Project Report:

Chimney Swift Nesting & Roosting Site Selection: Factors Within Manitoba Populations

Prepared for

The Manitoba Chimney Swift Initiative

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Abstract

The Chimney Swift (*Chaetura pelagica*) is a North American species of aerial insectivore known for nesting in chimneys attached to structures within human settlements. Due to a series of factors, including changes in construction norms, the spread of urban and agricultural development, widespread use of pesticides, and the impacts of climate change, the species is now considered to be threatened by many national and international conservation organizations. Within the province of Manitoba, The Manitoba Chimney Swift Initiative (MCSI) is working to monitor and conserve the species and its habitat. While there is a general understanding of factors which may influence nest site selection among Chimney Swifts – including proximity to water, age of settlement, and abundance of green space – no Manitoba-specific research project has taken place to test these factors. Using data provided through the MCSI, this project aims to test these factors to determine which appear to have the strongest influence on swift site selection. In addition, a map will be produced which will highlight communities that would potentially be suitable sites for monitoring for the species. It is intended that these outputs will be helpful in facilitating efficient and effective future research and monitoring efforts by the MCSI.

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1. Introduction

1.1 Company Details

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1.2 Introduction

The Chimney Swift is a species of aerial insectivore which has been classified as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species at Risk Act (SARA) in Canada (COSEWIC, 2007). The Manitoba Chimney Swift Initiative is a provincial initiative to monitor and conserve Chimney Swift populations and their habitat (Machovec, 2013). While data has been collected on where Chimney Swifts have been found in the province, and while there is a level of understanding within the literature regarding what sorts of habitat features may attract the species to certain sites (Wheeler, 2013; Steeves et al., 2014; Cornell Lab of Ornithology, 2015), research has shown that it would be worthwhile analyzing Manitoba data to help determine what sorts of landscape features may encourage or discourage Chimney Swifts from nesting and roosting in certain areas (Kearney & Porter, 2006; Schwartz et al., 2013).

1.3 Thesis Question

The key question to be answered by this study is whether there is a relationship between the detected locations of Chimney Swifts and surrounding habitat features; and if so, what factors encourage or discourage Chimney Swifts from nesting and roosting in certain locations. Surrounding habitat features (including land cover, land use, and anthropogenic features) will be analyzed alongside data regarding where the species has and has not been found to help reach conclusions.

Following analysis, findings will be used to develop a predictive map of communities throughout Southern Manitoba would provide appropriate habitat for the species, and which can be used as a guide for future research and monitoring efforts.

1.4 Background

The Chimney Swift (*Chaetura pelagica*) is a North American species of aerial insectivore from the family *Apodidae*. The species historically would have nested and roosted in the hollowed trunks of dead trees, though due to ever increasing anthropogenic landscape conversion – in particular the spread of agricultural land use and urban areas, as well as resource extraction and transportation corridors – the vast majority of these habitable spaces have been lost over the past century (COSEWIC, 2007). The Chimney Swift has managed to adapt to these changes, however, finding a new type of nesting site among the very people who were instrumental in destroying their previous habitat: our chimneys. This shift has been so dramatic that today the species is very rarely observed nesting in tree trunks, and has taken its name from its newly chosen habitat (Cornell Lab of Ornithology, 2015).

Unfortunately, despite its adaptive personality, the Chimney Swift is facing new threats today. An increase in use of pesticides has not only limited their prey supply – as an aerial insectivore, the species feeds off of aerial insects while in flight – it has likely lead to poisonings of individuals of the species, whether from ingesting poisoned insects or direct poisoning to the birds (Stewart & Stewart, 2013; Steeves et al., 2014). Furthermore, the impacts of climate change are altering suitable habitat sites both for the Swifts and their prey, putting a strain on populations (COSEWIC, 2007; BirdLife International, 2016).

Perhaps of greatest concern is changes in their name-bearing nesting sites, the chimneys. Only certain types of chimneys are truly suitable for the species – those which are unlined, uncapped, made of brick (or other rough material) and with at least 2.5 by 2.5 bricks in width – and these chimneys are disappearing rapidly. Construction norms have changed, and suitable chimneys are rarely being built today. Along with this is the fact that many already existing suitable chimneys are being rendered useless to the Swifts – many are being capped or torn-down as new heating methods render them obsolete, and those that remain are often in such a state of disrepair that they were unusable to the species (COSWEIC, 2007; BirdLife International, 2016). While some research indicates that chimney loss is less of a factor than it has been believed to be (Fitzgerald et al., 2014), it is still generally accepted that the loss of suitable chimney sites is posing a major threat to the species (Cornell Lab of Ornithology, 2015).

It is due largely in part to these factors that the Chimney Swift has found itself on multiple lists of at-risk species. While global population is estimated at around 15 million, this number has been declining throughout most of its North American range. Numbers of the species have declined by up to 95% in Canada since the 1970s (COSEWIC, 2007; BirdLife International, 2016). The International Union for Conservation of Nature (IUCN) has listed the species as "Near Threatened" - a clearly negative development from its "Least Concern" title only seven years ago (BirdLife International, 2016). In Canada, the species has been listed as "Threatened" by the Committee on the Status of Endangered Wildlife (COSEWIC), and "Schedule 1 – Threatened" by the Species at Risk Act (SARA). In Manitoba the species is listed as a "Threatened Species" under the Manitoba Endangered Species Act (Manitoba Wildlife Branch, 2016).

Aside from the intrinsic value of protecting a threatened species, and the value of its specific part in the complex ecosystems it inhabits, several researchers have pointed to the species' incredible potential for insect control as one reason that people may want to protect the Chimney Swift. It is estimated that a single Chimney Swift can eat up to 1000 aerial insects in a single day – protection and encouragement of the species within urban setting could have a marked impact on pest control spending (Woods, 1940; COSEWIC, 2007).

In response to these developments, organizations such as the Manitoba Chimney Swift Initiative (MCSI) had been founded to help monitor and protect the species and its habitat. By identifying locations where Chimney Swifts nest and roost, sites can be protected and rehabilitated, and can also be monitored to keep up to date information on population trends (Machovec, 2013). The findings of this study would be able to assist these efforts in the following ways:

- Information found regarding which habitat features are beneficial to Chimney Swifts could be spread to researchers, conservationists, and the general public to encourage the preservation of these features and thus the preservation of the species.
- Better knowledge of what to look for when looking for Chimney Swift habitat could lead to newly discovered nesting and roosting sites which could then be monitored, protected, and rehabilitated.
- Knowledge of appropriate habitat features could also help determine what areas are *unlikely* to harbor Chimney Swifts, saving time and effort with regard to monitoring and research.

1.5 Study Area / Scope

The data provided regarding confirmed Chimney Swift observations will come primarily from the Manitoba Breeding Bird Atlas (BBA), and will be based upon BBA squares (10 km by 10 km sections of the province). Thus, the area under examination will be delineated by BBA regions – regions of Manitoba which have been separated by BBA planners. The study will deal with regions where Chimney Swift observations have been confirmed, which includes all of Southern Manitoba, some of the Interlake region, North through Nopiming Provincial Park in the East, and North to Flin Flon in the West. Specifically, this area encompasses regions 1-8 (see Appendix B: Image 1): 1 (Southwest), 2 (South Central), 3 (Red River Valley), 4 (Southeast), 5 (Nopiming/Winnipeg River), 6 (Southern Interlake), 7 (Mountain), and 8 (The Pas/Flin Flon). The area under study is primarily of Prairie, Aspen Parkland, and Boreal Transition Zone habitat type, including little area of Canadian Shield or Northern Tundra, where Swifts are rarely found. This area correlates with the known range of the Chimney Swift in Manitoba (see Appendix B: Image 2) (Cornell Lab of Ornithology, 2015).

The study will rely on data collected over the past five years through the efforts of the Manitoba Chimney Swift Initiative and the Manitoba Breeding Bird Atlas, making it as up-to-date as possible. While based upon information from the recent past, the study will also look forward to potential new findings that may be discovered in the near future.

2. Materials and Methods

2.1 Data

Data used for the project falls into two categories: that which was provided by project partners (the Manitoba Chimney Swift Initiative), and that which was acquired through other means.

The key data which was provided by the Manitoba Chimney Swift Initiative (MCSI) was a roost and nest site database for the years 2007 through 2015. This data (see Appendix A: Table 6) provided information for each registered site, including: Site ID, Settlement, Neighbourhood, Location (including UTM coordinates), Site Description (church, school, hotel, etc.), Status of Site (Active or Inactive) and Number of Swifts sighted entering the chimney for each year.

Also provided were shapefiles delineating the Breeding Bird Atlas (BBA) regions and study squares, which were used to select study areas for the project.

Data which was acquired independently through other means includes the following:

Land cover data in raster format, accessed through the Manitoba Land Initiative's website (http://mli2.gov.mb.ca/). This data provided full coverage information for Manitoba, with land separated into 15 categories: Agriculture, Coniferous Forest, Cultural Features, Deciduous Forest, Forest Cut Blocks, Forest Fire Burnt Areas, Mixed-wood Forest, Open Deciduous Forest, Range & Grassland, Roads & Rail Lines, Sand & Gravel, Treed Rock, Waterbodies, Bogs, and Marshes.

Shapefiles for Manitoba communities, rivers and lakes, as well as Winnipeg retention ponds, parks, rail lines, and boundary, provided by Red River College.

Data on neighbourhoods and neighbourhood clusters within Winnipeg, provided by the city of Winnipeg and accessed through their Open Data website (https://data.winnipeg.ca/). Data used from this source included shapefiles for neighbourhood clusters, as well as information on ages of homes within each neighbourhood.

Data on mosquito fogging buffer zones (areas by which residents of Manitoba have requested a buffer zone in which mosquito fogging will not take place) by neighbourhood within the City of Winnipeg, provided by the City of Winnipeg Insect Control Branch.

Data on whether mosquito fogging has taken place in various towns and rural communities, provided by community members through direct email correspondence.

Data on ages of towns and rural communities collected through internet research, most prominently through the Manitoba Historical Society website (http://www.mhs.mb.ca/).

2.2 Software

All mapping work, and much of the data extraction, was conducting using the ArcGIS ArcMap software. Data collection and organization, as well as some calculations and statistical work, were done using Microsoft Excel. The proposal, progress reports, and final report were all completed using Microsoft Word.

2.3 Methods

Several methods were used to extract findings from the data with regards to whether there are any relationships between Chimney Swift locations and surrounding habitat features.

Prior to analysis, it was decided that the swift sightings data would split into two sections which would be analyzed separately: Winnipeg sites, and all other sites. This separation was deemed necessary for several reasons. First, the high numbers of sites in close proximity to one another within the city of Winnipeg would create study area redundancies that could skew the findings towards Winnipeg-specific habitat features. Second, the Land Cover data provided by the Manitoba Land Initiative used the category of "Cultural Features" to describe any urban development. Due to this, the vast majority of the City of Winnipeg fell under a single category, with only small areas that included Grasslands, Waterbodies, Roads, and other categories. While more robust data existed for the City of Winnipeg, including greenspaces, retention ponds, neighbourhood ages, and fogging data, this data was not necessarily accessible for all sites in the database. Due to these factors, it was determined that the project would function better by splitting it into two distinct sections.

2.3a: Winnipeg

The data extraction process for the City of Winnipeg was again separated into two distinct sections: the first would focus on Winnipeg's 23 Neighbourhood Clusters (geographically logical groupings of Winnipeg's 230 Neighbourhoods), while the second would focus on study areas based on buffers distances of 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers surrounding the swift sites within the city. These numbers were chosen because the average foraging distance for Chimney Swifts is generally considered to be around 500 – 3000 meters, with 6 kilometers being considered the greatest common foraging distance (Steeves et al., 2014).

In the case of Neighbourhood Clusters (see Appendix B: Image 3), there were initially five measures of how attractive to swifts each cluster was, based upon data of past swift sightings: the first was the number of past swift sites that were recording within each neighbourhood, while the second through fifth referred to the percent of each neighbourhood that was covered by study areas around the swift sites of 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers. Upon determining the percentages for these latter measures, it was decided that the 6 km study area data would be of little value in this case, as 18 of the 23 clusters were covered over 90% by this area, with 13 of them being covered 100%. For this reason, four measures of attractiveness-to-swifts remained.

While number of swift sites within each neighbourhood were simply counted, the process for determining percentages of each neighbourhood covered by each study area was more complex. Using built-in ArcMap tools, a *buffer area* was first created around each swift site for each distance (0.5, 1, 3, and 6 kilometers). This buffer area was then *clipped* to create a new shapefile including only the section of the buffer area that falls within the neighbourhood in question. Finally, summary statistics were checked to determine the total area of this new shapefile, which was then divided by the total area of the neighbourhood to determine the percentage of the neighbourhood that was covered by the study area.

These four measures were compared to six measures of habitat features within each neighbourhood: 1) the percentage of the neighbourhood covered by parks and greenspace; 2) the percentage of the neighbourhood covered by retention ponds; 3) the percentage of the neighbourhood covered by a 500 meter study area around all rivers and streams within the city (500 meters was chosen as this is generally considered to be the least distance from their nests that swifts are known to forage); 4) average house age within the neighbourhood; 5) number of active (active meaning registered within the last year) mosquito fogging buffer zones in the neighbourhood; and 6) total number of historic mosquito fogging buffer zones within the neighbourhood.

The number of active and historical mosquito fogging buffer zones was provided by neighbourhood, rather than by neighbourhood cluster, and thus had to be calculated by adding together all the buffer zones for all the neighbourhoods within each cluster.

Data regarding house ages for each neighbourhood was accessed through the City of Winnipeg's Open Data website, though was in the format of number of houses build in each decade. To determine the average house age for each neighbourhood, the number of houses built in each decade was multiplied by that decade's median year (ex: 1965 for the 1960s), then the total of all decades was divided by the total number of houses.

The percentage of each area covered by parks, ponds, and the 500 meter study area surrounding all rivers was done in the same manner as the method described above for determining the percentage of each neighbourhood cluster which was covered by the various study areas - buffering, clipping, summary statistics, and division.

Each measure of attractiveness-to-swifts was compared to each measure of surrounding habitat, using a scatterplot graph. By observing the trend line of this graph, it was determined how strong of a correlation existed. Each trend line was categorized as one of the following: Strongly Positive, Moderately-Strongly Positive, Moderately Positive, Slightly Positive, Very Slightly Positive, No Correlation, Very Slightly Negative, Slightly Negative, Moderately Negative, Moderately-Strongly Negative, and Strongly Negative. Each of these categories was assigned a numeric value: 5, 4, 3, 2, 1, 0, -1, -2, -3, -4, and -5, respectively. For each measure of surrounding habitat, the scores from each measure of attractiveness-to-swifts were summed, then divided by four to reach an average score. This score corresponds to the above-mentioned scale of Strongly Positive to Strongly Negative, to determine which factors were more and less influential.

The second method dealt with defined study areas. Four study areas were created by creating four buffer zones around each swift site of 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers (see Appendix B: Image 4). The Manitoba land cover raster data was then clipped to each of these study areas. Additionally, Manitoba land cover data was clipped to the entire city of Winnipeg, and then four comparison study areas were created by erasing the four previous study areas from the City of Winnipeg clip. The result was eight total study areas: four which related to sections of Winnipeg *within* a distance of swift sites, and four which related to sections of Winnipeg *beyond* a distance of swift sites.

Within each of these study areas, each land cover type was selected individually, and summary statistics were used to determine the total area that each land cover type covered. Each of these values was then divided by the area of the entire study area to determine the percent of that study area that was covered by each land cover type. These results were then compared to determine whether there appeared to be any clear differences between land cover in areas nearer and farther from swift sites.

Through these methods it was determined which factors seemed to be most influential on swift nest site selection within the City of Winnipeg, based on the data available.

2.3b: All Other Sites

The data extraction process for all other sites (including all towns and rural areas) began with a selecting which sites to analyze. Many of the sites in the database were very near to one another, and it was decided that using all of them would cause data redundancy and would result in a process that would take a much longer amount of time than would be necessary. It was determined that the best method would be to select a maximum of one site from each Breeding Bird Atlas (BBA) square. The site for each square was chosen based on whichever had the most swift sightings in recent years, and was thus considered to be the "best" swift site (see Appendix B: Image 5 for a map of selected sites). Following site selection, the data extraction process was once again split into two sections.

The first section dealt with the Manitoba land cover raster data, and the process was similar to the second method for data extraction within the City of Winnipeg. In this case, each swift site was first assigned a comparison site. This was done using the random number generator in Microsoft Excel, and was based on the BBA squares. A random number was generated between 1 and 8, with 1 representing the BBA square to the direct North-West of the active swift site under analysis. Numbers followed clockwise, with 2 representing the square immediately North, 3 representing the square immediately North-East, and so on. Within the selected comparison square, a specific point was selected by finding the largest cluster of "Cultural" land cover, as this category of land cover represents urban and anthropogenic development, where all known swift sites in Manitoba have been found (see Appendix B: Image 6 for a map of these sites).

Following the selection of active swift sites and comparison sites, study areas were created around each by buffering distances of 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers (see Appendix B: Image 8 for an example of these study areas). Within each of these areas, the percentage of each category of land cover was determined and compared using the same methods mentioned above in the *2.3a: Winnipeg* section.

The second section dealt again with the active swift sites and the comparison sites. This time four measures of habitat were compared: whether mosquito fogging has taken place in recent years, the age of the settlement, the distance from the site to the nearest water body, and the distance of the site to the nearest flowing water body (river or stream).

Mosquito fogging information was collected through correspondence with community members, with each site being assigned a “Yes,” “No,” or “No Data.” The total number of yesses and no’s for active sites and comparison sites were then compared.

Settlement ages were determined through internet research, and the average and range of these ages was determined for active swift sites and comparison sites, and then compared.

Distance to the nearest water body and the nearest flowing water were determined using vector and raster data of land cover, streams, and water bodies throughout Manitoba. ArcMap’s measure tool was used to find the distance to the nearest feature for each – in cases where flowing water was the closest water to the site, the same result was used for closest flowing water and closest water body.

2.3c: Suitable Community Prediction

To predict and display which communities are likely to be suitable for swift sight selection, and thus appropriate to focus upon for future monitoring efforts, it was necessary to first understand which habitat factors are of greatest influence. These factors were used to create a polygon layer of appropriate areas in Manitoba, which were then be overlaid with a point shapefile of communities in Manitoba. Those communities that intersected the appropriate areas layer were deemed to be suitable communities.

3. Results

To help determine what habitat features may or may not influence nest site selection among Chimney Swifts in Manitoba, this project tested for five factors: 1) Proximity to Water; 2) Proximity to Flowing Water; 3) Age of Nearby Human Settlement; 4) Mosquito Pesticide Fogging Operations in Area; and 5) General Makeup of Nearby Land Cover. Each of these factors were tested separately for within the City of Winnipeg, and among all sites outside of Winnipeg. Results will be organized by these factors.

3.1: Proximity to Water

City of Winnipeg: Proximity to Water was dealt with by focusing on retention ponds. By averaging the scores derived from Number of Swift Sites, and Percentage of Neighbourhood Cluster Covered by Study Areas of 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers, the influence of Retention Ponds within Winnipeg got a total score of -2.75, which equates to a Moderately Negative Correlation. This result indicates that as the number of retention ponds in an area increases, the number of swift sights appears to decrease moderately. (See Appendix A: Table 1 and Appendix C)

All Other Sites: Proximity to Water was dealt with by measuring the distance to whichever water feature was closest to the site, including flowing water sources. It was found that the average distance from a known swift site to water was 0.77 kilometers, with a range of 0.11 to 3.50 kilometers. For comparison sites, the average was 1.23 kilometers, with a range of 0.01 to 7.56 kilometers. While the range for comparison sites has a lower bottom value, this value appears to be something of an outlier, due to a comparison site that was located directly beside a river. With the comparison site's average being nearly 60% higher than that of the known swift sites, this data appears to show that swift sites tend to be significantly closer to water than their comparison sites, and that there is thus a positive correlation between swift site selection and proximity to water. (See Appendix A: Table 3)

3.2: Proximity to Flowing Water

City of Winnipeg: Proximity to Flowing Water was dealt with by focusing on a 500 meter study area surrounding all rivers and streams within the City of Winnipeg. By averaging the scores derived from comparisons to all attractiveness-to-swifts measures, the influence of flowing water got a total score of 3.75, or Moderately-Strongly Positive. This indicates that as an area has more flowing water nearby, the number of swifts in the area appears to increase moderately-strongly. (See Appendix A: Table 1 and Appendix C)

All Other Sites: For flowing water, it was found that the average distance from a swift site was 1.31 kilometers, with a range of 0.11 to 8.06 kilometers. The average distance for comparison sites was 2.87, with a range of 0.01 to 11.81. Again, the lower bottom value of the range for comparison sites can be seen as an outlier, especially when taking into account the fact that the average values seem to strongly indicate that active swift sites have greater proximity to flowing water than their comparison sites – the average distance to flowing water for comparison sites is nearly 120% higher than that for active swift sites. This shows that there is a strong positive correlation between swift site selection and proximity to flowing water. (See Appendix A: Table 3)

3.3: Age of Nearby Human Settlement

City of Winnipeg: Average ages of houses in each Neighbourhood Cluster was determined and compared to the four measures of attractiveness-to-swifts, resulting in a total score of -4, or Moderately-Strongly Negative. This indicates that the older the average house age in an area, the more likely one would be to find swifts in that area, with the correlation being moderately strong. (See Appendix A: Table 1 and Appendix C)

All Other Sites: The average year of founding for settlements containing an active swift site was found to be 1891, with a range of 1824 to 1958, while the average year of founding for comparison sites was found to be 1895, with a range of 1851 to 1958. Given that the bottom end of the swift site range appears to be an outlier (the second oldest settlement was founded in 1851, the same bottom value as for the comparison sites), and that the averages are only four years apart, this does not seem to provide strong evidence that there is a correlation here. It should be noted that there are some limitations to the usefulness of this data, as discussed in the following "Limitations" section. (See Appendix A: Table 3)

3.4: Mosquito Pesticide Fogging Operations in Area

City of Winnipeg: Data collected with regards to mosquito fogging within Winnipeg was split into two sets of information: Active Buffer Zones, meaning those that have been registered in the past year, and Historical Buffer Zones, meaning the total of all the Mosquito Buffer Zones that have been registered since the buffer zone initiative was put in place. The average score for all four measures of attractiveness-to-swifts came out to 3.75, or Moderately-Strongly Positive, for Active Buffer Zones, and 4.5, or Strongly Positive, for Historic Buffer Zones. This indicates that the more fogging buffer zones in place in an area, especially over an extended period of time, the more likely swifts are to use the area for nesting, with a moderately-strong to strong correlation. (See Appendix A: Table 1 and Appendix C)

All Other Sites: For swift sites it was found that 8 communities had fogged in recent years, and 7 had not, while 9 did not respond. For comparison sites it was found that 3 had fogged, and 6 had not, while 15 did not respond. By these results, it appears that fogging for mosquitos appears to have a positive impact on Chimney Swift site selection. (See Appendix A: Table 3)

3.5: General Makeup of Nearby Land Cover

City of Winnipeg: Within Winnipeg there were two methods used to test this factor. First there was influence of Parks, analyzed by Neighbourhood Cluster, which resulted in an average score of 1.25, or Slightly Positive. This indicates that as more parks are present in an area, swifts are slightly more likely to be found there. (See Appendix A: Table 1 and Appendix C)

Secondly, the land cover raster data in Winnipeg was analyzed by comparing land cover within and beyond the bounds of study areas surrounding known swift sites by 500 meters, 1 kilometer, 3 kilometers, and 6 kilometers. Each size of study area revealed essentially the same results: areas closer to swift sites tended to have more Cultural (aka: Urban, Anthropogenic) and water features, and less Agricultural, Range & Grass features than areas farther from swift sites. This would indicate that Chimney Swifts prefer areas with more urban development and water features, and less agricultural and grassland features. Percentage of cover of other landscape types were generally small enough (often below 1%) that it seemed unlikely they would have a strong impact, though there was a small amount more Roads & Rail Lines beyond the study areas (3.5% more). (See Appendix A: Table 2)

All Other Areas: In this case, the only method used was very similar to that of the second method used within Winnipeg, except that comparisons were done between active swift sites and comparison sites, rather than within and beyond study area boundaries. Generally, it was found that areas near swift sites have a higher amount of Cultural features, with less Agriculture, less Range & Grass, and less Water. There was also about 2% more Deciduous Forest Features near comparison sites, while all other land cover categories generally occupied less than 1% of the area of both swift sites and comparison sites. Again, each study area size revealed essentially the same information. (See Appendix A: Table 4)

3.6: Suitable Community Prediction

Given the results of analysis and the data at hand, the suitable community prediction process proved to be somewhat limited. The only truly valuable and usable information was that swift sites should be in an area of human development, and within 2 kilometers of flowing water. While mosquito fogging and settlement age appear to be influential, there was insufficient time to access the extra data needed to make use of these factors for predictive purposes. To create the prediction, a buffer area of 2 kilometers was created around all Manitoba rivers and streams. A point shapefile was then uploaded and all records within this shapefile that intersected the stream buffer were selected and chosen as a suitable community. This process resulted in 149 communities, of varying sizes, which could be considered suitable for Chimney Swift nest site selection, and thus also suitable for monitoring efforts. A full list of these communities can be seen in Appendix A: Table 5. A map of these sights can be seen in Appendix B: Image 7.

4. Limitations

While the findings of this project are of interest and can be used to help guide further research and monitoring, there are various limitations to keep in mind with regard to data and methodology.

For several reasons, it was determined that the data relating to mosquito fogging in rural areas is ultimately of little value. First, the data is far from complete, with only half of the towns and municipalities contacted providing a response. Second, it is only taking into account *pesticide fogging for mosquitos* in these areas, and is not taking into consideration any other kind of pesticide use. It is likely that a large portion of the agricultural land surrounding many of these sites uses some kind of pesticide to some degree, and these applications may have as much or more affect than those of mosquito fogging. Given that fogging information for the City of Winnipeg was more robust, and that much of the city is much more distant from agricultural development than rural areas, the fogging information for Winnipeg was deemed to be of far more value.

Data relating to age of settlements for non-Winnipeg sites is likewise unlikely to be particularly applicable. This is largely in part because the information pertains to the founding of these settlements, rather than the ages of buildings actually existing in these settlements. The majority of towns in Southern Manitoba were founded within a few decades of each other throughout the late 1800's, though the ages of current buildings within these settlements is likely to vary drastically from settlement to settlement based upon population rises and falls during different periods. An assessment of average house age, as was done for Winnipeg Neighbourhood Clusters, would be more appropriate, though this information is not readily available and would be outside of the scope of this project to gather. It is also worth noting that several sites, especially among the comparison sites, did not fall within any defined settlement, and it was thus difficult or impossible to determine an age without contacting the property owner directly.

The data relating to distance to water bodies and to flowing water can generally be taken to be accurate and of value to the project, though it should be noted that many streams and water bodies in Southern Manitoba are highly ephemeral in nature. It is not unlikely that many smaller ponds and streams included in the data may not exist every year, or may only exist for parts of the year. For the purposes of this project, however, the data on hand was taken to be accurate, and all marked streams and waterbodies were considered.

The Manitoba land cover data used is certainly applicable to the area of study, though it should be noted that there may be some issues here as well. Most obviously is the fact that all settled areas are categorized as “Cultural,” with little attempt to separate out different land cover within towns and cities. Secondly, and not surprisingly, the vast amount of the surrounding area of settlements was taken up by Agriculture, with a combination of Agriculture and Cultural land cover generally taking up over half of the area within any study region. This could have the impact of downplaying the influence of some other land cover categories that are seen in much smaller amounts, such as Marsh and Forested areas. A more nuanced approach to dealing with data analysis could prove useful in overcoming this limitation, though such an approach would require more time and resources than were allotted for this project.

With regard to the data delineated by Neighbourhood Cluster within the City of Winnipeg, one must keep in mind that correlation does not mean causation, and that there may be other influences at work. In particular, it is notable that the number of swift sites is negatively correlated to the number of retention ponds within each Neighbourhood Cluster. While this may indicate that Chimney Swifts avoid areas with more non-flowing surface water, it should be noted that the vast majority of retention ponds in the city have been built in more recently developed areas which are father from the city centre, such as Island Lakes, Southdale, and Waverly West. It is possible that non-flowing surface water may have no effect, or even a positive effect on Chimney Swift site selection (as is suggested by the analysis of non-Winnipeg sites), but that this effect is overpowered but other influences, such as average house age and proximity to rivers and streams.

Finally, it should be noted that while the database supplied by the Manitoba Chimney Swift Initiative represents the most robust data on Chimney Swift sightings within the province, it is unlikely that all swift sites within Manitoba are accounted for here. Given that monitoring efforts are not uniform throughout the entire study area, it is likely that there will be more sightings in areas that happen to have more interested and skilled monitoring participants – this can certainly be seen in the drastically higher number of swift sites within the City of Winnipeg, where many involved with the MCSI reside. It is conceivable that Chimney Swift nests may even exist in the settlements I’ve chosen as my comparison sites, which for the purposes of this project are assumed to not harbor the species.

5. Discussion

With regard to the five potential factors of influence under analysis in this study, and with a knowledge of the literature and limitations involved, the following appear to be the key findings of this project:

1) Proximity to Water seems to be a factor outside of Winnipeg, though it should be noted that in many cases the nearest water source was in fact flowing water, and the correlation between flowing water and swift site selection seems to be much stronger. Given the negative correlation between retention ponds and swift sites within the City of Winnipeg, even taking into account the potential limitation of correlation with average house age which is discussed, the results suggest that "Proximity to Water" of any kind is not necessarily a strong factor in swift site selection. This leads to the next point.

2) Proximity to Flowing Water appears to be an important factor both within the City of Winnipeg and among sites outside of Winnipeg. This factor proved to be the third most influential within the City of Winnipeg, and the most influential for all other sites, aside from the site being located among anthropogenic development. Given that the average distance from flowing water for swift sites was 1.31, while the average for comparison sites was 2.87, a reasonable round benchmark of 2 kilometers could be seen as a distance from flowing waters that a community should have to be of interest to researchers.

3) While Age of Nearby Settlements did not appear to have a major influence on site selection beyond Winnipeg, this data was ultimately determined to be of little value, as discussed in the limitations section above. Due to this, the City of Winnipeg analysis was considered to be of more value, and it clearly indicates that the age of buildings in an area have a strong connection to swift site selection – specifically that older settlements tend to attract more swifts. This follows general understandings of the species' behavior, and stands to reason, as older buildings tend to be more likely to a) have a chimney, and b) have a chimney of appropriate size and material. In particular, the data seems to suggest that neighbourhoods in which the average house was built in or before the 1960's are preferable to swifts, as there is a notable rise in number of swift sites among neighbourhoods that meet this criteria.

4) The results pertaining to the influence of Mosquito Fogging are similar to those of Settlement Age, as the data outside of Winnipeg was determined to be of little value, while the data within the City of Winnipeg suggests that fogging has a fairly strong influence on swift site selection. Specifically, areas with more Buffer Zones, and thus less use of pesticide mosquito fogging, tend to have higher populations of Chimney Swifts. This result is in line with assumptions based on past studies, which suggest that pesticide fogging limits swift populations by limiting populations of their needed prey (aerial insects).

5) Analysis of land cover in the vicinity of swift sites resulted in little more than confirmation that swifts prefer – or possibly *need* – human development for nesting purposes. This was already widely accepted, as swifts are almost never found outside of human settlement in modern times. While the results also indicate that Agricultural land takes up a large portion of land cover around swift sites, this information can largely be ignored, as the case is the same for comparison sites, and as the majority of Southern Manitoba is Agricultural land anyhow.

To summarize, the findings of this project suggest that the key influences upon swift site selection appear to be: Proximity to Human Settlement (being within human settlement can be considered essentially a necessity), Proximity to Flowing Water (being within 2 kilometers of flowing water can be seen as an indicator of a suitable site), Age of Settlement (older settlements being more appealing, especially those built in the 1960's or before), and a Lack of Mosquito Fogging.

The results regarding suitable communities serve here as a start for a guide to further monitoring efforts. With more time, this list could be pared down to a much shorter list through further research into individual community statistics, including age and mosquito fogging history. Additionally, further factors may arise which could help to narrow this list down further.

These findings correlate to what has been suggested throughout the literature, and the beliefs and assumptions of many working with the species. While little was found with regard to the influence of nearby land cover type – parks and greenspaces were of particular interest – the results of this project by no means suggests rejection of the idea that these may be important factors, especially when the limitations of the project are taken into account. Likewise, in part due to discussed limitations, it may be overenthusiastic to suggest that these findings *confirm* previously suggested ideas. Rather, the findings of this study act as a case study, and as a guide for further research efforts.

6. Recommendations

The primary goal of this project was to determine habitat features that influence Chimney Swift site selection with the intention of helping guide future research and monitoring of the species and its habitat. While a list of suitable communities has been compiled, it may appear to be dauntingly large for practical monitoring efforts. Seeking out settlements in Southern Manitoba which are not only within 2 kilometers of flowing water, but which have also not recently fogged for mosquitos, and in which the average house was built before 1970 would be the best course of action. This would require some further research to determine average house age in different communities, as well as further research on what communities have and have not fogged for mosquitos.

The City of Winnipeg itself has already been fairly extensively monitored, especially those areas that best fit the criteria suggested by the results of this project. With this in mind, the findings herein would be most applicable to communities outside of Winnipeg which have yet to receive extensive monitoring efforts.

Further research on the topic would require more robust data of the sort mentioned above, as well as more robust data on land cover within communities. For the purposes of wider scholarly consideration of the topic, more in depth statistical analysis would be required, though for the purposes of this project it did not seem necessary to go beyond a general understanding on whether a factor had a weak, strong, or no influence on swift site selection.

7. Conclusion

As a threatened species, it is important to continue proper research and monitoring of the Chimney Swift. Within our province, the Manitoba Chimney Swift Initiative (MCSI) is at the forefront of these activities. While there is some agreement throughout the literature regarding factors which influence nest site selection for Chimney Swifts, these factors have not been tested in a Manitoba-specific context. Through use of the most up to date data on Chimney Swift sightings in the province, an analysis of suspected factors can help guide further work on the species to take place in the most efficient and effective manner possible.

Using Geographic Information System technology, along with basic statistical analysis, the findings of this project suggest that the key factors to look for are sites within human settlements that are within 2 kilometers of flowing water, which have been subjected to a minimal amount of mosquito fogging operations, and in which the average house was built before 1970. While the veracity of these findings is subject to a series of limitations with regard to data available and research methods, they appear to be in line with common accepted ideas suggested by the literature.

It is hoped that through further research, the MCSI will be able to tailor future endeavors towards communities within the province that fit these criteria so as to best address the issue of declining Chimney Swift numbers.

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Appendix A: Tables

Table 1: Winnipeg Statistics by Neighbourhood

	% Parks	% Ponds	% River Buffer	Avg House Age	Active BZs	Hist BZs	# of Sites	% in 500m	% in 1km	% in 3km	% in 6km
Assiniboine South	10.03%	0.06%	9.87%	1973	63	297	3	2	8	30	63
Downtown East	3.24%	0.00%	33.10%	1961	41	419	35	73	92	100	100
Downtown West	5.41%	0.00%	39.55%	1946	211	1245	14	24	71	100	100
Fort Garry North	7.60%	1.64%	19.36%	1977	69	296	5	8	24	68	99
Fort Garry South	4.86%	0.25%	22.83%	1979	49	310	5	4	13	65	97
Inkster East	3.39%	0.12%	2.37%	1953	2	36	0	0	0	28	100
Inkster West	6.91%	2.73%	0.52%	1978	5	20	0	0	0	0	45
Point Douglas North	2.90%	0.00%	15.64%	1945	35	237	2	11	31	88	100
Point Douglas South	7.40%	0.00%	39.93%	1954	17	82	7	30	63	100	100
River East East	13.85%	2.72%	2.38%	1976	20	123	0	0	4	56	98
River East South	5.07%	0.00%	32.02%	1951	14	110	0	8	12	93	100
River East West	7.98%	0.29%	44.68%	1961	45	231	5	20	56	100	100
River Heights East	7.74%	0.00%	80.13%	1957	80	570	12	48	96	100	100
River Heights West	4.43%	0.04%	18.60%	1951	150	739	4	21	59	100	100
Seven Oaks East	8.63%	0.18%	19.08%	1969	42	240	1	0	3	67	100
Seven Oaks West	1.61%	0.19%	0.00%	1980	3	35	0	0	0	7	59
St. Boniface East	5.31%	1.02%	17.16%	1977	39	241	0	0	4	41	100
St. Boniface West	12.62%	0.00%	85.10%	1954	73	302	5	27	90	100	100
St. James - Assiniboia East	6.79%	0.10%	40.97%	1954	53	241	10	11	16	71	100
St. James - Assiniboia West	3.09%	0.04%	27.39%	1971	20	150	0	0	0	2	70
St. Vital North	11.94%	0.25%	72.14%	1959	49	249	6	22	58	100	100
St. Vital South	4.13%	0.15%	29.14%	1985	61	241	0	1	5	44	92
Transcona	5.39%	0.39%	0.00%	1972	27	172	0	0	0	1	39
Average	6.54%	0.44%	28.35%	1964.48	50.78	286.35	4.96	13.48	30.65	63.52	89.65

Table 2: Winnipeg Land Cover Statistics by Study Area

	6km Within	6km Beyond		3 km Within	3 km Beyond		1 km Within	1 km Beyond		500 m Within	500 m Beyond	
Agriculture	10949.31	12580.56		3852.09	18179.82		408.6	18781.2			18781.2	
Coniferous Forest												
Cultural	23543.01	5045.4		19696.23	14264.55		11938.14	24005.79		10487.7	24798.33	
Cut Block												
Decicuous	2160.18	512.37		1401.93	1549.62		574.11	2356.74		275.31	2562.39	
Burnt		6.12			6.12			6.12			6.12	
Mixed Wood Forest	2.61	1.71			3.33			3.33			3.33	
Open Deciduous Forest	9.99	34.56		3.96	38.61			41.58			41.58	
Range & Grass	11582.73	8204.85		5370.03	14812.65		836.91	16742.34		203.49	16890.84	
Roads & Rail	2551.05	1659.06		1634.22	2509.11		266.22	3099.78		124.29	3525.14	
Sand & Gravel		27.54			27.54			27.54			27.54	
Treed Rock												
Waterbodies	1525.68	728.37		1334.7	1157.22		816.39	1965.15		746.01	2070.99	
Bogs												
Marsh	85.95	70.2		40.68	137.07			150.48			150.48	
Total	52410.51	28870.74		33333.84	52685.64		14840.37	67180.05		11836.8	68857.94	
			Difference			Difference			Difference			Difference
Agriculture	20.89%	43.58%	-22.68%	11.56%	34.51%	-22.95%	2.75%	27.96%	-25.20%	0.00%	27.28%	-27.28%
Coniferous Forest	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cultural	44.92%	17.48%	27.44%	59.09%	27.07%	32.01%	80.44%	35.73%	44.71%	88.60%	36.01%	52.59%
Cut Block	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Deciduous	4.12%	1.77%	2.35%	4.21%	2.94%	1.26%	3.87%	3.51%	0.36%	2.33%	3.72%	-1.40%
Burnt	0.00%	0.02%	-0.02%	0.00%	0.01%	-0.01%	0.00%	0.01%	-0.01%	0.00%	0.01%	-0.01%
Mixed Wood Forest	0.00%	0.01%	0.00%	0.00%	0.01%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Open Deciduous Forest	0.02%	0.12%	-0.10%	0.01%	0.07%	-0.06%	0.00%	0.06%	-0.06%	0.00%	0.06%	-0.06%
Range & Grass	22.10%	28.42%	-6.32%	16.11%	28.12%	-12.01%	5.64%	24.92%	-19.28%	1.72%	24.53%	-22.81%
Roads & Rail	4.87%	5.75%	-0.88%	4.90%	4.76%	0.14%	1.79%	4.61%	-2.82%	1.05%	5.12%	-4.07%
Sand & Gravel	0.00%	0.10%	-0.10%	0.00%	0.05%	-0.05%	0.00%	0.04%	-0.04%	0.00%	0.04%	-0.04%
Treed Rock	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Waterbodies	2.91%	2.52%	0.39%	4.00%	2.20%	1.81%	5.50%	2.93%	2.58%	6.30%	3.01%	3.29%
Bogs	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Marsh	0.16%	0.24%	-0.08%	0.12%	0.26%	-0.14%	0.00%	0.22%	-0.22%	0.00%	0.22%	-0.22%

Table 3: Non-Land Cover Statistics for All Other Sites

	Sites				Comparison Sites			
	Fogging	Age	Dist to Water	Dist to Stream	Fogging	Age	Dist to Water	Dist to Stream
Brandon	yes	1882	1.19	1.19			2.44	5.68
Carman	yes	1905	0.24	0.24			7.56	7.56
Clearwater		1897	0.23	0.23		1898	0.28	1.03
Darlingford		1902	1.15	1.95		1886	1.72	6.92
Dauphin	no	1898	0.43	0.43	no	1941	0.59	0.59
La Broquerie	no	1877	0.95	0.95	no		0.01	6.01
Lac Du Bonnet	no	1958	0.15	0.15	no	1958	0.01	0.01
Lorette	no	1878	0.23	0.23		1925	2.82	5.28
Manitou		1880	1.25	8.06		1886	0.29	0.29
Melita		1879	0.11	0.11			0.56	11.81
Otterburne		1909	0.13	0.13		1877	1.69	1.69
Portage	yes	1851	0.64	3.41	yes	1851	1.31	2.93
Selkirk 1	yes	1882	2.08	2.08	no	1903	0.01	0.01
Selkirk 2	yes	1882	0.16	0.16			0.14	0.14
Selkirk 3	yes	1882	0.35	0.35	no	1906	0.25	0.25
Souris		1904	0.12	0.12			5.84	5.84
Southport		1952	1.41	1.41			0.31	1.56
St. Adolphe		1906	0.38	0.38		1873	0.23	0.23
St. Francois Xavier	no	1824	0.13	0.69	yes	1853	0.09	0.09
St. Jean Baptiste	yes	1878	0.35	0.35	yes	1883	0.58	0.58
Starbuck		1885	3.5	5.61		1885	0.09	0.09
Steinbach	no	1874	0.4	0.4		1874	0.59	7.64
Stonewall	yes	1878	2.42	2.42	no	1891	1.47	1.47
Wasagaming	no	1933	0.39	0.39		1928	0.7	1.21
Average		1891.5	0.77	1.31		1895.18	1.23	2.87
Min		1824	0.11	0.11		1851	0.01	0.01
Max		1958	3.5	8.06		1958	7.56	11.81
Total	8 Yes, 7 No				3 Yes, 6 No			

Table 4: Land Cover Statistics for All Other Sites

	Sites 500 m	Comps 500 m		Sites 1km	Comps 1km		Sites 3km	Comps 3km		Sites 6km	Comps 6km	
Agriculture	2854.71	6914.88		10990.44	17397.36		65758.05	79216.74		212598.63	238284.36	
Coniferous Forest	0.27			0.27	0.45		51.12	37.17		1097.82	651.96	
Cultural	3131.01	801.45		4718.88	1203.48		7597.35	2122.83		8791.02	5225.22	
Cut Block										75.15	46.17	
Deciduous	387.09	901.53		1054.71	2260.89		6469.11	9262.53		25215.21	27531.18	
Burnt										0.09	0.18	
Mixed Wood Forest	10.17	0.54		104.22	2.25		1491.03	309.42		20019.96	3054.24	
Open Deciduous Forest	33.93	1.8		69.12	64.62		282.87	607.32		2445.39	2899.62	
Range & Grass	1019.43	1165.14		2645.19	3090.24		15241.23	15341.31		45595.08	44973.9	
Roads & Rail	3537.99	5588.19		4086.45	5977.08		10826.19	11999.7		18711.09	21911.94	
Sand & Gravel	0.81			12.69	13.14		197.28	129.33		694.53	299.79	
Treed Rock								27.54		32.58	122.58	
Waterbodies	3419.28	5504.85		3770.37	5826.42		7229.07	29200.69		19294.38	29708.01	
Bogs							18.36	11.61		941.04	1923.21	
Marsh	6.21	27.99		65.97	77.85		487.35	2092.95		3954.06	5518.98	
Total	14400.9	20906.37		27518.31	35913.78		115649.01	150359.14		359466.03	382151.34	
			Difference			Difference			Difference			Difference
Agriculture	19.82%	33.08%	-13.25%	39.94%	48.44%	-8.50%	56.86%	52.69%	4.18%	59.14%	62.35%	-3.21%
Coniferous Forest	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.02%	0.02%	0.31%	0.17%	0.13%
Cultural	21.74%	3.83%	17.91%	17.15%	3.35%	13.80%	6.57%	1.41%	5.16%	2.45%	1.37%	1.08%
Cut Block	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.01%	0.01%
Deciduous	2.69%	4.31%	-1.62%	3.83%	6.30%	-2.46%	5.59%	6.16%	-0.57%	7.01%	7.20%	-0.19%
Burnt	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Mixed Wood Forest	0.07%	0.00%	0.07%	0.38%	0.01%	0.37%	1.29%	0.21%	1.08%	5.57%	0.80%	4.77%
Open Deciduous Forest	0.24%	0.01%	0.23%	0.25%	0.18%	0.07%	0.24%	0.40%	-0.16%	0.68%	0.76%	-0.08%
Range & Grass	7.08%	5.57%	1.51%	9.61%	8.60%	1.01%	13.18%	10.20%	2.98%	12.68%	11.77%	0.92%
Roads & Rail	24.57%	26.73%	-2.16%	14.85%	16.64%	-1.79%	9.36%	7.98%	1.38%	5.21%	5.73%	-0.53%
Sand & Gravel	0.01%	0.00%	0.01%	0.05%	0.04%	0.01%	0.17%	0.09%	0.08%	0.19%	0.08%	0.11%
Treed Rock	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	-0.02%	0.01%	0.03%	-0.02%
Waterbodies	23.74%	26.33%	-2.59%	13.70%	16.22%	-2.52%	6.25%	19.42%	-13.17%	5.37%	7.77%	-2.41%
Bogs	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.01%	0.01%	0.26%	0.50%	-0.24%
Marsh	0.04%	0.13%	-0.09%	0.24%	0.22%	0.02%	0.42%	1.39%	-0.97%	1.10%	1.44%	-0.34%

Table 5: List of Suitable Communities for Chimney Swift Nest Site Selection

Altamont	Elphinstone	Lyleton	Reinland
Arborg	Emerson	Macdonald	River Hills
Arrow River	Erickson	Manhattan Beach	Rivers
Baldur	Fisher Branch	Marchand	Riverton
Balmoral	Fisher River Cree	Marquette	Roland
Balmy Beach	Nation	Mather	Roseisle
Barrier Bay	Fork River	McAuley	Rosengart
Beausejour	Forrest	Melita	Rosenort
Benito	Fort la Reine	Miami	Rosser
Bethany	Foxwarren	Miniota	Russell
Beulah	Gardenton	Minitonas	Sandy Hook Golf
Binscarth	Garland	Minnedosa	Course
Birds Hill	Gilbert Plains	Minto	Sanford
Birtle	Glenwood	Morden	Schanzenfeld
Blumenfeld	Gnadenthal	Morris	Schoenwiese
Blumengart	Grand Beach	Myrtle	Siglavik
Boissevain	Grandview	Neepawa	Snowflake
Bowsman	Graysville	Neuenburg	Somerset
Brunkild	Grunthal	Neuhorst	South Beach
Caddy Lake	Gunton	Ninette	Sprague
Cardinal	Hartney	Ninga	Springstein
Carroll	Hodgson	Nutimik Lake	St. Eustache
Cartwright	Holland	Oak Point	St. Malo
Chortitz	Holmfield	Oakburn	Ste. Anne
Clandeboye	Ile des Chênes	Oakville	Ste. Rose du Lac
Clanwilliam	Inglis	Ochre River	Sunset Beach
Clear Springs	Justice	Old England	Teulon
Clearwater	Kemnay	Otterburne	Tilston
Crandall	Kenton	Petersfield	Treherne
Crystal City	Kenville	Pinawa	Valley River
Cypress River	Killarney	Pipestone	Virden
Ditch Lake	Kleefeld	Pleasant Valley	Wasagaming
Dunrea	Kola	Plum Coulee	Wawanesa
Durban	Laurier	Powerview - Pine	West Lynne
Eden	Lester Beach	Falls	White Mud Falls
Elie	Libau	Rapid City	Whitemouth
Elkhorn	Linden	Rathwell	Winnipeg Beach
Elma	Little Britain	Reinfeld	Winnipegosis

Table 6: Manitoba Chimney Swift Initiative Roost and Nest Site Database 2007-2015

					UTM		Maximum number of chimney swifts entering										
Site ID	**Settlement**	**Neighbourhood**	**Location**	**Site**	**Easting**	**Northing**	**###**	**###**	**###**	**###**	**###**	**###**	**###**	**###**	**###**	**###**	**Status**
2016-19	**Aubigny**	.	30178 Provincial Road 246	Church of St Anthony (RC)	626972	5479737	.	.	.	.	.	.	.	.	.	0	Inactive
900	**Brandon**	.	1203 Princess Ave	Orange Block, small chimney	431316	5522047	.	.	.	2	3	5	7	5	4	3	Active
901	**Brandon**	.	1323 Rosser Ave	East Chimney	431256	5522223	.	.	.	3	3	4	7	5	.	.	Demolished
800	**Carman**	.	12-2nd Avenue SW	Carman Memorial Hall	572232	5484099	.	.	.	39	16	8	3	3	0	5	Active
801	**Carman**	.	156 2nd St. SW	Carman Elementary School	572039	5483850	.	.	.	11	2	3	18	1	1	2	Demolished
802	**Carman**	.	118 1st St. SW	private home	572178	5484019	.	.	.	3	2	3	2	.	0	4	Active
1055	**Clearwater**	.	10th Street & Boundary Trail	Harvest Moon Learning Ctre	497373	5442225	.	.	.	.	.	3	3	2	.	0	Active
1056	**Clearwater**	.	10th Street & Boundary Trail	Clearwater Memorial Hall	497464	5442227	.	.	.	.	.	4	0	.	.	.	Active
2015-9	**Darlingford**	.	197 Bradburn St	Darlingford School Heritage Museum	545106	5450455	.	.	.	.	.	.	.	.	2	2	Active
600	**Dauphin**	.	213 Main St. N		426675	5667123	.	48	15	70	67	87	121	48	33	49	Active
1000	**La Broquerie**	.	107 rue Principale	St Joachim RC Church	680209	5488809	.	.	.	2	6	9	4	3	3	5	Active
1500	**La Salle**	.	27 rue Beaudry	Ste Hyacinthe Church	624939	550610	.	.	.	.	0	.	.	.	.	.	Inactive
1205	**Lac Du Bonnet**	.	68 1st Street	Casey's Inn	709565	5571442	.	.	0	0	0	.	0	1	2	0	Active
2015-2	**Lac Du Bonnet**	.	100 1st Street	Lac Du Bonnet Physiotherapy	709518	5571473	.	.	.	.	.	.	.	.	1	2	Active
510	**Lorette**	.	1282 Dawson Road	Catholic Church	653235	5511733	.	.	.	.	.	2	2	.	.	.	Demolished
2016-16	**Manitou**	.	338 Hamilton St	St Andrews United Church	533474	5454423	.	.	.	.	.	.	.	.	.	4	Active
2015-10	**Melita**	.	41 Ash St	Antler River Historical Society Museur	355134	5459745	.	.	.	.	.	.	.	.	3	2	Active
2015-11	**Melita**	.	95 Main St	Legion Memorial Hall	355136	5459538	.	.	.	.	.	.	.	.	3	1	Active
2015-12	**Melita**	.	133 Summit St	Melita and Area Health Centre	354838	5459540	.	.	.	.	.	.	.	.	2	3	Active
1400	**Morden**	.	325 Stephen St.	Pembina Hills Art Centre	565713	5448962	.	.	.	.	.	.	.	.	.	.	Inactive
550	**Otterburne**	.	Providence College	Chimney near bell tower	641456	5486012	.	.	.	.	.	2	2	0	2	2	Active
551	**Otterburne**	.	Providence College	"Large" chimney SW	641483	5485001	.	.	.	.	.	2	3	1	2	6	Active
552	**Otterburne**	.	Providence College	"Skinny" chimney SE	641492	5484994	.	.	.	.	.	3	6	1	4	5	Active
2016-17	**Otterburne**	.	37 Main St	RC Church of Saint-Viateur	641157	5484396	.	.	.	.	.	.	.	.	.	0	Inactive
2016-18	**Otterburne**	.	33 Eglise Ave	Convent	641259	5484399	.	.	.	.	.	.	.	.	.	0	Inactive
1200	**Pine Falls/Powervie**	.	4 Maple Street	Chateau Video	697018	5605093	.	.	.	.	0	0	0	.	.	.	Inactive
100x	**Portage la Prairie**	.	329 Duke Avenue	"Women's Jail" - chimney not noted	551262	5535743	.	.	.	.	6	2	.	.	.	.	Active
100	**Portage la Prairie**	.	329 Duke Avenue	Portage Corr. Centre, Small Chimney	551262	5535743	5	3	2	3	1	.	2	2	2	3	Active
101	**Portage la Prairie**	.	329 Duke Avenue	Portage Corr. Centre, Large Chimney	551262	5535743	2	2	1	3	5	.	2	.	.	.	Active
102	**Portage la Prairie**	.	124 Duke Avenue E	Old Bus Depot	550991	5535804	2	.	2	1	.	.	.	.	.	.	Demolished
103	**Portage la Prairie**	.	16 Royal Road South	MTS Building	550948	5535804	2	.	2	0	.	.	.	.	.	.	Active
104	**Portage la Prairie**	.	15 Tupper St. S	Trinity United Church	550783	5535802	1	0	7	2	9	4	3	2	2	6	Active
104-B	**Portage la Prairie**	.	15 Tupper St. S	Trinity United Church	550783	5535802	.	.	.	.	.	.	.	.	.	4	Active
105	**Portage la Prairie**	.	20 Tupper St. N	Duffield and Duffield	550838	5535953	1	.	2	2	3	.	2	.	.	1	**Demolished**
106	**Portage la Prairie**	.	CP Rail Station	CP Rail Station	551203	5536402	.	.	0	0	.	.	.	.	.	.	Inactive
107	**Portage la Prairie**	.	170 Saskatchewan Ave. W.	Keystone Sporting Goods (old library)	550652	5535883	.	.	2	.	.	.	.	.	.	.	Capped
108	**Portage la Prairie**	.	32 5th Street SE	Victoria School (Red River College)	551473	5535728	.	.	6	10	6	8	5	2	0	5	Active
109	**Portage la Prairie**	.	124 Saskatchewan Ave. E.	Red Apple	551001	5535886	.	.	1	.	.	.	.	.	.	.	Demolished
110	**Portage la Prairie**	.	36 13th St NW	Fort LaReine School	**549655**	**5535894**	.	.	.	.	.	.	0	.	.	.	Inactive
T5	**Portage la Prairie**	.	301-3rd Street N.E.	Old CP Rail Station	**551199**	**5536434**	.	.	.	.	.	0	0	.	.	.	Inactive
825	**Rose Isle/Leary**	.	Leary brickyard chimney		541552	5480724	.	.	.	.	.	.	0	.	.	.	Inactive
400A	**Selkirk**	.	Selkirk Mental Health Ctre, 825 Manitoba	Large stack	650829	5557925	31	43	61	37	48	47	56	49	52	33	Active
401	**Selkirk**	.	Selkirk Mental Health Ctre, 825 Manitoba	Powerhouse Chimney "yellow brick"	650869	5557951	4	0	8	10	5	9	5	5	2	3	Active
400B	**Selkirk**	.	Selkirk Mental Health Ctre, 825 Manitoba	Unit B "red brick"	651059	5558047	.	.	25	48	10	9	9	11	6	.	Capped
402	**Selkirk**	.	383 Eveline St	Merchants Hotel	652236	5556783	.	.	1	3	3	2	5	4	2	8	Active
2014-1	**Selkirk**	.	241 Manitoba Ave.		652065	5556895	.	.	.	.	.	.	.	3	.	2	Active
2014-2	**Selkirk**	.	Selkirk Mental Health Ctre, 825 Manitoba	Infirmary chimney	651059	5558047	.	.	.	.	.	.	.	10	2	4	Active
42491	**Selkirk**	.	East of junction #204 + Ferry Rd #212	East Selkirk Hydro Stack	653478	5555740	.	.	.	.	.	.	.	.	.	3	Active
2015-5	**Souris**	.	5th Ave W & 1st St S	Uptown Lounge/Restaurant	409108	5496893	.	.	.	.	.	.	.	.	4	5	Active
2015-6A	**Souris**	.	6th Ave W	Chocolate Shop Café, E chimney	409093	5496775	.	.	.	.	.	.	.	.	2	1	Active
2015-18	**Souris**	.	6th Ave W	Corner Closet; < 5m from Choc. Shop	409088	5496780	.	.	.	.	.	.	.	.	2	1	Active
2015-19	**Souris**	.	6th Ave W	Specialty Shop; 10-15 m from Choc. S	409103	5496775	.	.	.	.	.	.	.	.	2	.	Demolished
2015-20	**Souris**	.	47 5th Ave W	St. Paul's United Church	408955	5496946	.	.	.	.	.	.	.	.	1	.	Active
2015-7	**Souris**	.	80 5th Ave W	White House; private residence	408834	5496877	.	.	.	.	.	.	.	.	2	.	Active
2015-21A	**Souris**	.	26 Cres. Ave E	Hillcrest Museum - E chimney; candid	409219	5496730	.	.	.	.	.	.	.	.	.	.	Inactive
2015-21B	**Souris**	.	26 Cres. Ave E	Hillcrest Museum - W chimney; candi	409219	5496730	.	.	.	.	.	.	.	.	.	.	Inactive
2015-22	**Souris**	.	99 2nd St S	Kowalchuk's Funeral Home; candidat	408920	5496877	.	.	.	.	.	.	.	.	.	.	Inactive
2016-8	**Souris**	.	8 1st St S	Rock Shop	409101	5497211	.	.	.	.	.	.	.	.	.	2	Active
200	**Southport**	.	230 Centennaire	building connected to barracks	552135	5529511	1	.	.	.	.	.	.	2	2	.	Active
501	**St Adolphe**	.	344 Main St.	Club Amical - SE Chimney	636295	5503821	2	2	2	3	2	2	3	2	2	3	Active
500	**St Adolphe**	.	344 Main St.	Club Amical - NE Chimney	636295	5503832	2	2	6	3	4	2	4	4	2	2	Active
504	**St Adolphe**	.	372 Main St.	Brodeur Bros.	636284	5503912	.	.	2	5	3	2	4	3	2	2	Active
502	**St Adolphe**	.	392 Main St.	St Adolphe RC Church	636327	5504011	2	8	19	9	3	11	8	3	3	8	Active
503	**St Adolphe**	.	395 Main St.	private residence	636233	5503986	1	2	2	2	2	7	9	3	2	2	Active
1100	**St Francois Xavier**	.	1053 Hwy 26	St. Francois Xavier RC Church	604757	5530015	.	.	.	0	.	.	.	.	.	1	Active
1025	**St Jean Baptiste**	.	153 Caron Street	Paroisse Catholique St-J-B	620676	5458134	.	.	.	0	.	.	2	.	4	2	Active
300	**Starbuck**	.	6131 Rd. 56 NW	4 miles north of Starbuck	599632	5520439	4	2	1	0	0	0	0	0	.	.	Active
1300	**Ste Anne**	.	Ste Anne RC Church	Rue De 'L'eglise & Av Centrale	669870	550472	.	.	.	.	.	.	.	.	.	.	Inactive
1005	**Steinbach**	.	316 Henry Street	Bethesda Hospital	667842	5488900	.	.	.	.	.	.	4	10	3	3	Active
2016-10	**Stonewall**	.	336 Main St	Manitoba Agriculture	619602	5554996	.	.	.	.	.	.	.	.	.	2	Active
1600	**The Pas**		380 Hazelwood Ave.	VIA Rail Station	352069	5966223	.	.	.	.	.	.	.	.	.	.	Inactive
700	**Vita**	.	221 1st St W	Vita Medical Clinic doctor's quarters	677480	5445489	.	.	0	.	.	.	.	.	.	.	Inactive
701	**Vita**	.	NW 28-I-6E, near Gardenton	St. Micheal's Church	664978	5437881	.	.	0	.	.	.	.	.	.	.	Inactive
2015-13	**Wasagaming**	.	128 Wasagaming Drive	The Lakehouse	431143	5612132	.	.	.	.	.	.	.	.	.	.	Inactive
2014-8	**Wasagaming**	.	133 Wasagaming Drive	RMNP Visitors Centre	431276	5612041	.	.	.	.	.	.	.	2	.	2	Active
1050	**Whitewater Lake**	.	near Roads 14N & 122W	Strathallan SD 635 (old school)	411236	5451320	.	.	.	.	.	0	.	.	.	.	Inactive
41	**Winnipeg**	Charleswood	4025 Roblin Blvd	Assiniboine Links	624504	5525527	0	.	.	.	.	.	.	.	.	0	Inactive
32	**Winnipeg**	City Centre	80 George Ave		634231	5529299	.	.	.	.	.	.	.	.	.	.	Capped
30	**Winnipeg**	City Centre	11 Martha St		633924	5529224	0	.	.	.	.	.	.	.	.	.	Capped
85	**Winnipeg**	City Centre	80 Lombard Ave	Nutty Club Food Club	634050	5528655	.	.	.	.	0	.	.	.	.	.	Inactive
21	**Winnipeg**	City Centre	380 Assiniboine Ave	Bessborough Apartments	633595	5527414	0	.	.	0	.	.	.	.	.	.	Inactive
26	**Winnipeg**	City Centre	8 Forks Market Road	CityTV	634202	5527885	0	.	.	.	.	.	.	.	.	.	Capped
76	**Winnipeg**	City Centre	52 Donald St	commercial building	633652	5527605	.	.	0	.	.	.	.	.	.	.	Inactive
79	**Winnipeg**	City Centre	61 Carlton St	Dalnavert	633461	5527598	.	.	0	.	.	.	.	.	.	.	Capped
64	**Winnipeg**	City Centre	52 Edmonton	Fairmount Apartments	633336	5527492	.	1	.	.	.	.	.	.	.	.	Capped
75	**Winnipeg**	City Centre	90 Alexander St	Great West Metal Ltd	634139	5529188	.	.	0	.	.	.	.	.	.	.	Inactive
78	**Winnipeg**	City Centre	400 Edmonton St	Knox Church	632910	5528666	.	.	0	.	.	.	.	.	.	.	Capped
72	**Winnipeg**	City Centre	172 Edmonton	Ladywood Apartments	633212	5527924	.	.	.	.	.	.	.	.	.	.	Inactive
28	**Winnipeg**	City Centre	554 Main St	McLaren Hotel	633700	5529263	.	.	0	.	.	.	.	.	.	.	Inactive
73	**Winnipeg**	City Centre	45 Carlton St	Monterrey Apartments	633512	5527543	.	.	0	.	.	.	.	.	.	.	Inactive
80	**Winnipeg**	City Centre	windsor Park Golf Course	Mount Royal Apartments	633714	5527629	.	.	0	.	.	.	.	.	.	.	Inactive
29	**Winnipeg**	City Centre	139 Market Ave	Nygard	633885	5529056	1	0	.	.	.	.	.	.	.	.	Active
27	**Winnipeg**	City Centre	311 Ross Ave	Paulin's Biscuits and Candies	633510	5529381	.	.	0	.	.	.	.	.	.	.	Inactive
31	**Winnipeg**	City Centre	146 Alexander Ave	Prosperity Knitwear	633952	5529258	0	1	2	.	.	.	.	.	.	.	Demolished
68	**Winnipeg**	City Centre	66 Edmonton St	Rochester Apartments	633355	5527569	.	.	5	.	.	.	.	.	.	.	Capped
77	**Winnipeg**	City Centre	318 Ross Avenue	S. and S. Sportswear	633449	5529336	.	.	0	.	.	.	.	.	.	.	Inactive
67	**Winnipeg**	City Centre	71 Kennedy St	Scarsdale Apartments	633297	5527539	.	.	.	0	.	.	.	.	.	.	Inactive
22	**Winnipeg**	City Centre	272 Main St	Scott Block	633780	5528375	0	.	.	.	.	.	.	.	.	.	Inactive
19	**Winnipeg**	City Centre	450 Portage Ave	The Bay	632939	5528065	0	.	.	.	.	.	.	.	.	.	Capped

71	**Winnipeg**	City Centre	346 Broadway	Townhouse Apartments	633453	5527679	.	.	1	0	0	.	.	.	.	.	Active
74	**Winnipeg**	City Centre	24 Edmonton St	Victorian House	633404	5527447	.	.	0	.	.	.	.	.	.	.	Inactive
25	**Winnipeg**	City Centre	172 Main St	VJ's East Chimney	633896	5528022	0	.	.	.	.	.	.	.	.	.	Inactive
24	**Winnipeg**	City Centre	222 York Ave	VJ's; Middle Chimney	633868	5528021	0	.	.	.	.	.	.	.	.	.	Inactive
23	**Winnipeg**	City Centre	160 Main St	VJ's; West Chimney	633868	5528010	0	.	.	.	.	.	.	.	.	.	Inactive
2016-4	**Winnipeg**	City Centre	442 William Ave	Filcasa Housing Coop	633009	5529309	.	.	.	.	.	.	.	.	.	4	Active
2016-6	**Winnipeg**	City Centre	22 Granite Way	Granite Curling Club	632857	5527216	.	.	.	.	.	.	.	.	.	1	Active
2016-9	**Winnipeg**	City Centre	579 McDermot Ave	Western Paperbox Company Ltd. Wa	632551	5529332	.	.	.	.	.	.	.	.	.	2	Active
2016-14	**Winnipeg**	City Centre	41 Princess St	Peck Building	633365	5528791	.	.	.	.	.	.	.	.	.	3	Active
2016-15	**Winnipeg**	City Centre	471 William Ave	Victoria Court	632961	5529391	.	.	.	.	.	.	.	.	.	1	Active
2014-7	**Winnipeg**	East Kildonan	1010 Brazier St	Radmon House apartments	636814	5522774	.	.	.	.	.	.	.	1	1	0	Active
2015-3	**Winnipeg**	East Kildonan	1030 Brazier St	Linlee Apartments	636857	5533122	.	.	.	.	.	.	.	.	2	1	Active
2015-4	**Winnipeg**	East Kildonan	1011 Henderson Hwy	Curtis Gordon Motor Hotel	636671	5533189	.	.	.	.	.	.	.	.	2	0	Active
53	**Winnipeg**	East Kildonan	1490 Henderson Hwy	John Pritchard School	637317	5534483	2	1	0	2	0	.	.	.	.	.	Capped
54	**Winnipeg**	East Kildonan	300 Donalda Ave	St Alphonsus Rectory	636145	5531472	1	.	0	0	.	.	.	.	.	.	Active
2015-17	**Winnipeg**	East Kildonan	712 Watt St	Pro-Tac Roofing	636954	5531801	.	.	.	.	.	.	.	.	2	2	Active
49	**Winnipeg**	Fort Garry	1181 Pembina Hwy	behind Flag Shop	632732	5523065	1	.	0	2	2	0	2	3	.	2	Active
51A	**Winnipeg**	Fort Garry	444 South Dr	St John's Ravenscourt; Admin.	634995	5522888	3	.	4	3	3	7	3	.	.	4	Active
51B	**Winnipeg**	Fort Garry	444 South Dr	St John's Ravenscourt; Res.	634947	5522813	.	.	0	.	0	.	.	.	.	.	Inactive
50	**Winnipeg**	Fort Garry	633 Manchester Blvd N	Wildwood Apartments	633717	5523090	0	.	.	.	.	.	.	.	.	.	Capped
2016-13	**Winnipeg**	Fort Garry	1295 Pembina Hwy	Rexall Pharma Plus	632716	5522774	.	.	.	.	.	.	.	.	.	1	Active
2014-4	**Winnipeg**	Fort Richmond	University of Manitoba	Chancellor's Hall	634222	5519171	.	.	.	.	.	.	.	1	0	.	Active
52	**Winnipeg**	Fort Richmond	University of Manitoba	power plant stacks	634342	5518800	0	.	.	.	.	.	.	.	.	.	Inactive
69	**Winnipeg**	Fort Richmond	633 Patricia Avenue	St Avila School	634267	5517946	.	.	2	0	2	0	0	0	.	2	Active
47	**Winnipeg**	Fort Rouge	517 Beresford Ave	apartments	634077	5524823	0	.	2	3	2	4	0	.	4	0	Active
48	**Winnipeg**	Fort Rouge	469 Beresford Ave	apartments	634233	5524905	2	.	2	3	2	0	2	.	.	.	Active
46	**Winnipeg**	Fort Rouge	510 Hay St	Churchill High School	634289	5525551	0	.	.	.	.	.	.	.	.	.	Capped
66	**Winnipeg**	Fort Rouge	625 Osborne St	Fort Rouge Leisure Centre	634026	5525094	.	.	0	.	.	.	.	.	2	0	Active
45	**Winnipeg**	Fort Rouge	915 Corydon Ave	Maple Leaf Apartments	632186	5525666	0	2	0	0	.	.	.	.	.	5	Active
2015-1	**Winnipeg**	Fort Rouge	481 Woodward Ave	private residence	633597	5525641	.	.	.	.	.	.	.	.	0	.	Inactive
2015-16	**Winnipeg**	Fort Rouge	94 Roslyn Rd	Signature Homes Ltd	633209	5526947	.	.	.	.	.	.	.	.	2	2	Active
2015-14	**Winnipeg**	Fort Rouge	100 Roslyn Rd	Blackstone Apt	633186	5526936	.	.	.	.	.	.	.	.	2	2	Active
2016-2	**Winnipeg**	Fort Rouge	166 Roslyn Rd	Dennistoun House	632823	5526903	.	.	.	.	.	.	.	.	.	0	Inactive
2015-15	**Winnipeg**	Fort Rouge	395 River Ave	The Biltmore	633329	5526948	.	.	.	.	.	.	.	.	2	0	Active
2016-11	**Winnipeg**	Fort Rouge	444 River Ave	Augustine United Church	633245	5526831	.	.	.	.	.	.	.	.	.	2	Active
2016-12	**Winnipeg**	Fort Rouge	411 Stradbrook	Lancaster Apartments	633396	5526786	.	.	.	.	.	.	.	.	.	4	Active
37	**Winnipeg**	North End	998 Main St	Westmount Apts/Best Care	634047	5530629	.	.	.	.	.	.	.	.	.	.	Capped
38	**Winnipeg**	North End	205 College Ave	Redwood Apartments	634210	5531289	0	.	.	.	.	.	.	.	.	.	Inactive
39	**Winnipeg**	North End	135 Anderson Ave	St John's Cathedral	634649	5531545	0	.	2?	2	2	2	.	.	.	2	Active
44	**Winnipeg**	River Heights	378 Academy Rd	River Heights Apartments	630665	5526141	6	6	6	17	3	2	0	.	.	3	Active
43-A	**Winnipeg**	River Heights	465 Lanark St	Lanark Gardens	629427	5524998	.	.	.	0	.	.	.	.	.	2	Active
43-B	**Winnipeg**	River Heights	495 Lanark St	Lanark Gardens	629427	5524998	.	.	.	0	.	.	.	.	.	.	Inactive
43-C	**Winnipeg**	River Heights	525 Lanark St	Lanark Gardens	629427	5524998	.	.	.	0	.	.	.	.	.	.	Inactive
65	**Winnipeg**	River Heights	161 Stafford St	NW corner at Grosvenor	631943	5525871	.	2	0	.	.	.	.	.	.	.	Capped
2015-23	**Winnipeg**	River Heights	291 Yale Ave	private residence	631363	5525663	.	.	.	.	.	.	.	.	.	.	Active
36	**Winnipeg**	South Point Douglas	68 Higgins Ave	Standard Press	634845	5529436	.	.	3	.	1	0	2	.	.	5	Active
35	**Winnipeg**	South Point Douglas	114 Higgins Ave	King's Hotel	634562	5529552	1	.	.	.	.	.	.	.	.	.	Inactive
34	**Winnipeg**	South Point Douglas	120 Higgins Ave	NW Fabrics	634526	5529551	0	.	.	.	.	.	.	.	.	.	Inactive
90	**Winnipeg**	South Point Douglas	Gomez & Sutherland	Richlu Man. Bldg	634730	5529665	.	.	.	.	.	.	0	.	.	.	Inactive
33	**Winnipeg**	South Point Douglas	515 Waterfront Dr	Vita Foam	634487	5529394	0	.	.	.	.	.	.	.	.	1	Active
83	**Winnipeg**	St Boniface	865 Tache Ave	Cladan Electrics	634357	5528989	.	.	.	0	.	.	.	.	.	2	Active
84	**Winnipeg**	St Boniface	690 St. Joseph St	Kaljeb Logistics	634739	5528605	.	.	.	5	3	2	3	.	.	.	Active
55	**Winnipeg**	St Boniface	393 Marion St	Marion Hotel	635842	5527248	0	.	.	1	1	2	2	3	.	.	Active
57	**Winnipeg**	St Boniface	188 St Mary's Rd	Nelson McIntyre Collegiate	635049	5526482	0	.	.	.	.	.	.	.	.	.	Inactive
56	**Winnipeg**	St Boniface	261 Youville St	Springs Christian Academy	635897	5527060	1	1	2	5	4	4	3	3	.	2	Active
5B	**Winnipeg**	St James	1975 Portage Ave	Assiniboine Hotel; "Beer Store"	627439	5526675	.	.	2	0	0	.	.	.	.	.	Active
5A	**Winnipeg**	St James	1975 Portage Ave	Assiniboine Hotel; "Bev. room"	627439	5526675	2	.	0	0	0	.	.	.	.	.	Active
6	**Winnipeg**	St James	175 Winston Rd	Assiniboine School	628613	5526581	0	0	3	4	2	6	8	110	166	156	Active
70	**Winnipeg**	St James	1790 Portage Ave	Carillon Towers	628506	5526670	.	.	4	5	2	4	4	3	2	3	Active
4	**Winnipeg**	St James	2109 Portage Ave	Deer Lodge Centre; large stack	626835	5526650	0	0	.	.	3	0	.	.	.	.	Active
1	**Winnipeg**	St James	300 Booth Dr	Grace Hospital	623707	5527022	0	.	.	.	.	.	.	.	.	.	Inactive
63	**Winnipeg**	St James	1755 Portage Ave	King's Theatre	628533	5526715	.	5	2	4	2	6	2	0	3	3	Active
3	**Winnipeg**	St James	2187 Portage Ave	Moorgate Apartments	626445	5526440	1	.	3	3	3	3	2	.	.	.	Active
2	**Winnipeg**	St James	2235 Portage Ave	New Silver Heights Apartments	626331	5526415	6	6	6	7	2	3	2	2	3	.	Active
81B	**Winnipeg**	St James	303 Assiniboine Ave	Newcastle Apt.; N chimney	633741	5527599	.	.	0	.	.	.	.	.	.	.	Inactive
81A	**Winnipeg**	St James	303 Assiniboine Ave	Newcastle Apt.; S chimney	633741	5527599	.	.	0	.	.	.	.	.	.	.	Inactive
2014-6	**Winnipeg**	St James	115 Handsart Blvd	private residence	628169	5525916	.	.	.	.	.	.	.	4	.	1	Active
2014-5	**Winnipeg**	St James	271 Hampton St	St Anne's RC Church - East chimney	628427	5527031	.	.	.	.	.	.	.	3	6	2	Active
2014-5B	**Winnipeg**	St James	271 Hampton St	St Anne's RC Church - North chimney	628427	5527031	.	.	.	.	.	.	.	.	7	.	Active
42552	**Winnipeg**	St James	1780 Portage Ave	Marner Apartments	628540	5526666	.	.	.	.	.	.	.	.	.	1	Active
2014-3	**Winnipeg**	St Norbert	35 De La Digue Ave.	St Norbert Behav. Health Fdn	632947	5514222	.	.	.	.	.	.	.	7	2	6	Active
42430	**Winnipeg**	St Norbert	80 St Pierre Street	St Norbert Parish Church	633709	5514141	.	.	.	.	.	.	.	.	.	3	Active
61	**Winnipeg**	St Vital	847 St Mary's Rd	Christ the King School	635757	5523474	0	.	0	.	0	.	.	.	.	0	Inactive
62	**Winnipeg**	St Vital	891 St Mary's Rd	Good News Fellowship Church	635707	5523206	1	2	0	0	3	0	0	.	.	.	Active
59	**Winnipeg**	St Vital	596 St Mary's Rd	Miller's Meat	635699	5525208	.	.	1	.	0	.	.	.	.	.	Active
58	**Winnipeg**	St Vital	531 St Mary's Rd	Riverside Billiards	635791	5525544	0	.	0	.	.	.	.	.	.	0	Inactive
60	**Winnipeg**	St Vital	613 St Mary's Rd	St Mary's Road United Church	635810	5525078	1	2	1	2	2	0	0	.	.	.	Active
42	**Winnipeg**	Tuxedo	15 Conservatory Drive	Assiniboine Park	627298	5525637	2	2	2	4	2	0	.	.	0	.	Active
14	**Winnipeg**	West Broadway	686 Portage Ave	.	632100	5527722	1	.	.	.	.	.	.	.	.	.	Capped
15	**Winnipeg**	West Broadway	650 Portage Ave	.	632256	5527804	0	.	.	.	.	.	.	.	.	.	Capped
13	**Winnipeg**	West Broadway	730 Portage Ave	Abandoned car dealer	631972	5527663	1	.	.	.	.	.	.	.	.	.	Demolished
20	**Winnipeg**	West Broadway	464 St Mary Ave	Abbot Clinic	632858	5527885	0	.	.	1	1	0	.	.	.	.	Active
16	**Winnipeg**	West Broadway	669 Broadway	Thompson Funeral Home	632304	5527582	0	.	.	.	.	.	.	.	.	.	Capped
7	**Winnipeg**	West End	258 Burnell St	Behind Shoppers Drug Mart	631363	5527559	1	.	.	0	.	.	.	.	.	.	Active
88	**Winnipeg**	West End	841 Erin Street	Clearline Self Storage	630276	5528081	.	.	.	.	.	.	0	.	.	.	Inactive
87	**Winnipeg**	West End	803 Erin Street	Elan Designs and Upholstery	630402	5527944	.	.	.	.	.	.	2	.	.	.	Active
8	**Winnipeg**	West End	318 Home St	Mennonite Church	631556	5527620	0	.	.	.	.	.	.	.	.	.	Inactive
82	**Winnipeg**	West End	1349 Portage Ave	Second Encore Music Store	630028	5527131	.	.	.	0	.	.	.	.	.	.	Inactive
86	**Winnipeg**	West End	1586 Wall Street	Wpg Building & Decorating	630429	5529915	.	.	.	.	.	0	.	.	.	.	Inactive
40	**Winnipeg**	West Kildonan	442 Scotia St	Marymound	635730	5533653	.	.	.	.	.	.	.	.	.	.	Inactive
18	**Winnipeg**	Wolseley	28 Woodrow Pl	.	632057	5526820	2	2	.	.	.	.	.	.	.	.	Demolished
9	**Winnipeg**	Wolseley	252 Home St	Apartment building	631547	5527397	1	.	.	0	.	.	.	.	.	.	Active
11	**Winnipeg**	Wolseley	154 Evanson St	The Lothian Block Apartments	631403	5527104	0	.	.	.	.	.	.	.	2	2	Active
12	**Winnipeg**	Wolseley	72 Lenore St	Apartment building	631302	5526857	1	.	.	.	.	.	.	.	.	.	Capped
89	**Winnipeg**	Wolseley	172 Lenore Street	Fleetwood Apartments	631359	5527065	.	.	.	.	.	.	1	.	2	2	Active
17	**Winnipeg**	Wolseley	115 Maryland St	Foodfare	632165	5527134	.	.	.	2	2	2	1	.	.	2	Active
10	**Winnipeg**	Wolseley	189 Evanson St	Old Grace Hosp.; large stack	631472	5527239	3	.	.	0	.	2	2	2	.	.	Demolished

Appendix B: Images

Image 1: Manitoba Breeding Bird Atlas Regions

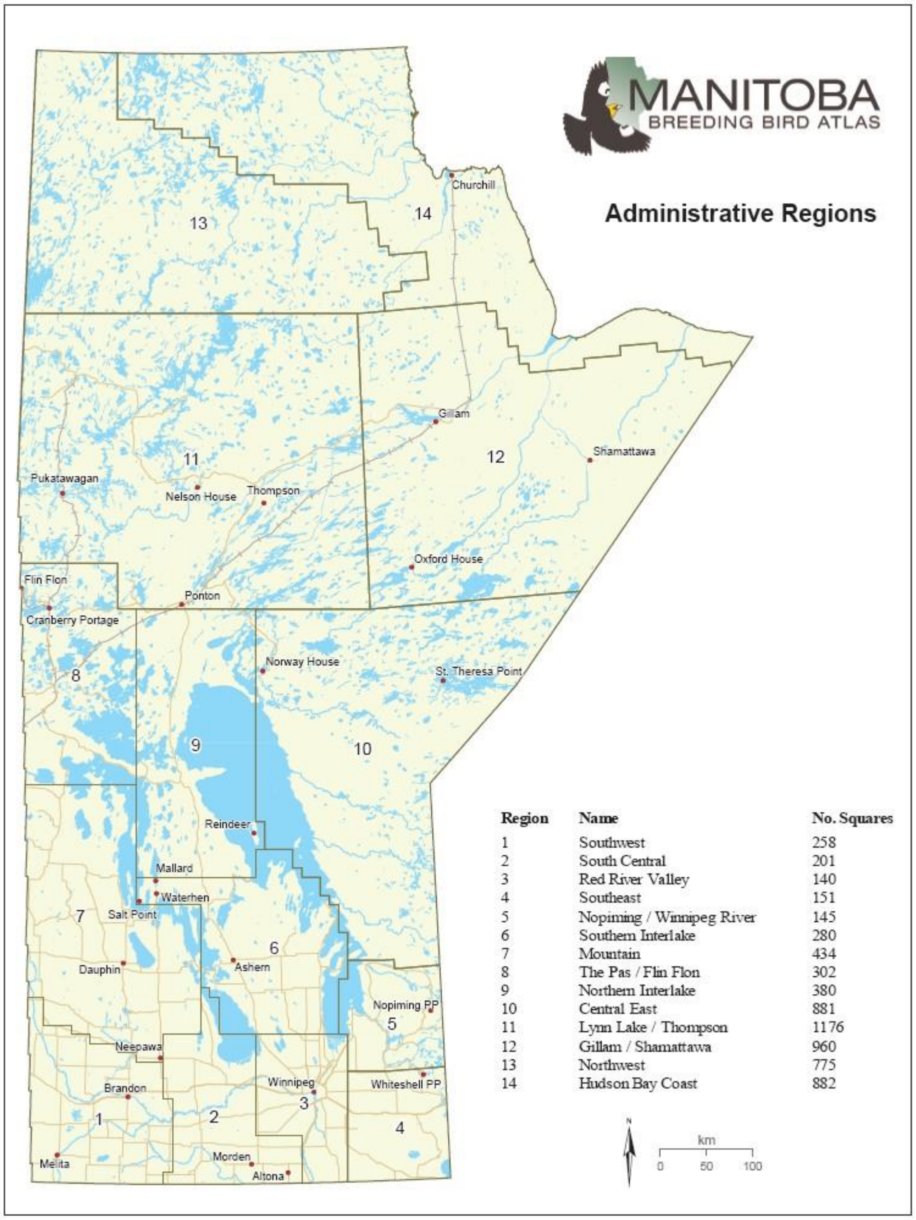


Image 2: Chimney Swift Range in Manitoba (Blue Area)

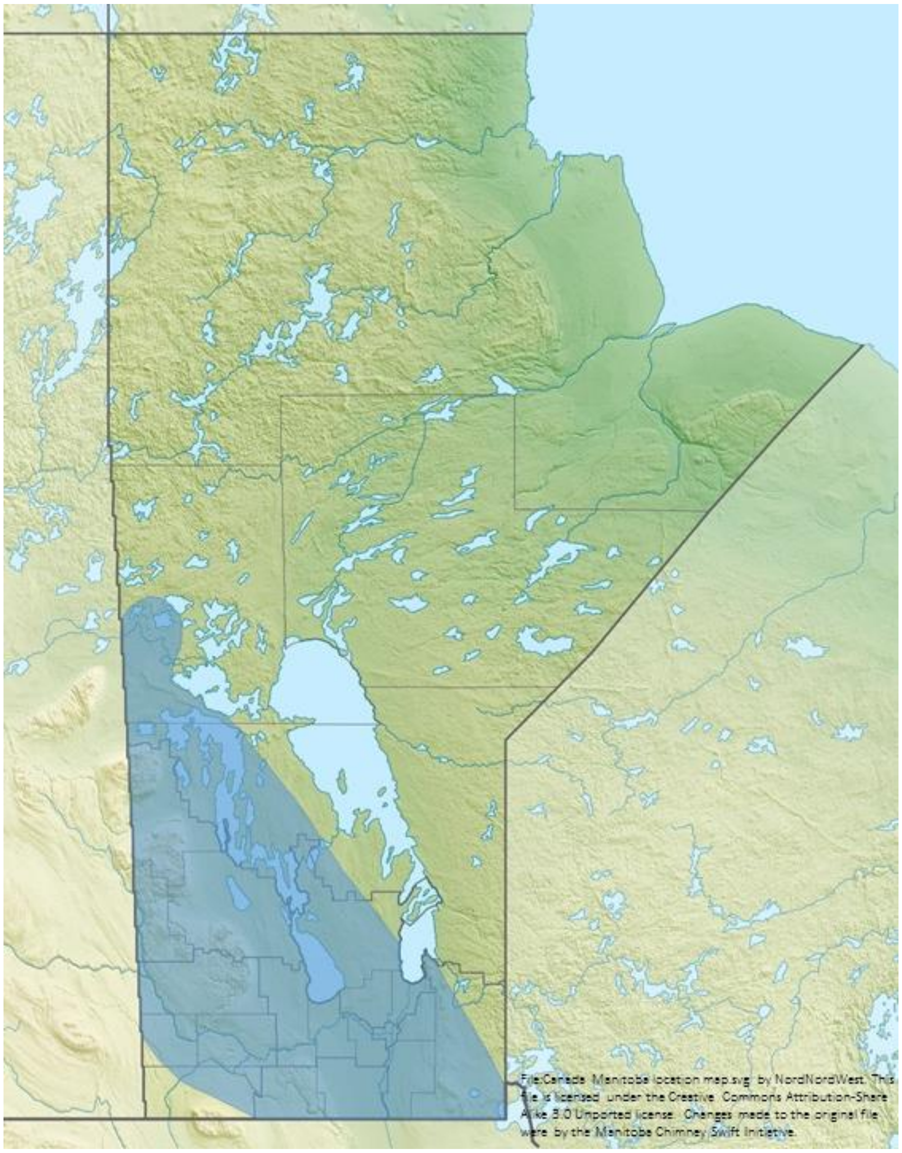


Image 3: Winnipeg Separated by Neighbourhood Cluster, showing swift sites, river, parks, and retention ponds

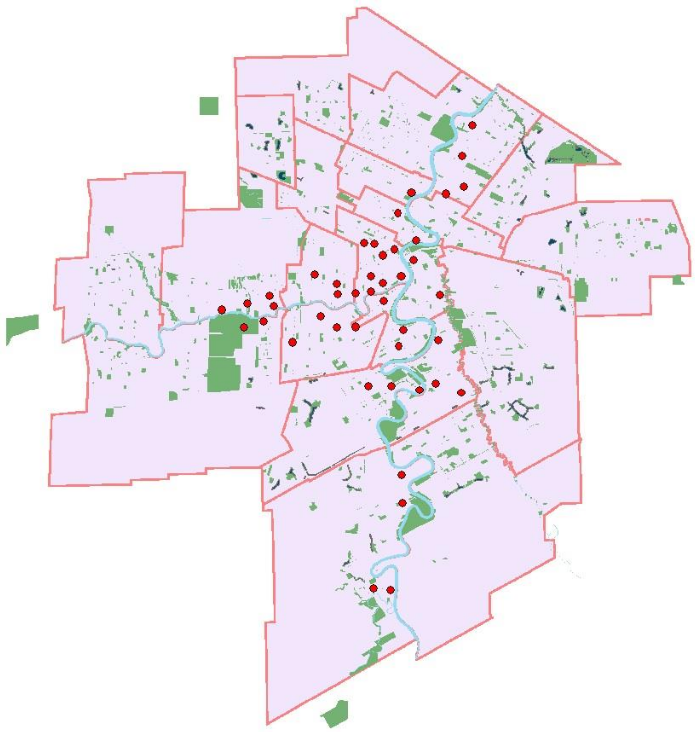


Image 4: Winnipeg With Swift Sites and 500 m, 1 km, 3 km, 6 km Study Areas

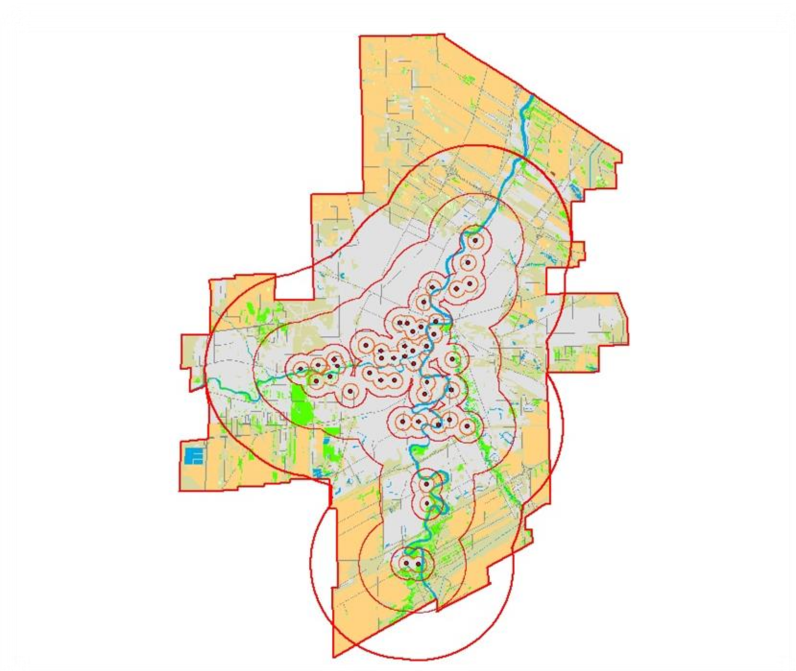


Image 5: Active Swift Sites in Southern Manitoba

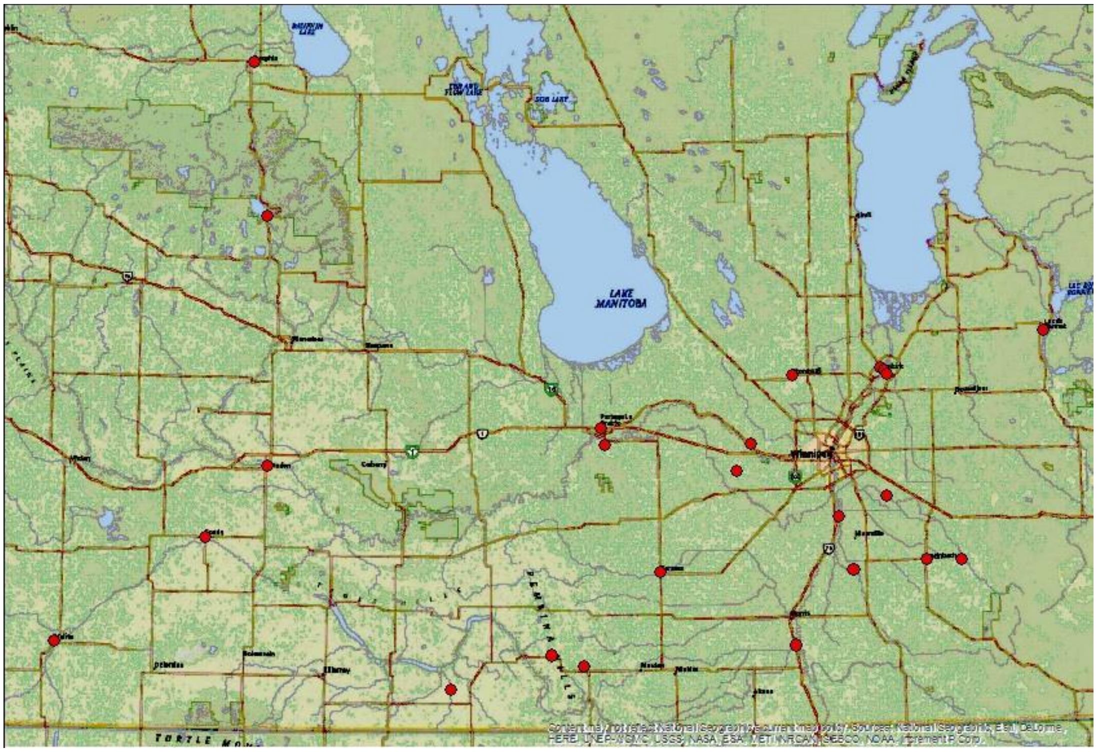


Image 6: Comparison Sites

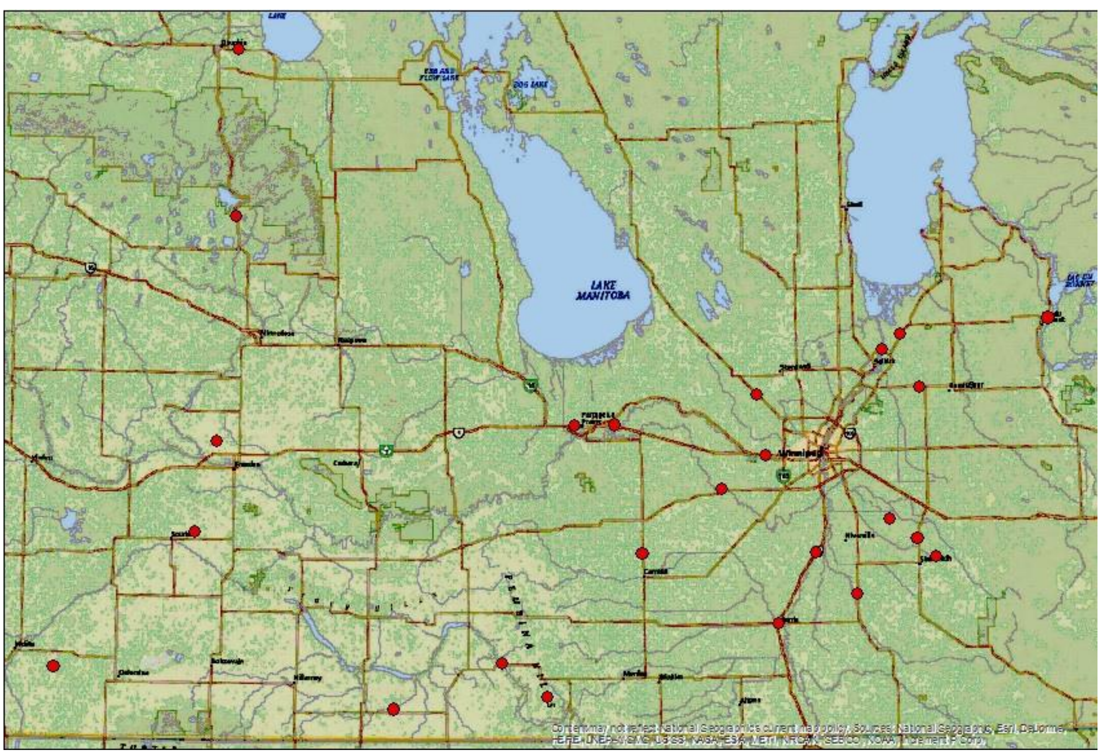


Image 7: Predicted Suitable Communities

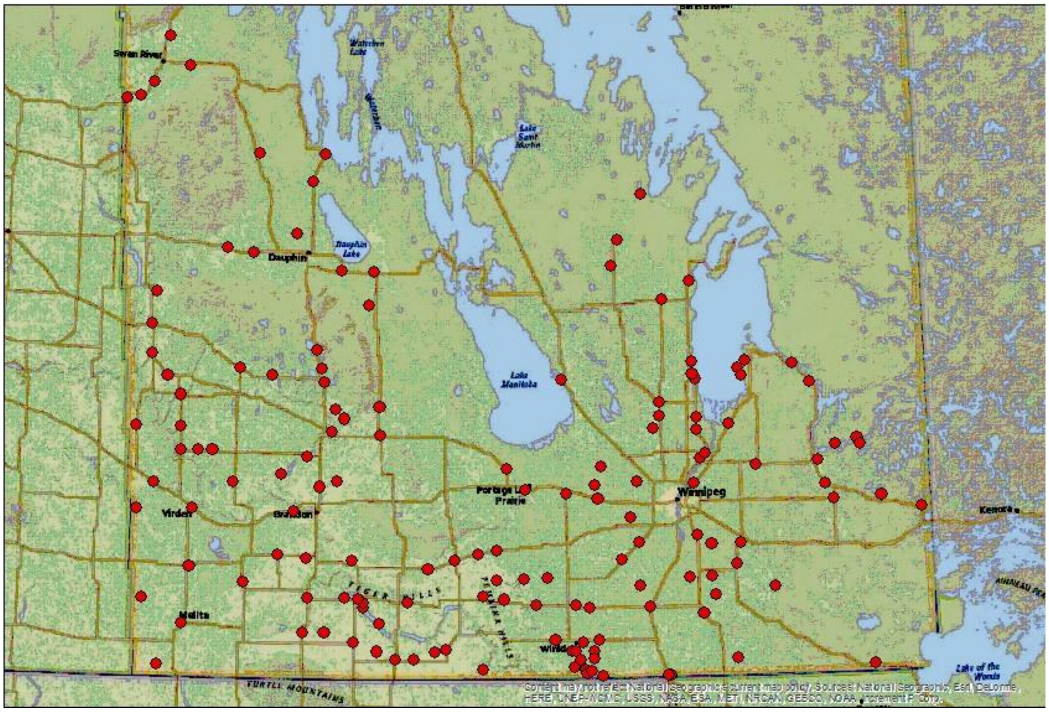
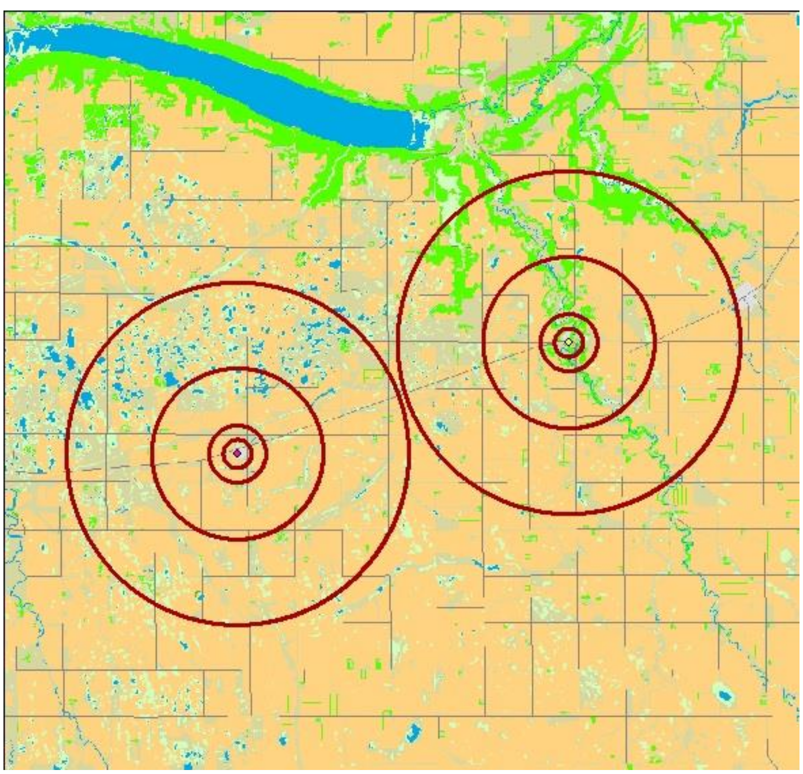
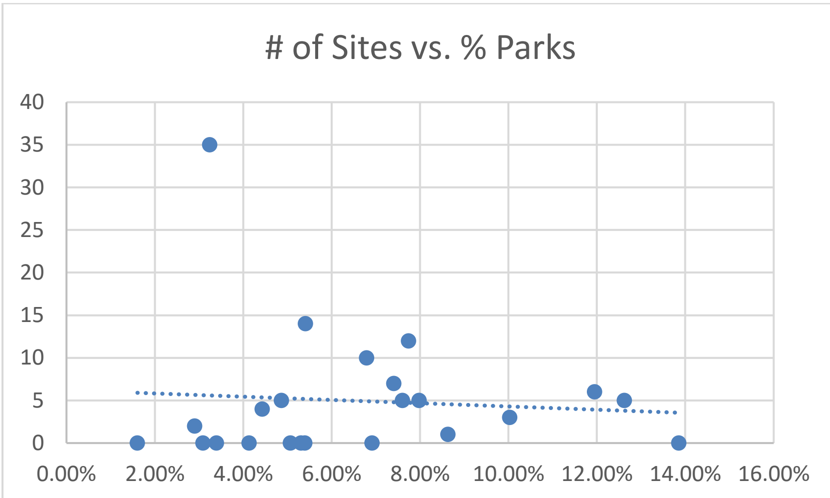


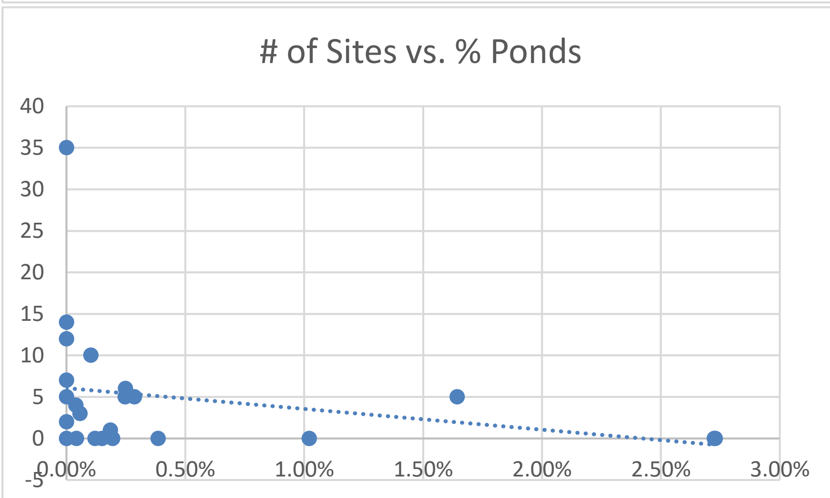
Image 8: Detail of Active Swift Site (right) and Comparison Site (left) with Study Areas and Raster Base Map

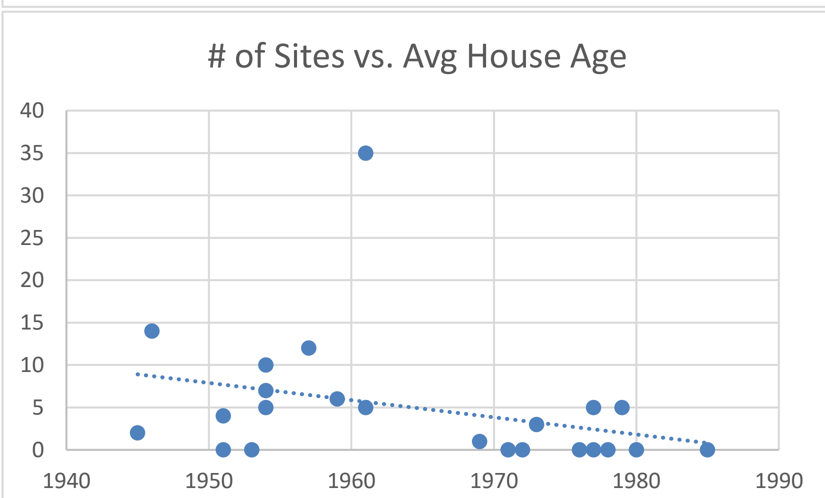


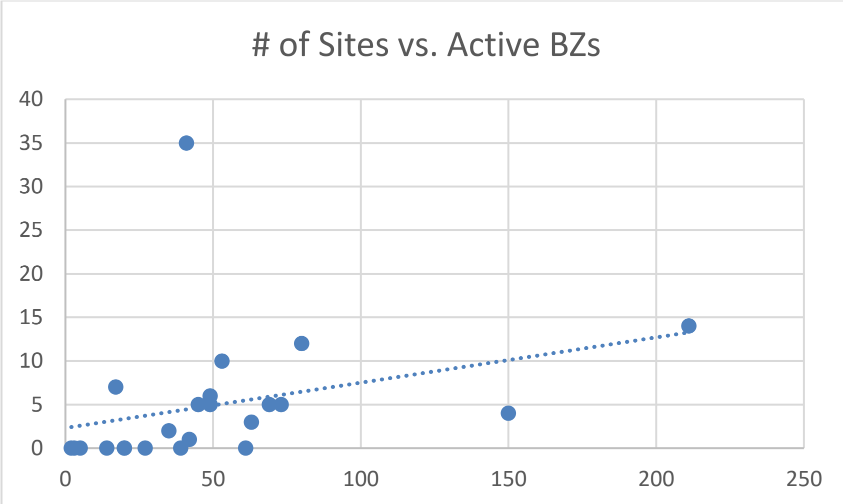
Appendix C: Graphs

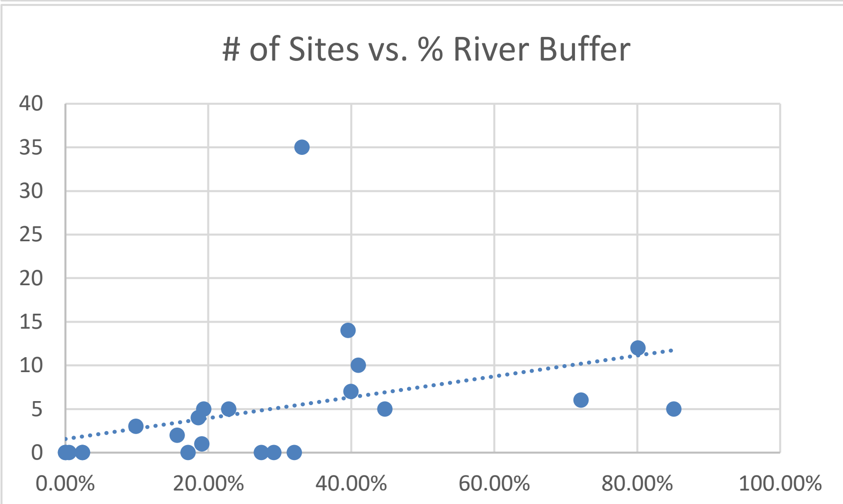
Winnipeg Habitat Features Compared to Measures of Attractiveness-to-Swifts

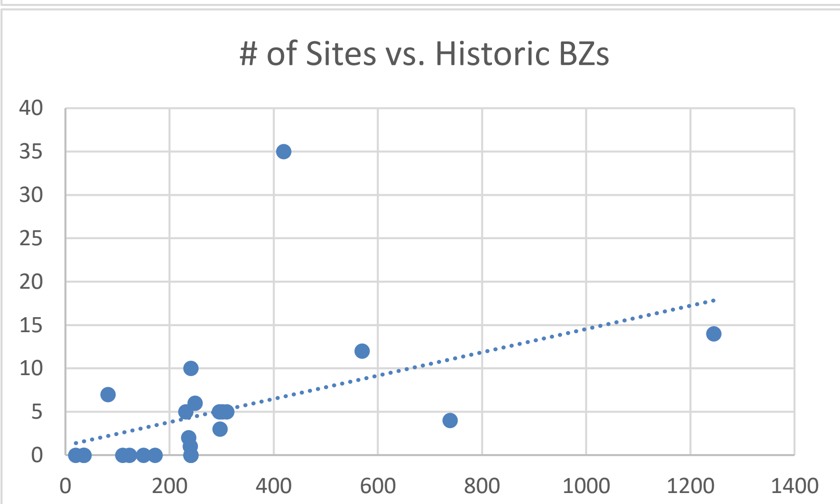


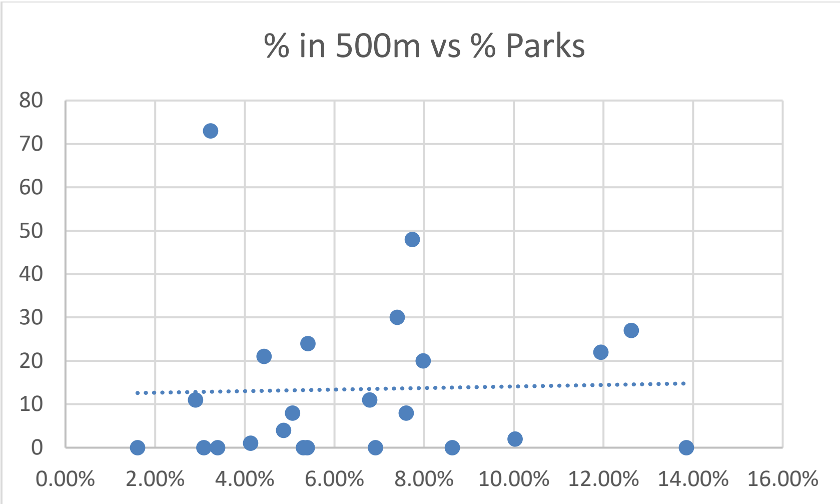


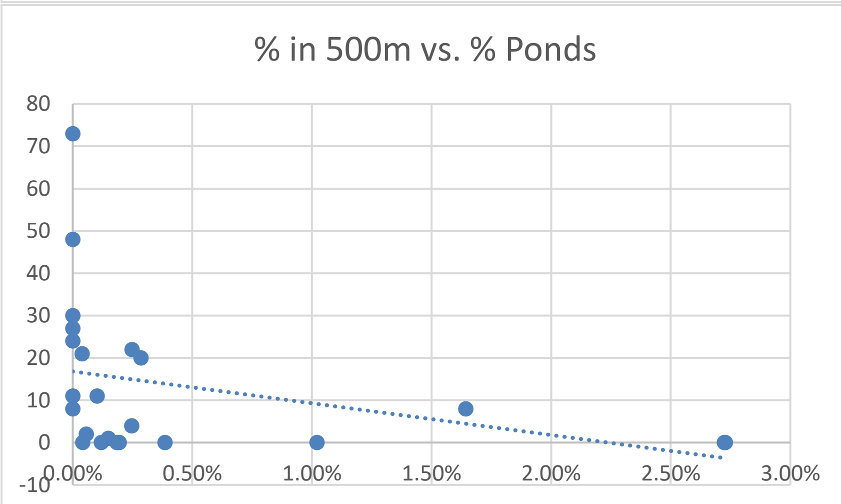


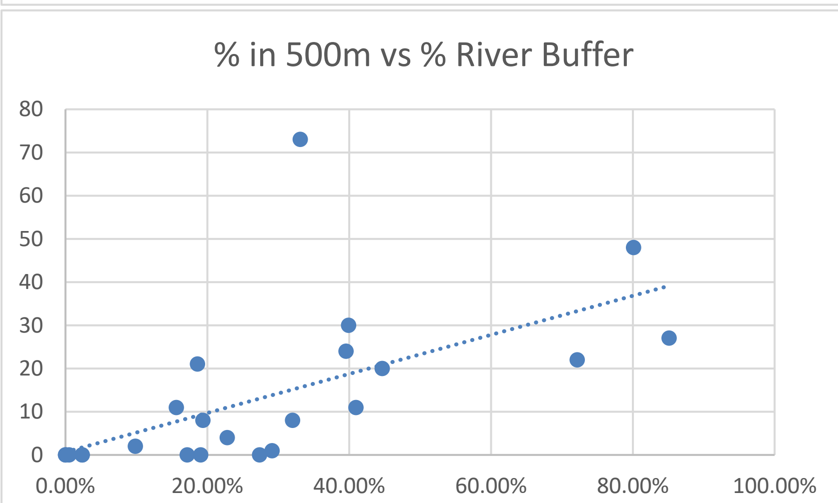

# of Sites vs. Active BZs
40
35
30
25
20
15
10
5
0
0
50
100
150
200
250

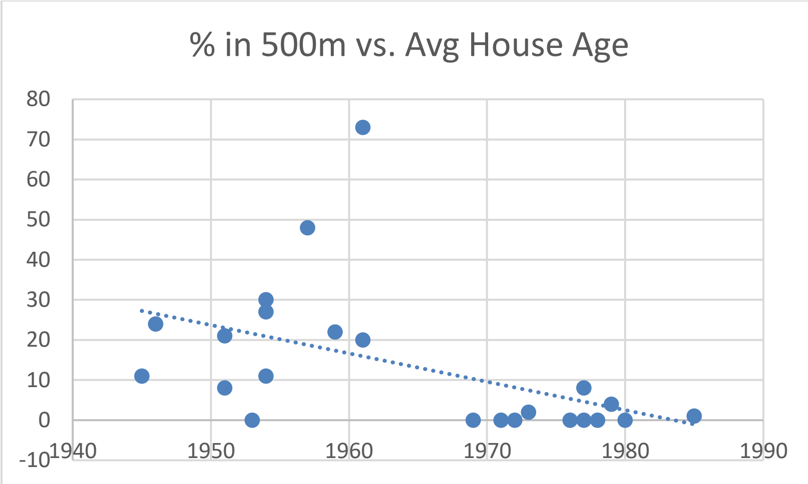

# of Sites vs. % River Buffer
40
35
30
25
20
15
10
5
0
0.00%
20.00%
40.00%
60.00%
80.00%
100.00%

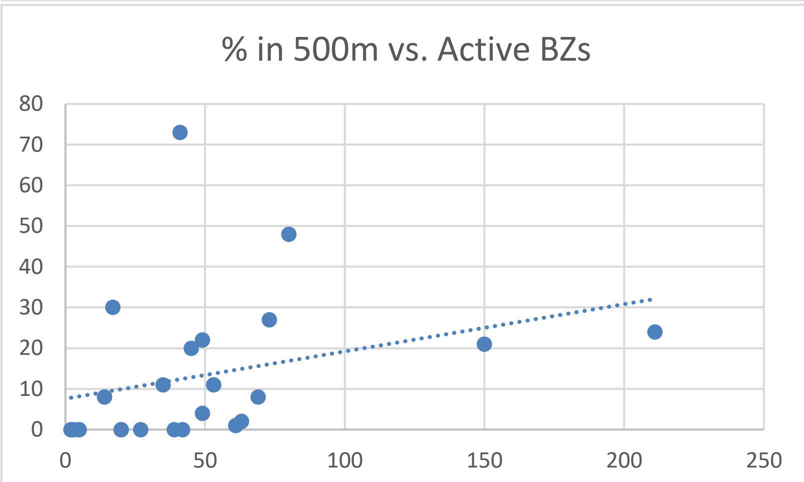

# of Sites vs. Historic BZs
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400

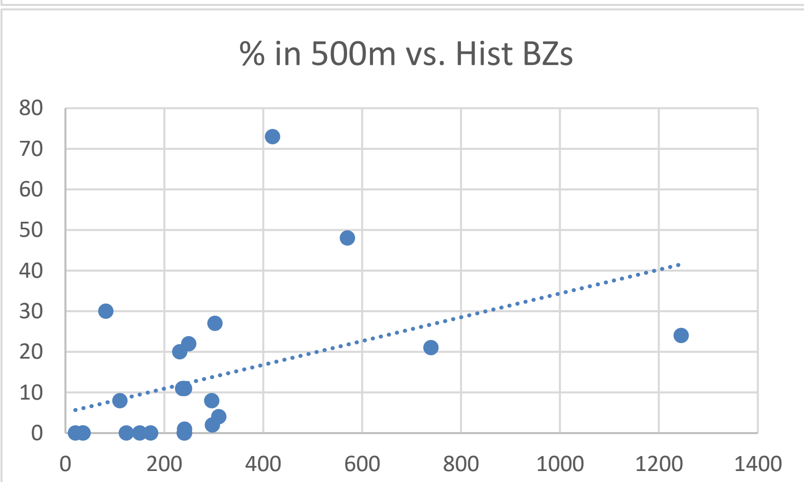

% in 500m vs % Parks
80
70
60
50
40
30
20
10
0
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
14.00%
16.00%

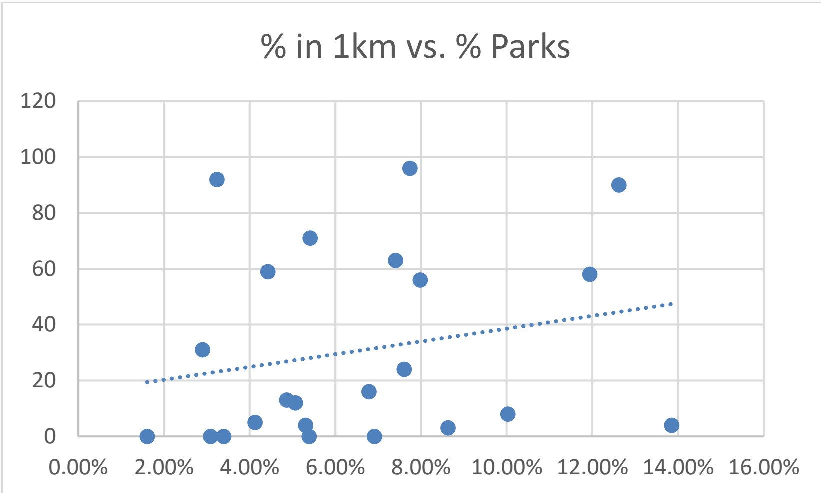

% in 500m vs. % Ponds
80
70
60
50
40
30
20
10
0
-10
0.00%
0.50%
1.00%
1.50%
2.00%
2.50%
3.00%


% in 500m vs % River Buffer
80
70
60
50
40
30
20
10
0
0.00%
20.00%
40.00%
60.00%
80.00%
100.00%

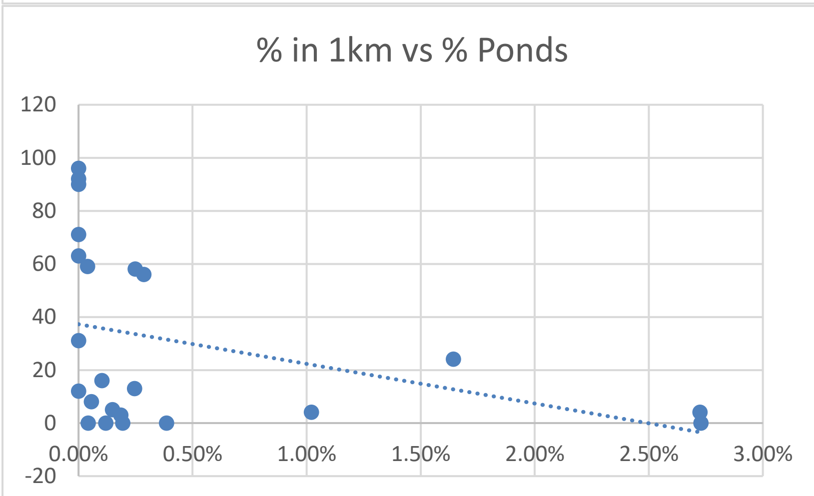

% in 500m vs. Avg House Age
80
70
60
50
40
30
20
10
0
-10
1940
1950
1960
1970
1980
1990


% in 500m vs. Active BZs
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250

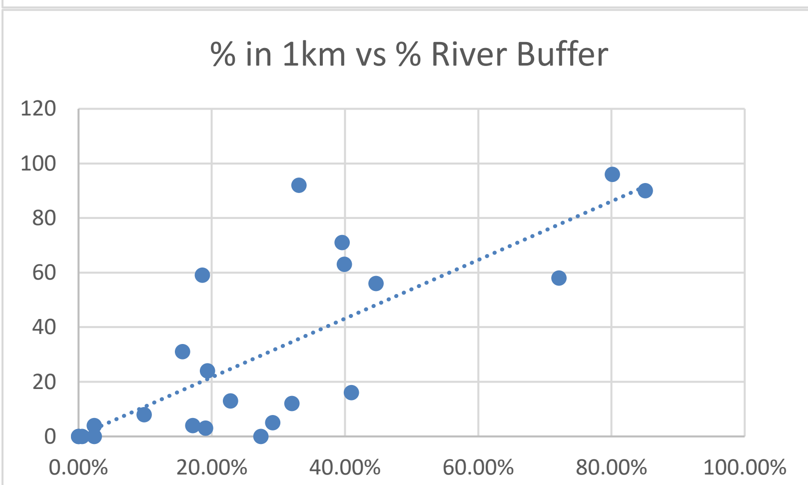

% in 500m vs. Hist BZs
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
1400



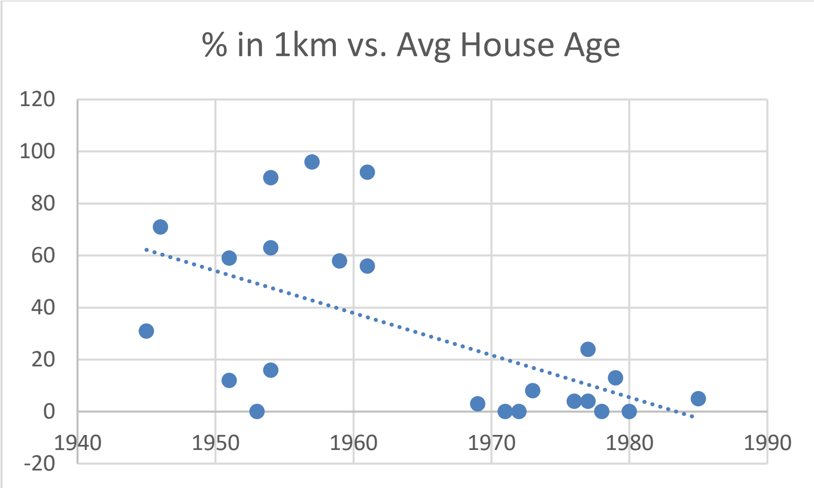
% in 1km vs. % Parks
120
100
80
60
40
20
0
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
14.00%
16.00%

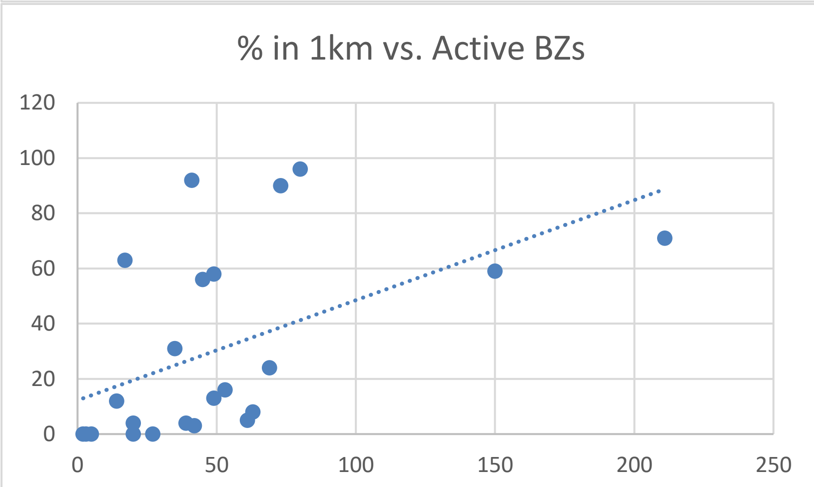


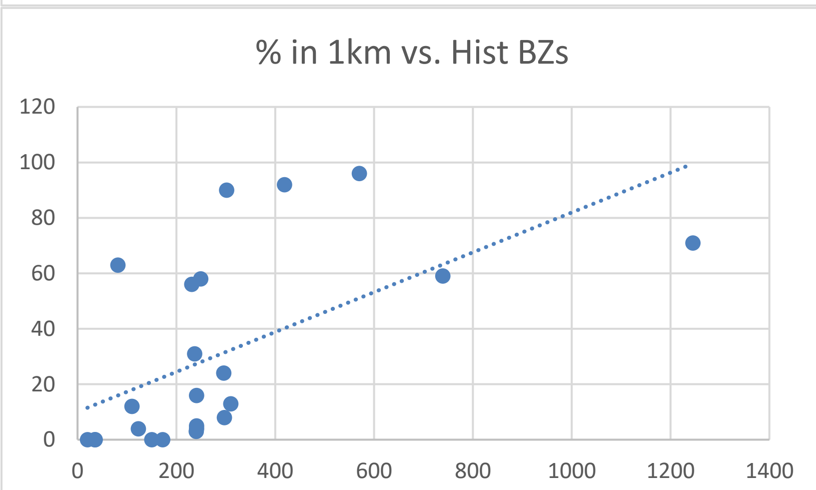
% in 1km vs % Ponds
120
100
80
60
40
20
0
-20
0.00%
0.50%
1.00%
1.50%
2.00%
2.50%
3.00%

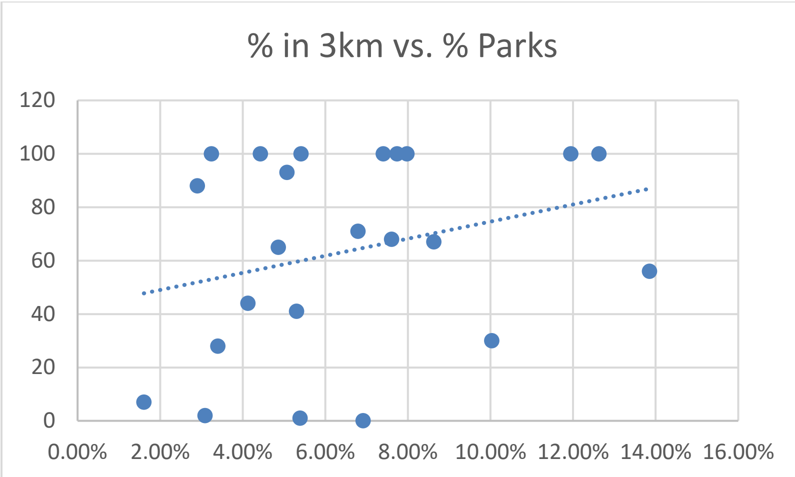


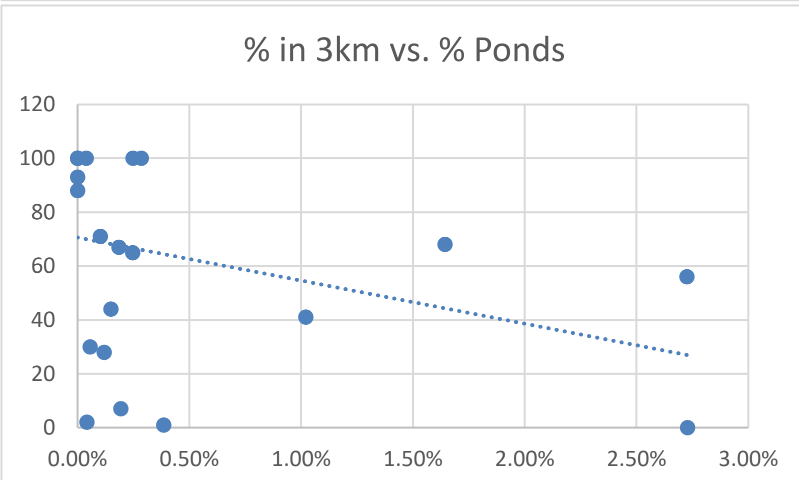
% in 1km vs % River Buffer
120
100
80
60
40
20
0
0.00%
20.00%
40.00%
60.00%
80.00%
100.00%

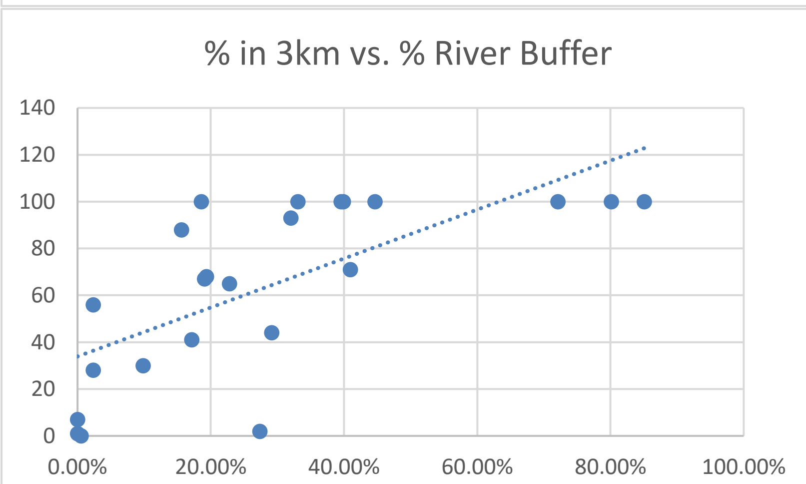

% in 1km vs. Avg House Age
120
100
80
60
40
20
0
-20
1940
1950
1960
1970
1980
1990

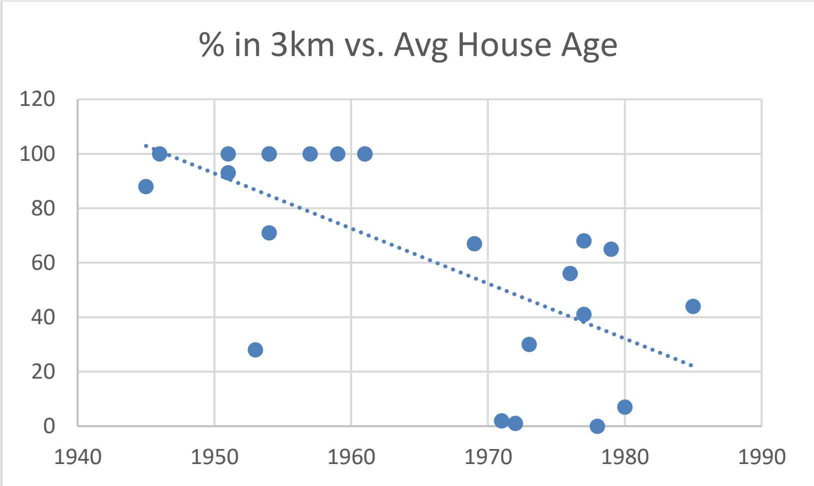

% in 1km vs. Active BZs
120
100
80
60
40
20
0
0
50
100
150
200
250

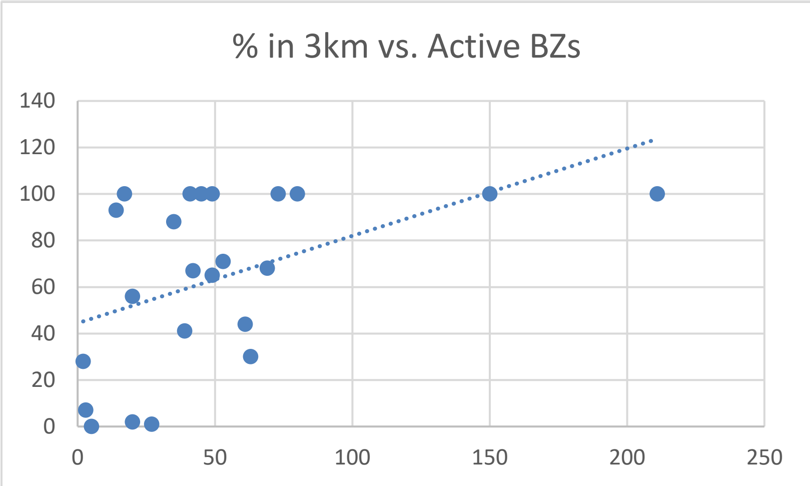

% in 1km vs. Hist BZs
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400

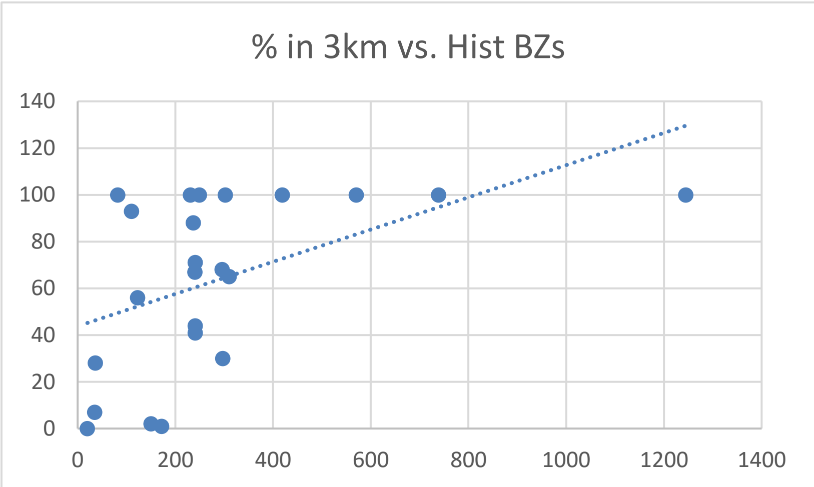

% in 3km vs. % Parks
120
100
80
60
40
20
0
0.00% 2.00% 4.00% 6.00% 8.00% 10.00% 12.00% 14.00% 16.00%


% in 3km vs. % Ponds
120
100
80
60
40
20
0
0.00% 0.50% 1.00% 1.50% 2.00% 2.50% 3.00%


% in 3km vs. % River Buffer
140
120
100
80
60
40
20
0
0.00% 20.00% 40.00% 60.00% 80.00% 100.00%


% in 3km vs. Avg House Age
120
100
80
60
40
20
0
1940
1950
1960
1970
1980
1990


% in 3km vs. Active BZs
140
120
100
80
60
40
20
0
0
50
100
150
200
250


% in 3km vs. Hist BZs
140
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400