Cut For Trail Maintenance	Soil Compaction	Total Disturbances	Windthrow	Issues Related To Drainage	Deer Xing	Fire Disturbances (Not) Lrg Area Fires	Major Erosion	Flooding	Total Disturbances
					36	40	8	2	2	6	31	125	24	5	15	9	15	5	73
13	2021-10-26T15:45:56Z	YY	2	Start of Shaw Property							1						1		
19	2021-10-26T16:10:59Z	N	2	Trail Xing	1		1												
21	2021-10-26T16:15:14Z	YY	2	Trail Xing	1	1					1						1		
22	2021-10-26T16:18:13Z	N	2				1												
23	2021-10-26T16:19:29Z	N	2	Graffiti		1			1										
24	2021-10-26T16:23:34Z	YY	2	Graffiti							1						1		
25	2021-10-26T16:25:02Z	N	2	Trail Xing	1														
27	2021-10-26T16:29:35Z	YY	2					1			1						1		
28	2021-10-26T16:31:48Z	N	2	End of Shaw Property															
29	2021-11-02T16:43:00Z	YY	2	Bike Lock & Glass		2					1						1		
30	2021-11-02T16:48:30Z	N	2	Cut Trees						1									
31	2021-11-02T16:50:15Z	YY	2	Plastic Bag & Sign		2					1		1				1		
32	2021-11-02T17:03:52Z	N	2			1													
33	2021-11-02T17:04:31Z	N	2			1													
34	2021-11-02T17:09:40Z	N	2	Cut Trees (trail mgmt)						1									
35	2021-11-02T17:10:50Z	YY	2	Sign & Cut Trees (trail mgmt)						1	1		1						
36	2021-11-02T17:13:17Z	N	2			1	1												
40	2021-11-02T17:24:38Z	N	2			1													
43	2021-11-02T17:30:32Z	N	2	Cut Trees (trail mgmt)						1									
46	2021-11-02T17:37:21Z	YY	2								1		1				1		
48	2021-11-02T17:44:39Z	YY	2			1					1		1	1				1	
49	2021-11-02T17:47:46Z	N	2	Trail Xing	1														
50	2021-11-02T17:51:08Z	YY	2	Water Xing							1								
53	2021-11-02T18:08:18Z	YY	2	Flipflop		1					1		1				1		
55	2021-11-02T18:11:50Z	YY	2	Rope (T) & Firepit (S)		1	1				1		1						
57	2021-11-02T18:17:23Z	N	2	Trail Xing	1														
63	2021-11-02T18:54:59Z	YY	4								1		1						
67	2021-11-02T19:10:21Z	N	4	Leaving forest															
79	2021-11-04T18:54:47Z	YY	3			1					1								
81	2021-11-04T19:05:01Z	N	1			1													
82	2021-11-04T19:05:41Z	YY	1	Trail Xing	1						1						1		
83	2021-11-04T19:11:00Z	N	1	Trail Xing	1														
84	2021-11-04T19:12:37Z	YY	1	Survey marker (+10m)							1						1		
85	2021-11-04T19:23:43Z	YY	1	Trail Xing & green tape markers (that continue periodically)	1						1								
86	2021-11-04T19:28:25Z	N	1	Trail Xing	1														
87	2021-11-04T19:28:55Z	N	1	Trail Xing	1														

Table 5: Prepaired by Inman, 2021

Marker ID	Zulu Time (Summer + 3hrs Winter+4hrs)	Interval (Yes or No) YY = Yes & Rec. Disturbance	Trail Type 1 = Marked 2 = Unmarked 3 = Path 4 = Cutline	Identity Description	Anthropogenic Disturbances Recorded								Natural Disturbances Recorded						
					Human Trail Crossings	Garbage	Firepits	Domestic Animal Waste	Campsite	Trees Cut For Trail Maintenance	Soil Compaction	Total Disturbances	Windthrow	Issues Related To Drainage	Deer Xing	Fire Disturbances (Not) Lrg Area Fires	Major Erosion	Flooding	Total Disturbances
88	2021-11-04T19:29:24Z	YY	1	Trail Xing x2	2						1								
89	2021-11-04T19:35:14Z	N	1	Trail Xing	1														
90	2021-11-04T19:36:39Z	N	1	Trail Xing	1														
92	2021-11-08T17:56:36Z	N	1	Trail Xing	1				1										
93	2021-11-08T17:58:16Z	N	1	D XING											1				
94	2021-11-08T17:58:53Z	YY	1	Firepit inside live tree / poss. animal feed?			1				1			1		1			
95	2021-11-08T18:04:54Z	N	1	Trail Xing	1														
96	2021-11-08T18:05:52Z	N	1	Trail Xing (on near side of creek)	1														
97	2021-11-08T18:08:01Z	YY	1	Trail Xing	1										1				
100	2021-11-08T18:25:24Z	N	1	(water underground)															
101	2021-11-08T18:26:43Z	YY	1	red tape marker (W) / flood plane (NW +10 m) paralleling marked trail	1						1						1	1	
102	2021-11-08T18:33:06Z	N	1	Trail Xing (SE) / red tape marker (NW)	1														
103	2021-11-08T18:38:32Z	YY	1	paralling flood plane ends (green tape markers go through flood plane)							1			1				1	
105	2021-11-08T18:46:36Z	N	1	Trail Xing	1														
109	2021-11-08T19:04:23Z	N	1			1													
113	2021-11-08T19:19:30Z	N	1	Trail Xing	1														
114	2021-11-08T19:20:44Z	YY	1	Trail Xing & hewn stone	1						1						1		
115	2021-11-08T19:23:49Z	N	1	Trail Xing & end of red reflective markers	1														
116	2021-11-08T19:32:51Z	YY	2	Trail Xing & red survey tape markers	1								1		1				
117	2021-11-08T19:38:05Z	N	2	Trail Xing (red survey tape trail breaks away to SW)	1														
120	2021-11-08T19:45:29Z	N	2	Cutline Xing	1														

Marker ID	Zulu Time (Summer + 3hrs Winter+4hrs)	Interval (Yes or No) YY = Yes & Rec. Disturbance	Trail Type 1 = Marked 2 = Unmarked 3 = Path 4 = Cutline	Identity Description	Anthropogenic Disturbances Recorded								Natural Disturbances Recorded						
					Human Trail Crossings	Garbage	Firepits	Domestic Animal Waste	Campsite	Trees Cut For Trail Maintenance	Soil Compaction	Total Disturbances	Windthrow	Issues Related To Drainage	Deer Xing	Fire Disturbances (Not) Lrg Area Fires	Major Erosion	Flooding	Total Disturbances
121	2021-11-08T19:46:47Z	YY	4	Old concrete (S) & possible rd or track foundation (T)		1							1						
122	2021-11-08T19:52:08Z	YY	4	Old concrete (+ some between 121 & 122)		1					1		1	1					
123	2021-11-08T19:55:11Z	N	4	Scattered Red brick with mortar		1													
126	2021-11-08T20:01:59Z	YY	4	wetland between 125 & 126									1						
131	2021-11-09T17:51:32Z	YY	4	Some sort of disturbance in general area (tree stand v.young)											1				
132	2021-11-09T17:57:39Z	N	4	Trail Xing	1														
133	2021-11-09T17:58:32Z	YY	4	Bog +10m down slope							1		1						
134	2021-11-09T18:04:44Z	YY	4	Bog +15m down slope									1		1				
135	2021-11-09T18:08:39Z	N	4	Trail Xings	1														
138	2021-11-09T18:24:04Z	YY	4	Trail Xing	1								1						
139	2021-11-09T18:40:42Z	N	4	Terra Cotta chimney stack piece		1													
140	2021-11-09T18:42:48Z	N	4	half eaten apple		1													
142	2021-11-09T18:48:19Z	N	4	broken glass		1													
143	2021-11-09T18:49:04Z	YY	4	Trail Xing / old concrete	1	1					1		1						
144	2021-11-09T18:51:13Z	N	4	Old concrete post holes x8		8													
148	2021-11-09T19:02:15Z	N	4	D XING SE											1				
156	2021-11-09T19:38:31Z	N	4	survey marker at edge of lake (cutline cont. other side)															
157	2021-11-09T19:40:21Z	YY	2	Possible Purple Loosestrife in lake (S)							1		1		1				
158	2021-11-09T19:43:47Z	N	2	D XING NE		1									1				
163	2021-11-09T19:57:01Z	N	2	broken glass		1													
172	2021-11-09T20:17:40Z	N	2				1												
178	2021-11-09T20:34:34Z	YY	2					1			1			1				1	

Marker ID	Zulu Time (Summer + 3hrs Winter+4hrs)	Interval (Yes or No) YY = Yes & Rec. Disturbance	Trail Type 1 = Marked 2 = Unmarked 3 = Path 4 = Cutline	Identity Description	Anthropogenic Disturbances Recorded								Natural Disturbances Recorded						
					Human Trail Crossings	Garbage	Firepits	Domestic Animal Waste	Campsite	Trees Cut For Trail Maintenance	Soil Compaction	Total Disturbances	Windthrow	Issues Related To Drainage	Deer Xing	Fire Disturbances (Not) Lrg Area Fires	Major Erosion	Flooding	Total Disturbances
179	2021-11-09T20:36:51Z	YY	2	Cut trees (trail mgmt)						1			1		1				
180	2021-11-09T20:39:11Z	N	2			1													
183	2021-11-09T20:46:12Z	N	2	Trail Xing	1														
184	2021-11-09T20:47:08Z	YY	2	Geo-cache									1			1			
191	2021-11-12T16:48:31Z	N	4	THERMOS		1													
193	2021-11-12T16:54:32Z	YY	4	T_BALL		1					1					1			
194	2021-11-12T16:57:17Z	N	4	GLASS/CAN/ P SKY LINE		2													
195	2021-11-12T16:58:59Z	YY	4				1				1		1		1	1			
196	2021-11-12T17:02:42Z	YY	4	FIRE		1							1			1			
198	2021-11-12T17:11:09Z	YY	4	FORT/T XING	1		1				1		1						
199	2021-11-12T17:15:46Z	N	4	T XING	1										1				
200	2021-11-12T17:17:01Z	YY	4	D XING						1	1		1		1	1	1		
201	2021-11-12T17:21:16Z	N	4	D XING											1	1			
202	2021-11-12T17:22:20Z	YY	4	BEER CAN		1							1				1	1	
203	2021-11-12T17:26:04Z	N	4	D XING											1	1			
209	2021-11-12T17:45:35Z	N	4	T XING	1														
211	2021-11-12T17:55:03Z	YY	4	END CUTL									1			1	1		
214	2021-11-12T18:21:35Z	N	2	inukshuk															
216	2021-11-12T18:33:15Z	N	2	T XING/F TAPE	1														
220	2021-11-12T18:41:19Z	N	2	D XING											1				

Photographs

Example of Anthropogenic Disturbances

Figure. 16: Prepaired by Inman, 2021

Example of Natural Disturbances

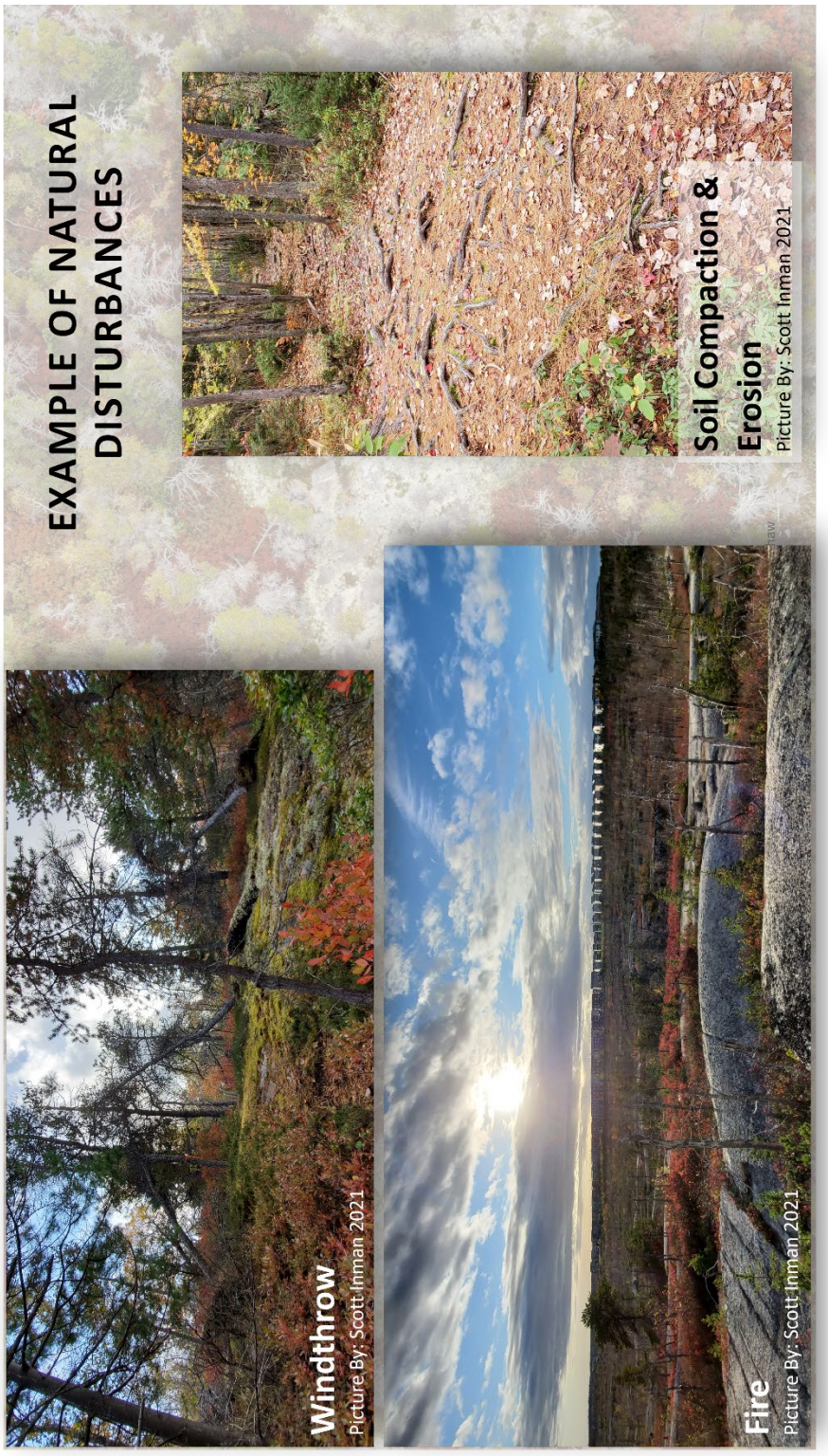


Figure. 17: Prepaired by Inman, 2021