A TREE INVENTORY MANAGEMENT PLAN FOR THE TORONTO DISTRICT SCHOOL BOARD

King Edward Junior Public School

FOR3008H Research Paper in Forest Conservation
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ABSTRACT

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In May of 2004, the Toronto District School Board approached the Faculty of Forestry, University of Toronto, and requested that a tree inventory be conducted for their 600 school properties. This project offers a tree inventory strategy at maximum efficiency with minimal cost and provides recommendations for future years on collecting attribute data, georeferencing trees on school properties and using inventory data for individual tree level management.

Key Words: tree inventory, schoolyard greening, shade provision, urban forest management, education, geographic information systems, database, mapping, benefits

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1.0 INTRODUCTION

Schoolyards which often consist of an asphalt plane with few, if any trees, have become a point of concern (TDSB 2004). In order to change schoolyards into healthy, naturalized spaces, tree inventories are essential. Based on a collection of tree attributes as well as a spatial database for GIS, inventories enable landowners to effectively evaluate green spaces and develop long-term management initiatives.

This project is a strategy for collecting a tree inventory for the Toronto District School Board; it is a procedure for efficiently and cost effectively collecting attribute data and creating a spatial database. This report overviews the preliminary findings in the downtown area of the initial months and provides the rationale and methodology for the strategy, recommendations for future data collection and perspective data analysis. The inventory will enable the Toronto District School Board (TDSB) to move forward effectively to better manage school grounds so they facilitate children's growth, development and education. This project was established at the request of the Toronto District School Board and was the direct result of the Master of Forest Conservation internship offered in the summer of 2004 to Adrina C. Ambrosii.

1.1 BACKGROUND

Many School Board trees are located in areas restricted to students, such as the front or side of main buildings and in or around parking lots (Day 2004). This is a concern since, according to the Canadian Dermatology Association (2003); children have the highest risk for sun exposure as they spend between 10-25% of their day outside. Schoolyards generally have an expanse of asphalt and turf grass with little or no

surrounding trees to offer protection. From kindergarten to grade eight, children spend over 250 days outside during peak ultra violet radiation exposure times (Greater Kitchener Waterloo Chamber of Commerce 2004).

Currently, the TDSB does not have a tree inventory database. This year funds have been allocated for a tree inventory to take place, which the School Board envisions will initiate the development of a forest management plan. This inventory will provide the basis for these efforts to serve the interests of the TDSB Environmental Health Committee on children's wellbeing and to aid in outdoor education in conjunction with the TDSB's Ecoschools initiative (2003) in partnership with Evergreen Foundation. The School Board approached the Faculty of Forestry, University of Toronto, in May 2004 with the intention of creating a partnership to begin this inventory.

1.2 BENEFITS OF TREES IN SCHOOLYARDS

The diversity of green space in a school ground is imperative to the well being of students. Green spaces have tremendous psychological, social and even economic benefits. Studies have shown that people feel a closer sense of "community" when surrounded by greenspaces because they are more likely to enjoy being outside (Westphal 2003). Students interact more positively with one another outdoors; this creates social ties within the school environment thereby leading to a safer community (Kuo 2003).

Schoolyard trees not only provide protection from ultra violet rays, they also promote educational, social and environmental benefits (adapted from a recent study conducted by Dyment and Evergreen of the Toronto District School Board 2004):

- Trees, planted through greening projects, provide an outdoor classroom on school grounds where teachers are able to deliver subjects using a variety of methods
- Student learning is enhanced by the unconventional environment
- Students are encouraged to be involved in schoolyard greening; this instils environmental awareness that leads to stewardship and fosters a sense of community pride
- Trees provide habitat for urban wildlife such as squirrels, birds and insects, all of which children learn to appreciate
- Green school grounds provide a diversity of play areas that increase recreational opportunities; this in turn promotes positive social interactions and inclusion
- Trees provide a healthier and safer environment for students by shielding children from the sun, wind chill, city dust and pollution

Promoting a more natural environment with trees and shrubs within the TDSB landscape will not only provide a host of benefits but also create a positive environment where communities would rather work in and send their children to school.

1.3 CONTEXT

1.3.1 History of the Community and its Urban Forest

In 1998, the City of Toronto amalgamated four municipalities and 2.4 million people; consequently, the Toronto District School Board merged six Boards and became the second largest landowner in Toronto following the City's own Parks and Recreation. Currently there are 300,000 students and 30,000 staff members who comprise the TDSB community.

The Toronto District School Board, embodying over 5,000 acres (including schoolyards, parking lots, buildings and driveways) and 600 schools, is the largest school board in Canada (see Figure 1) and the 5th largest in North America.

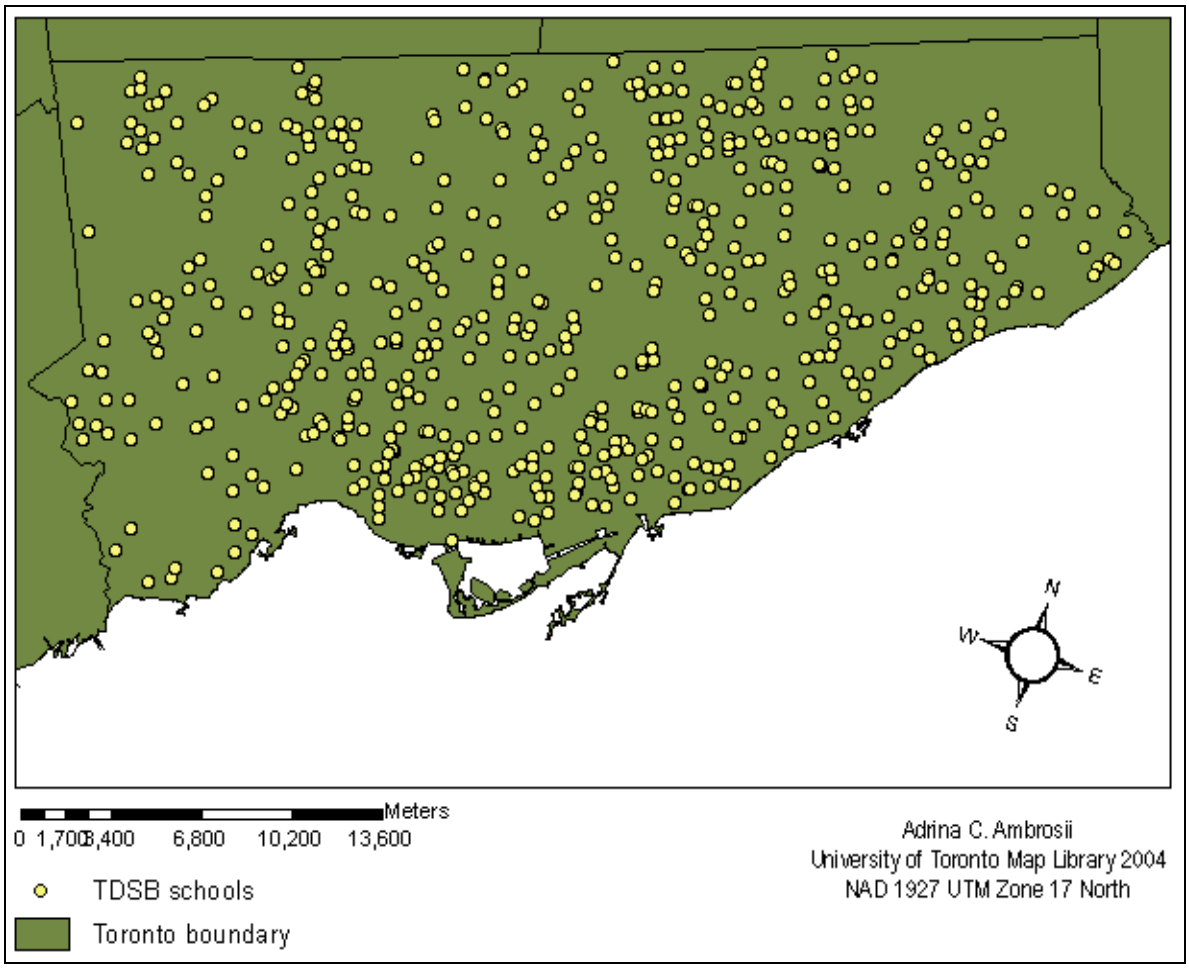

Figure 1: Toronto District School Board properties across amalgamated City of Toronto

To date, there has never been a tree inventory taken in order to determine the importance of this resource. The current TDSB Environmental Policy (Day 2004) lacks standardization of best practices across the twenty-two wards[1].

[1] 1) Etobicoke North; 2) Etobicoke Centre; 3) Etobicoke-Lakeshore; 4) York West; 5) York Centre; 6) York South-Weston; 7) Parkdale-High Park; 8) Eglinton-Lawrence; 9) Davenport; 10) Trinity-Spadina; 11) St. Paul's; 12) Willowdale; 13) Don Valley West; 14) Toronto Centre-Rosedale; 15) Toronto-Danforth; 16) Beaches-East York; 17) Don Valley East; 18) Scarborough South-West; 19) Scarborough Centre; 20) Scarborough-Agincourt; 21) Scarborough-Rouge River; 22) Scarborough East.

1.3.2 Staffing and Personnel

The Facility Services department is responsible for grounds maintenance and for the day-to-day management of trees as well as design and construction, caretaking and trades. Funding for the TDSB tree inventory is allocated internally through the Facility Services budget and therefore data collectors for the inventory process are hired into this department. The structure of Facility Services can be seen in Figure 2.

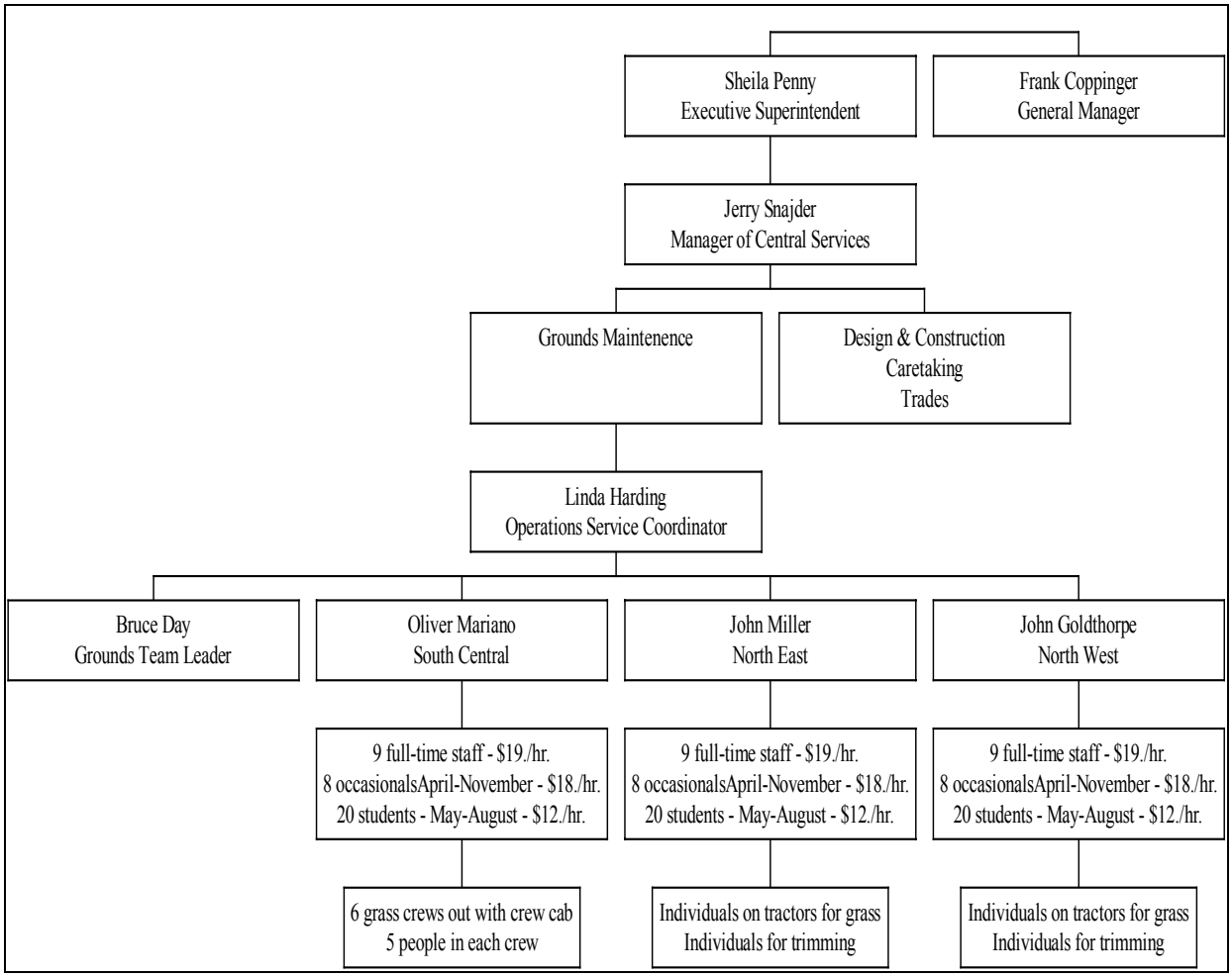

Figure 2: Organizational Structure of Facility Services

Currently, there are three regions made up of 111 full-time and part-time staff resources dedicated to the enhancement of school grounds. The three regions, South Central, North East and North West are further divided according to type of grounds

keeping: soft surfaces (trees, shrubs, turf, horticulture, arboriculture) and hard surfaces (asphalt, concrete, interlocking brick, flagstone, Astroturf). The soft surface grounds crews are responsible for the maintenance of trees in the fields, behind schools and caretakers at each school are responsible for the front and sides of the property. The TDSB eliminated 600 caretakers in the past six years, thereby greatly reducing their capacity to maintain trees (Day 2004). However, contractors are hired for specific tree maintenance that is beyond the expertise and capacity of the grounds crews (e.g. pruning high areas). Currently, the primary focus of grounds design is to emphasize trees, rocks and mulch.

1.3.3 Public Education and Communication

In 2001, Evergreen Foundation, as part of their Learning Grounds program in partnership with the Toronto District School Board, established the School Ground Greening Initiative. Through workshops, design consultations, resources and other support, schools are offered incentives, education and help to create greener schoolyards. The TDSB Ecoschools Program (TDSB 2003) promotes environmental awareness by focusing on school ground greening; energy conservation; waste minimization and ecological literacy. For example, at Dovercourt Junior Public School, students planted a black spruce nursery (100 seedlings) (see Figure 3).

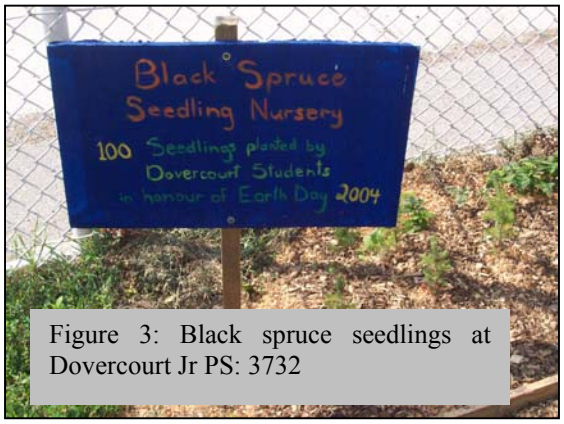

Figure 3: Black spruce seedlings at Dovercourt Jr PS: 3732

Educating the community on the benefits of their green spaces encourages them to care about trees and parks, and hopefully promotes proper maintenance of healthy

living environments. Education and awareness bind people to responsibility, give insight to the larger picture of society and generate collective consciousness (Westphal 2003). For in-depth examples of greening initiatives in Canadian schools, please refer to the publication, *Grounds for Learning* (Evergreen 2001).

1.3.4 Policies and Standards

The TDSB is the only School Board in Canada with an Environmental Policy that is committed to "achieving continual, measurable improvements in environmental and operational practices within its control" (TDSB 2003). The role of the policy is to prescribe organization within the school system through long-term planning and setting overall goals and objectives (BCSTA 1998). TDSB tree policies, such as "one-for-one" tree replacement (Day 2004), only minimally reflect the values of the TDSB community, for example, increasing species diversity and abundance. Therefore, the implementation of new policies, particularly with respect to trees and grounds maintenance may need revisiting and standardizing across the three regions (South Central, North East, North West). The recently published School Ground Greening Guide (TDSB and Evergreen 2004), whose main objective is designing for shade provision, is one progressive example of applying greening standards across the School Board at the planning stages.

In terms of tree maintenance, as a private landowner the School Board must abide by the City of Toronto's Municipal Code, Chapter 813, Trees, Article III. The Tree Protection Policy, passed on Sept. 30th, 2004 was harmonized and broadened to ensure preservation of significant trees on private property, guarantee sustainable urban forestry and regulate removal of trees (C. Walker-Gayle, public presentation, 25 November 2004). As such, the TDSB is subject to its convictions.

2.0 THE PROJECT

2.1 OBJECTIVES AND RATIONALE

The Toronto District School Board set out to establish a framework to measure the quantity and quality of their trees and to monitor changes over time. To accomplish this goal, they needed to:

- Identify and evaluate the benefits of trees on school properties;
- Determine relevant data for collection;
- Identify the tools and resources to collect, house and maintain the data; and
- Develop a cost-effective system for collecting the data to manage their urban forest at the individual level.

The primary objective of this project was to develop an efficient, cost effective strategy to collect a tree inventory and create a spatial (GIS) database that suits the needs and budget of the TDSB. The objective for collecting the tree inventory was to determine the TDSB urban forestry resource and to use it to effectively manage individual trees.

On school properties, it is vital that trees are healthy and properly cared for as hazard abatement is a primary concern surrounding children. This inventory provides a detailed assessment of each tree and will enable operational staff to effectively guide tree management, pruning, plant health care, track changes over time and identify funding requirements for specific arboricultural needs based on concrete data.

This project is a strategy for the collection of tree inventory data for the Toronto District School Board. It is an applied methodology and considers aspects of inventory collection and maintenance, fieldwork, employee conduct, TDSB protocol and GIS management. The questions that this project will answer are the following:

- What is the systematic methodology for collecting tree inventory for the Toronto District School Board at minimal cost?
- How much will the process cost?
- Why is a GIS database necessary and what benefits will it provide?
- What are the applications of the inventory data?

2.2 SITE DESCRIPTION

School properties owned by the TDSB are non-contiguous parcels of land managed by their Facility Services department. These schools are also imbedded within the greater community of Toronto and serve multiple benefits to all community members both during and after school hours.

Between May and August of 2004, 37 schools were catalogued (see Appendix I) in the downtown Toronto area moving outward from the University of Toronto campus (see Figure 4). The study areas are bordered by Davenport Road to the north, King Street to the south, University Avenue to the east and Keele Street to the west. The sites were individual school properties that collectively comprised a fragmented urban forest classified in the Carolinian Zone.

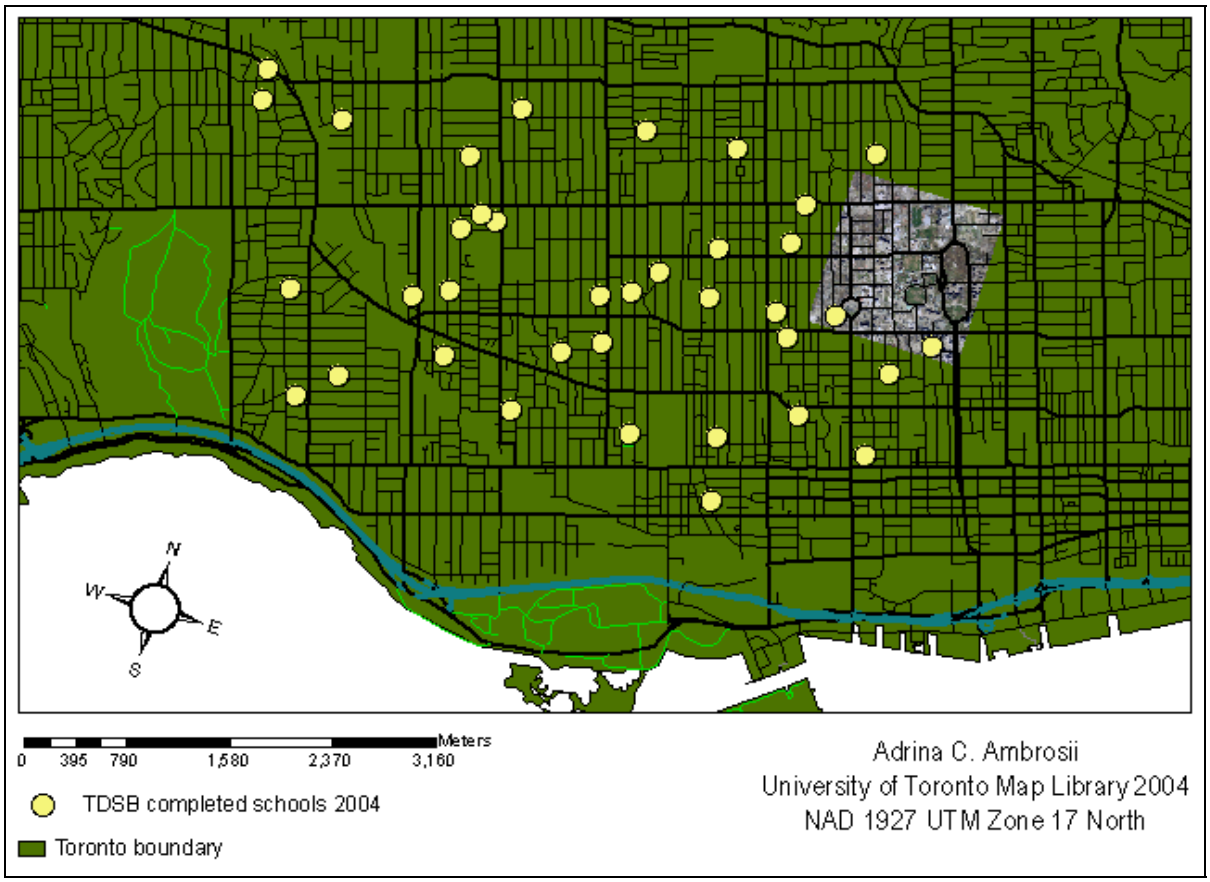

Figure 4: Toronto District School Board completed schools 2004 as shown in proximity to U of T campus

2.3 GIS & MAPPING

A geographic information system is a database of information that is geographically oriented. This technology combines common database functions with the visualization and geographic analysis benefits that are offered by maps (Lo 2002).

The primary purpose of a spatial database is to geographically reference (georeference) points. Georeferencing trees enables the TDSB to better plan planting strategies and predict outcomes within their forest. This procedure will allow the Planning and Facility Services departments to manage individual trees more effectively and to understand the status of their urban forest in a spatially explicit way. For example, generating maps allows grounds designers to develop effective planting plans by being

aware of the underground infrastructure; at Ossington/Old Orchard Public School, a tree was removed in the front of the building because of an old oil tank leaking under it (Day 2004). This type of situation can be avoided at the planning stages.

3.0 METHODOLOGY

3.1 THE STRATEGY

This strategy is the preliminary stage (of what is currently projected to be a five-year project) to logistically develop an inventory for all trees owned by the Toronto District School Board. The tree inventory process consists of two components: an attribute database, and a spatial database. To avoid repetition please note that georeferencing and inventory collection details are systematically presented in the Step-by-Step Inventory Collection Manual (Appendix II).

Prior to establishing a strategy, many decisions had to be made. Goals and objectives were established, resources (present or needed) were determined, data to be collected were established based on the TDSB's overall goals and a budget was created (see Section 4.0 for budget). The number of schools catalogued (37) was arbitrary in that setting up the computer components for the strategy was the primary objective (see Appendix III for schedule).

In addition to the tree inventory, a complete database was required by the TDSB that included all collected data. A main database was therefore created using Microsoft Excel with both attribute and spatial data ('x' and 'y' coordinates of each tree); photograph files that correspond with each tree are also included in the project. In subsequent years, collected data will be added to this database.

3.2 GIS AND MAPPING

The GIS component was not established at a complex level as the Facility Services Department is not currently equipped to deal with this type of information, nor can they afford to at this stage, as software can be expensive. Meeting the needs and budget of the client was given priority over providing them with information they are not able to use. The computer applications used were MapMaker Pro and OziExplorer 3.95.3 (desktop versions) and OziExplorerCE (portable handheld version).

The first component for collecting the inventory involves preparing digital images of each school property using orthophotos (aerial imagery). This is an efficient way of georeferencing since orthophotos are already spatially referenced, thus extra steps, if using a GPS unit, are eliminated (see Figure 5 for GIS process).

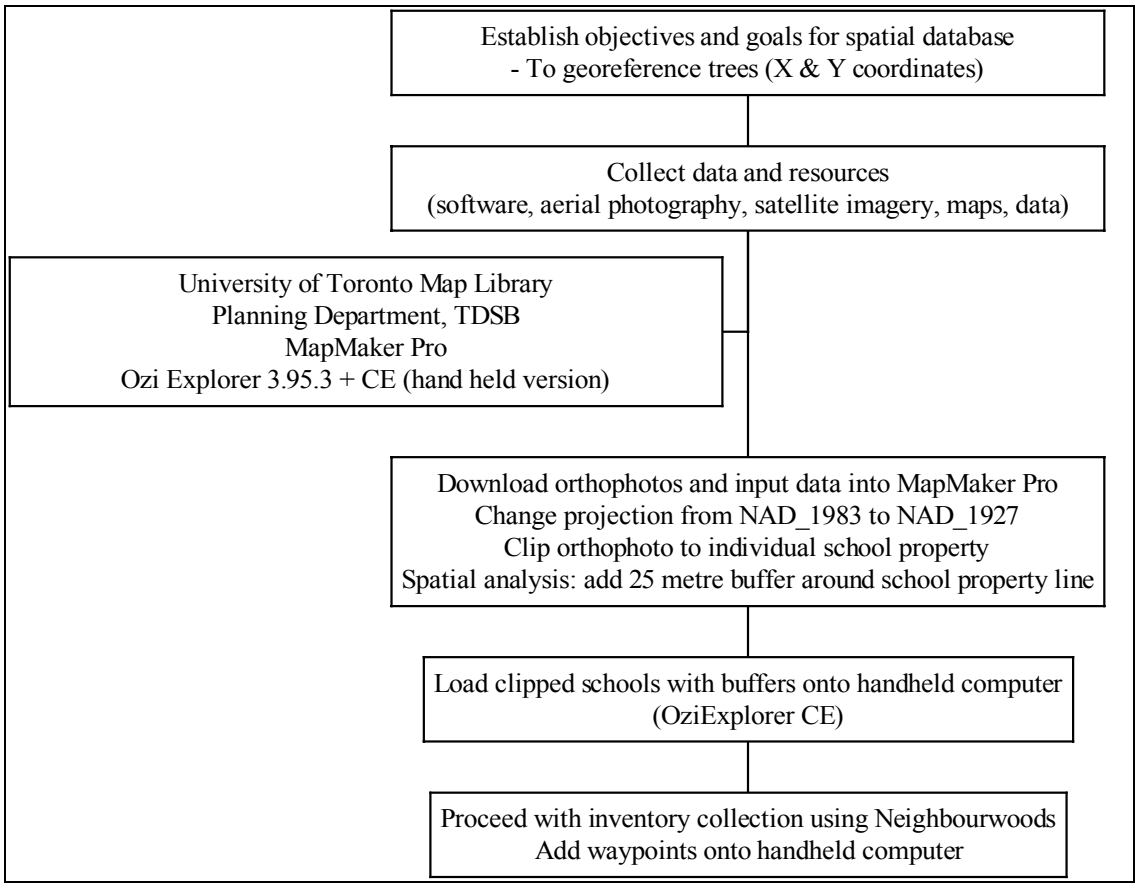

Figure 5: Methodology for preparing maps for georeferencing

The GIS component consists of geo-referencing each tree on each property using orthophotos and shapefiles of each school. Orthophotos were downloaded from the University of Toronto map library in NAD_83 projection. Since the Toronto District School Board uses NAD_27, all orthophotos were converted to this projection. Using MapMaker Pro, school properties were cropped from their respective orthophotos, given a 25-metre buffer to determine proximity to major streets when in the field, saved individually and loaded onto a handheld computer (see Appendix II for the Step-by-Step Inventory Collection manual for systematic details). The process is very time consuming and must be done prior to going into the field for each school property. Data was entered in the field directly onto a handheld iPAQ computer; trees were simultaneously

identified, assessed and georeferenced (see Appendix IV for school maps completed 2004). The georeferenced points are referred to as waypoints in the computer software. These waypoints retain information on the date and time of tree evaluation as well as its geographic location (see Figure 6).

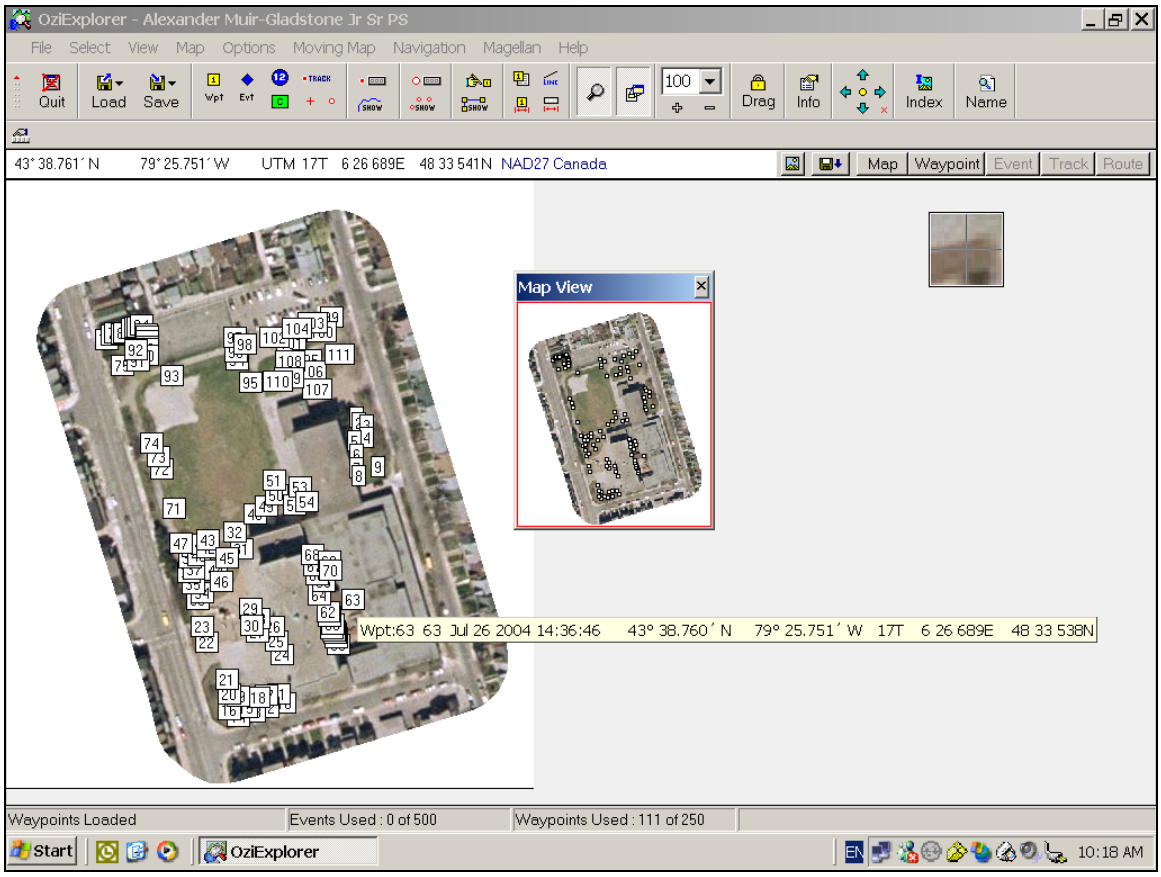

Figure 6: Interface of OziExplorer with waypoints at Alexander Muir Junior Public School

At the operational level, this information alone will not lead grounds crews to the tree, it will lead them to its proximity on the school ground, but without the link to the attribute database, identifying it would be challenging.

3.3 Attribute Data Collection

Tree attribute data was collected using the Neighbour*woods*© program developed by W. A. Kenney and D. Puric-Mladenovic (2001). Neighbour*woods*© is one of many

tree inventory programs; however, it is designed to be used by both non-professionals and professionals alike. Based on a series of attributes required for collection, Neighbour*woods*© has a weighting system (calculated with inputted formulas) for determining a single condition value and rating for each tree. This classifies trees as *Excellent, Good, Fair, Poor* and *Very Poor*. Furthermore, specific details of each attribute are retained in the database; this allows operational staff to single out trees that require attention, and gives an overall indication of the state of the forest. The final condition ratings are calculated using an algorithm that averages weights given to each condition class. Collecting information on a single attribute or overall tree condition is susceptible to subjectivity and vulnerable to inconsistency; however, the collection of numerous attributes reduces the variance in surveyors with the distinctive rating system employed by Neighbour*woods*©. For more information on the Neighbour*woods*© rating classification please see Appendix V for the Quick Reference Guide.

Methodical steps were taken in conducting the tree inventory. First, goals and objectives were established in order to determine the level of detail in which to collect tree data. Since the School Board wanted the inventory procedure established and had no particular objectives for analyzing the inventory data, it was decided that all the Neighbour*woods*© default attributes would be collected. For example, species; size measurements (DBH, Height, Crown Width, Crown Height); health and condition; scarring; rot/decay; assessment of growing environment: % hard surface, location, and the presence of absence of overhead wires. The spreadsheet (see Appendix VI for template) was set up according to ease of collection of these features and therefore many changes were made in the initial stages of the inventory process.

As the TDSB is an exceptional client with distinct needs; their grounds must cater to both children and trees, therefore, modifications were made to Neighbour*woods*© to suit those distinctions and better assess trees with respect to school properties. For example, the original "*Pruning Scars*" category was modified to "*Branch Scars*" and "*Stem Scars.*" The Neighbour*woods*© spreadsheet was finalized prior to collecting field data. Since the amount of shade in active play areas is a primary concern, distinctions between active play areas and other uses were made under the "*Location*" field and "*Crown Form*" was recorded as well (see Table 1).

Table 1: Location and crown form codes for collecting data

Location	**Description**	**Crown Form**	**Description**
F	Front of school	S	Spherical
B	Back of school	F	Fastigate
S	Side	Y	Cylindrical
L	Parking lot	C	Conical
P	Playground/Field	V	Vase
		W	Weeping

Each school has a unique 4-digit functional location code assigned, recognized and used by the Planning Department at the TDSB. For example, Ogden Junior Public School is "*3663*." Based on the code, the "*Tree ID*" field was created by inputting the code as a prefix to every tree number, for example, the ID of the first tree at Ogden Junior Public School is "*36631*" and so on. This number acts as a serial code for each tree and links the attribute data to the spatial database.

Tree species were recorded using a 6-character species code determined by the common name of the tree, for example, a Silver Maple was recorded as "*mapsil*" in the "*Species Code*" field. This code represents the first three letters of the common genus name and the first three letters of the common species name. This makes sorting the data

more efficient when searching for a particular tree or genus (see Appendix VII for entire species list and codes). It was decided that cultivars would not be recorded but that some shrub species would be (see Appendix II for the Step-by-Step Inventory Collection manual for systematic details). Once the spreadsheet was created and loaded into the handheld computer along with its corresponding school map, fieldwork commenced.

One crew consisting of two students (A. Ambrosii & E. Benczkowski) from the Faculty of Forestry, University of Toronto, was hired for the initial summer beginning in mid-May 2004. This crew was working under the direction of Bruce Day, Grounds Team Leader, Toronto District School Board. Daily communication was maintained between the crew and the Grounds Team Leader to ensure successful monitoring and inventory collection in the field (see Figure 7 for daily activities).

Since Facility Services workers are not regular employees at the schools they visit (e.g. teacher, caretaker, principal, etc.), it is TDSB policy that a crew member must sign in to the Facility Services book located in the main office and let staff know that work will be commencing on the grounds. A crew member must also sign out when the job is complete. As security on school properties is a concern, this protocol must *always* be followed.

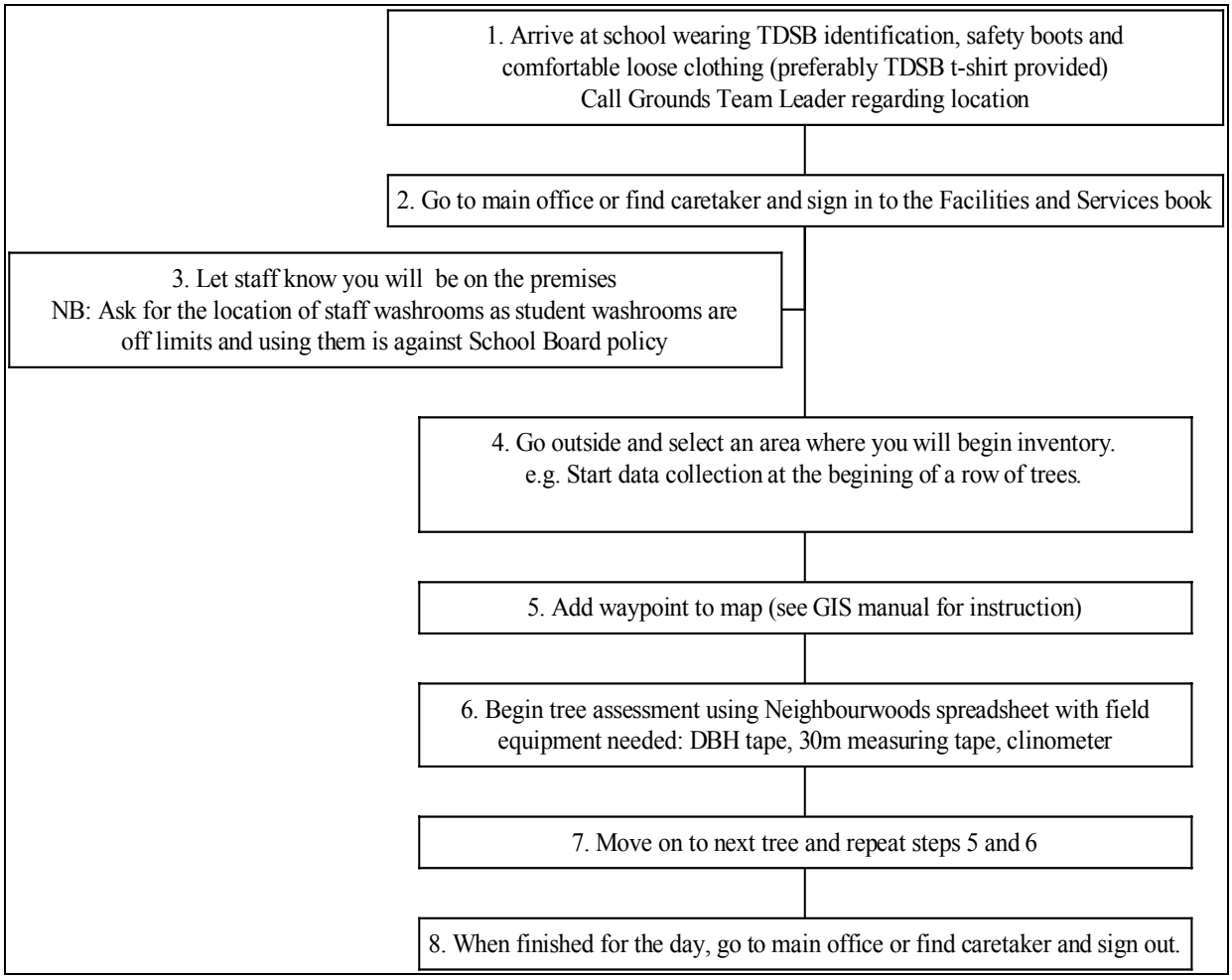

Figure 7: Methodology of collecting tree inventory in the field

Once in the field, after adding a waypoint to the map in OziExplorerCE on the handheld, the inventory data was collected following the Neighbour*woods*© protocol, this involved: identifying species and filling in fields; and taking tree measurements (DBH, Total Height, Crown Width, Crown Height) (see Appendix II for the Step-by-Step Inventory Collection manual for systematic details).

Both crew members kept a daily journal to record any unusual events that occurred or interesting details that were observed on the trees. If an urgent matter arose, the Grounds Team Leader was informed immediately and notes were made if a particular

tree needed immediate attention. Also, a digital camera was used to take pictures in the field and establish a photograph library of TDSB trees.

On average, one school was completed each day in the field depending on the amount and condition of the trees. A tree can take anywhere from 2 to 15 minutes to inventory and therefore working in a crew of two was advantageous. The process is faster as one person enters the data when the other calls out the information.

3.4 MANAGING INVENTORY DATA

After completion of each school, the handheld computer was synchronized with the main computer and the collected data was sorted and organized. This involved exporting the waypoint log from OziExplorerCE to the main computer; bringing coordinate information into individual data spreadsheets; adding data to the Microsoft Excel main spreadsheet and sorting out shrubs from the main inventory (see Appendix II for the Step-by-Step Inventory Collection manual for systematic details). Each school had its own computer folder where all information pertaining to tree inventory data was kept, inclusive of the main spreadsheet file.

After completing each school, the digital camera was also connected to the main computer and the photographs were downloaded and sorted into their respective folders. A separate folder for tree photographs was created within which each school had its own folder designated by its name and *functional location code*. Subsequently, each tree photograph was labelled with its *Tree ID* code to ensure proper identification (see Appendix VIII for photograph© library).

All TDSB files were backed up regularly to ensure security and update letters were written regularly and sent to the Grounds Team Leader (Bruce Day, TDSB) and Academic Supervisor (Dr. Andy Kenney, University of Toronto). This was done to keep all interested parties aware of the progress and solicit any suggestions and input into the methodology.

4.0 BUDGET AND JUSTIFICATION

Assessing tree status using the Neighbour*woods*© protocol and georeferencing tree location accumulates facts about individual trees (species, size, condition etc.), information about growing conditions (growing space, location, size, conflicts etc.) and may be sufficient to specify maintenance needs. This method enables the surveyor to identify and assess the tree in detail while minimizing the level of subjectivity. There are various types of inventories but the funds allocated and the objectives for the inventory data are usually the deciding factors for which type will be employed. Other computer-based systems using GIS can be very expensive to undertake and maintain.

Funding for the tree inventory is allocated through Facility Services. The budget for the initial summer of 2004 can be seen in Table 2 below. The method employed for this initial summer was efficient, cost-effective and did not record extraneous information.

Table 2: Tree inventory budget June-August 2004

TORONTO DISTRICT SCHOOL BOARD						
Budget - June-August 2004						
		EXPENSES	JUNE	JUL	AUG	Total summer
Crew of 2		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
Equipment	CFE	DBH tape	54.50	0.00	0.00	54.50
	CFE	Yamayo fibreglass measuring tape	36.50	0.00	0.00	36.50
	HP	IPAQ hand held computer	399.00	0.00	0.00	399.00
	HP	IPAQ extra battery	80.00	0.00	0.00	80.00
Safety		CSA approved footwear - $90.00x2	180.00	0.00	0.00	180.00
Software	online	Mapmaker Gratis	0.00	0.00	0.00	0.00
	online	Ozi Explorer	150.00	0.00	0.00	150.00
Admin		Travel - TTC transit (reimbursed)	0.00	80.00	80.00	160.00
		Petty cash	20.00	20.00	20.00	60.00
		Contingency - 10%	0.00	0.00	0.00	1550.00
		TOTAL EXPENSES	4,760	3,920	3,920	14,190

Although the method employed for the initial summer was effective, based on the large number of properties owned by the Toronto District School Board and the progress made this summer, completion of the inventory in this manner would take roughly five years. It is in the best interest of the TDSB to complete the inventory as soon as possible, in order to begin and ensure funding for a forest management plan. Therefore, suggestions for both an optimal budget (Table 3) and secondary budget (Table 4) can be found below.

The optimal budget requires the addition of another crew of two people and a project organizer (please see Section 7.3 for staffing recommendations). In addition, this method requires purchasing a laptop computer for students who are undertaking the project. The laptop would then travel with the project, thus keeping the programs and files on the same computer (hard drive), as well as all of the program codes. Both of these

amendments would accelerate the data collection process and allow the School Board to focus on the principle objectives of the inventory.

Table 3: Optimal tree inventory budget for subsequent years

TORONTO DISTRICT SCHOOL BOARD

Optimal budget for subsequent years

		EXPENSES	JUNE	JUL	AUG	Total summer
Project Organizer		salary - 40 hrs/wk x $15 x 4 wks/mnth	2400.00	2400.00	2400.00	7200.00
2 Crews of 2		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
Equipment	CFE	DBH tape	54.50	0.00	0.00	54.50
	CFE	Suunto clinometer - 145.95x2	291.90	0.00	0.00	291.90
	CFE	Yamayo fibreglass measuring tape	36.50	0.00	0.00	36.50
	HP	IPAQ hand held computer	399.00	0.00	0.00	399.00
	HP	IPAQ extra battery	80.00	0.00	0.00	80.00
	Toshiba	Toshiba Laptop	1500.00	0.00	0.00	1500.00
Safety		CSA approved footwear - $90.00x4	360.00	0.00	0.00	360.00
		Telephone (cell)	30.00	30.00	30.00	90.00
Software	online	Mapmaker Pro	650.00	0.00	0.00	650.00
	online	Ozi Explorer	150.00	0.00	0.00	150.00
Admin		Travel - TTC transit (reimburse)	150.00	150.00	150.00	450.00
		Petty cash	20.00	20.00	20.00	60.00
		Contingency - 10%	0.00	0.00	0.00	3000.00
		TOTAL EXPENSES	11,402	7,860	7,860	37,362

Please note that salary recommendations are for summer students and therefore only include workers' compensation insurance. They do not include overhead or benefits.

The secondary budget (Table 4) involves only the addition of a project organizer. This recommended strategy is less expensive than the optimal one, however, the inventory process would proceed less quickly in comparison. The secondary option is best if funding resources are limited.

Table 4: Secondary tree inventory budget for subsequent years

TORONTO DISTRICT SCHOOL BOARD Secondary budget for subsequent years			JUNE	JUL	AUG	Total summer
		EXPENSES				
Project Organizer		salary - 40 hrs/wk x $15 x 4 wks/mnth	2400.00	2400.00	2400.00	7200.00
Crew of 2		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
		salary - 40 hrs/wk x $12 x 4 wks/mnth	1920.00	1920.00	1920.00	5760.00
Equipment	CFE	DBH tape	0.00	0.00	0.00	0.00
	CFE	Suunto clinometer	145.95	0.00	0.00	145.95
	CFE	Yamayo fibreglass measuring tape	0.00	0.00	0.00	0.00
	HP	IPAQ hand held computer	0.00	0.00	0.00	0.00
	HP	IPAQ extra battery	0.00	0.00	0.00	0.00
Safety		CSA approved footwear - $90.00x2	180.00	0.00	0.00	180.00
		Telephone (cell)	30.00	30.00	30.00	90.00
Software	online	Mapmaker Pro	650.00	0.00	0.00	650.00
	online	Ozi Explorer	0.00	0.00	0.00	0.00
Admin		Travel - TTC transit (reimburse)	80.00	80.00	80.00	240.00
		Petty cash	20.00	20.00	20.00	60.00
		Contingency - 10%	0.00	0.00	0.00	1800.00
		TOTAL EXPENSES	4,946	3,950	3,950	21,886

5.0 USING INVENTORY DATA FOR DAILY OPERATIONS AT THE INDIVIDUAL TREE LEVEL (derived from Ambrosii and Pansino 2004)

Collecting data inventory is an integral part of forest management since it retains information and can be used to determine maintenance practices on how to move forward; however, if that inventory data is not used effectively, then the process will be ineffective.

It is possible to extract information from the attribute and spatial database, for maintenance prescriptions and remediation, by generating maps and condition reports based on certain criteria. The database can be queried to determine the specific problems

associated with individual trees, based on various characteristics (e.g. tree location, site characteristics, species name, tree size, tree condition, and conflicts between trees and other infrastructure). This data can be searched, sorted and grouped according to the above features, depending on certain objectives; the first being tree health and maintenance, then hazard abatement and shade assessment.

The following sections will discuss urban forest planning components and how inventory data can be used to manage individual trees. Please note that the separate shrub database has been excluded from all data analysis since measurements of shrubs were not calculated.

5.1 TREE HEALTH/MAINTENANCE

Objectives for tree health and maintenance include identifying sites that need pruning, planting and various types of plant health care. Below is an example of a condition report that can be generated to establish maintenance priorities for a particular school (see Figure 8). Grounds crews can place priority on various conditions according to their class ratings; for example, “Class 1” defoliation is more serious than “Class 2” for weak or yellow foliage.

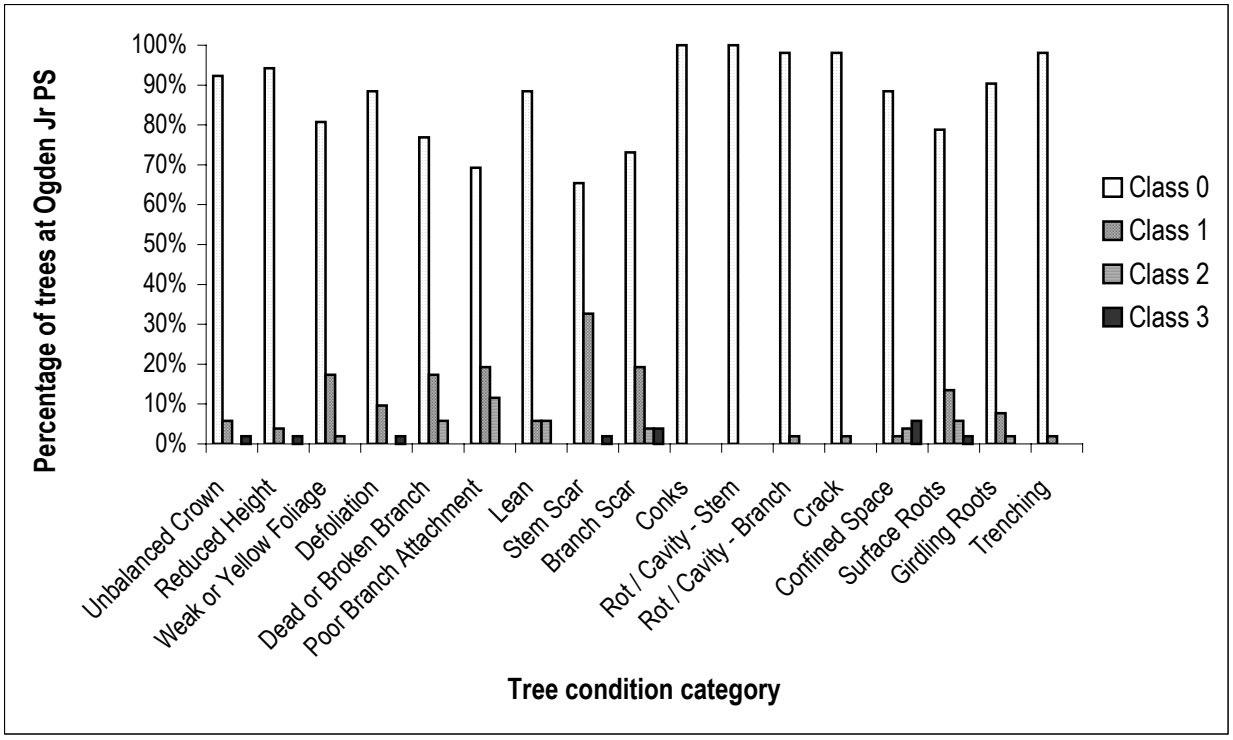

Figure 8: Breakdown of tree condition rating at Ogden Junior Public School

Other conditions that can be looked at are: rot/conks, poor branch attachment, dead/broken branches, trenching, weak/yellow foliage, girdling roots, surface roots. It is important to keep in mind, however, that data for trees must be considered relative to species and growing conditions (Location, Confined space, % hard surface).

An essential maintenance task that should consistently be performed is pruning. Proper pruning, performed by certified arborists, does not damage trees; therefore, qualified and trained maintenance staff, either employed by the TDSB or on contract should be doing all tree work and should consistently be reporting potential hazards and monitoring for risk assessment. The database can be queried to find trees that need pruning based on certain criteria such as dead/broken branches, rot/cavity in branches, limbs and branches in *conflict* with traffic signals, signs, and overhead wires (see Table

5). Pruning can be classified into immediate pruning for hazards, routine pruning, training pruning, deadwooding, and structural pruning (Ambrosii and Pansino 2004).

Table 5: Example of schools to be pruned based on dead/broken branches and rot/cavity criteria

Function code	School Name	# of Trees to Prune
3730	Dewson St J PS	7
3607	Kensington & Horizon	6
3756	Essex & Hawthorne	4
3784	Harbord CI	4
3669	Ossington-Old Orchard	4
3702	Central Tech	3
3583	Huron St Jr PS	3
3615	King Edward	3
3623	Lord Lansdowne	3
3663	Ogden	3
3678	Beverly & Subway II	2
3700	Central Commerce	2
3643	Montrose & Delta	2
3671	Palmerston	2
3683	Perth & St. Luigi	2
3692	Brock Jr PS	1
3704	Charles G. Fraser	1
3609	Kent & Bloor CI	1
3649	Niagara	1
3713	Shirley Jr City View Alt	1
3739	Ursula Franklin	1
3737	West Toronto CI	1

Exposed surface roots can represent a safety concern for playing/running children (see Figure 9). Currently, the trend is to promote mulch as the primary focus of plant health care for trees with exposed roots in order to minimize root damage and tripping accidents. As such, the database can by queried to find trees with exposed roots. Table 6 shows the number of trees at each school that could be mulched based on those condition ratings.

Figure 9: Exposed roots at Ogden Jr PS: 366337

Table 6: Example of schools to be mulched based on exposed roots criteria

Function code	School Name	# of Trees to Mulch
3730	Dewson St Jr PS	12
3663	Ogden	11
3707	Ryerson	11
3669	Ossington-Old Orchard	9
3662	Alexander Muir-Gladstone	6
3702	Central Tech	5
3768	Garden Jr PS	5
3583	Huron St Jr PS	5
3798	Howard Jr PS	4
3609	Kent & Bloor CI	4
3623	Lord Lansdowne	4
3671	Palmerston	4
3737	West Toronto CI	4
3714	Clinton St Jr PS	3
3756	Essex & Hawthorne	3
3772	Givins-Shaw	3
3681	Pauline	3
3692	Brock Jr PS	2
3700	Central Commerce	2
3704	Charles G. Fraser	2
3732	Dovercourt	2
3784	Harbord CI	2
3615	King Edward	2
3665	Orde St Jr	2
3585	Indian Road	1
3625	Lucy McCormick	1
3683	Perth & St. Luigi	1

5.2 HAZARD ABATEMENT

Hazard trees are the main concern for the TDSB for obvious reasons and identifying trees that are potential hazards is one of the main goals for a safe and natural environment. Since the objectives for hazard abatement are to identify hazard trees and inspect them on a regular cycle, condition reports can be easily generated from the attribute database that identify those trees based on certain criteria, such as cables or rot/cavity, cracks, poor branch attachments, etc. By linking the attribute and spatial

database, hazard trees can be mapped for ready reference. Figure 10 indicates the location of the hazard tree and displays its condition criteria. This tree can be flagged for immediate inspection.

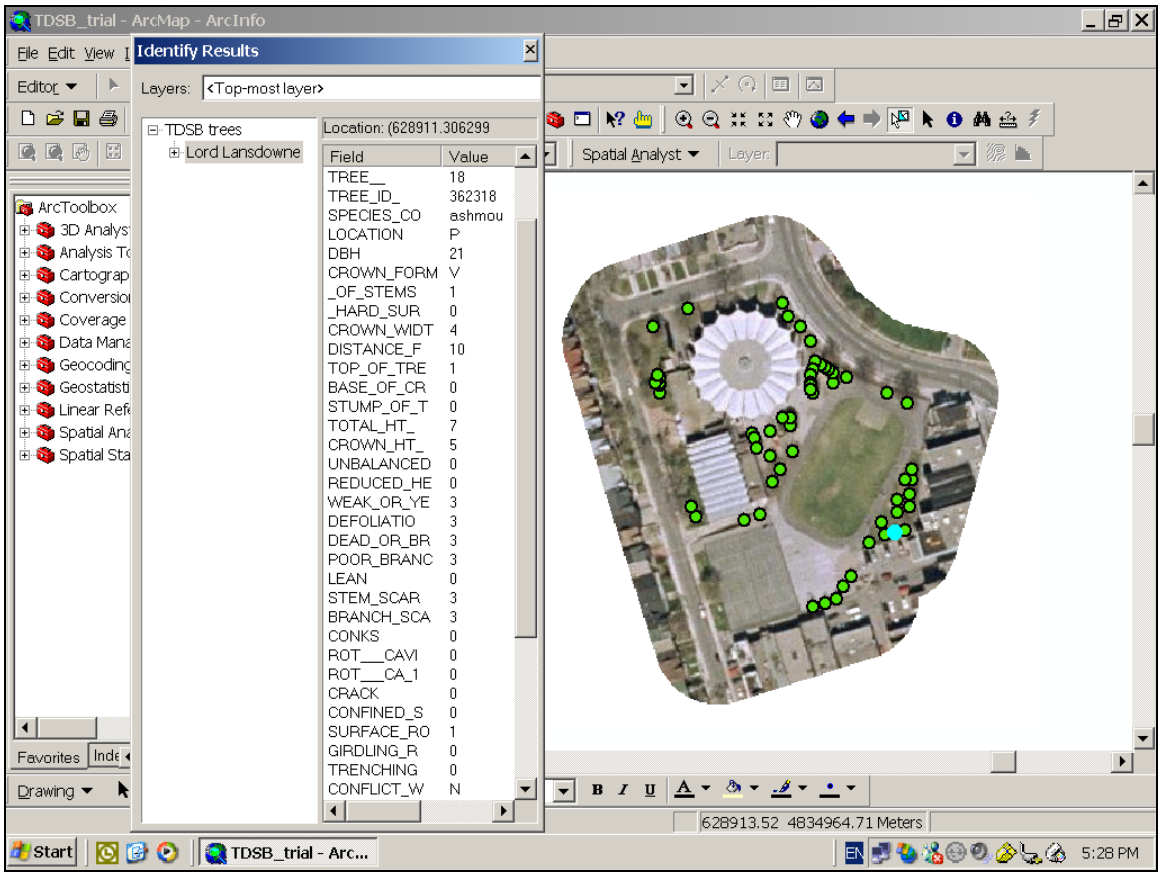

Figure 10: ArcGIS interface displaying hazard tree at Lord Lansdowne Jr PS

Using the database for inspection cycles is imperative. Most trees do not need to be inspected every year. Some trees with certain characteristics, such as a cable or bracing must be inspected every year in order to ensure safety.

Protective caging (kept on for 8 years) on individual trees on TDSB grounds is also a prevalent maintenance practice. This is to ensure the sustainability of certain tree species such as Birch and Ginkgo (e.g. Givins/Shaw Junior Public School). Caging, however, is not effective for larger trees containing numerous epicormic shoots in need of pruning and thus, these cages should be removed.

The main threats to Toronto School Board trees are soil compaction and basal scarring due to damage from lawnmowers and other sources (see Figure 11). Another observed threat to TDSB trees is the result of seemingly harmless child's play. Children often use school vegetation as part of their environmental education; however, there are various instances where this can prove harmful to the tree. For example, bird houses, ribbons, plastic and string were all found tied extremely tightly to branches of trees. These practices girdle branches and stems causing structural damage and health deficiencies. The *Comments* field in the Neighbour*woods*© spreadsheet is very important in this case so that other information (things that are out of place or striking, etc.) can be recorded by data collectors.

Figure 11: Pitbull damage at Winchester Jr Sr PS: 3749

Grounds maintenance can work with the Planning department to recognize and promote that a healthier urban forest is essential to the School Board's character and children's learning.

5.3 SHADE ASSESSMENT

Since one of the primary objectives of the School Board is to provide shade for children in active play areas, tree species with high shade values (e.g. Maple, Oak, Mountain Ash, Elm, Beech etc.) should be selected for planting. However, during this inventory, it was found that there were many fastigate (pyramidal, columnar) formed

trees planted in schoolyards; this form of tree generally has decreased shade benefits but high aesthetic value (e.g. Central Technical School). There were also many rows of trees planted along fences or property lines creating borders, but not necessarily in the centre of active play areas (see Figure 12).

Figure 12: Row of White Poplars, West Toronto Collegiate: 3737

It is important that trees are planted over play structures and areas (see Figure 13) to provide necessary shade for children as stipulated in the TDSB design standards (TDSB 2004).

Figure 13: Effective shading in a play area, Fern Avenue Junior and Senior Public School: 3758

The objective of shade audits is to determine canopy cover across each school, and essentially to raise it. Measuring canopy cover is an important parameter, it is inexpensive to estimate and it is possible to extract from inventory data, (using "Crown Width") and the mapping software (OziExplorer and/or MapMaker). The approximate area for each TDSB property can be determined using the tracking tool in OziExplorer as seen in Figure 14 below. *Please note that the area must exclude the initial 25 metre buffers that were added when clipping the orthophotos.*

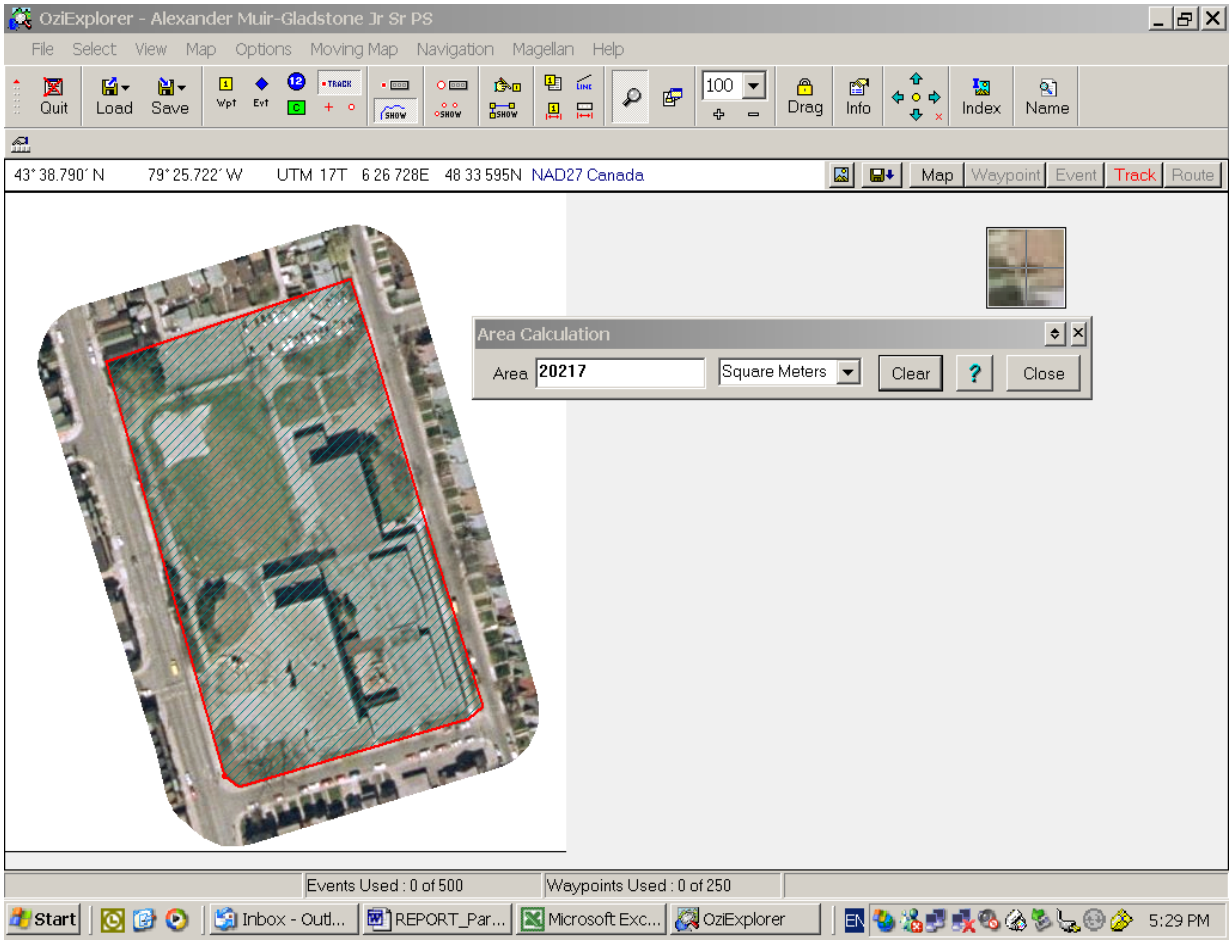

Figure 14: Alexander Muir Jr Sr PS approximate area calculation using OziExplorer

The percentage of canopy cover at each school is the relative amount of school property covered by the shade trees; it is based on the area of the school property, without

the area of the school building, and the combined crown widths of all trees. For example, the total area of Alexander Muir Junior and Senior Public School is approximately 20217m^2. The total area of the school building is approximately 5874m^2. Thus, the total area of the outdoor property is 14343 m^2 (20217 – 5874). Total crown projection area is approximately 724.8 m^2. Therefore, the canopy cover at Alexander Muir is roughly 20% (14343 / 724.8 = 19.7889). Opportunities to expand canopy cover on some schools can be inferred from these basic calculations once all schools are analyzed. This information can also easily be done in the mapping software and can ultimately create a mapped region illustrating tree distribution and shade angles on each designated school ground (see Section 8.3).

6.0 LIMITATIONS

When inputting the tree location on the handheld computer, waypoints were based on where the center of the canopy is from orthophoto interpretation; they do not depict trunk locations and therefore accuracy of the position is within two meters.[2]

Determining property lines for school grounds can be very time consuming and some trees will be jointly owned with the City of Toronto. In this situation, an educated guess must be made. Collecting the tree inventory only up to the property lines of the TDSB limits hypotheses and analyses that can be made regarding shade provision on school grounds. Many City trees provide shade to children and if shade is a primary concern than those trees should also be taken into consideration by creating an ownership

[2] Without verifying the actual true position in the field, tree locations cannot be utilized for construction/development purposes.

field in the collection criteria and then filtering out non-TDSB trees. However, within the scope of this project, only trees that are owned by the TDSB will be inventoried.

With respect to the mapping software used, data manipulation and upkeep is limited and given the assumed budget parameters, the 5-year period required for initial data collection may impact data integrity. Moreover, no provision has been made for the maintenance and upkeep of collected data during the 5-year period.

Lastly, it is difficult to meet both objectives of forest conservation for the purposes of tree health care as well as hazard abatement for children on school grounds. The TDSB is doing an exceptional job managing both of these, however, there are challenges. For example, the practice of topping trees, known to be physiologically detrimental (Shigo 1998), is common, but justified as it enables the TDSB to keep beneficial trees for longer periods of time (see Figure 15).

Figure 15: Topped tree at Queen Alexandra Jr PS: 3685

7.0 RECOMMENDATIONS AND DISCUSSION

It is recommended that, for the inventory procedure, the method employed in 2004 be continued for the remainder of the inventory to ensure consistency of data collection. As well, it is in the best interests of the School Board to complete this inventory as soon as possible so that a forest management plan inclusive of planting, pruning and health care plans, can be developed and implemented based on individual tree data. Subsequently, the TDSB does not have to wait until the end of the inventory to begin executing a management system, as there are issues that need immediate attention at particular school grounds. This information is readily available at the end of each inventory collection day. Lastly, in order to maintain the integrity of the data, routine maintenance and tree inspection is recommended since rotational inspections will support maintenance activities.

7.1 COLLECTING THE DATA

In terms of the methodology for data collection, the Neighbour*woods*© spreadsheet is organized chronologically of how data should be recorded. There are various techniques that can be adopted by data collectors that would accelerate the process. First, it is not necessary for trees in groves to be waypointed individually; they can be input all at once, and then assessed. Second, only data that is unique to the tree in question should be entered into the handheld in the field; empty cells can be filled much faster on the main computer. Third, trees next to one another that appear to be the same height do not need to be measured individually as this step is the most time consuming in the field.

Inputting information directly into a handheld computing device was found to be much more efficient than using pen and paper. Many hours and errors were saved by directly inputting the data into a computer at the time of assessment and collection. Once a school is completed, it is recommended that the data collected on the handheld be transferred and organized into a main computer immediately to reduce the probability of error. Out of a five-day workweek, future data collectors should plan to be in the field for four days and in the office for one. In the event that the School Board hires a project organizer, data collectors should spend all five days in the field and turn in their hand held computers upon completion of each school. The project planner will then synchronize and organize all the data into the main database. This way, the project planner organizes all information while the data collectors are conducting the inventory.

As stated in the methodology (Section 3.3), the crew must report to the main office and/or the caretaker of each school site upon arrival. However, in the event that the team arrives at the school (usually at 7am) and no one is there, inventory collection should begin regardless; the crew should check in later. Also, be sure to have all necessary items when in the field:

1. Letter from Facility Services, Grounds Team Leader on TDSB letterhead stating the purpose of the project
2. TDSB identification cards (must be worn at all times when on school property)
3. Dendrology texts, inventory equipment (measuring tapes, clinometer, handheld computer with extra battery), pen and paper (just in case)
4. Sunscreen (imperative), lots of water and food (some schools are in residential areas where commercial establishments may be more than 15 minutes away

In the field, team members should be aware of their roles. One person can call out the condition rating and the other can input the data into the handheld computer.

One concern during the initial summer was locating property lines between the School Board and the City of Toronto. There is various telling features of where one property ends and the other begins that should be noted: terminal fence posts, chainlink fences and building faces (see Appendix II for details).

Although this is a tree inventory, there are various species that are large shrubs or small trees that have shade value and are thus being promoted by the School Board (see Appendix VII). These species should be included in the inventory, yet are dealt with differently in the attribute collection (see Appendix II).

It is strongly recommended that photographs be taken regularly to show details of tree condition. Keeping this visual library also enables the TDSB to refer to particular cases for maintenance (see Appendix VIII).

Until all 600 school properties are catalogued into the database, acquisition of a vehicle for transportation between schools (especially outside the downtown Toronto core) should also be considered.

7.2 DATABASE MAINTENANCE

Existing data should be maintained regularly to reflect changes; depending on the frequency of activity this should be done weekly or monthly since, for example, removals lead to plantable spots. One staff member should input all data until all three regions of Facility Services attain the resources to be on one network.

When changes need to be made in the dataset, follow the instructions in the Step-by-Step manual (Appendix II). If a tree is removed and another is planted, the original tree number and all associated, attribute data is stored in an archive and a new tree is planted with a **different tree ID** but with the same UTM coordinates, thus avoiding confusion when retrieving data from past years.

Files should be kept organized to ensure accuracy and efficiency. When creating map files, the path and name of the file should not be altered since the program may not be able to read from it – if the database were to be upgraded to ArcGIS than a feature called ArcCatalogue automatically knows to move all associate files when one map file is moved (see Section 8.3). TDSB files should be backed up regularly (i.e. every two days) in the event of an emergency. Lastly, the purchase in a laptop computer to keep data organized and limit the possibility of loosing TDSB files should be considered.

7.3 STAFFING & PERSONNEL

The two students hired for the following summers will be responsible for data collection. The ideal candidates should have some knowledge of dendrology. Their qualifications should include an ability to work with people; make quick, logical decisions; work in any type of weather as long as the handheld computer is not jeopardized and have exceptional organization skills.

It is recommended that the TDSB hire a third person for the remainder of the inventory process to ensure quality control and act as project manager. The project organizer will oversee the data management and overall project organization. This person also will act as a quality controller, occasionally showing up at the school unannounced

to oversee the data collection process and ensure that the crew is working at their full potential, using the equipment correctly and making logical decisions. This person can also attend meetings and report regularly to the Toronto District School Board contact.

The ideal candidate should have computer proficiently in Microsoft Office, exceptional organization and communication skills, and the ability to work with people, make informed decisions, oversee and direct the data collection crew.

Committing additional staffing resources would accelerate data collection, however, in the event that the TDSB hires only two students one team member must take on the role of crew chief and be in charge of data, map management and project organization.

8.0 POSSIBLE EXTENSIONS FOR INVENTORY DATABASE

Looking forward, the database can eventually be upgraded and analyzed; this information can be used for standardizing practices across the Board by satisfying a variety of objectives. Section 8 will discuss possible examples of those extensions including suggestions for:

- Database maintenance;
- Using inventory data to determine growing condition, species diversity/richness, tree condition, canopy cover, size-class distribution and tree appraisal;
- Upgrading the GIS and mapping components; and
- Developing a strategic urban forest management plan

The following sections offer possible suggestions that can be implemented in the management process as the School Board acquires resources and personnel.

8.1 DATABASE MAINTENANCE

Currently, the database has been created using Microsoft Excel. Bringing the database into Access or Oracle and setting up interfaces to generate reports and queries will make the information more accessible. Since Excel has a limit on the amount of records it can support, creating an Access database will enable the TDSB to continuously add trees without constraints. The spatial database linked with the attribute tree data, complete with phone numbers, addresses of schools, other TDSB contacts, greenhouses, nursery stock suppliers, arborist listings and photograph files can all be maintained in one database using Access or Oracle.

8.2 USING INVENTORY DATA

The Toronto District School Board needs factual data concerning their trees to more effectively manage school grounds. The data collected in the tree inventory provides facts (statistics and condition) of what the School Board currently has. Once they have this data, they will then be able to proceed effectively with a management plan. This section will examine the overall impressions of schoolyard environments and tree condition having completed the inventory for the initial 37 schools. The results from analysing the data are a few examples of what the inventory data can generate. Please note, however, that the separate shrub database has been excluded from all data analysis since measurements of shrubs were not recorded.

8.2.1 Location and Growing Conditions

Individually, the school properties have more trees in the front, rather than in the back playgrounds. Many schools (e.g. Perth Avenue Junior Public School/St. Luigi,

Indian Road Crescent Junior Public School, Pauline Junior Public School/St. Sebastian, Harbord Collegiate, Orde Street Junior Public School, Kensington Community School) have the majority of their trees growing in areas off limits to children; this can be seen by the large amount of combined "F," "S," and "L" location values (meaning front of school, side of school, parking lot respectively) attributed to each tree record in the main database (see Figure 16).

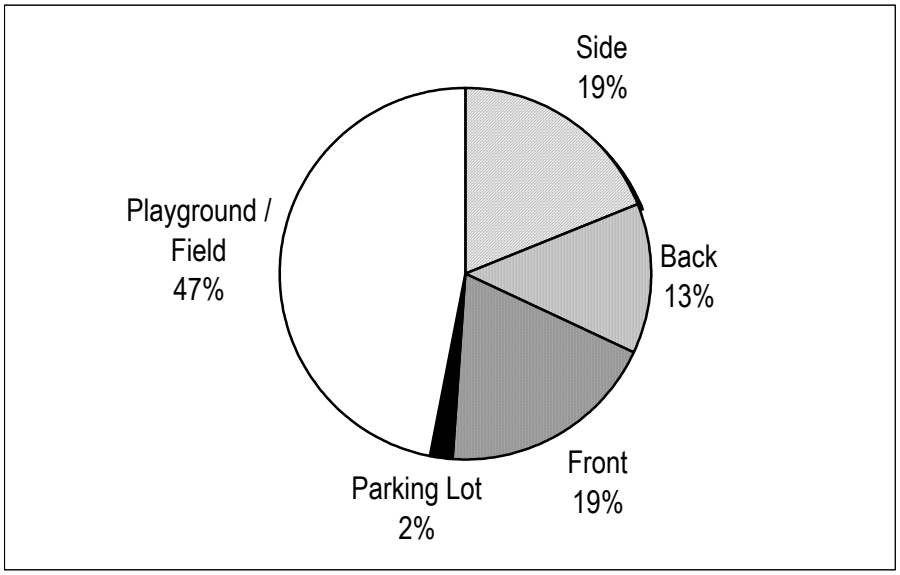

Figure 16: Proportion of trees from 37 schools in 5 classes of location codes on school grounds

Without trees, active play areas are hot, unimaginative and environmentally unfriendly; there were numerous examples of schools with large expanses of concrete in playgrounds, surrounded by little, if any, vegetation (see Figure 17 below and Appendix IV for maps). Moreover, many trees located in playgrounds and fields of the schools had been planted in groves and rows bordering active play areas and at the perimeters of the properties.

Figure 17: Without trees, school grounds are hot, unimaginative and unfriendly environments, Pauline Jr PS/St. Sebastian: 3681

Since playgrounds are high traffic areas, soil compaction and the amount of hard surface around trees is a concern. Growing conditions were similar at many schools; the soil under the dripline (if any) was highly compacted and 42% of all trees inventoried were growing in a variety of hard surfaces (see Figure 18 and Figure 19).

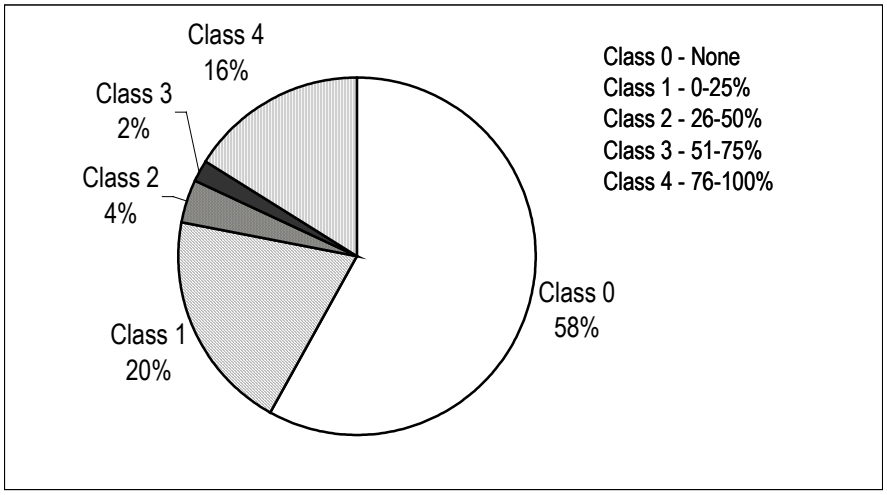

Figure 18: Proportion of trees from 37 schools in 5 classes of hard surface %

Figure 19: Garden Avenue Junior Public School: 37685

Furthermore, the percentage of trees growing in confined spaces, such as concrete/wooden planter boxes or against the side of a building can be determined. However, across the 37 schools inventoried to date, only 11% or all the trees were observed to be growing in confining spots (see Figure 20).

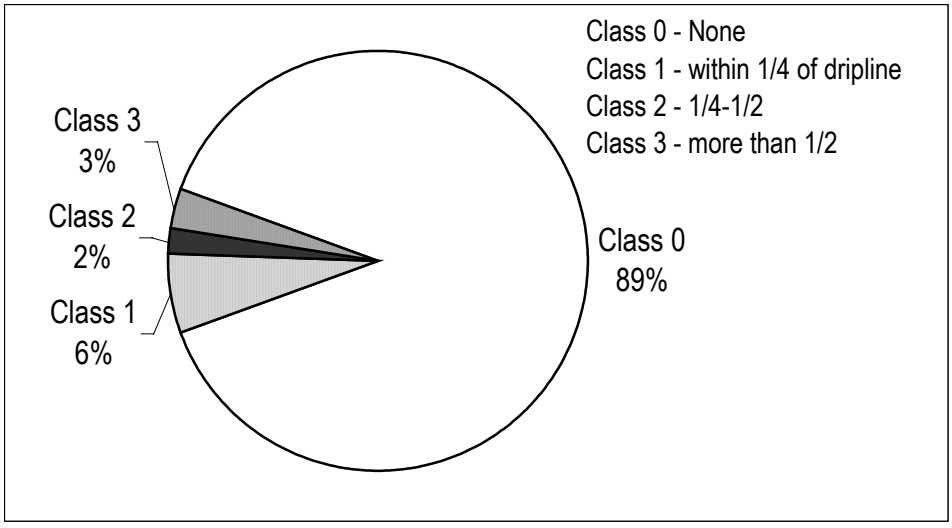

Figure 20: Proportion of trees from 37 schools in 4 classes of confined space

8.2.2 Species Diversity and Richness

Out of the total 1857 trees inventoried across 37 school properties there was a total of 74 species (see Appendix VII). The average abundance at each school is 52 trees, and the average species diversity at each school is 11. Based on the collected data, the Toronto District School Board currently has 44 genera in their urban forest (see Figure 21 below and Appendix IX for number of trees by genus).

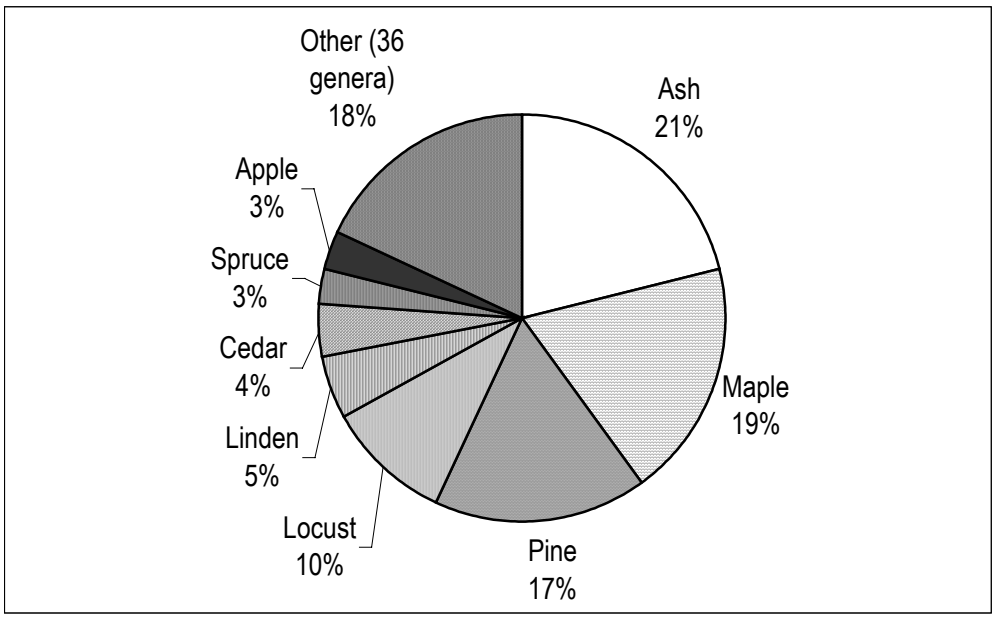

Figure 21: Genera composition across 37 TDSB schools

The most common species is Austrian Pine representing 16% of the population, followed by Green Ash at 13%, Norway Maple at 12%, Honey Locust at 10% and White Ash at 6% (see Appendix X for number of trees by species). Figure 22 shows the distribution of species across the 37 schools inventoried; 43% of all trees are from 74 different species and 57% are from only 5 species.

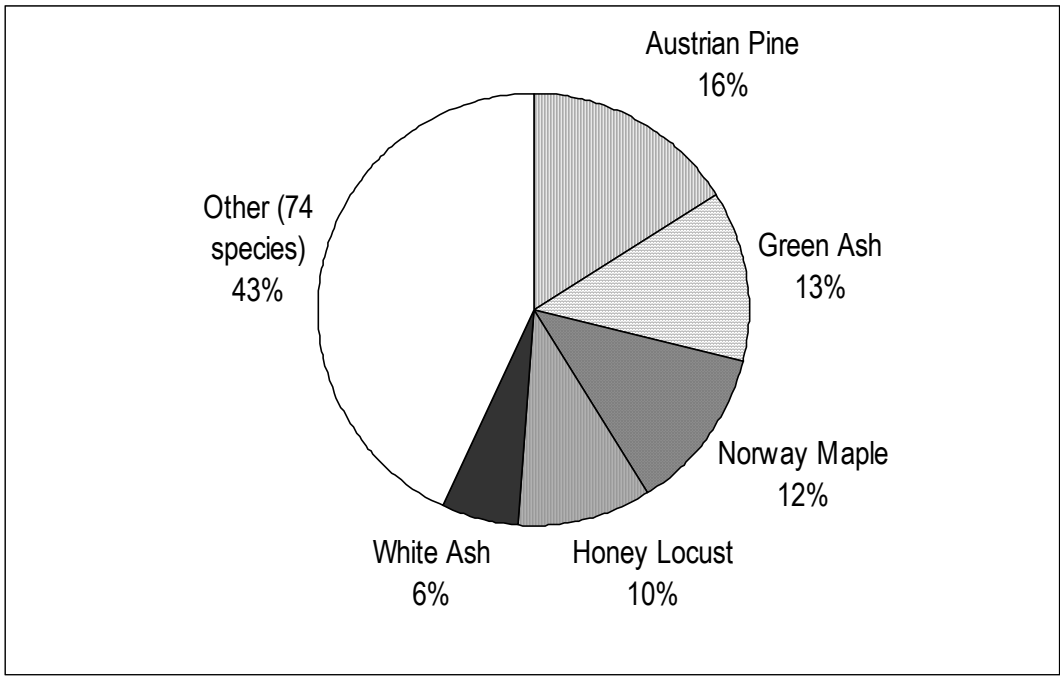

Figure 22: Species composition across 37 TDSB schools

The most common tree observed growing in groves was Austrian Pine; these trees were generally in excellent condition wherever they were planted on TDSB property. Spruces and Maples were also generally performing well as part of this urban forest. Inventory data can generate information regarding the relationship between tree condition and species. Tree species that consistently do not grow well on school grounds could be subsequently identified.

Since each school property is an individual management unit, determining species composition across each school is also a factor in maintaining diversity over the entire TDSB forest (see Figures 23 and Figure 24).

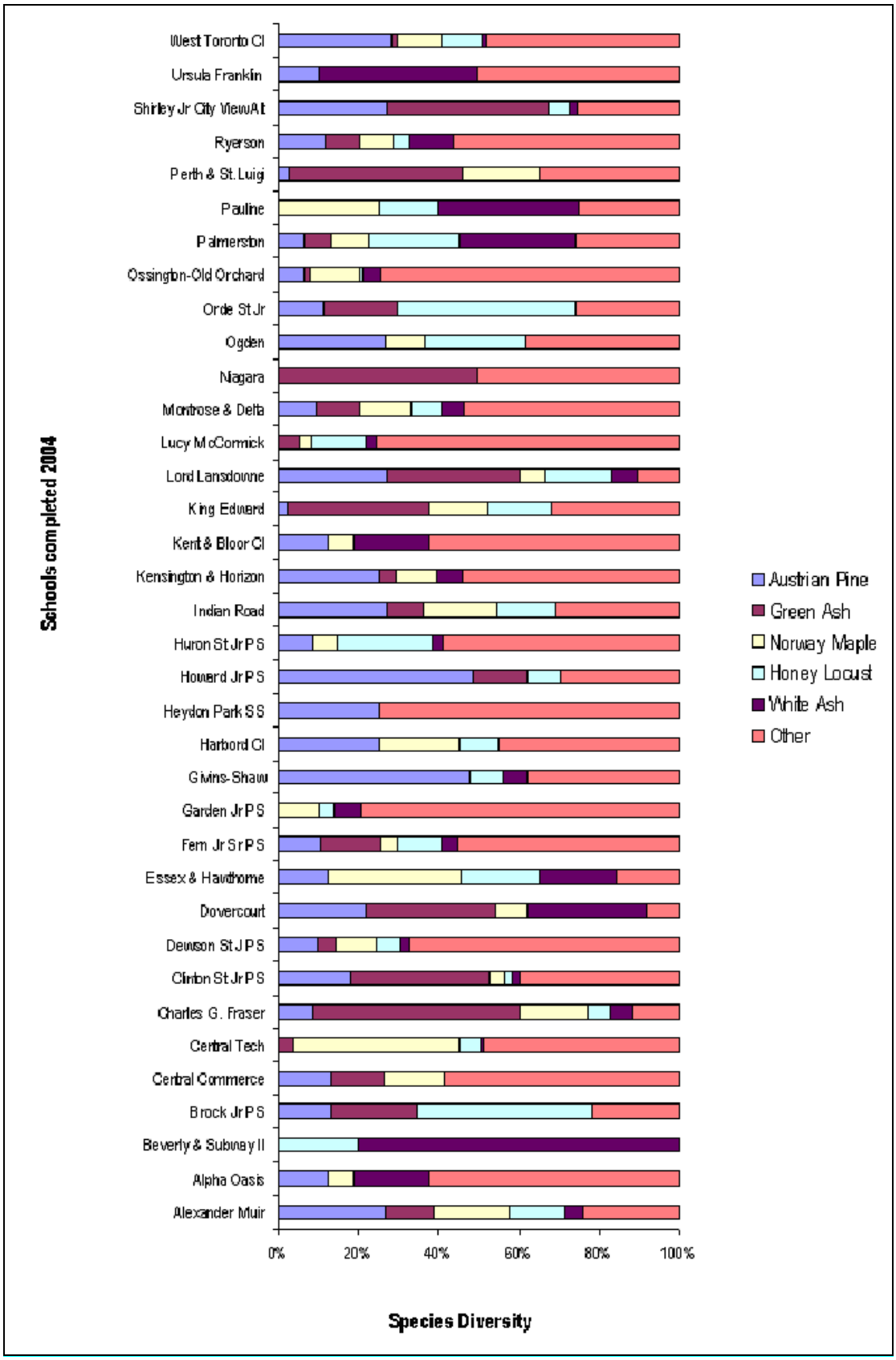

Figure 23: Species Composition across each school

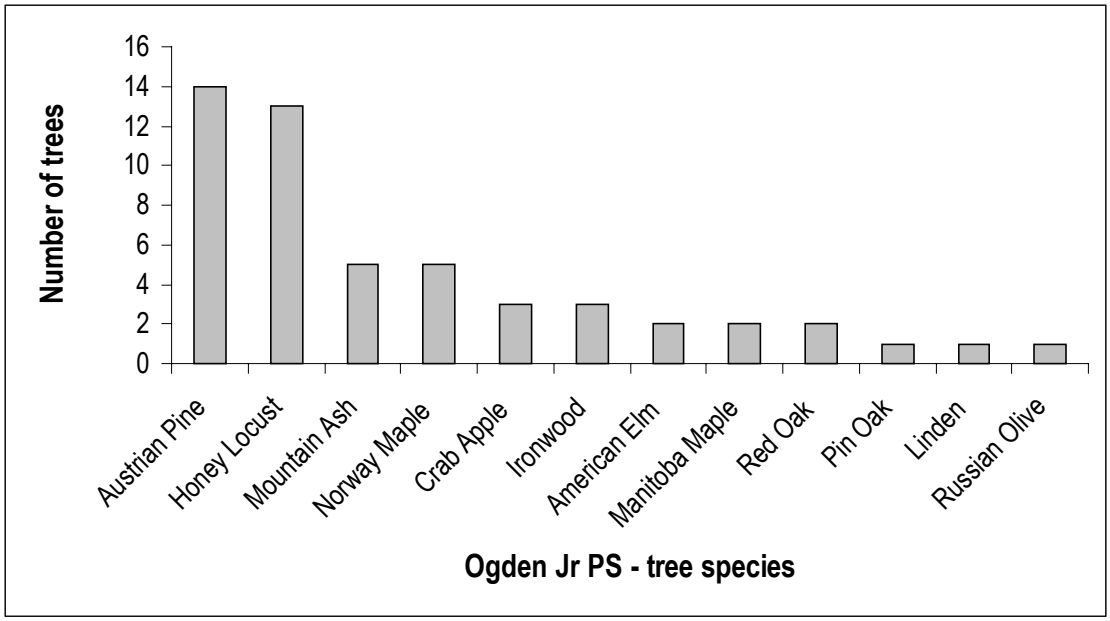

Figure 24: Species composition at Ogden Jr PS

There was a wide range of both species diversity and tree quantity at each school. Some schools contained well over 100 trees (e.g. Dewson Street Junior Public School, Ossington/Old Orchard Junior Public School, Central Technical School), while others had fewer than half that number (e.g. Orde Street Junior Public School, Huron Street Junior Public School, Ogden Junior Public School, Niagara Street Junior Public School). Diversity varied as well; most schools contained roughly 10 species, while others had 20 to 30. Pine, Maple and Ash were consistently observed on School Board property; Austrian Pine and Green Ash were the two most common species.

Diversity in the urban environment is important so that the forest becomes more resilient to pathogens, predators and senescence. Most plants are propagated vegetatively so that the end product is uniform and guarantees certain characteristics (e.g. faster growth, colour, etc.). However, because most of the trees planted are clones (genetically identical) or cultivars within the same genus, this allows disproportionately for a relatively narrow array of genotypes to be used when planting (Kenney 2004).

8.2.3 Tree Condition

Using the Neighbour*woods*© classifications and weighting system, trees were given individual values based on condition criteria (see Appendix VI). Trees were rated as *Excellent, Fair, Good, Poor,* or *Very Poor*. The majority of the total trees inventoried (74%) were rated as Excellent followed by 17% rated as Fair, 6% as Good, 2% as Poor and 1% as Very Poor (see Figure 25).

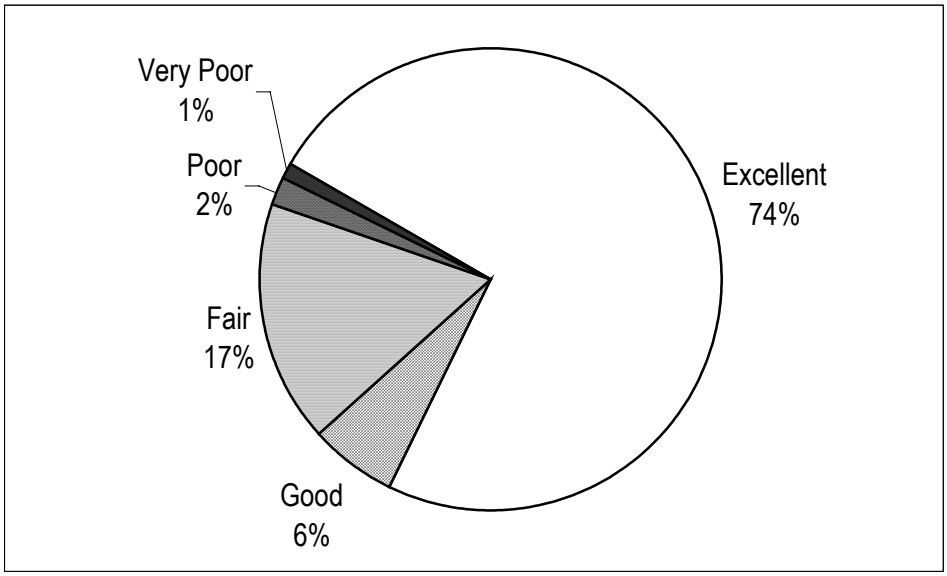

Figure 25: Overall tree condition rating across all 37 TDSB schools

While being aware of the overall condition of trees across the entire TDSB urban forest, management is based on individual school properties and therefore each school can also be graphed according to the final condition rating. This will give Facility Services and the grounds crews an idea of the overall condition at each school ground and this can also help in quickly identifying sites that may need immediate attention (see Figure 26).

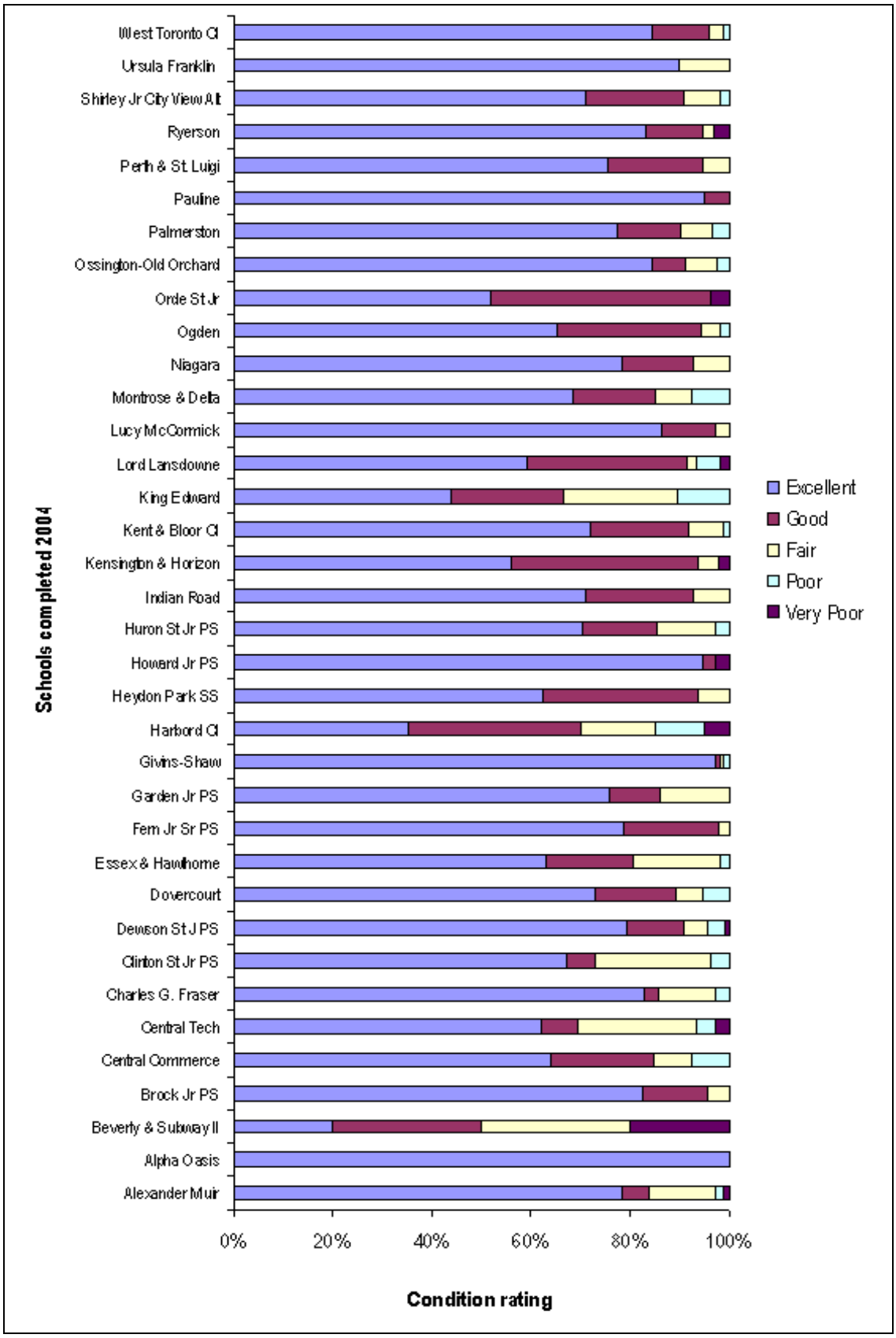

Figure 26: Overall tree condition rating across each TDSB school completed 2004

The database can also be queried to determine the specific problems associated with individual trees, this information can be used to prescribe maintenance activities or other remediation as discussed in Section 5.1. With reference to the state of individual trees on Board property, a wide range of differences was observed (see Figure 27).

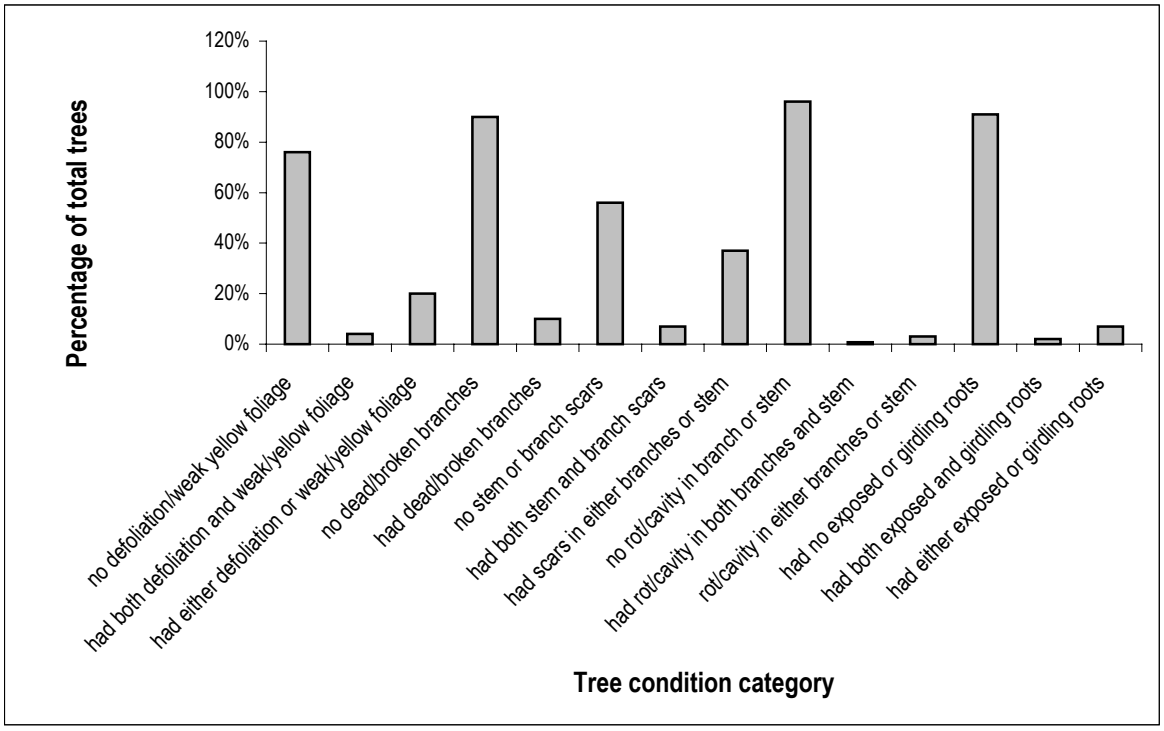

Figure 27: Breakdown of tree condition across 37 TDSB Schools

Almost 40% of the trees inventoried had stem and/or branch scars (Figure 28). Weak and yellow foliage (20%), especially on particular species (Crab Apples and Oaks) was also observed.

Figure 28: Stem/branch scars at Ogden Junior Public School: 366345

8.2.4 Size-Class Distribution

The diameters of trees can be grouped into classes and graphed by percentage of total trees that fall into each class (see Figure 29).

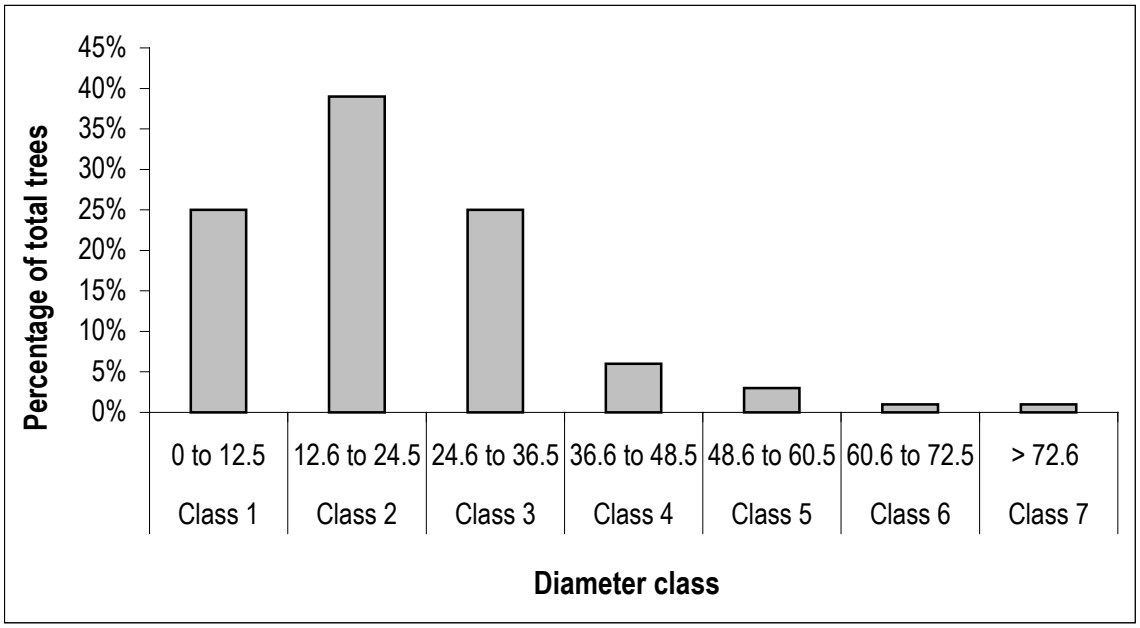

Figure 29: Diameter size class distribution of trees across all 37 TDSB schools

The TDSB's urban forest shows a typical reverse-J shaped curve; as the older trees die, the forest will regenerate if replanted. The largest group of trees at 39% is 12.6 to 24.5 cm in diameter. This distribution pattern is typical in the urban environment since it shows an un-even aged distribution. However, if the TDSB properties were stratified, the trees would prove to be relatively the same size in certain areas (e.g. newly planted groves, etc.). This type of analysis can generate information on age-class distribution. The ideal distribution for a school ground, depending on location, can be determined and planting/maintenance recommendations can be made. For example, if functional trees (Urban 2004) are the target age group, than it appears that trees are dying prior to reaching that stage.

8.2.5 Tree Appraisal

The Council of Tree & Landscapers Appraisers (CTLA 1992) has a standardized system by which trees can be appraised, also known as the "the ISA method" (International Society of Arboriculture). Using the inventory data, it is possible to implement the CTLA (1992) formula for determining a value for each tree based on certain criteria (Species, DBH, Location) (see Table 7).

Schools with many trees are not necessarily worth more than schools with fewer trees and schools with larger trees are not necessarily worth more than schools with smaller trees. The average value of each tree is $1815.89 and the standard deviation is $2227.18. The overall value for the trees combined across the 37 schools is $3,372,100.00.

It is important to remember that **this is an approximation of the appraisal values.** Professional arborists can spend an entire day on some trees in order to go through the valuation process. This cannot be used for accurate valuation of individual trees since the Location value used (75%) is an average for all location sites. However, this overall average value can be used to give an idea of the economic value of tree resource across the TDSB.

Keeping this in mind, there are many economic benefits associated with urban trees. By determining an economic value for the services trees provide, investments can be rationalized within forest management and public awareness and education can be raised. An extension of this work can include research that encompasses those economic implications such as a life cycle cost analysis of school ground greening (Bell 2004).[3]

[3] "The study will provide a picture of the 'hard' capital and operating costs and benefits of greening initiatives, including reductions in pesticide use, energy use, water use and mowing. Where possible, it will also produce 'softer'

Table 7: Values based on CTLA tree valuation for each school

School Name	Total # trees	Species Diversity	Total value of trees ($)
West Toronto CI	71	13	239,900.00
Central Technical School	111	18	216,300.00
Ossington/Old Orchard Jr PS	128	31	210,200.00
Kent Sr PS & Bloor CI	86	14	202,700.00
Ryerson Jr & Sr PS	94	19	184,200.00
Alexander Muir/Gladstone Ave Jr Sr PS	111	12	174,800.00
Dewson Street Jr PS	135	26	165,800.00
Givins / Shaw Jr PS	105	10	152,200.00
Central Commerce CI	53	12	117,200.00
Indian Road Crescent Jr PS	55	13	105,200.00
Clinton Street Jr PS	55	14	99,800.00
Dovercourt Jr PS	37	6	89,300.00
Huron Street Jr PS	34	16	89,200.00
Garden Avenue Jr PS	29	14	87,400.00
Ogden Jr PS	52	12	85,600.00
Shirley Street Jr PS / City View Alt	55	8	85,200.00
Kensington Community School Jr / Horizon Alt	48	8	82,800.00
King Edward Jr Sr PS	48	8	80,600.00
Essex Jr & Sr PS / Hawthorne II Bilingual Alt	57	8	80,200.00
Lord Lansdowne Jr Sr PS	59	9	78,200.00
Lucy McCormick School Sr	37	13	75,100.00
Palmerston Jr PS	31	9	71,600.00
Howard Jr PS	37	12	69,700.00
Montrose Jr PS / Delta Alt	54	15	67,100.00
Fern Avenue Jr Sr PS	47	9	57,900.00
Perth Avenue Jr PS (St Luigi CS)	37	9	57,200.00
Charles G Fraser Jr PS	35	7	49,900.00
Pauline Jr PS (St Sebastian CS)	20	6	48,500.00
Harbord CI	20	8	48,000.00
Heydon Park	16	4	44,700.00
Brock Jr PS	23	4	40,000.00
Beverley Jr PS/ Subway II	10	2	40,000.00
Orde Street Jr PS	27	5	34,700.00
Ursula Franklin/Western Tech-CommSchool	10	5	15,600.00
ALPHA Alt School Jr Sr and Oasis Alt	16	6	13,700.00
Niagara Street Jr PS	14	3	11,600.00

economic data on such benefits as improved storm water management, reduced vandalism, fewer accidents and less violence on the school ground, and the value of the space created for hands-on, outdoor learning" (Bell 2004).

8.3 GIS AND MAPPING

As spatial analysis and GIS are a large component of collecting a tree inventory, the TDSB may consider upgrading their system (as resources permit) from MapMaker Pro and OziExplorer 3.95.3 to ArcGIS 9. This program can be used to display and spatially analyze aspects of attribute data, provided that that the trees have been georeferenced and included in the main data spreadsheet through the inventory collection strategy.

The potential for mapping trees has many implications for forest management and planning. For example, vector and raster techniques can be used in the digital representation of the geographic data to display and analyze various attributes based on specific objectives (see Table 8).

Table 8: Examples of objectives for spatial analysis using GIS software

DISPLAY	SPATIAL ANALYSIS
To display species diversity and abundance at individual sites (colour gradation)	To add buffers around trees according to dripline (i.e. crown width measurements) for maintenance and/or building considerations
To locate the most valuable trees based on condition rating	To add 1–3 metre buffers around trees to determine mulch quantities for plant health care plans combined with % hard surface
To display crown width and/or DBH according to class sizes to determine amount of possible shade provision (graduated symbology)	To determine plantable sites based on constraint analysis to exclude areas that are inappropriate for planting based on location code (e.g. not in front of schools)
	To determine distance between trees and/or play structures

Based on the above examples, it is possible to generate various reports, display particular attributes and design effective maps (see Figure 30).

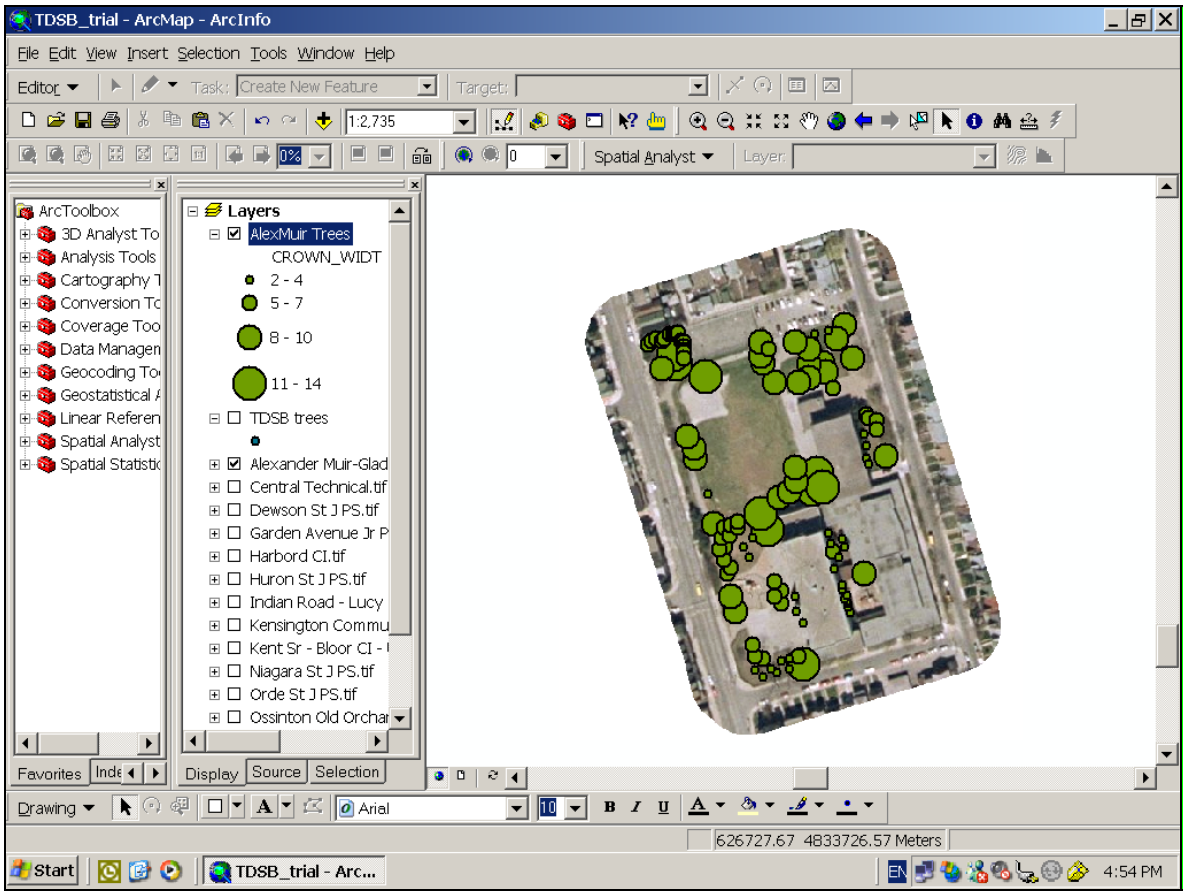

Figure 30: GIS analysis: Graduated symbology for crown width size classes at Alexander Muir: 3662

Figure 30 shows the interface of ArcGIS 9 using Alexander Muir as the study site. As discussed in Section 5.3, it is possible to determine percentage of canopy cover using the mapping software. The cover at Alexander Muir is roughly 20% and features, such as using graduated symbology to display crown width based on size classes, allows the TDSB to visualize the trees with the most potential for shade provision on the school grounds. Using buffers and crown width measurements could show actual canopy extensions. Lastly, by using the HTML Imaging extension for ArcGIS 9, the information can be accessible for viewing in a regular browser if interested parties do not have the computer program.

Since mapping shade is an important parameter, being able to map shade angles at 9am, 12pm and 3pm to determine where shade falls when children are outside is very important. GIS and animation technology are both very progressive fields and based on computer programming this is made possible using the inventory data.

However, ArcGIS 9 only projects trees as polygons without accounting for the bulge created by the tree crown in its shape; in essence, it can project trees as cubes or cylinders (see Figure 31) without the extensive level of detail provided by animation software in non-spatially referenced modeling programs (see Figure 32).

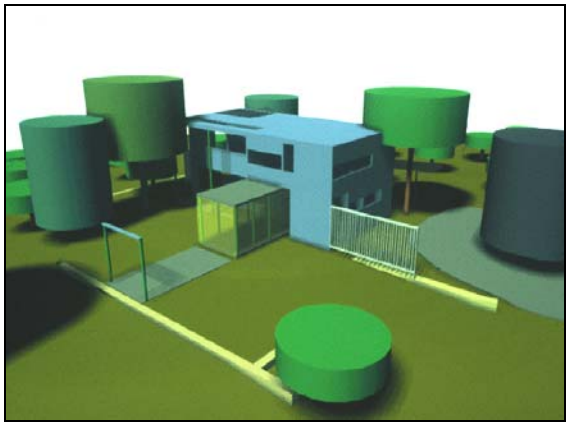

Figure 31: Representation of trees in spatial analysis (Ervin and Hasbrouck 2001)

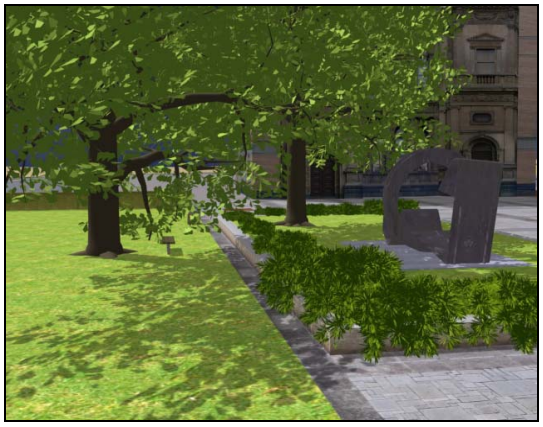

Figure 32: Tree shadows (http://www.sli.unimelb.edu.au/envis/Vegetation_Modelling.htm)

Nonetheless, if it were possible to merge certain features of the leading GIS software and powerful 3D animation software such as Maya 6, then the possibilities seem promising for achieving the multiple benefits they can offer when combined (i.e. getting both accurate spatial information and detailed 3D tree visualizations).

Moreover, inventory data can be collected and tree canopy benefits can be quantified using other programs such as CITYgreen, developed by American Forests (http://phytosphere.com/treeord/gis.htm). This program is ArcView based, using many algorithms, and can generate maps. It has spatial components such that the amount of carbon sequestration, species distribution and leaf area density can be seen. However,

there are limitations to this program. First, the algorithms are built into the program and cannot be seen by the user. Second, climate data is based on regional averages for the United States. CITYgreen generates effective maps and visuals based on averages, however, it is not as accurate as other inventory programs such as the Urban Forest Effects Model (UFORE) (Nowak et al 2003), an inventory collection program with no spatial components.

8.4 STRATEGIC URBAN FOREST MANAGEMENT PLAN

Given the detailed information from Neighbour*woods*© and the spatial information, the completed TDSB tree inventory provides a foundation for the development of a strategic urban forest management plan (Ambrosii and Pansino 2004), with goals and objectives that are directed and established by the TDSB community. The long-term vision would be to maintain the health and condition of all trees and increase species diversity across the TDSB properties to ultimately promote the growth of large, functional trees and achieve a high level of net environmental, ecological, educational, economic, and social benefits (Clark 1997).

An overall management plan will encompass various plans such as: a planting plan, a pruning plan, a plant health care plan and a hazard tree plan. Each school is an individual management unit and therefore will have unique situations particular to each property. A detailed budget that allocates funds to an ongoing tree inventory should also be included with temporal projections of inventory collection and regular maintenance. In essence, this would help maintain healthy school grounds for years to come.

Conservation of trees in the urban environment can only be achieved effectively through the development and implementation of a strategic urban forest management plan that standardizes policies and practices surrounding all activities related to trees. As the second largest private landowner in Toronto, the TDSB is the proprietor of thousands of trees. Subsequently, a plan that encompasses a long-term vision with short-term goals is necessary for the conservation and management of trees on school grounds. This, in turn, will link local environmental issues and community education to the overall Toronto District School Board vision[4]. The management plan will satisfy both a variety of interests and concerns from the Environmental Health Committee on children's wellbeing and work in conjunction with the TDSB's Ecoschools initiative (TDSB 2003).

9.0 CONCLUSION

The focus of this project was to develop a strategy for collecting a tree inventory for the Toronto District School Board based on their objectives and budget constraints. All of the objectives and deliverables were met and an efficient and cost-effective protocol for collecting the inventory and spatial database was created and implemented.

Using the Neighbour*woods*© program reduced subjectivity and maintained consistency in the collection procedure. The software chosen for the mapping component, MapMaker and OziExplorer, were sufficient, relatively easy to use and cost effective compared to other GIS programs. Recommendations were offered with respect to inventory collection and data management for the remainder of the initial inventory.

[4] "Our mission is to enable all students to reach high levels of achievement and to acquire the knowledge, skills and values they need to become responsible members of a democratic society." Toronto District School Board Mission Statement.

Lastly, examples were presented with respect to managing trees at the individual tree level and possible extensions of using inventory data were discussed with examples generated from the initial 37 schools that were inventoried.

The complete TDSB tree inventory will retain information on each tree and enable the operational staff to extract details for depicted features such as condition classes; identify plantable spots from removed trees; evaluate tree growing conditions and determine their potential for success. Overall, the inventory will provide Grounds Maintenance with information that will enable them to manage trees more effectively at the individual level and formulate a forest management plan.

This project is the foundation of a long-term initiative partnered with the Faculty of Forestry, University of Toronto, which will prove to be a model for other school boards across Canada. Potentially, it has great educational and health benefits for future generations in Toronto and supports a necessary environmental need that influences the health of communities and their children by complimenting the School Board's greening endeavors. By pioneering a tree inventory methodology that school boards across Ontario can emulate, the Toronto District School Board is setting an admirable precedent.

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APPENDIX I

List of TDSB schools completed summer 2004

Species Diversity	Total # trees	Function Code	School Name	X	Y	Street Address	Phone Number	Postal Code	M WARD	OPT FAMILY	MET CODE
18	111	3702	Central Technical School	628290.1	4835447.8	725 Bathurst Street	416-393-0060	M5S2R5	20	SW6	8371
8	20	3784	Harbord Cl	627834.1	4835278.7	286 Harbord Street	416-393-1650	M6G1G4	19	SW6	8457
8	48	3607	Kensington Community School Jr / Horizon Alternative School	628557.7	4834708.5	401 College Street	416-393-1290	M5T1P3	20	SW6	8481
8	48	3615	King Edward Jr & Sr PS	628399.0	4834904.6	112 Lippincott Street	416-393-1320	M5S2P1	20	SW6	8485
9	59	3623	Lord Lansdowne Jr & Sr PS	628867.4	4834994.4	33 Robert Street	416-393-1350	M5S2K2	20	SW6	8489
2	10	3678	Beverley Jr PS/ Subway II	629375.8	4834690.4	64 Baldwin Street	416-397-2750	M5T1L4	20	SW6	8355
4	16	3733	Heydon Park	629413.4	4834585.9	70 D'Arcy Street	416-393-0660	M5T1K1	20	SW6	8512
5	27	3665	Orde Street Jr PS	629642.4	4834996.3	18 Orde Street	416-393-1900	M5T1N7	20	SW6	8411
15	54	3643	Montrose Jr PS / Delta Alternative School Sr	627514.7	4834983.4	301 Montrose Avenue	416-393-9770	M6G3G9	19	SW6	8501
12	53	3700	Central Commerce Collegiate	627232.0	4834815.2	570 Shaw Street	416-393-0030	M6G3L6	19	SW6	8370
16	34	3583	Huron Street Jr PS	628775.0	4836329.6	541 Huron Street	416-393-1570	M5R2R6	20	SW5	8468
26	135	3730	Dewson Street Jr PS	627069.2	4834661.8	65 Concord Avenue	416-393-9120	M6H2N9	19	SW6	8388
14	55	3714	Clinton Street Jr PS	627853.7	4834870.8	460 Manning Avenue	416-393-9155	M6G2V7	19	SW6	8379

Species Diversity	Total # trees	Function Code	School Name	X	Y	Street Address	Phone Number	Postal Code	M WARD	OPT FAMILY	MET CODE
9	31	3671	Palmerston Jr PS	627721.1	4836016.4	734 Palmerston Avenue	416-393-9305	M6G2R4	20	SW5	8414
12	52	3663	Ogden Jr PS	629387.4	4834029.8	33 Phoebe Street	416-393-9110	M5T1A8	20	SW6	8408
8	57	3756	Essex Jr & Sr PS / Hawthorne II Bilingual Alternative School	627111.5	4836008.6	50 Essex Street	416-393-0717	M6G1T3	19	SW5	8402
7	35	3704	Charles G Fraser Jr PS	628278.0	4833840.1	79 Manning Avenue	416-393-1830	M6J2K6	19	SW6	8373
12	111	3662	Alexander Muir/Gladstone Ave Jr & Sr PS	626653.4	4833583.9	108 Gladstone Avenue	416-393-9140	M6J3L2	18	SW2	8347
19	94	3707	Ryerson Jr & Sr PS	628798.0	4834133.0	96 Denison Avenue	416-393-1340	M5T1E4	20	SW6	8433
3	14	3649	Niagara Street Jr PS	628374.5	4833327.0	222 Niagara Street	416-393-1371	M6J2L3	19	SW6	8504
10	105	3772	Givins / Shaw Jr PS	627604.7	4833600.5	49 Givins Street	416-393-1240	M6G2W5	19	SW6	8450
6	16	3661	ALPHA Alt School Jr & Sr and Oasis Alt SS	629158.2	4833556.7	20 Brant Street	416-393-9830	M5V2M1	20	SE2	8349
6	37	3732	Dovercourt Jr PS	626057.2	4835890.5	228 Bartlett Avenue	416-393-9220	M6H3G4	18	SW6	8389
13	71	3737	West Toronto CI	625651.0	4834147.8	330 Lansdowne Avenue	416-393-1500	M6H3Y1	18	SW2	8516
6	20	3681	Pauline Jr PS (St Sebastian CS)	625807.0	4835357.2	100 Pauline Avenue (St Sebastian Portion)	416-393-9360	M6H3M8	18	SW6	4462
4	23	3692	Brock Jr PS	625981.5	4834334.9	93 Margueretta Street	416-393-9245	M6H3S4	18	SW2	8364
9	47	3758	Fern Avenue Jr & Sr PS	625309.8	4833447.4	128 Fern Avenue	416-393-9130	M6R1K3	14	SW2	8403

Species Diversity	Total # trees	Function Code	School Name	X	Y	Street Address	Phone Number	Postal Code	M WARD	OPT FAMILY	MET CODE
14	29	3768	Garden Avenue Jr PS	625074.0	4833174.0	225 Garden Avenue	416-393-9165	M6R1M9	14	SW2	8448
12	37	3798	Howard Jr PS	624810.4	4834020.1	30 Marmaduke Street	416-393-9255	M6R1T2	14	SW2	8465
8	55	3713	Shirley Street Jr PS / City View Alternative School Sr	626051.0	4833825.5	38 Shirley Street	416-393-9270	M6K1S9	18	SW2	8437
9	37	3683	Perth Avenue Jr PS (St Luigi CS)	624772.5	4835390.9	14 Ruskin Avenue (St Luigi Portion)	416-393-1410	M6P3P8	18	SW2	4179
31	128	3669	Ossington/Old Orchard Jr PS	627083.2	4834261.7	380 Ossington Avenue	416-393-0710	M6J3A5	19	SW6	8413
14	86	3609	Kent Sr PS & Bloor Collegiate Institute	626028.3	4834932.9	980 Dufferin Street	416-393-0400	M6H4B4	18	SW6	8482
5	10	3739	Ursula Franklin/Western Tech-CommSchool	622979.1	4834677.5	125 Evelyn Crescent	416-393-0500	M6P3E3	13	SW2	8517
13	55	3585	Indian Road Crescent Jr PS	624138.1	4835366.8	285 Indian Road Crescent	416-393-9025	M6P2G8	14	SW2	8469
13	37	3625	Lucy McCormick School Sr	624131.3	4835531.8	2717 Dundas Street West	416-397-2713	M6P1Y1	14	SW2	8490

APPENDIX II

STEP-BY-STEP TREE INVENTORY MANUAL: HOW TO GEOREFERENCE WITH GIS AND CONDUCT A TREE INVENTORY WITH NEIGHBOUR*WOODS*©

Adrina Bardekjian Ambrosii
Elise Benczkowski

CONTENTS

INTRODUCTION

This tree inventory involves georeferencing each tree with mapping software and assessing each tree with the Neighbour*woods*© program which has been modified for school properties. As outlined in this manual, these two components are prepared separately, but are used simultaneously when collecting data in the field; tree number for the attribute data (Neighbour*woods*©) must correspond with the same number on the map.

The following software is needed to complete both the GIS component and the attribute data: MapMaker Pro; Microsoft Excel; OziExplorer version 3.95.3; OziExplorerCE; and Img2Ozf Conversion Utility.

1. PREPARING AND LOADING MAP IMAGE FILES

Downloading orthophotos for TDSB school sites

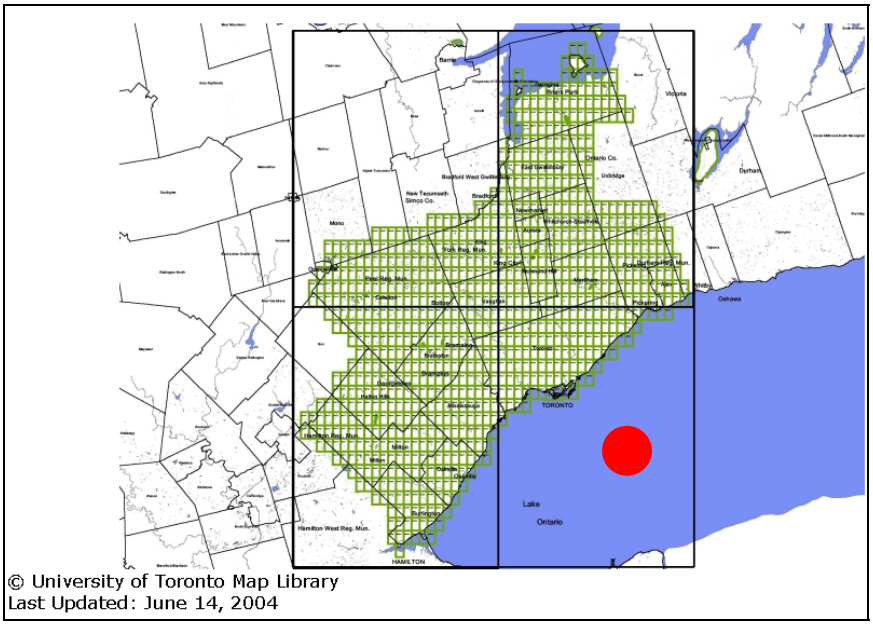
1. Go to the University of Toronto map library website: (http://prod.library.utoronto.ca:8090/maplib/)

2. Click on: "Air Photo Inventory"

3. Scroll down and select: "1999 Aerial photos of Toronto"

4. Click on the website: (http://prod.library.utoronto.ca/maplib/AS_1999B/)

NB: Please make note of projection and datum (NAD27, UTM17), as this will be important for georeferencing



5. Click bottom right-hand box that contains the city of Toronto

6. Click the set of aerial photos that reads “41631”

7. Click on each desired orthophotos by number; below is a table of the orthophoto numbers that encompass the School Board properties:

40623	41623	42623	43627
	41625	42625	
40627	41627	42627	
40629	41629	42629	43629
	41631	42631	43631
	41633	42633	
	41635	42635	
	41637	42637	

Three files will appear at the top of screen

8. Right click on the (.tiff) image – this will be the file on the left-hand side – and click “Save Target As”

9. Save the (.tfw) file – this will be the file in the middle – as an image document and title it with the number of the photograph

NB: Please note that this file (.tfw) contains the ‘x’ & ‘y’ coordinates of the photo.

10. Open (.tfw) file and copy all contents to Notepad (Startup\ menu\Programs\Accessories)

11. Save (.tfw) file in Notepad as a (.txt) document and title it with the number of the photograph followed by the extension (.tfw) [eg. 40623.tfw]

NB: Please note that the file will then be saved as [eg. 40623.tfw.txt]

12. Close

13. Repeat this process for each desired orthophoto (.tiff) and its corresponding (.tfw) file.

NB: Please note that all orthophoto files (.tiff & .tfw) should be saved together within a new folder.

Changing .txt documents to .tfw files

1. Open Windows Explorer

2. Click file where orthophotos and their corresponding files are kept

3. In the "View" menu, click "List" then "Details" – this will show the type of file

4. For (.tfw.txt) files, left click twice slowly (without opening the file)

5. Rename by deleting the (.txt) extension from the name

6. Click enter and "Yes"

7. Close

Changing orthophoto projections from NAD_83 to NAD_27

1. Open .tfw file containing NAD_83 coordinates of desired orthophoto

NB: Below is an example of the contents of a .tfw file (Central Technical Institute) opened in Notepad

0.50000000
0.00000000
0.00000000
-0.50000000
628083.12502490
4835640.87497510

The last two rows are the 'y' and 'x' coordinates respectively

2. Subtract the 'y' coordinate by 13m and the 'x' coordinate by 222m

3. Save and ensure that the .tfw file name corresponds with the .tif file name (eg. XXXX_NAD27.tif and XXXX_NAD27.tfw where the XXXX is the number of the orthophoto)

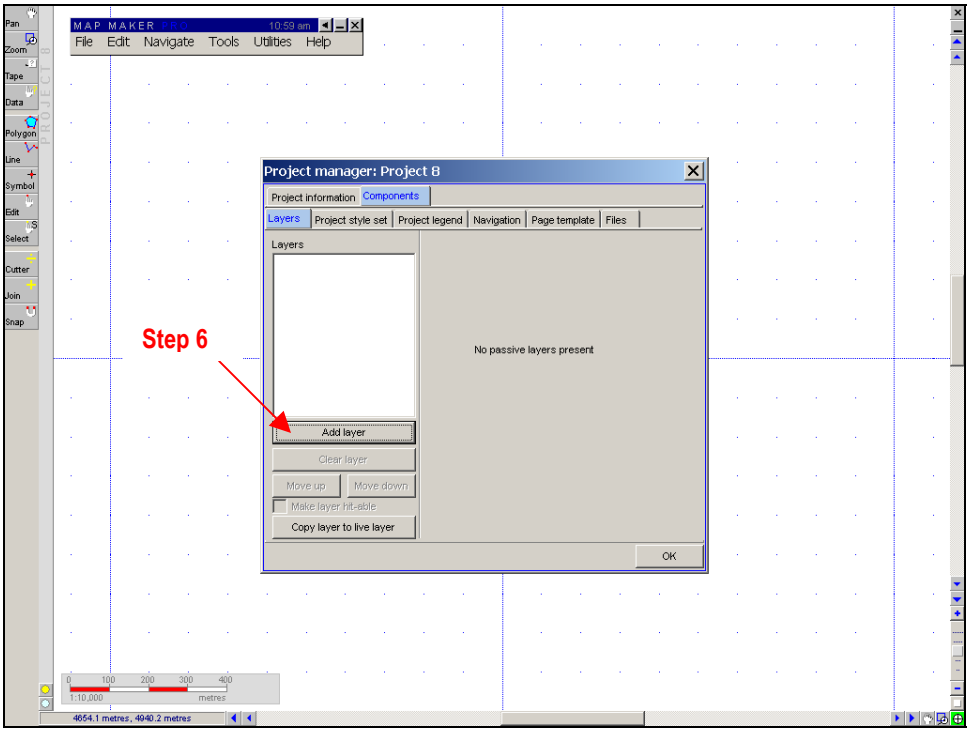
4. Close

5. Repeat this for each .tfw file

NB: This allows the files to shift and line up with the NAD27 school layer obtained directly from the school board.

Loading orthophotos into MapMaker Pro

1. Open MapMaker Pro
2. Hit space bar on keyboard and click "Add New Layer"
3. Select orthophoto to be added then click "OK"
4. Repeat this for each orthophoto
5. Hit space bar on keyboard to add a new layer
6. Click "Add New Layer"



7. Select shape (.shp) file that contains school property outlines georeferenced in NAD_27

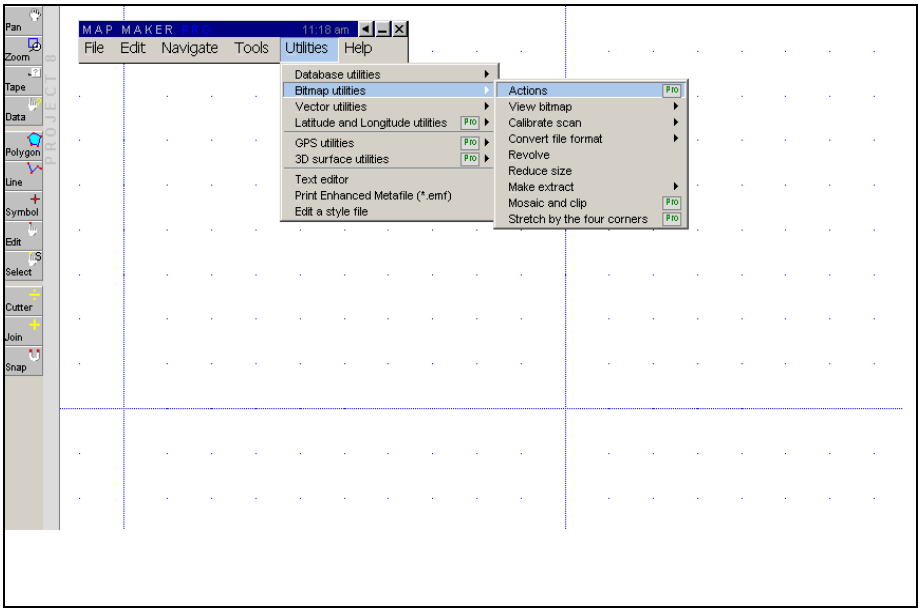
NB: This file was obtained directly from the TDSB

8. Save this session in MapMaker as a Project file

Clipping orthophotos in MapMaker Pro

1. Open MapMaker Pro and open project file created in the above step

2. Follow path: “Utilities\vector utilities\actions\polygon manipulation\generate buffer zone” route to create a 25m buffer zone around each school property



3. Follow path: “Utilities\vector utilities\actions\polygon manipulation\join adjacent polygons of the same name” route to join the buffer and school file into a new file

4. Save and name new file “schools plus buffers_NAD27.dra”

5. Follow path: “Utilities\Bitmap Utility\Action\Clip\Clip bitmap to vector polygon” route to clip orthophotos

6. This utility also creates a world file (select this option)

7. Hit “Polygon file” and select file “schools plus buffers_NAD27.dra”

8. Click “OK”

9. Save clipped file as “XXXXX_NAD27_clipped.tif”.

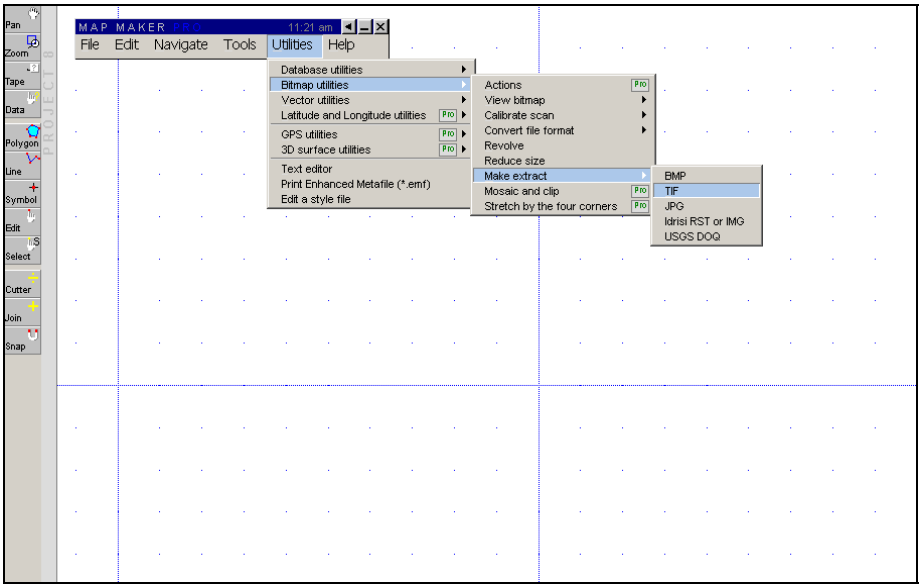
NB: The program saves another file with the same name but with the .tfw extension. This is the World File for the clipped images. ***Please note that once created, file names should not be changed. Changing file names may be detrimental to retrieving data.***

10. Close

Making extracts of individual schools in MapMaker Pro

1. Open MapMaker Pro

2. Follow path: “Utilities\Bitmap Utilities\make extract\tif”



3. Select saved file named “XXXXX_NAD27_clipped.tif”

4. Using the UTM coordinates provided by the TDSB, locate the desired school

NB: These coordinates are for the centre of the school property.

5. Click the cutter icon on the bottom right-hand side (red square with scissors)

6. Draw box around desired school and click “OK”

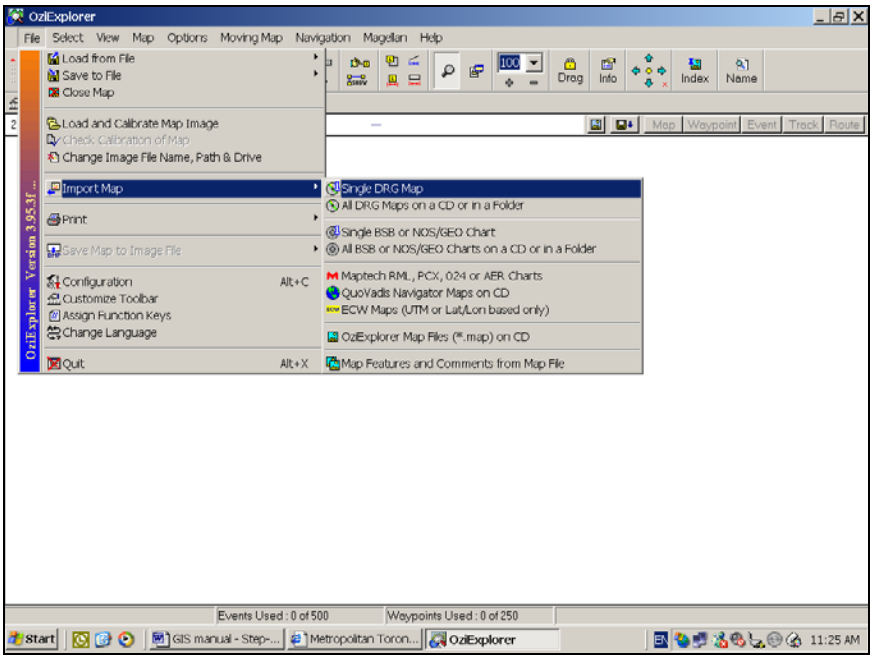
7. Save as school name
   NB: Please note that changing file names may be detrimental to retrieving data.

8. Close

Loading extracted schools into OziExplorer 3.95.3 and creating .map files

1. Open OziExplorer version 3.95.3 (desktop version)

2. Follow path: “File\import map\single DRG map” click “OK”



3. Find desired clipped school map from file folder

4. Open and click “OK”

5. Specify folder where clipped maps should be saved (eg. TDSB – clipped schools)

6. Click “OK” (to continue to next step)

DRG Import Defaults – ensure that the following information is entered:
Map datum: NAD27Canada
Map grid zone: 17
Hemisphere: N
Map projection: UTM

7. Click “OK”

8. Click “OK” to finish then close session

<u>Creating Img2Ozf files for OziExplorerCE to read</u>

1. Open Img2ozf Conversion Utility program

2. Under “Source Image,” select folder where image files are located, click “OK”

3. Select desired schools and click button “Process Image files to OZF2 Files”

4. Wait for conversion then close

Loading clipped school files into OziExplorerCE

1. Open folder where all clipped map files are saved

NB: There should be 5 files for each school saved in this folder (.tif, .tfw, .map, .ozf2, _ozf.map)

2. Copy .map, .ozf2 and _ozf.map extension files into the "Pocket_PC My Documents" folder created when installing handheld computer

3. Synchronize with handheld by connecting device

4. Repeat this step for each school file

2. SETTING UP NEIGHBOUR*WOODS*© SPREADSHEETS

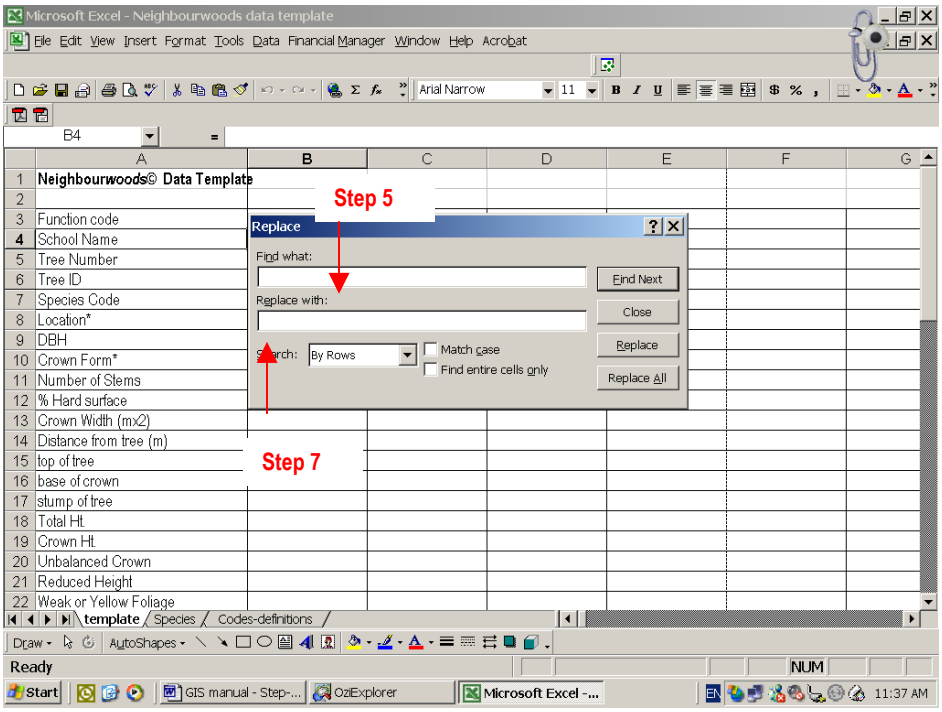
Creating spreadsheet

1. Open Neighbour*woods*© template spreadsheet (provided by School Board)

NB: Do not modify entry fields as they correspond with main inventory database (Excel).

2. Save as another file under desired school name

3. Under "Edit" menu, Click "Find"



4. Input the word "template" in "Find what"

5. Click "Replace"

6. Input school name in "Replace with"

7. Click "Enter"

8. Under "Edit" menu, Click "Find"

9. Input the numbers "1111" in "Find what"

10. Click "Replace"

11. Input school function location number in "Replace with"

NB: Each School Board property is assigned a unique number – this can be found in the file entitled "List of Schools," on the worksheet entitled, "tdsbschoolsites_NAD27" on the CDrom provided.

12. Click "Enter"

13. Select the tab at the bottom of the active worksheet entitled "template"

14. Right click and select "Rename"

15. Change name to school name

16. Verify that spreadsheet has the correct formulas in set fields before continuing. For example in column "B" the formulas will read as follows:

    "Tree ID" should read: =B1&B3
    "Total Height" should read: =sum(B13,B15)*(B12)
    "Crown Height" should read: =B16-(B14*B12+B15*B12)

NB: For each column the formula will remain the same, except the letters will correspond with the column letter.

17. Repeat this process for each individual school

<u>Background information regarding spreadsheet formulas</u>

The "Tree ID" field gives each tree a unique serial code; it is comprised of the "Tree Number" added to the end of the "Function Code" number.

"Total Height" is calculated by:
[(top of tree%) + (stump of tree%)] x distance from tree

"Crown Height" is calculated by:
Total Height – [(base of crown)(distance from tree) + (stump of tree)(distance from tree)]

<u>Loading spreadsheets into OziExplorerCE</u>

1. Open folder where individual school spreadsheet files are saved

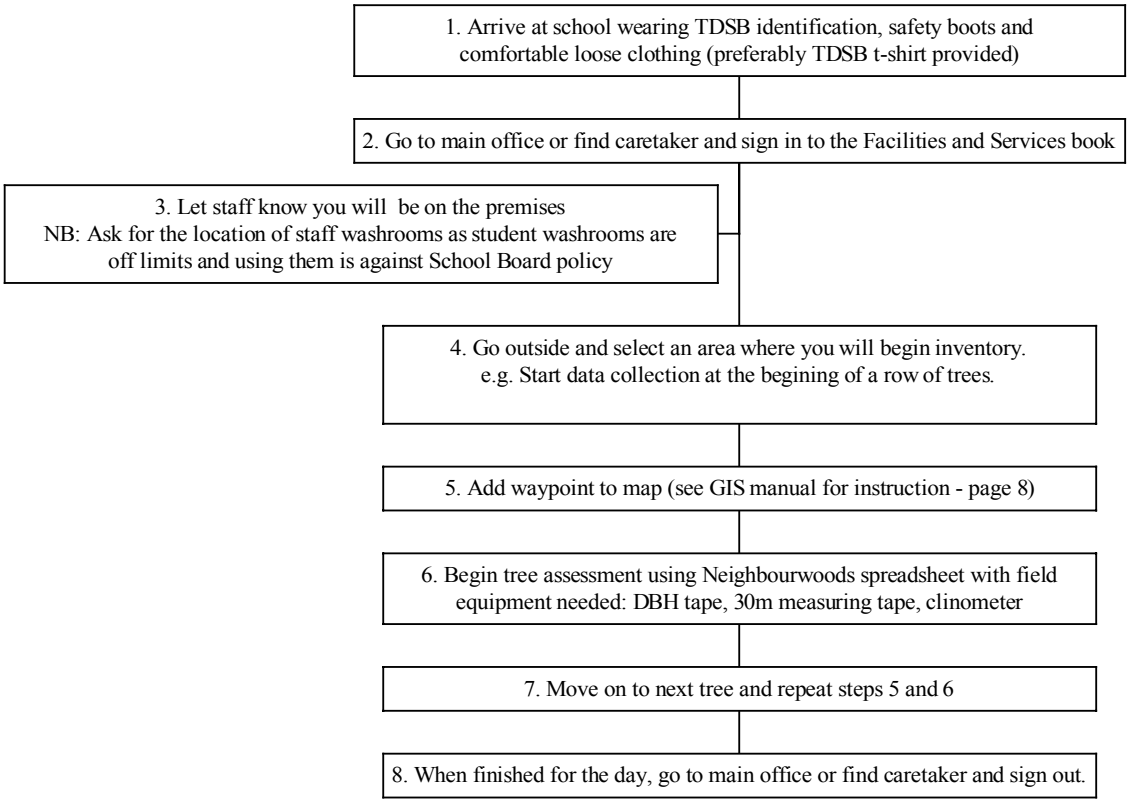
2. Copy file into the "Pocket_PC My Documents" folder created when installing handheld computer

3. Synchronize with handheld by connecting device

4. Repeat this step for each school file when needed

3. CONDUCTING THE FIELD INVENTORY

Conducting the inventory proceeds as follows:



Adding waypoints to handheld OziExplorerCE

NB: Waypoints are points that can be added to the map

1. Open desired map on handheld computer
2. Navigate to location of tree that is being assessed
3. Click waypoint button to add a new waypoint
4. Name waypoint in chronological order beginning with 1 (not 0)

NB: The two buttons on the bottom left-hand side of the handheld allow moving back and forth between OziExplorerCE and Excel.

Following Neighbour*woods*© on OziExplorerCE

1. Open spreadsheet created for school
2. Begin assessing tree whose "Tree Number" field corresponds with the waypoint number created above

NB: It may be faster to fill out only the data that is unique to each tree while in the field. This increases productivity outside, however, once the data has been synchronized with the main computer, the empty cells must be filled in with either 0 or N depending on the section.

Identifying species and filling in fields

1. Identify tree

2. Each tree species is assigned a special 6-character code

3. This code is comprised of the first three letters of the tree's genus followed by the first three letters of the tree species: e.g. Sugar Maple = mapsug

NB: For a comprehensive list of species and codes inventoried to date, please refer to tab marked "Species" in the template spreadsheet. Also, when encountering a new species, record it in this list.

Tree Measurements (DBH, Total Height, Crown width and Crown Height)

1. Using DBH tape, wrap around stem of tree about 1.4m high (breast height) from germination point

2. Record number from diameter side of tape in "DBH" field

3. Using the 30m measuring tape, walk away from stem to the dripline of tree

4. Read and double this distance from tape (e.g. if tape says 3, record 6 in field)

5. Record in "Crown Width" field

6. Using the 30m measuring tape, walk away from stem about a tree length

7. Record this distance in meters in the "Distance from tree" field

8. Remain at this distance for the remainder of the measurements

9. Pick up the clinometer

NB: It is a good idea to keep it suspended from the neck for easy access

10. Look through eyehole keeping both eyes open

11. Place the cross hairs inside at the top of tree, wait a few seconds for stability

12. Read out number on right-hand side of the vertical bar

13. Record number as a percent (e.g. 15 should be recorded as .15 in the "Top of tree" field)

14. Place the cross hairs inside at the base of tree crown, wait a few seconds for stability

15. Read out number on right-hand side of the vertical bar

16. Record number as a percent in the "Base of crown" field

17. Place the cross hairs inside at the bottom of tree, wait a few seconds for stability

18. Record number as a percent in the "Stump of tree" field

What to include in the inventory

Although this is a tree inventory, there are some species that can be classified as multi-stemmed shrubs and/or small trees. This inventory will include those types of species only when they have shade benefits and are tree-like. The following is a list of possible examples that may be seen:

Evergreen	Deciduous		
Yew	Nannyberry	Amur Maple	Staghorn sumacs
Cedar	Serviceberry	Witch Hazel	Pussywillow
Juniper	Elder	Alternate Leafed Dogwood	

These species are treated differently when collecting data; they should be georeferenced (waypointed) on the map, however when filling in the attribute data, only the following fields should be filled in: "Species Code", "Location," "Crown form" and "% hard surface." The remaining fields should be filled in with "N/A."
NB: Please note that this is because these species have shade value but they will not be used in any analysis. These species will later be moved to another worksheet in the main database.

Do not include trees that are obviously dead. If dead trees are seen, make a note and give this to supervisor for their immediate removal.

4. ORGANIZING DATA AT THE END OF EACH COMPLETED SCHOOL

After collecting the data on the handheld, organize it in Excel spreadsheets on the main computer.

1. Synchronize data with the main computer
2. Open folder "Pocket_PC My Documents"
3. Select school file
4. Look over data – no strange symbols, no empty cells
5. Fill empty cells with "0," "N" or "N/A" in applicable fields
6. Save file in appropriate folder

NB: Do not save the file in the "Pocket_PC My Documents" folder. This folder is the temporary folder that is synchronized EVERY time the handheld is plugged in to the desktop, therefore save completed school files in other folder.

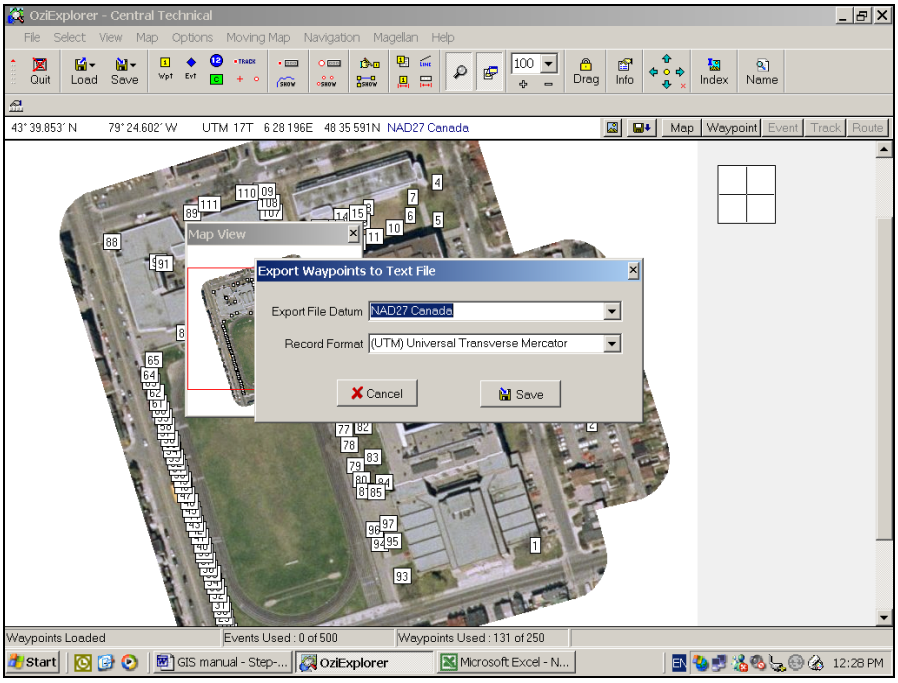
7. Prepare and load another spreadsheet into the handheld for the next schools to be inventoried

<u>Exporting Waypoint Log from OziExplorerCE to main computer</u>

NB: The waypoint log contains the 'x' & 'y' coordinates of each tree.

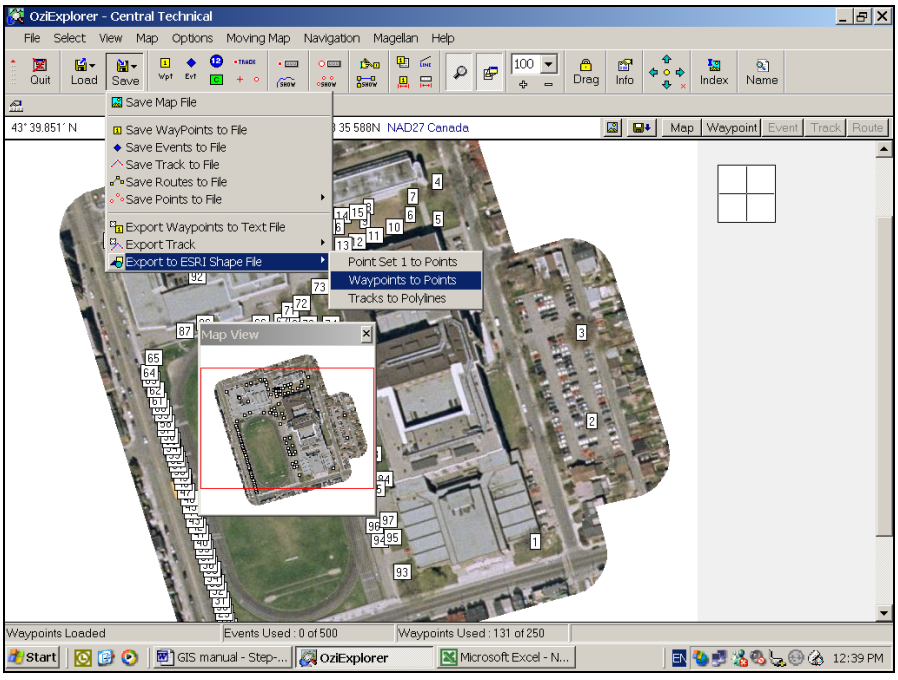
1. Connect handheld to main computer
2. Open Microsoft ActiveSync
3. Follow path: "Explore\My Pocket PC\OziExplorer\Data"
4. Drag waypoint file into the desired folder on the main computer
5. Open OziExplorer 3.95.3
6. Follow path: "Load\Load Map File" and choose desired map file (i.e. the school that has just been completed) (.map file)
7. Follow path: "Load\Load Waypoints from File" and choose waypoint file for corresponding school
8. Follow path: "Save\Export Waypoints to Text File"

The “Export Waypoints to Text File” dialogue box opens.
In the “Export File Datum” field, select “NAD27 Canada”
In the “Record Format” field, select “(UTM) Universal Transverse Mercator”



9. Click “Save” and save the waypoint file (.txt) in desired folder

10. If the map was closed after the last step, load same map and waypoints using the above steps. Follow path: “Save\Export to ESRI Shape File\Waypoints to Points”



11. Save the waypoint file (.shp) in desired folder

NB: These shape files can now be opened by Map Maker – or any other software that reads ESRI shapefiles. ***Please note that once created, file names should not be changed. Changing file names may be detrimental to retrieving data.***

Bringing in coordinate information to Neighbour*woods*© data spreadsheets

1. Open Microsoft Excel
2. Follow path: "File\Open"
3. Choose folder "Waypoint Files"
4. Select text file of desired school
5. Select "Delimited" then "Next"
6. Unselect "Tab" and select "Comma"
7. Click "Finish"
8. When spreadsheet opens, delete every column **except** the 'x' and 'y' coordinates columns as well as the "Date" column
9. Select the 'x' and 'y' coordinates columns as well as the "Date" column
10. Follow path: "Right click\Copy"
11. Paste fields into corresponding Neighbour*woods*© data spreadsheets
12. Close session

Making changes to existing files

In the event that a new tree must be added to a completed school file, it is important that the waypoint is added to the existing waypoint file; therefore both the waypoint file and the map file must be loaded onto the handheld.

Refer to steps above on loading maps and georeferencing.

5. MAIN DATABASE

Adding data to Microsoft Excel main database

1. Open Microsoft Excel

2. Open individual school data sheet that has just been completed

3. Select cells of area to be copied

NB: Only select data that has been collected (i.e. do not select the Neighbourwoods© headings).

4. Follow path: "Right click\Copy"

5. Open file "TDSB Database" (main database)

6. Select worksheet "Inventory Details"

7. Select top left-hand cell under the last school entered

8. Right click and select "Paste Special"

9. Select the box "Transpose"

10. Click "OK" then close session

Sorting out shrubs from main inventory

1. Open Microsoft Excel

2. Open file "TDSB Database"

3. Select column "G" (DBH column) and follow path: "Data\Filter\Autofilter"

NB: A dropdown menu will appear at bottom left-hand corner of column "G" row "1"

4. Click dropdown menu and select "N/A"

NB: This will automatically select all data that was recorded with having an "N/A" in the DBH field. These species are the multi-stemmed shrubs that cannot be used in data analysis.

5. Select area to be copied, right click then "Copy"

6. Select worksheet "Shrubs"

7. Select top left-hand cell under the last school entered

8. Right click and select “Paste”

9. Click “OK” then close session

Rating trees according to Neighbour*woods*© weighting

1. Open Microsoft Excel

2. Open file “TDSB Database”

3. Select worksheet “Inventory Details”

4. Select “Tree ID” data cells (in column “D”) that have recently been collected and added to this worksheet

5. Follow path: “Right click\Copy”

6. Select worksheet “Condition Summary”

7. Select top left-hand cell under the last “Tree ID” entered

8. Right click and select “Paste”

9. Select cells (columns “B” to “V”) from the row above the first new tree being added

NB: Select cells that are already full to copy the formulas

10. At bottom right-hand corner of last cell selected (highlighted), there will be a little square. Place curser on square.

11. Left-click and drag formula down to last row containing a “Tree ID” number

NB: This should fill all the cells above with values and ratings.

12. Select worksheet “Inventory Details”

13. Select last cell in “Rating” column (column “AP”)

14. At bottom right-hand corner of last cell selected (highlighted), there will be a little square. Place curser on square.

15. Left-click and drag formula down to last row containing a tree

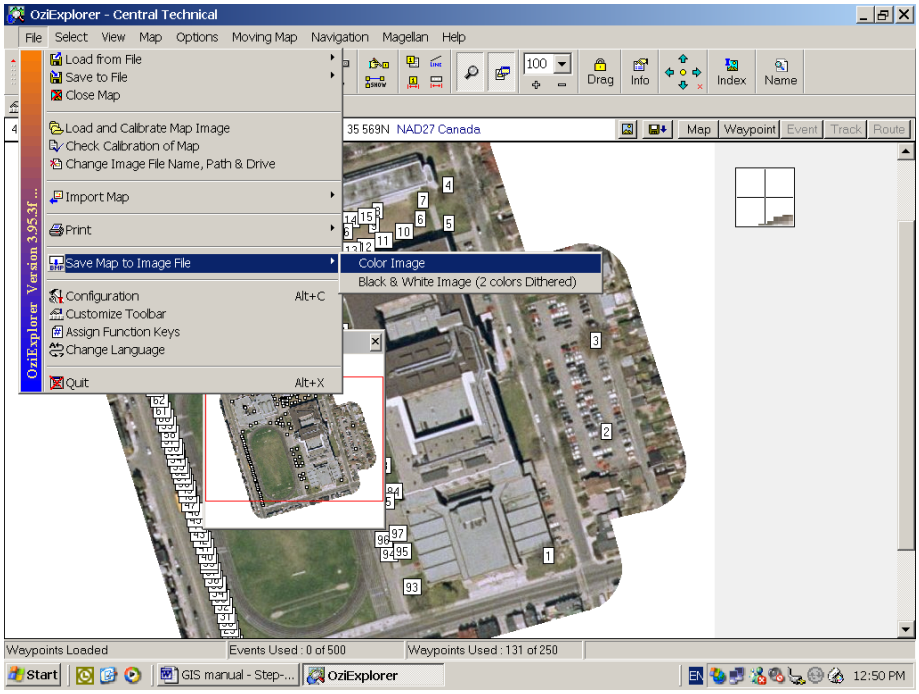
16. Save file and close session

6. LOOKING AT WAYPOINTS ON MAPS

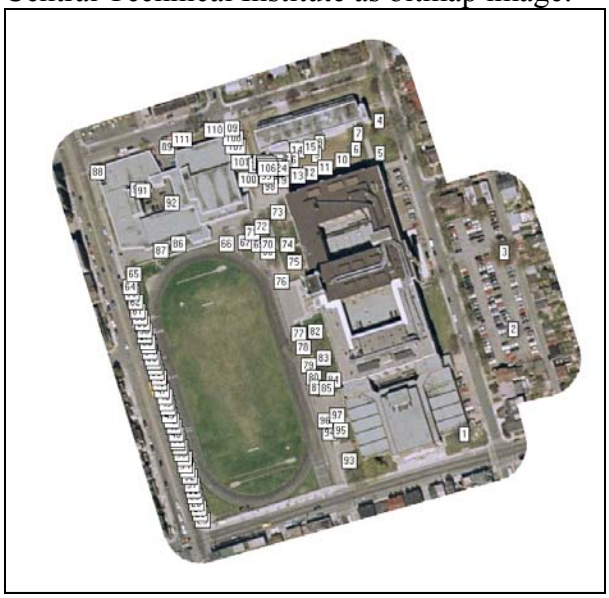
1. Open OziExplorer 3.95.3

2. Load desired school map and waypoints following steps above

NB: The maps and waypoints can be saved as bitmap images for quick viewing. Follow path: "File\Save Map to Image File\Color Image."



Central Technical Institute as bitmap image:



APPENDIX III

Schedule of inventory collection summer 2004

May-04

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17 Getting started with GIS organization	18	19	20	21	22
23 30	24 orthophotos 31	25	26 Meeting @ 849 Eastern	27 TDSB IDs - Central Tech	28 Faculty: training @ Central Tech	29

Jun-04

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 GIS - crop orthophotos	2	3 How-to manual, school lists	4	5
6	7 georeferencing	8	9	10	11	12
13	14 Central Tech Institute	15	16 Central Tech & Harbord	17 sorting data	18	19
20	21 GIS manual	22 research / writing	23 clipping maps	24 Lord Landsdowne	25 Kind Edward	26
27	28 Lord Landsdowne	29 Beverly / Subway II / Orde / Heydon	30 Huron St Jr PS			

Jul-04

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 CANADA DAY	2 GIS - crop orthophotos	3
4	5 Central Commerce CI	6 research / writing	7	8	9 clipping maps	10
11	12 Huron, Harbord, Central Tech	13 Dewson & Clinton	14 sort data, clip maps, waypoints	15 Meeting 10am	16 Palmerston, Ogden	17
18	19 Ogden	20 Essex	21 sort data, clip maps, waypoints	22 Essex Hawthorne	23 Property tour - Meeting	24
25	26 Alexander Muir & Charles G. Fraser	27 sort data, clip maps, writing	28	29 Givins-Shaw, Niagara, Alpha-Oasis	30 Ryerson	31

Aug-04

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 CIVIC HOLIDAY	3 Dovercourt & West Toronto	4 in office	5 West Toronto	6 Shirley St. & Shade Audit	7
8	9 Fern Ave & Garden Public	10 Brock Ave & Pauline	11 Howard Jr PS	12 in office	13 Perth Ave Jr PS - St. Luigi	14
15	16 Kent, Bloor, Ursula Franklin	17 Indian Road & Lucy McCormick	18 Ossington/Old Orchard	19 research and writing →	20	21
22	23 in office →	24	25	26	27 →	28
29	30 Meeting	31 finalize reports and photographs				

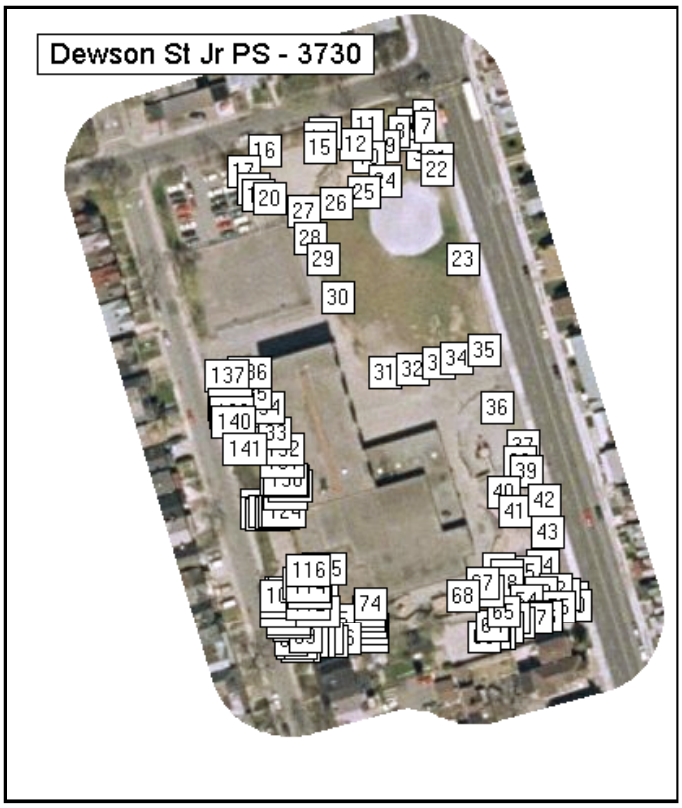
Sep-04

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 Prepare reports, files & receipts	2 Meeting: submit reports and database	3 Last official day - in office	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

APPENDIX IV

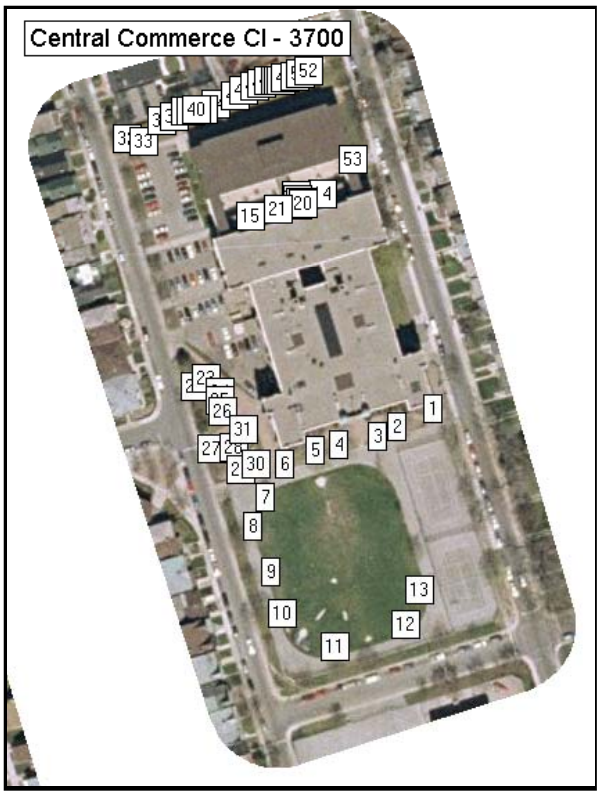
MAPS OF SCHOOLS COMPLETED SUMMER 2004

Adrina Bardekjian Ambrosii

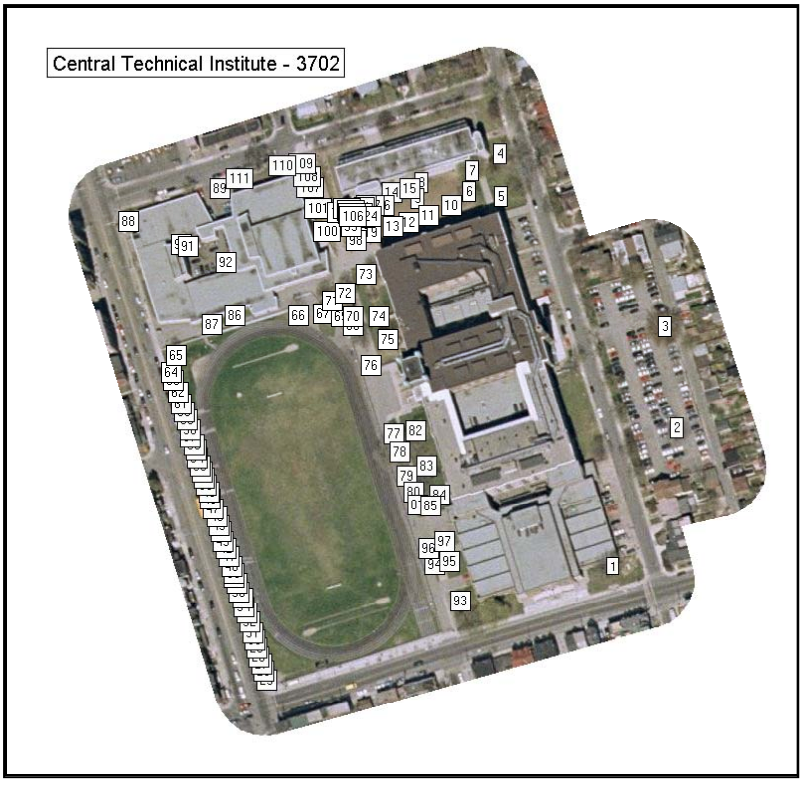


School Name	Dewson Street Jr PS
Function Code	3730
Street Address	65 Concord Avenue
CITY	Toronto
Postal Code	M6H2N9
Phone Number	416-393-9120
X coordinates	627069.2
Y coordinates	4834661.8
M WARD	19
OPT FAMILY	SW6
ID	603
MET CODE	8388
Species Diversity	26
Total # trees	135

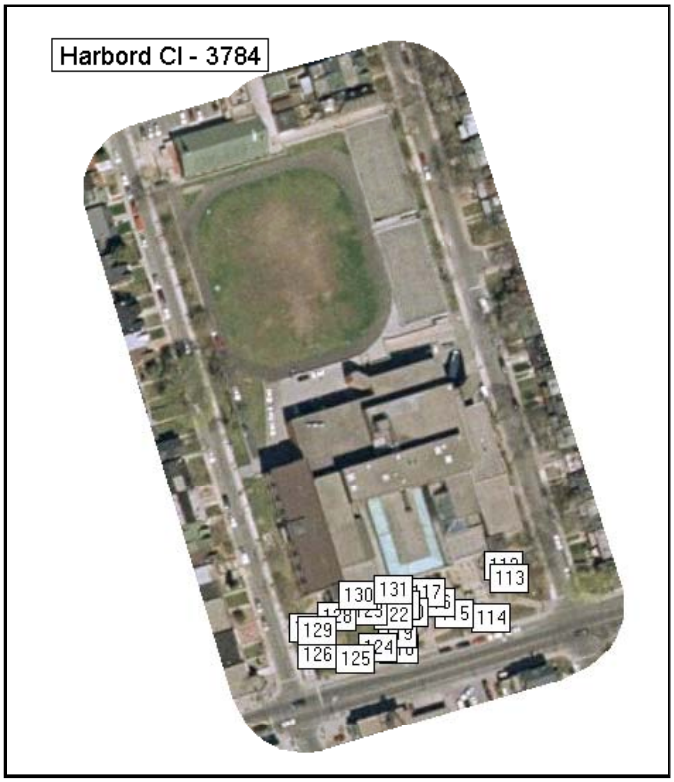
School Name	Beverley Jr PS/ Subway II
Function Code	3678
Street Address	64 Baldwin Street
CITY	Toronto
Postal Code	M5T1L4
Phone Number	416-397-2750
X coordinates	629375.8
Y coordinates	4834690.4
M WARD	20
OPT FAMILY	SW6
ID	193
MET CODE	8355
Species Diversity	2
Total # trees	10



School Name	Central Commerce CI
Function Code	3700
Street Address	570 Shaw Street
CITY	Toronto
Postal Code	M6G3L6
Phone Number	416-393-0030
X coordinates	627232.0
Y coordinates	4834815.2
M WARD	19
OPT FAMILY	SW6
ID	569
MET CODE	8370
Species Diversity	12
Total # trees	53

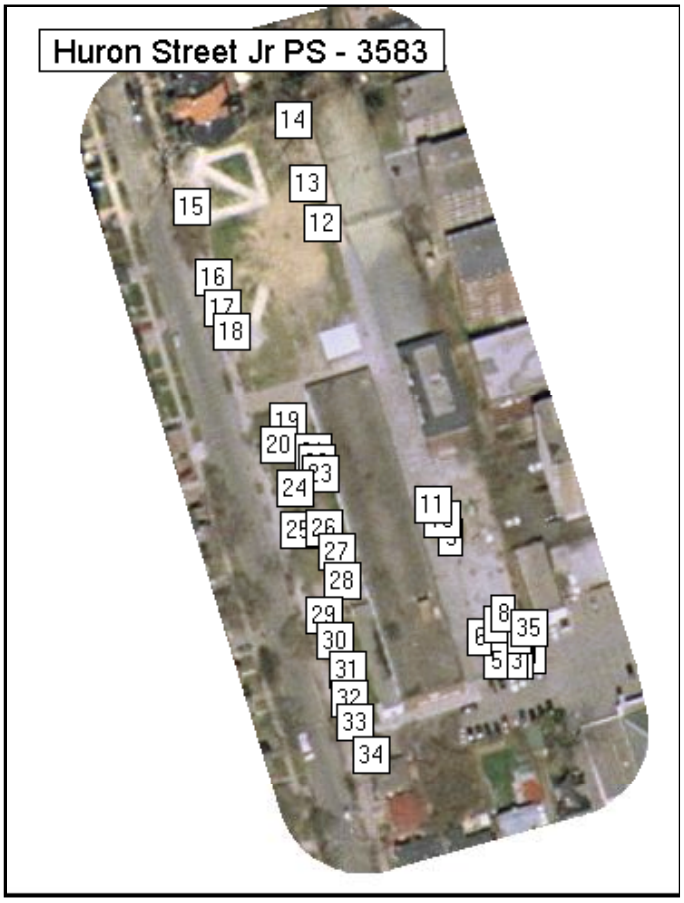


School Name	Central Technical School
Function Code	3702
Street Address	725 Bathurst Street
CITY	Toronto
Postal Code	M5S2R5
Phone Number	416-393-0060
X coordinates	628290.1
Y coordinates	4835447.8
M WARD	20
OPT FAMILY	SW6
ID	646
MET CODE	8371
Species Diversity	18
Total # trees	111

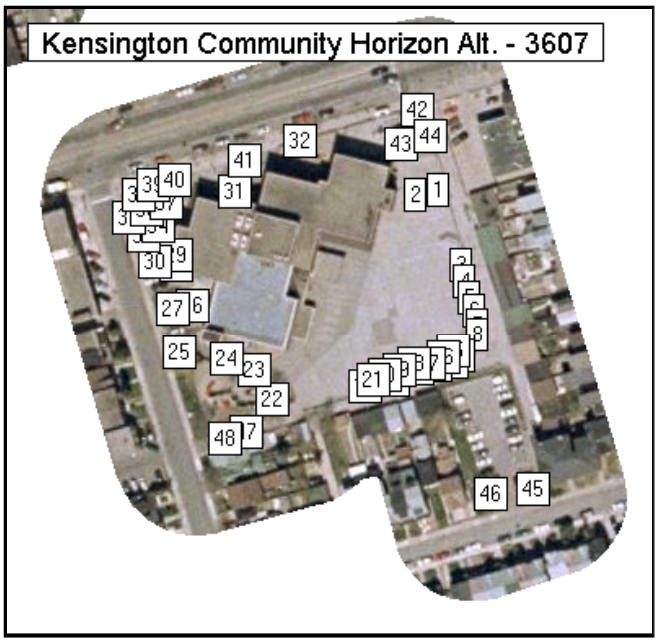


School Name	Harbord CI
Function Code	3784
Street Address	286 Harbord Street
CITY	Toronto
Postal Code	M6G1G4
Phone Number	416-393-1650
X coordinates	627834.1
Y coordinates	4835278.7
M WARD	19
OPT FAMILY	SW6
ID	343
MET CODE	8457
Species Diversity	8
Total # trees	20

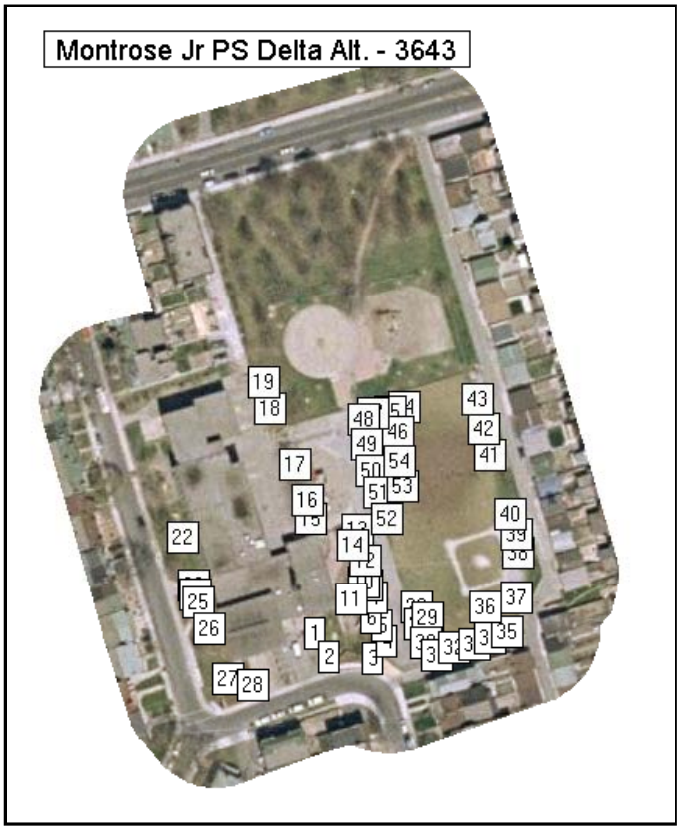
School Name	Heydon Park
Function Code	3733
Street Address	70 D'Arcy Street
CITY	Toronto
Postal Code	M5T1K1
Phone Number	416-393-0660
X coordinates	629413.4
Y coordinates	4834585.9
M WARD	20
OPT FAMILY	SW6
ID	52
MET CODE	8512
Species Diversity	4
Total # trees	16



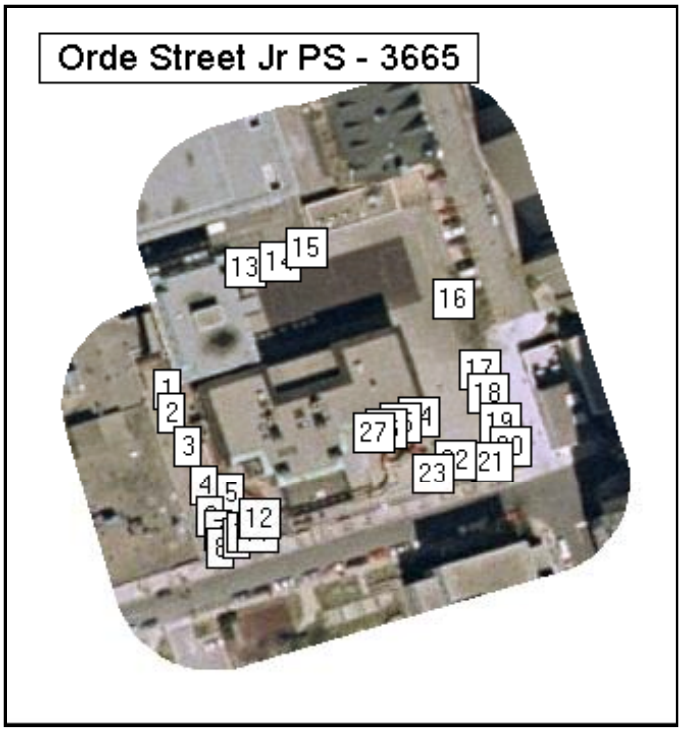
School Name	Huron Street Jr PS
Function Code	3583
Street Address	541 Huron Street
CITY	Toronto
Postal Code	M5R2R6
Phone Number	416-393-1570
X coordinates	628775.0
Y coordinates	4836329.6
M WARD	20
OPT FAMILY	SW5
ID	548
MET CODE	8468
Species Diversity	16
Total # trees	34



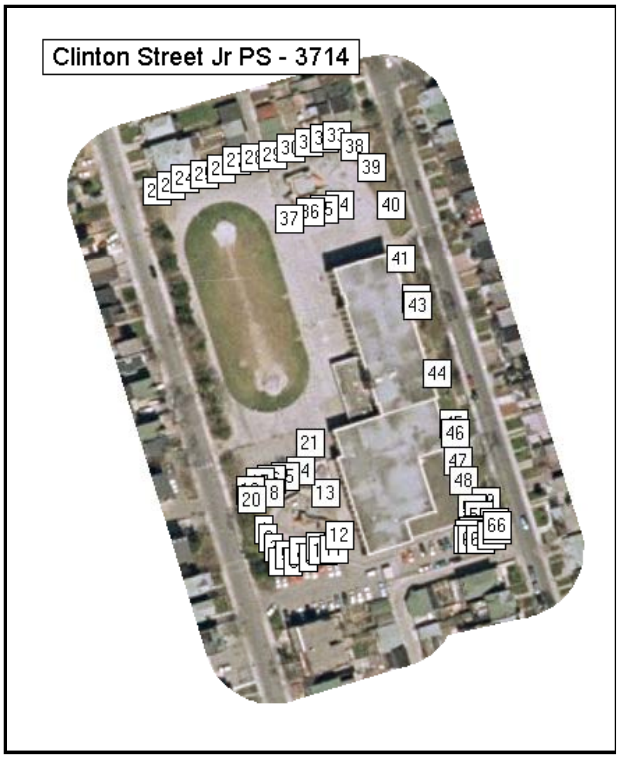
School Name	Kensington Community School Jr Horizon Alternative School
Function Code	3607
Street Address	401 College Street
CITY	Toronto
Postal Code	M5T1P3
Phone Number	416-393-1290
X coordinates	628557.7
Y coordinates	4834708.5
M WARD	20
OPT FAMILY	SW6
ID	457
MET CODE	8481
Species Diversity	8
Total # trees	48



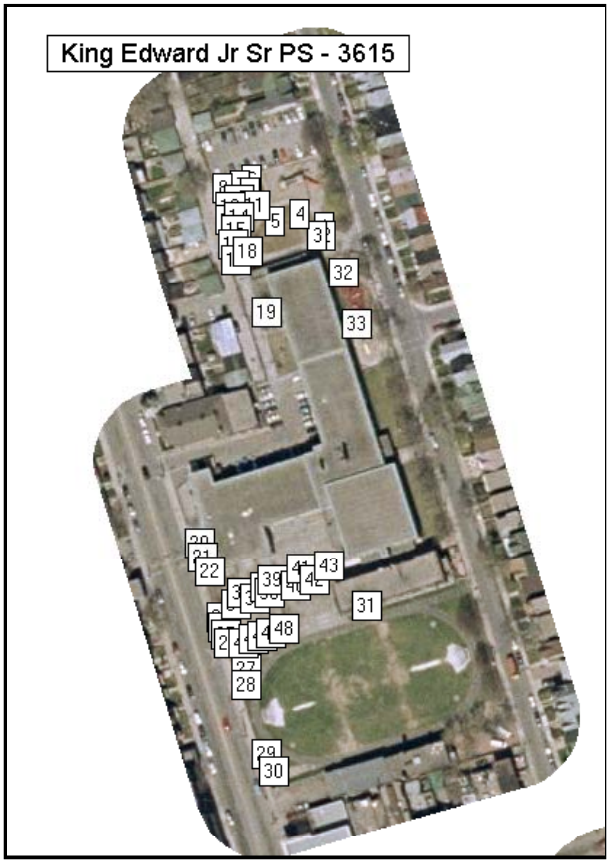
School Name	Montrose Jr PS / Delta Alternative School Sr
Function Code	3643
Street Address	301 Montrose Avenue
CITY	Toronto
Postal Code	M6G3G9
Phone Number	416-393-9770
X coordinates	627514.7
Y coordinates	4834983.4
M WARD	19
OPT FAMILY	SW6
ID	375
MET CODE	8501
Species Diversity	15
Total # trees	54



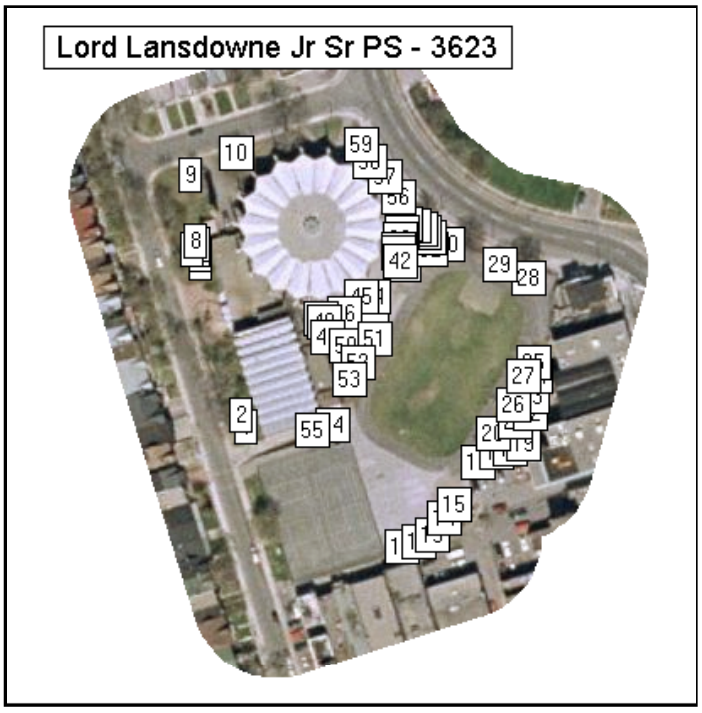
School Name	Orde Street Jr PS
Function Code	3665
Street Address	18 Orde Street
CITY	Toronto
Postal Code	M5T1N7
Phone Number	416-393-1900
X coordinates	629642.4
Y coordinates	4834996.3
M WARD	20
OPT FAMILY	SW6
ID	180
MET CODE	8411
Species Diversity	5
Total # trees	27



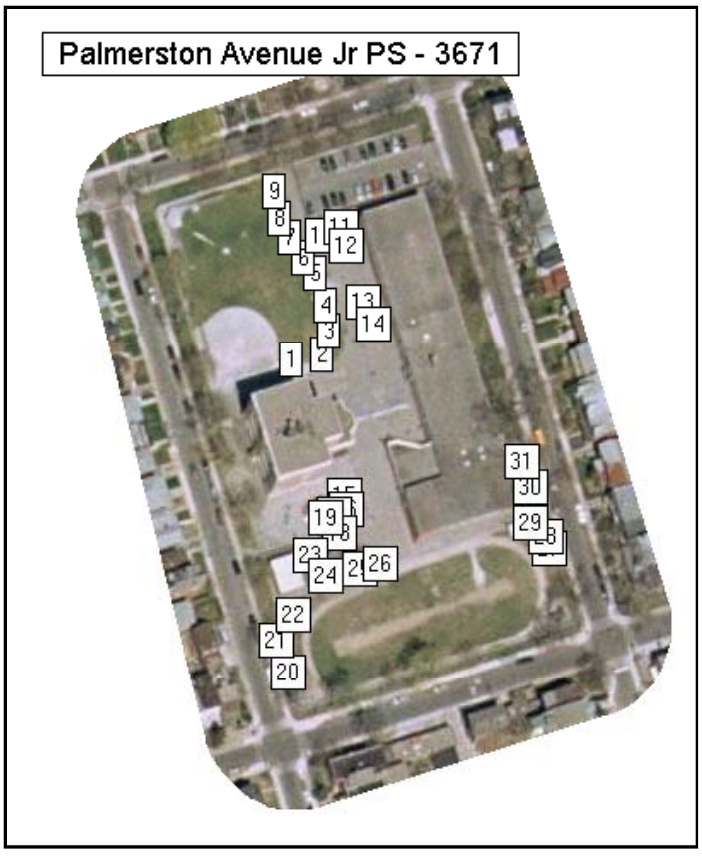
School Name	Clinton Street Jr PS
Function Code	3714
Street Address	460 Manning Avenue
CITY	Toronto
Postal Code	M6G2V7
Phone Number	416-393-9155
X coordinates	627853.7
Y coordinates	4834870.8
M WARD	19
OPT FAMILY	SW6
ID	498
MET CODE	8379
Species Diversity	14
Total # trees	55



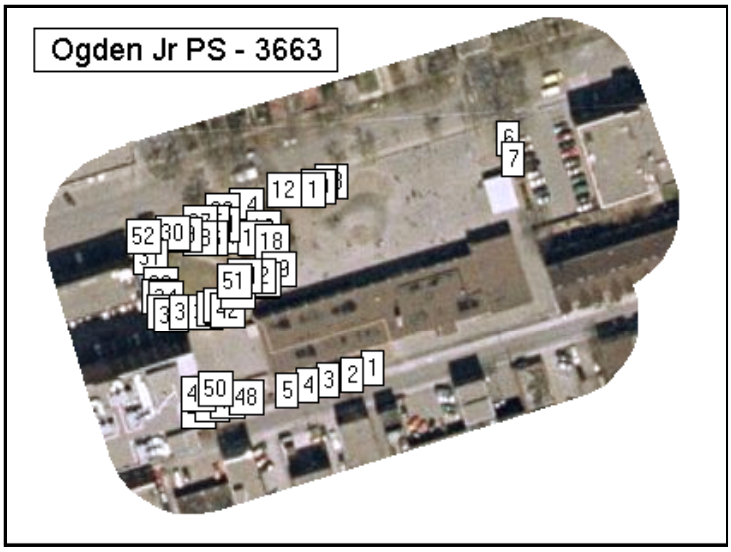
School Name	King Edward Jr & Sr P
Function Code	3615
Street Address	112 Lippincott Street
CITY	Toronto
Postal Code	M5S2P1
Phone Number	416-393-1320
X coordinates	628399.0
Y coordinates	4834904.6
M WARD	20
OPT FAMILY	SW6
ID	65
MET CODE	8485
Species Diversity	8
Total # trees	48



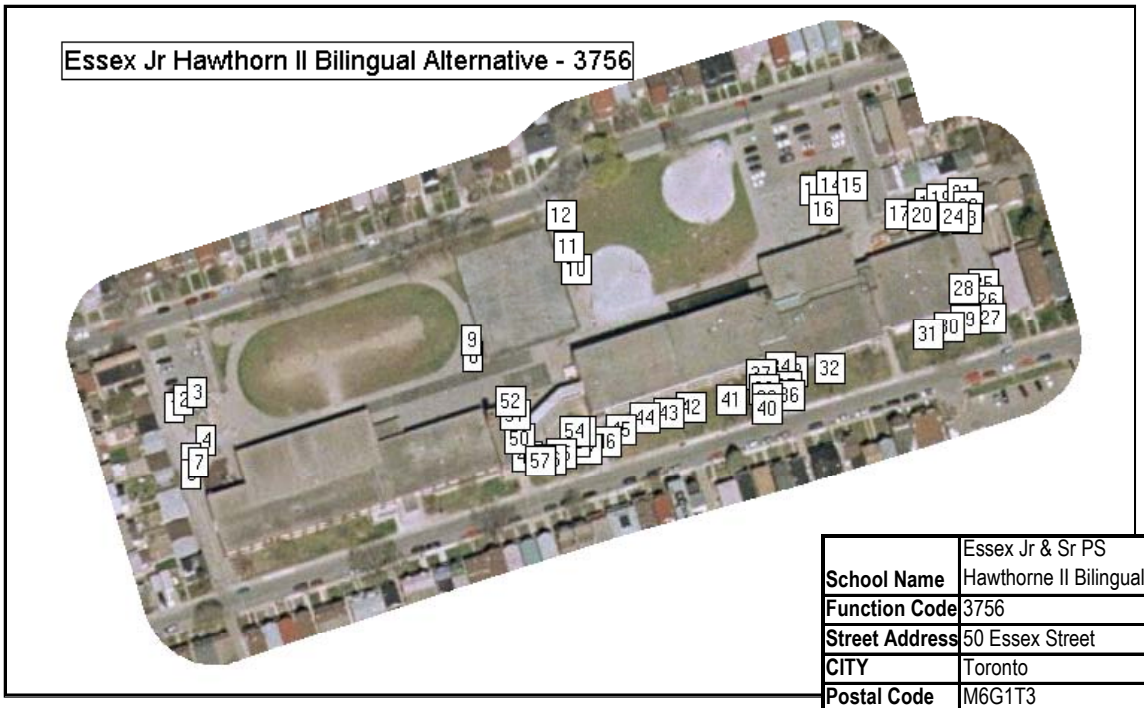
School Name	Lord Lansdowne Jr & Sr PS
Function Code	3623
Street Address	33 Robert Street
CITY	Toronto
Postal Code	M5S2K2
Phone Number	416-393-1350
X coordinates	628867.4
Y coordinates	4834994.4
M WARD	20
OPT FAMILY	SW6
ID	395
MET CODE	8489
Species Diversity	9
Total # trees	59



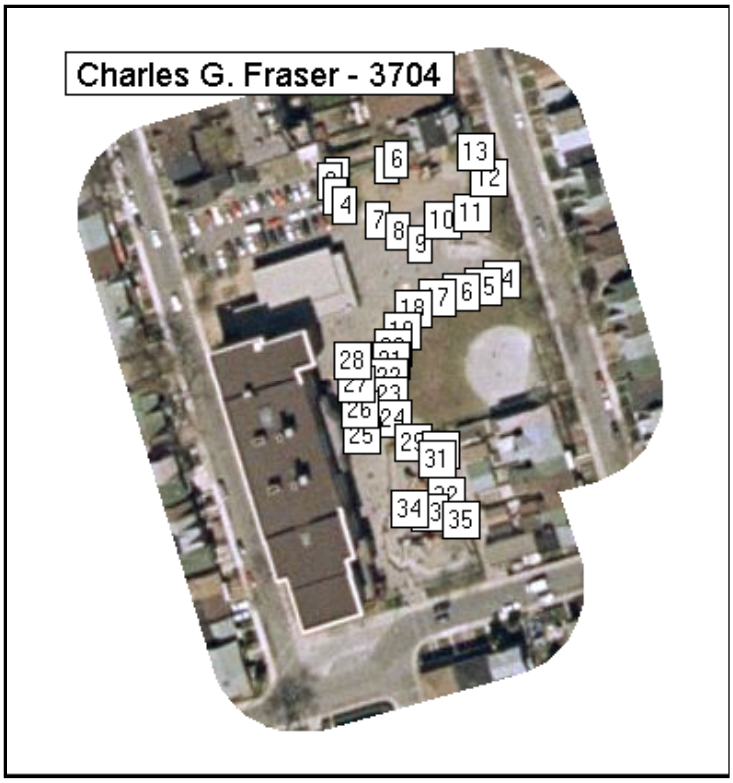
School Name	Palmerston Jr PS
Function Code	3671
Street Address	734 Palmerston Ave
CITY	Toronto
Postal Code	M6G2R4
Phone Number	416-393-9305
X coordinates	627721.1
Y coordinates	4836016.4
M WARD	20
OPT FAMILY	SW5
ID	650
MET CODE	8414
Species Diversity	9
Total # trees	31



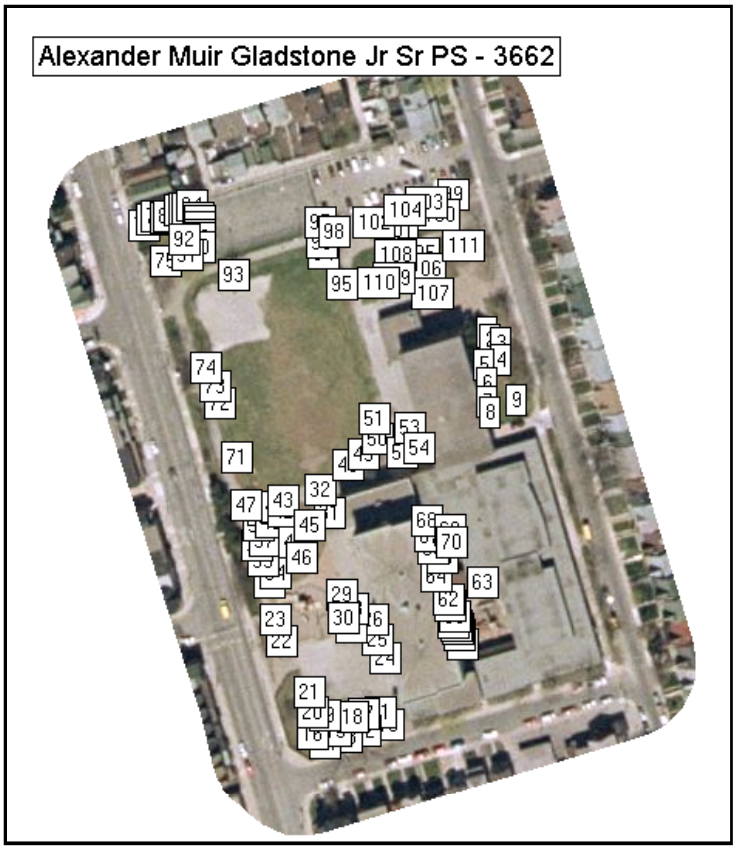
School Name	Ogden Jr PS
Function Code	3663
Street Address	33 Phoebe Street
CITY	Toronto
Postal Code	M5T1A8
Phone Number	416-393-9110
X coordinates	629387.4
Y coordinates	4834029.8
M WARD	20
OPT FAMILY	SW6
ID	393
MET CODE	8408
Species Diversity	12
Total # trees	52



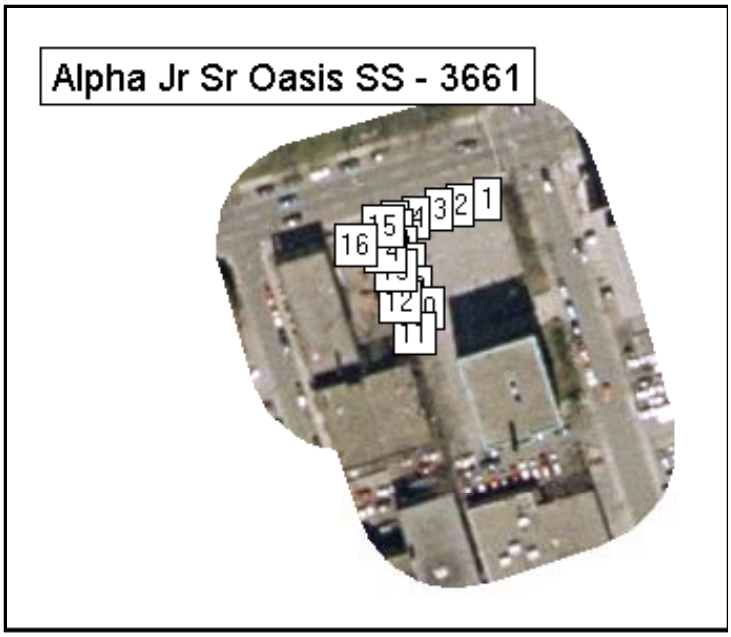
School Name	Essex Jr & Sr PS Hawthorne II Bilingual Alt
Function Code	3756
Street Address	50 Essex Street
CITY	Toronto
Postal Code	M6G1T3
Phone Number	416-393-0717
X coordinates	627111.5
Y coordinates	4836008.6
M WARD	19
OPT FAMILY	SW5
ID	517
MET CODE	8402
Species Divers	8
Total # trees	57



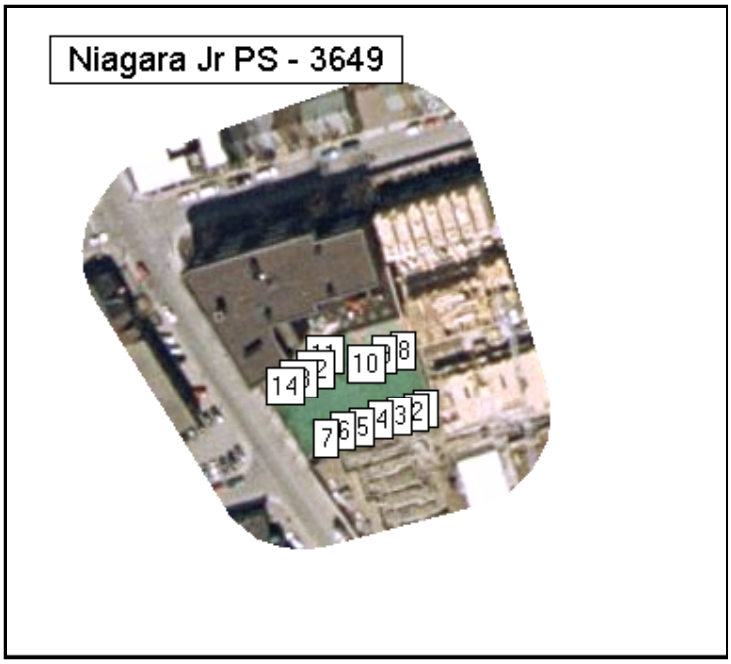
School Name	Charles G Fraser Jr PS
Function Code	3704
Street Address	79 Manning Avenue
CITY	Toronto
Postal Code	M6J2K6
Phone Number	416-393-1830
X coordinates	628278.0
Y coordinates	4833840.1
M WARD	19
OPT FAMILY	SW6
ID	665
MET CODE	8373
Species Diversity	7
Total # trees	35



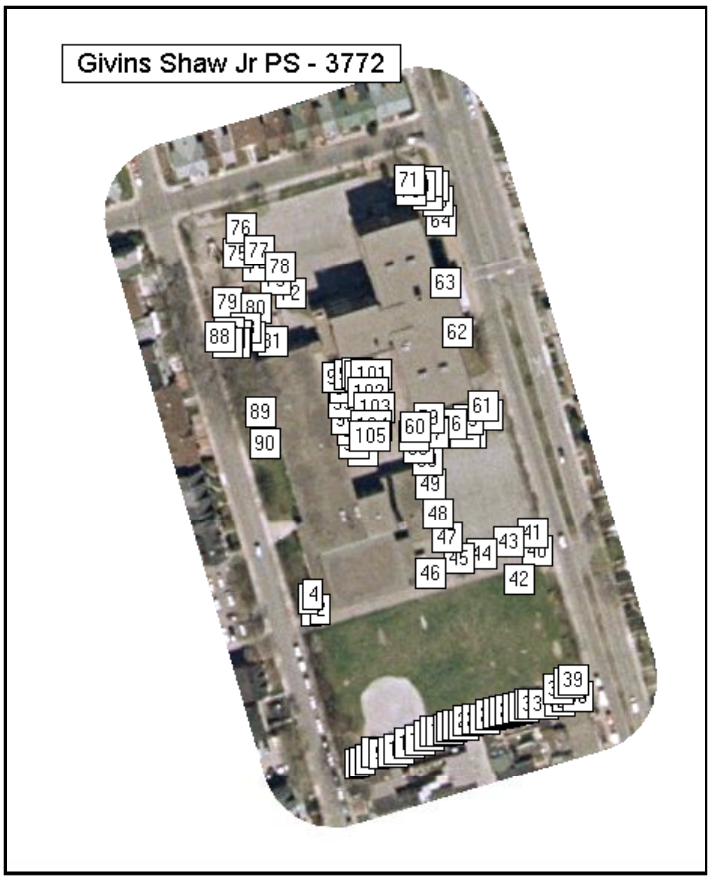
School Name	Alexander Muir/Gladstone Ave Jr & Sr PS
Function Code	3662
Street Address	108 Gladstone Avenue
CITY	Toronto
Postal Code	M6J3L2
Phone Number	416-393-9140
X coordinates	626653.4
Y coordinates	4833583.9
M WARD	18
OPT FAMILY	SW2
ID	46
MET CODE	8347
Species Diversity	12
Total # trees	111



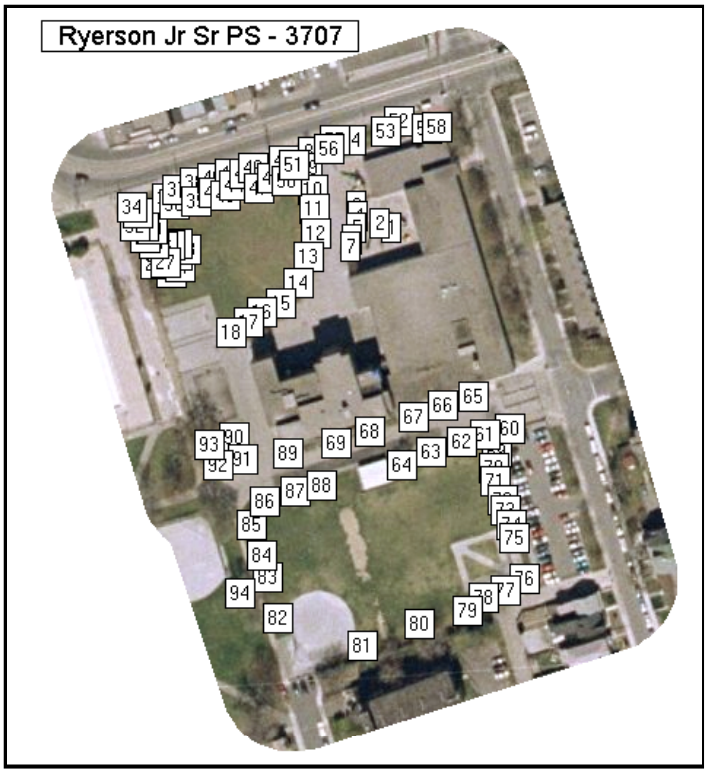
School Name	ALPHA Alt School Jr Sr Oasis Alt SS
Function Code	3661
Street Address	20 Brant Street
CITY	Toronto
Postal Code	M5V2M1
Phone Number	416-393-9830
X coordinates	629158.2
Y coordinates	4833556.7
M WARD	20
OPT FAMILY	SE2
ID	658
MET CODE	8349
Species Diversity	6
Total # trees	16



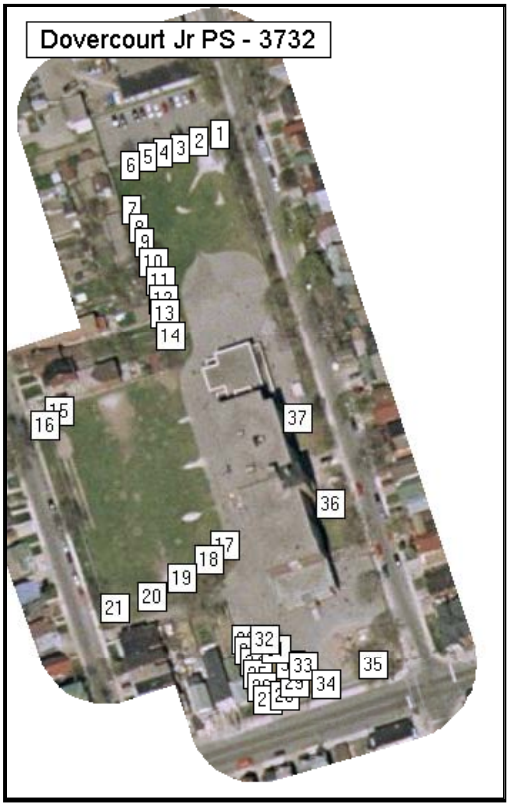
School Name	Niagara Street Jr PS
Function Code	3649
Street Address	222 Niagara Street
CITY	Toronto
Postal Code	M6J2L3
Phone Number	416-393-1371
X coordinates	628374.5
Y coordinates	4833327.0
M WARD	19
OPT FAMILY	SW6
ID	258
MET CODE	8504
Species Diversity	3
Total # trees	14



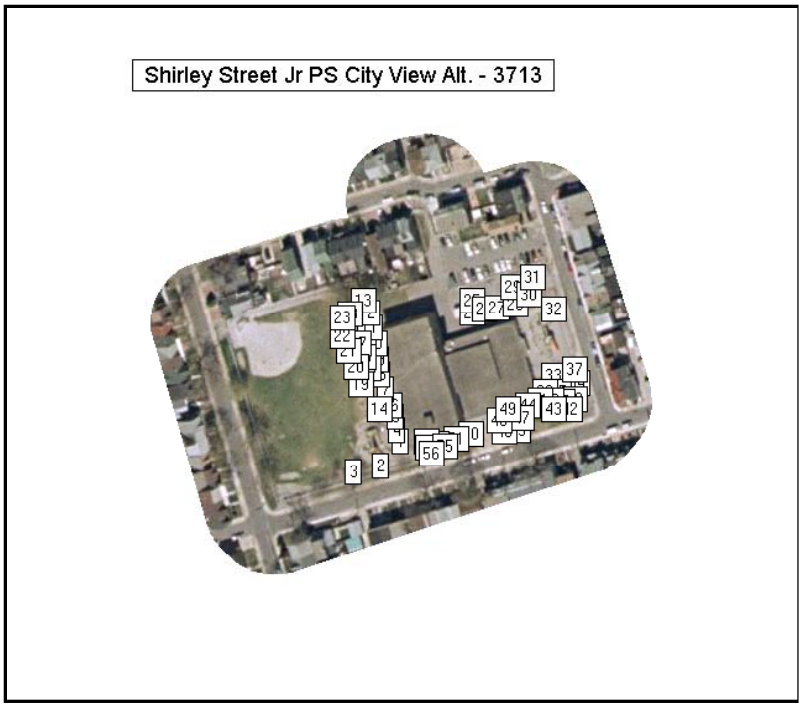
School Name	Givins / Shaw Jr PS
Function Code	3772
Street Address	49 Givins Street
CITY	Toronto
Postal Code	M6G2W5
Phone Number	416-393-1240
X coordinates	627604.7
Y coordinates	4833600.5
M WARD	19
OPT FAMILY	SW6
ID	185
MET CODE	8450
Species Diversity	10
Total # trees	105



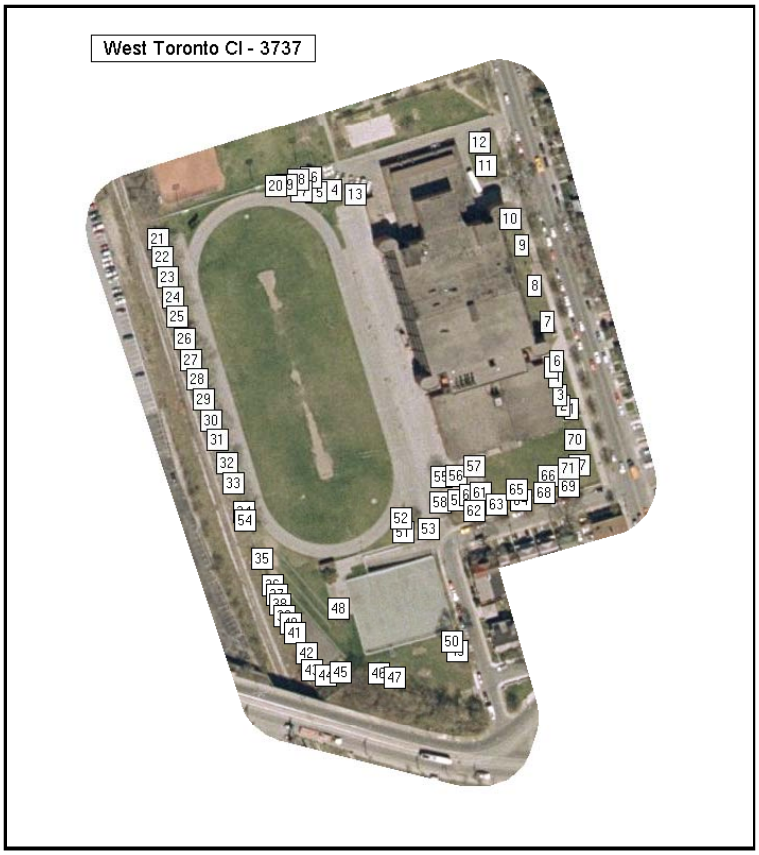
School Name	Ryerson Jr & Sr PS
Function Code	3707
Street Address	96 Denison Avenue
CITY	Toronto
Postal Code	M5T1E4
Phone Number	416-393-1340
X coordinates	628798.0
Y coordinates	4834133.0
M WARD	20
OPT FAMILY	SW6
ID	723
MET CODE	8433
Species Diversity	19
Total # trees	94



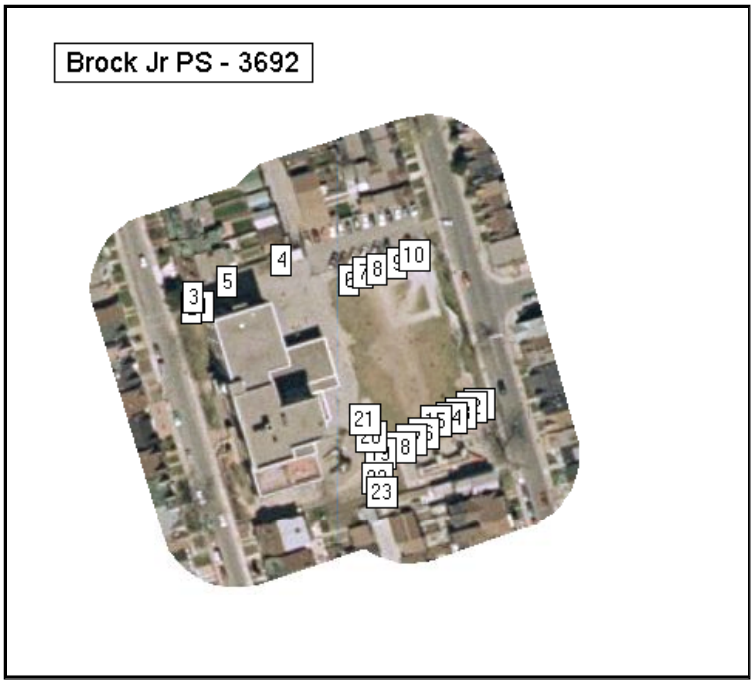
School Name	Dovercourt Jr PS
Function Code	3732
Street Address	228 Bartlett Avenue
CITY	Toronto
Postal Code	M6H3G4
Phone Number	416-393-9220
X coordinates	626057.2
Y coordinates	4835890.5
M WARD	18
OPT FAMILY	SW6
ID	272
MET CODE	8389
Species Diversity	6
Total # trees	37



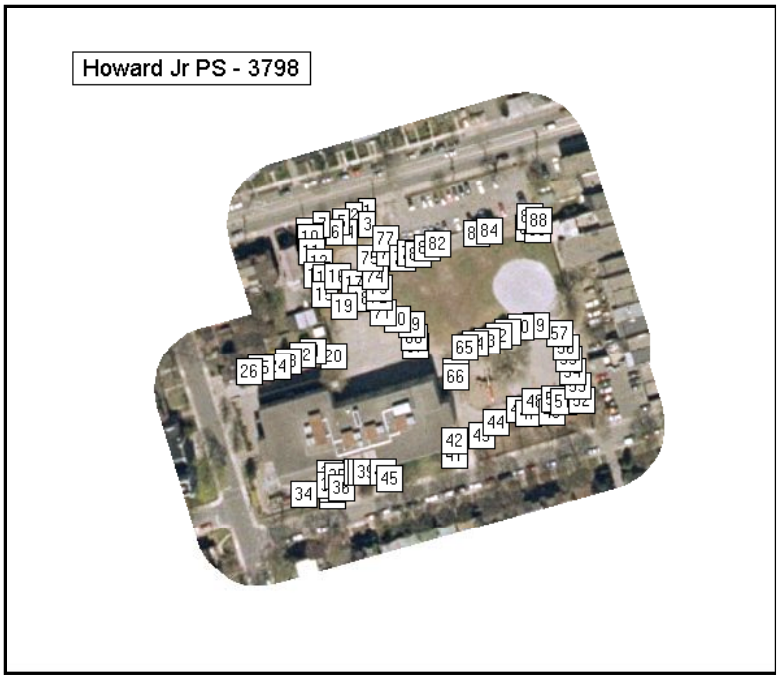
School Name	Shirley Street Jr PS City View Alternative School Sr
Function Code	3713
Street Address	38 Shirley Street
CITY	Toronto
Postal Code	M6K1S9
Phone Number	416-393-9270
X coordinates	626051.0
Y coordinates	4833825.5
M WARD	18
OPT FAMILY	SW2
ID	430
MET CODE	8437
Species Diversity	8
Total # trees	55



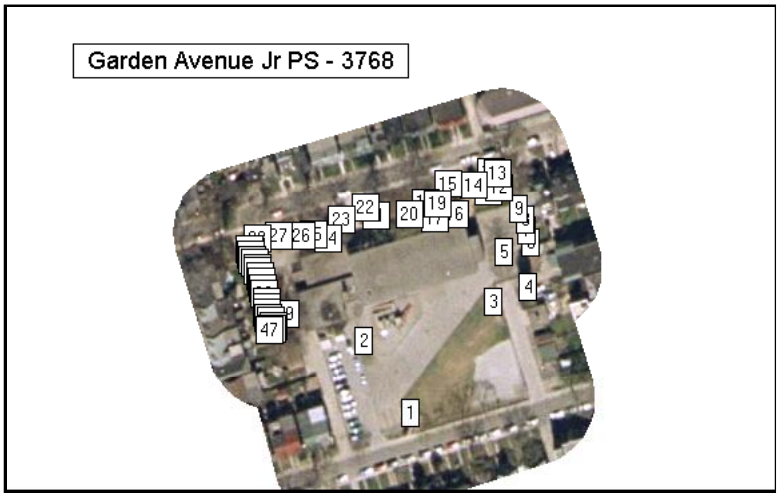
School Name	West Toronto CI
Function Code	3737
Street Address	330 Lansdowne Avenue
CITY	Toronto
Postal Code	M6H3Y1
Phone Number	416-393-1500
X coordinates	625651.0
Y coordinates	4834147.8
M WARD	18
OPT FAMILY	SW2
ID	396
MET CODE	8516
Species Diversity	13
Total # trees	71



School Name	Brock Jr PS
Function Code	3692
Street Address	93 Margueretta Street
CITY	Toronto
Postal Code	M6H3S4
Phone Number	416-393-9245
X coordinates	625981.5
Y coordinates	4834334.9
M WARD	18
OPT FAMILY	SW2
ID	707
MET CODE	8364
Species Diversity	4
Total # trees	23



School Name	Howard Jr PS
Function Code	3798
Street Address	30 Marmaduke Street
CITY	Toronto
Postal Code	M6R1T2
Phone Number	416-393-9255
X coordinates	624810.4
Y coordinates	4834020.1
M WARD	14
OPT FAMILY	SW2
ID	364
MET CODE	8465
Species Diversity	12
Total # trees	37

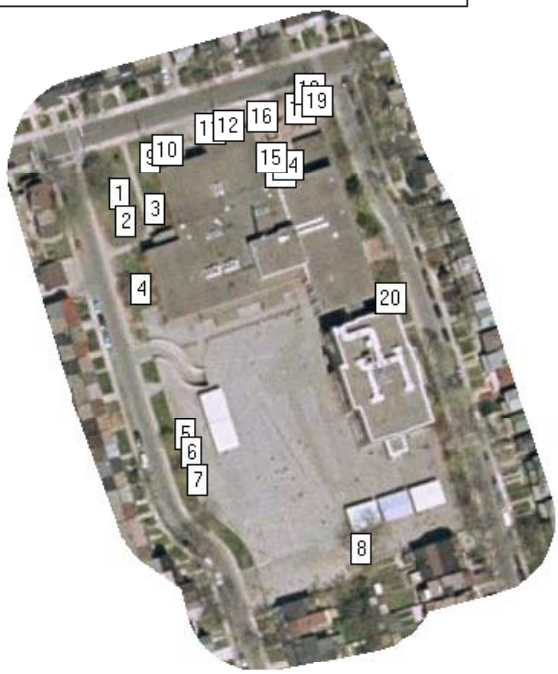


School Name	Garden Avenue Jr PS
Function Code	3768
Street Address	225 Garden Avenue
CITY	Toronto
Postal Code	M6R1M9
Phone Number	416-393-9165
X coordinates	625074.0
Y coordinates	4833174.0
M WARD	14
OPT FAMILY	SW2
ID	264
MET CODE	8448
Species Diversity	14
Total # trees	29

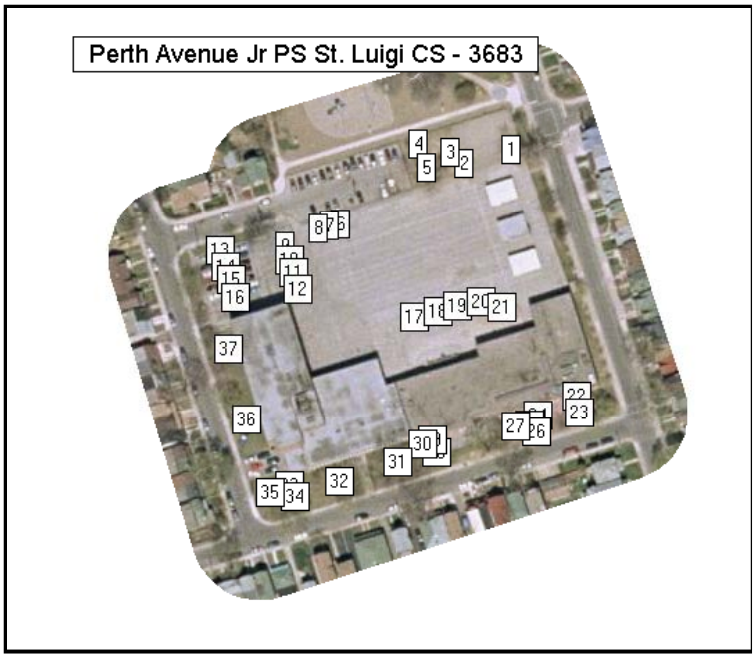
Fern Avenue Jr Sr PS - 3758

School Name	Fern Avenue Jr Sr PS
Function Code	3758
Street Address	128 Fern Avenue
CITY	Toronto
Postal Code	M6R1K3
Phone Number	416-393-9130
X coordinates	625309.8
Y coordinates	4833447.4
M WARD	14
OPT FAMILY	SW2
ID	89
MET CODE	8403
Species Diversity	9
Total # trees	47

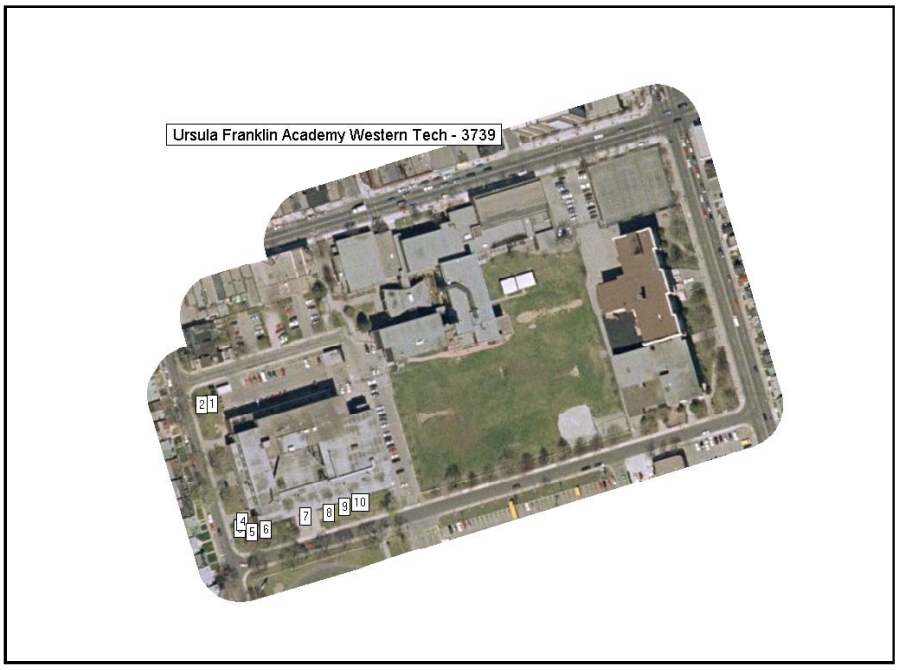
Pauline Jr PS St. Sebastian CS - 3681



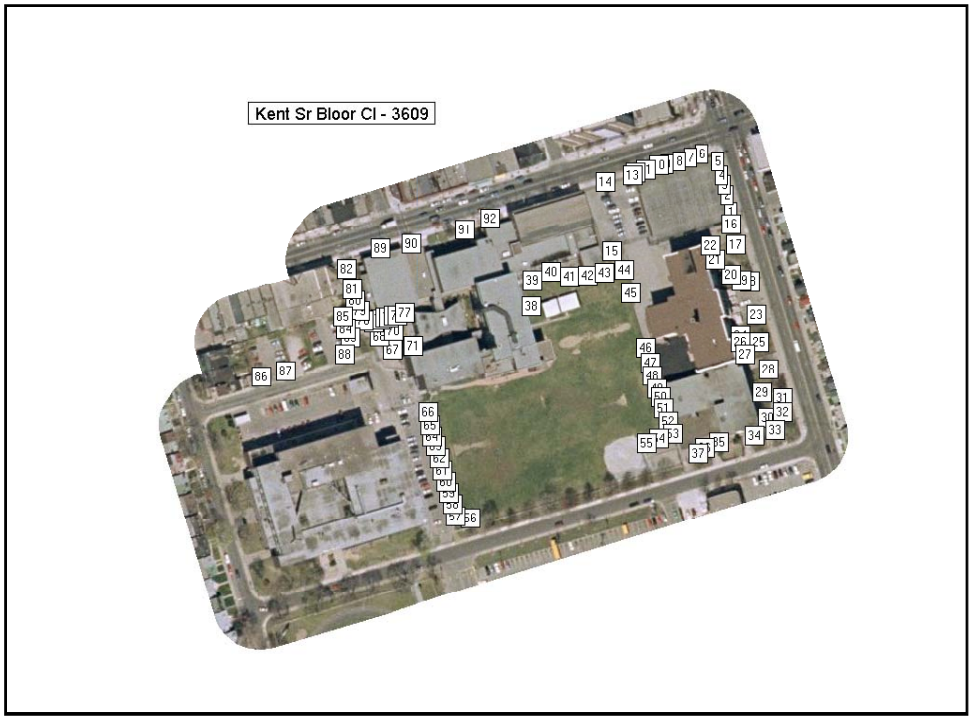
School Name	Pauline Jr PS (St Sebastian CS)
Function Code	3681
Street Address	100 Pauline Avenue
CITY	Toronto
Postal Code	M6H3M8
Phone Number	416-393-9360
X coordinates	625807.0
Y coordinates	4835357.2
M WARD	18
OPT FAMILY	SW6
ID	26
MET CODE	4462
Species Diversity	6
Total # trees	20



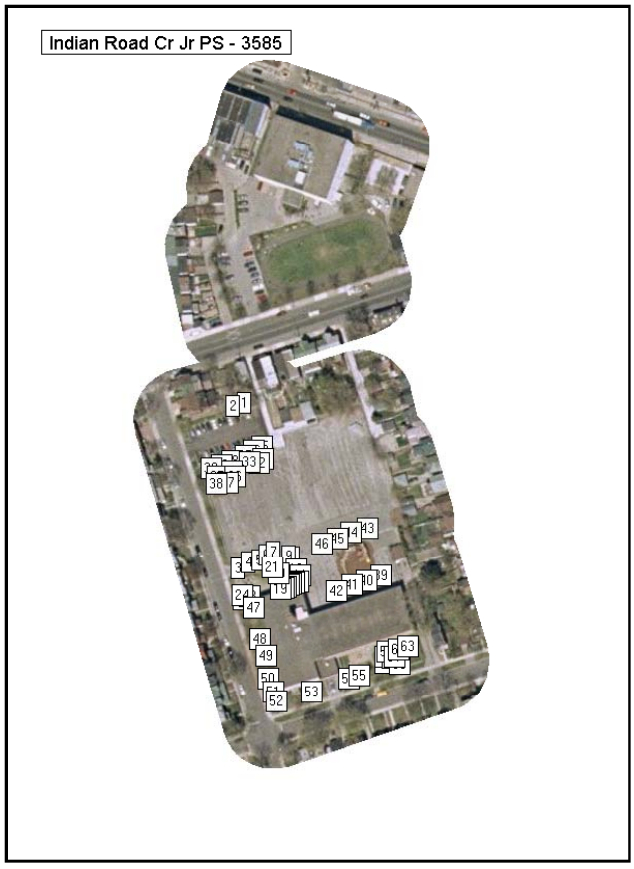
School Name	Perth Avenue Jr PS (St Luigi CS)
Function Code	3683
Street Address	14 Ruskin Avenue
CITY	Toronto
Postal Code	M6P3P8
Phone Number	416-393-1410
X coordinates	624772.5
Y coordinates	4835390.9
M WARD	18
OPT FAMILY	SW2
ID	111
MET CODE	4179
Species Diversity	9
Total # trees	37



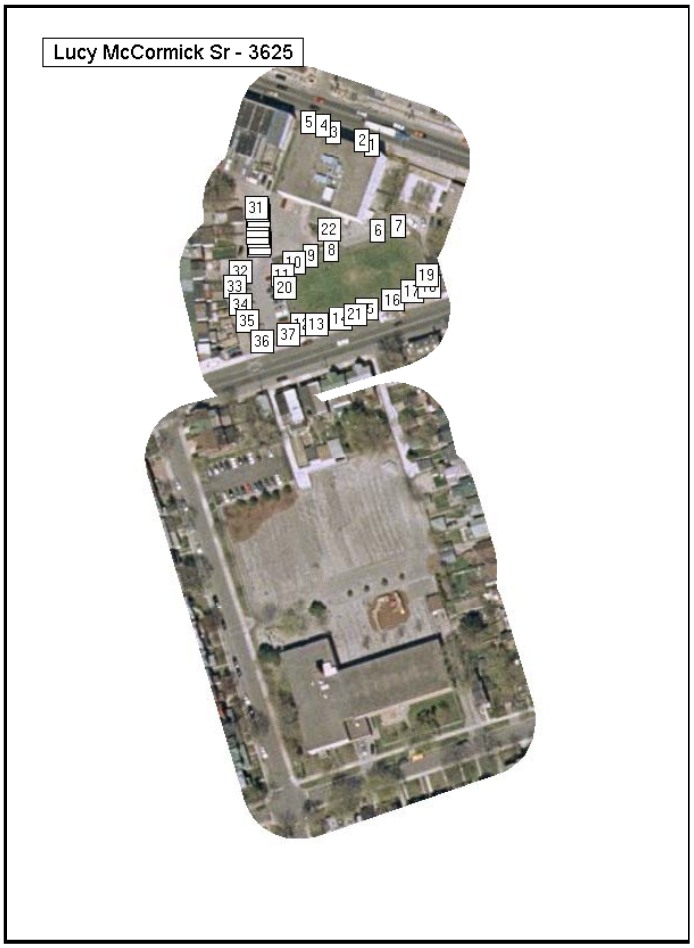
School Name	Ursula Franklin
Function Code	3739
Street Address	125 Evelyn Cr
CITY	Toronto
Postal Code	M6P3E3
Phone Number	416-393-0500
X coordinates	622979.1
Y coordinates	4834677.5
M WARD	13
OPT FAMILY	SW2
ID	84
MET CODE	8517
Species Diversity	5
Total # trees	10



School Name	Kent Sr PS & Bloor
Function Code	3609
Street Address	980 Dufferin Street
CITY	Toronto
Postal Code	M6H4B4
Phone Number	416-393-0400
X coordinates	626028.3
Y coordinates	4834932.9
M WARD	18
OPT FAMILY	SW6
ID	68
MET CODE	8482
Species Diversity	14
Total # trees	86

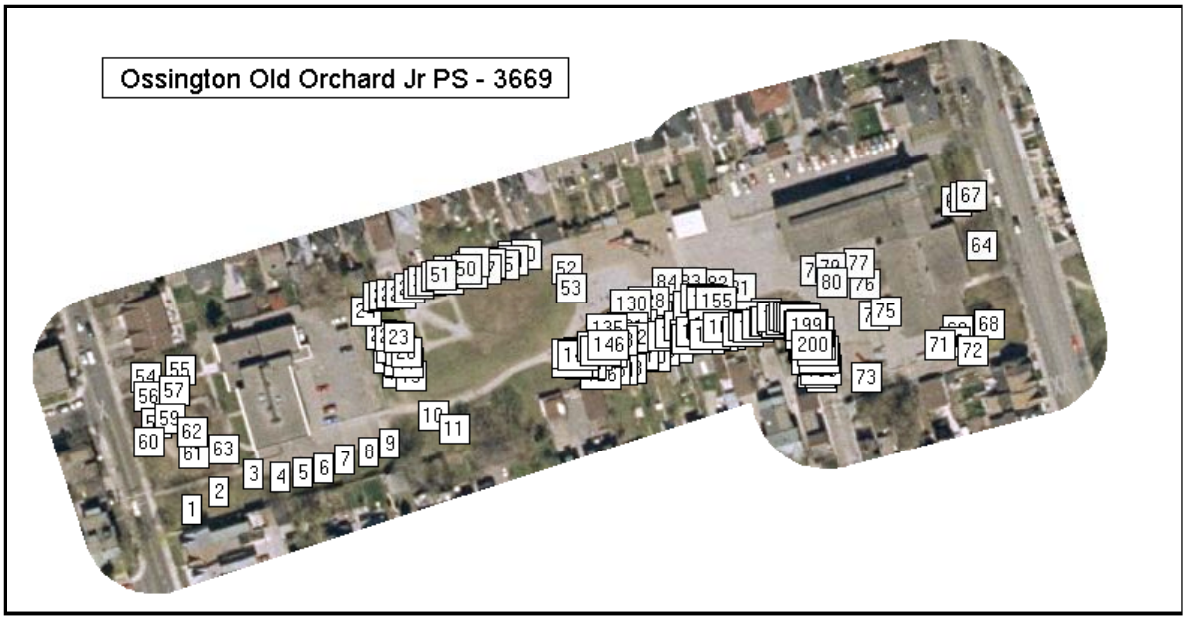


School Name	Indian Road CrJr PS
Function Code	3585
Street Address	285 Indian Road Cr
CITY	Toronto
Postal Code	M6P2G8
Phone Number	416-393-9025
X coordinates	624138.1
Y coordinates	4835366.8
M WARD	14
OPT FAMILY	SW2
ID	341
MET CODE	8469
Species Diversity	13
Total # trees	55



School Name	Lucy McCormick School Sr
Function Code	3625
Street Address	2717 Dundas Street West
CITY	Toronto
Postal Code	M6P1Y1
Phone Number	416-397-2713
X coordinates	624131.3
Y coordinates	4835531.8
M WARD	14
OPT FAMILY	SW2
ID	330
MET CODE	8490
Species Diversity	13
Total # trees	37

School Name	Ossington Old Orchard
Function Code	3669
Street Address	380 Ossington Avenue
CITY	Toronto
Postal Code	M6J3A5
Phone Number	416-393-0710
X coordinates	627083.2
Y coordinates	4834261.7
M WARD	19
OPT FAMILY	SW6
ID	432
MET CODE	8413
Species Diversity	31
Total # trees	128



APPENDIX V

Neighbour*woods*© Field Data Collection

Quick Reference

Percent Hard Surface

0	The tree is growing in an area with no hard surface.
1	Between 0-25% of the area under the dripline of the tree is hard surface (concrete, asphalt, bricks etc.) or 25-50% of the area is compacted soil.
2	Between 25-50% of the area under the dripline of the tree is hard surface (concrete, asphalt, bricks etc.) or 50-75% of the area is compacted soil.
3	Between 50-75% of the area under the dripline of the tree is hard surface (concrete, asphalt, bricks etc.) or 75-100% of the area is compacted soil.
4	Between 75-100% of the area under the dripline of the tree is hard surface (concrete, asphalt, bricks etc.).

Unbalanced Crown

0	There are no signs that the crown is unbalanced or lopsided; crown normally developed.
1	Crown slightly asymmetrical due to restricted growing space or lack of light.
2	Crown is asymmetrical, unbalanced or lopsided.
3	Crown is severely asymmetrical to the point where it clearly places damaging stress on the main stem or root system.

Reduced Height

0	There are no signs that tree height has been reduced. Crown has not been topped or pollarded.
1	Less than 1/4 of the crown volume has been removed.
2	1/4 to 1/2 of the crown volume has been removed.
3	More than 1/2 of the crown volume has been removed leaving behind only a few stubs.

Weak or Yellowing Foliage

0	Leaves are normal size, color, and texture.
1	Leaves appear to be somewhat smaller than normal; pale in colour.
2	Leaves are significantly smaller than what is normal; pale foliage; thinning of foliage; the crown is significantly more transparent than typical for the species.
3	Leaves are dramatically smaller than normal and/or leaf colour is dramatically different; the crown is very transparent; the tree appears to be in a serious state of decline.

Crown Defoliation

0	The tree crown is not defoliated (healthy). Allow for minor twig defoliation, which is normal in a healthy tree.
1	There are trace amounts of defoliation and less than 1/4 of the crown has lost its leaves; crown slightly defoliated.
2	A 1/4 to 1/2 of the crown had lost its leaves; crown moderately defoliated.
3	More than 1/2 of the crown is without leaves; crown severely defoliated.

Dead or Broken Branches

0	Tree does not have major dead branches; small branches within the inner crown should not be considered. The tree may have one or more minor dead or broken branches or stubs.
1	At least one dead or broken branch, or stub greater than 7cm in diameter is present. Its diameter is less than 1/4 of the diameter of the next order branch or main stem at the point of attachment.
2	The tree has one or more dead or broken branches or stubs BUT its diameter is 1/4 to 1/2 of the diameter of the next order branch or main stem at the point of attachment.
3	The tree has one or more dead or broken branches or stubs, which is (or was) a main branch (a scaffold branch. i.e. the diameter is more than 1/2 of the diameter of the main stem at the point of attachment).

Poor Branch Attachment (V-shaped Fork)

0	Branches are properly attached; there are no signs of poor attachment.
1	A V-shaped union between a minor branch and the main stem (the diameter of the branch is 1/2 of the diameter, or less than the branch or main stem where it is attached). There is no evidence of included bark, but the angle of the fork is such that there is a potential for this to appear as the tree grows. This includes epicormic shoots following topping, pruning or storm damage, etc.
2	As in 1, but the branch is more than 1/2 of the diameter of the branch or main stem where it is attached; there is evidence of included bark but no breakage. This includes epicormic shoots resulting from poor pruning or breakage, and multiple trunks or co-dominant stems.
3	As in type 2, but with evidence of a crack between the stems.

Lean

0	The tree is virtually vertically positioned over the base of the stem.
1	Slight or minor lean (<15° from vertical) but no apparent danger.
2	Slight or minor lean (< 15° from vertical) with some evidence of root mounding or soil cracking on the side of the tree away from the lean.
3	Serious lean (>15° from vertical) with some evidence of root mounding or soil

	cracking on the side of the tree away from the lean.

Stem Scars

0	The tree does not have any scars OR scars have healed over.
1	One or more scars with a width totaling 1/8 to 1/4 of the circumference, OR a scar less than 1/8 but more than 50 cm in length.
2	One or more scars with a width totaling 1/4 to 1/2 of circumference, OR 1/8 to1/4 the circumference but more than 50 cm in height, OR as in type 1 occurring more than once.
3	One or more scars with a width totaling more than 1/2 of circumference of the stem, OR it is between 1/4 to1/2 the circumference but more than 50 cm in height, OR as in type 2 occurring more than once.

Branch Scars

0	The tree does not have any scars OR scars have healed over.
1	One or more minor branch scars or stubs. Diameter of the scar is less than 1/4 of the diameter of the next order branch or main stem at the point of attachment.
2	Diameter of the scar is 1/4 to 1/2 of the diameter of the next order branch or main stem at the point of attachment, OR as in type 1 occurring more than once.
3	One or more main (scaffold) branch scars. Diameter is more than 1/2 of the diameter of the main stem at attachment, OR as in type 2 occurring more than once.

Conks

0	The absence of conks
1	The presence of conks

Rot Cavity (Stem & Branch separately)

0	Tree does not have any sign of rot or cavity
1	Rot/cavity is 1/8 to 1/4 of the diameter of the trunk or major branch.
2	Rot or cavity is 1/4 to 1/2 of diameter of the trunk or major branch.
3	Rot or cavity is more than 1/2 of diameter of the trunk or major branch.

Cracks

0	Tree does not have major cracks either on trunk or major branches.
1	One minor crack extends into the stem, major stubs or a branch of significant size. A minor crack is one that enters the wood (not just in the bark) but does not extend more than 1/2 of the distance to the centre of the stem.
2	Two or more minor cracks occur in the same general area of the stem, but there are no other defects in contact with the cracks; the crack condition is more serious than

	type 1, but less than type 3.
3	A crack(s) is in contact with another defect (e.g. rot, poor branch attachment, lean); tree has one deep crack where 1/2 or more of the tree diameter is structurally compromised; crack(s) in the tangential (horizontal) plane.

Confined space

0	No obstruction or conflicts are apparent in the area within the dripline of the tree.
1	An obstruction exists which would eliminate root development in an area less than 1/4 of the area within the dripline of the tree.
2	An obstruction exists which would eliminate root development in an area between 1/4 and 1/2 of the area within the dripline of the tree.
3	An obstruction exists which would eliminate root development in an area more than 1/2 of the area within the dripline of the tree.

Surface roots

0	There are no exposed roots.
1	A 1/4 of roots close are surfaced or exposed.
2	A 1/4 to 1/2 of roots are surfaced or exposed.
3	More than 1/2 of roots below the entire canopy (dripline) are surfaced or exposed.

Girdling roots

0	There are no signs of girdling roots on the surface or on the trunk.
1	Girdling roots on the surface but there is no trunk-swelling yet.
2	Between type 1 and type 3.
3	A typical butt swelling either with girdling roots seen at the soil surface or not.

Root trenching

0	There are no signs of root trenching or cutting within the rooting area.
1	Up to 1/4 of the root system has been cut during trenching or excavation.
2	Between 1/4 and 1/2 of the root system has been cut during trenching or excavation.
3	More than 1/2 of the root system has been cut during trenching or excavation.

Conflict with Wires

N	There are no conflicts.
E	The branches of a tree are currently within 0.5 meters of electrical, telephone, or other wires.
P	At some point (within the inspection cycle), as the tree grows, such a conflict could occur.

Conflict with Structure

N	There are no conflicts
E	Tree is already touching the structure.
P	There is potential for the tree to come into contact with the structure within the next inspection cycle.

Conflict with Sidewalk

N	There are no conflicts.
E	The sidewalk already shows signs of being lifted by stem or root growth.
P	A tree's stem, at some point in its life, would be within 0.5 m of a sidewalk

Conflict with another Tree

N	There are no conflicts.
E	The tree in question is currently touching the crown of another tree.
P	There is potential for existing conflict (E) to occur within the inspection cycle.

Conflict with Traffic Signs

N	There are no conflicts.
E	The tree in question is currently screening or touching the sign.
P	There is potential for existing conflict (E) to occur within the inspection cycle.

Cable or Brace

N	There is no cable or brace in/on tree.
Y	There is a cable or brace in/on tree.

APPENDIX VI

Neighbour*woods*© Data Template					
Function code					
School Name					
Tree Number					
Tree ID					
Species Code					
Location*					
DBH					
Crown Form*					
Number of Stems					
% Hard surface					
Crown Width (mx2)					
Distance from tree (m)					
top of tree					
base of crown					
stump of tree					
Total Ht.					
Crown Ht.					
Unbalanced Crown					
Reduced Height					
Weak or Yellow Foliage					
Defoliation					
Dead or Broken Branch					
Poor Branch Attachment					
Lean					
Stem Scar					
Branch Scar					
Conks					
Rot/Cavity - Stem					
Rot/Cavity - Branch					
Crack					
Confined Space					
Surface Roots					
Girdling Roots					
Trenching					
Conflict w/ Wires					
Conflict w/ Structure					
Conflict w/ Sidewalk					
Conflict w/ another tree					
Conflict w/ Traffic Sign					
Cable or Brace					
Comments					
Rating					
X coordinates					
Y coordinates					
Date					

APPENDIX VII

List of species and codes collected summer 2004

Species CODE	Common Name	Latin Name	Family Name
mapamu	Amur Maple	Acer ginnala	Aceraceae
mapman	Manitoba Maple	Acer negundo	Aceraceae
mapnor	Norway Maple	Acer platiniodes	Aceraceae
mapred	Red Maple	Acer rubrum	Aceraceae
mapsil	Silver Maple	Acer saccarinum	Aceraceae
mapsug	Sugar Maple	Acer saccharum	Aceraceae
mapmou	Mountain Maple	Acer spicatum	Aceraceae
firdou	Douglas Fir	Pseudotsuga menziesii	Pinaceae
hemeas	Eastern Hemlock	Tsuga canadensis	Pinaceae
pinaus	Austrian Pine	Pinus nigra	Pinaceae
pinsco	Scots Pine	Pinus sylvestris	Pinaceae
pinwhi	Eastern White Pine	Pinus strobus	Pinaceae
sprbla	Black Spruce	Picea nigra	Pinaceae
sprcol	Colorado Spruce	Picea pungens	Pinaceae
sprwhi	White Spruce	Picea glauca	Pinaceae
beeame	American Beech	Fagus grandifolia	Fagaceae
beeeur	European Beech	Fagus sylvatica	Fagaceae
cheame	American Chestnut	Castanea dentata	Fagaceae
oakbur	Bur Oak	Quercus macrocarpa	Fagaceae
oakeng	English Oak	Quercus robur	Fagaceae
oakpin	Pin Oak	Quercus palustris	Fagaceae
oakred	Red Oak	Quercus rubra	Fagaceae
oakswa	Swamp Oak	Quercus bicolor	Fagaceae
oakwhi	White Oak	Quercus alba	Fagaceae
ashbla	Black Ash	Fraxinus nigra	Oleaceae
ashgre	Green Ash	Fraxinus pennsylvanica	Oleaceae
ashmou	Mountain Ash	Sorbus aucuparia	Oleaceae
ashred	Red Ash	Fraxinus profunda	Oleaceae
ashwhi	White Ash	Fraxinus americana	Oleaceae
liljap	Japanese Lilac	Syringa vulgaris	Oleaceae
appcra	Crabapple	Malus spp.	Rosaceae
apptre	Apple Tree - edible	Malus pumilia	Rosaceae
cherry	Cherry	Prunus spp.	Rosaceae
hawbro	Broadleaf Hawthorn	Crataegus dilatata	Rosaceae
sersmo	Smooth Serviceberry	Amelanchier canadensis	Rosaceae
plumam	American Plum	Prunus americana	Rosaceae
elmame	White Elm (American)	Ulmus americana	Ulmaceae
elmchi	Chinese Elm	Ulmus parvifolia	Ulmaceae
elmred	Red Elm	Ulmus rubra	Ulmaceae
hacber	Hackberry	Celtis occidentalis	Ulmaceae
bernan	Nannyberry	Viburnum lentago	Caprifoliaceae
eldame	American Elder	Sambucus canadensis	Caprifoliaceae

Species CODE	Common Name	Latin Name	Family Name
eldred	American Red Elder	Sambucus pubens	Caprifoliaceae
hicwhi	White Hickory	Carya aquatica	Juglandaceae
walbla	Black Walnut	Juglans nigra	Juglandaceae
walwhi	White Walnut (Butternut)	Juglans cinerea	Juglandaceae
cedwhi	Eastern White Cedar	Thuja occidentalis	Cupressaceae
junipr	Juniper (common)	Juniper spp.	Cupressaceae
cedred	Red Cedar	Juniperus virginiana	Cupressaceae
chatre	Golden chain tree	Laburnum watereri vossii	Fabaceae
coftre	Kentucky Coffee Tree	Gymnocladus dioicus	Fabaceae
locbla	Black Locust	Robinia pseudoacacia	Leguminosae
locsha	Honey locust	Gledittsia triacanthos iner	Leguminosae
asptre	Trembling Aspen	Populus tremuloides	Salicaceae
popwhi	White poplar	Populus alba	Salicaceae
wilpus	Pussy Willow	Salix caprea	Salicaceae
basswo	American Basswood	Tilia americana	Tiliaceae
linden	Linden	Tilia spp.	Tiliaceae
sumsta	Staghorn Sumac	Rhus Typhina	Anacardiaceae
ironwo	Ironwood	Carpinus caroliniana	Betulaceae
catalp	Catalpa	Catalpa speciosa	Bignoniaceae
taxyew	Yew	Taxus spp.	Taxaceae
ashpri	Common Prickly Ash	Zanthoxylum americanium	Rutaceae
plalon	London Planetree	Platanus acerifolia	Platanaceae
hevtre	Tree-of-Heaven	Ailanthus altissima	Simaroubaceae
magtul	Tulip Magnolia (tree)	Liriodendrn tulipifera	Magnoliaceae
sasafr	Sassafrass	Sassafras albidum	Lauraceae
ginkgo	Maidenhair Tree	Ginkgo biloba	Ginkgoaceae
hazwit	Witch-Hazel	Hamamelis spp.	Hamamelidaceae
chehor	Horsechestnut	Aesculus hippocastanum	Hippocastanaceae
olirus	Russian Olive	Elaeagnus angustifolia	Elaeagnaceae
dogwoo	Alternate Dogwood	Cornus alternifolia	Cornaceae
haztur	Turkish Hazel	Corylus colurna	Corylaceae

APPENDIX VIII

TREE INVENTORY PHOTO© LIBRARY
SUMMER 2004

Adrina Bardekjian Ambrosii


36818 - 01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379820 - 03


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379820 - 05


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379861 - 02


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APPENDIX IX

Number of Trees by Genus

Common Name	Number of Trees	Proportion of Total Number of Trees (%)
Nannyberry	N/A	N/A
Serviceberry	N/A	N/A
Dogwood	N/A	N/A
Witch-Hazel	N/A	N/A
Ash	383	20.62
Maple	344	18.52
Pine	324	17.45
Locust	185	9.96
Linden	95	5.12
Cedar	80	4.31
Black Spruce	54	2.91
Apple / Crabapple	52	2.80
Oak	47	2.53
Yew	29	1.56
Juniper (common)	27	1.45
Maidenhair Tree	27	1.45
Lilac	27	1.45
Hackberry	23	1.24
Elm	21	1.13
Fir	18	0.97
Poplar	18	0.97
Catalpa	12	0.65
Ironwood	10	0.54
Cherry / Plum	9	0.48
Sumac	8	0.43
Horsechestnut	6	0.32
Basswood	6	0.32
Elder	5	0.27
Beech	5	0.27
White Hickory	5	0.27
Tree-of-Heaven	5	0.27
Russian Olive	4	0.22
Hawthorn	4	0.22
Aspen	4	0.22
Turkish Hazel	3	0.16
Walnut	3	0.16
Goldenrain tree	2	0.11
American Chestnut	2	0.11
Sassafrass	2	0.11
Magnolia	2	0.11
Hemlock	2	0.11
Pussy Willow	2	0.11
Coffee Tree	1	0.05
London Planetree	1	0.05

APPENDIX X

Number of Trees by Species		
Common Name	**Number of Trees**	**Proportion of Total Number of Trees (%)**
Witch-Hazel	N/A	N/A
Smooth Serviceberry	N/A	N/A
Nannyberry	N/A	N/A
Alternate Dogwood	N/A	N/A
Austrian Pine	305	16.42
Green Ash	235	12.65
Norway Maple	224	12.06
Honey locust	184	9.91
White Ash	104	5.60
Linden	95	5.12
Eastern White Cedar	76	4.09
Sugar Maple	58	3.12
Crabapple	39	2.10
Mountain Ash	38	2.05
Silver Maple	36	1.94
Colorado Spruce	35	1.88
Yew	29	1.56
Maidenhair Tree (Ginkgo)	27	1.45
Juniper (common)	27	1.45
Japanese Lilac	27	1.45
English Oak	27	1.45
Hackberry	23	1.24
White poplar	18	0.97
Douglas Fir	18	0.97
White Spruce	17	0.92
Red Maple	15	0.81
Apple Tree - edible	13	0.70
Catalpa	12	0.65
White Elm (American)	11	0.59
Scots Pine	11	0.59
Red Oak	10	0.54
Ironwood	10	0.54
Staghorn Sumac	8	0.43
Eastern White Pine	8	0.43
Chinese Elm	7	0.38
Cherry	7	0.38
Manitoba Maple	6	0.32
Horsechestnut	6	0.32

Common Name	Number of Trees	Proportion of Total Number of Trees (%)
American Basswood	6	0.32
White Hickory	5	0.27
Tree-of-Heaven	5	0.27
Swamp Oak	5	0.27
Trembling Aspen	4	0.22
Russian Olive	4	0.22
Common Prickly Ash	4	0.22
Broadleaf Hawthorn	4	0.22
American Red Elder	4	0.22
Turkish Hazel	3	0.16
Red Elm	3	0.16
European Beech	3	0.16
Amur Maple	3	0.16
Tulip Magnolia (tree)	2	0.11
Sassafrass	2	0.11
Red Cedar	2	0.11
Pussy Willow	2	0.11
Plum Tree	2	0.11
Pin Oak	2	0.11
Mountain Maple	2	0.11
Golden chain tree	2	0.11
Emerald Cedar	2	0.11
Eastern Hemlock	2	0.11
Bur Oak	2	0.11
Black Walnut	2	0.11
Black Spruce	2	0.11
American Chestnut	2	0.11
American Beech	2	0.11
White Walnut (Butternut)	1	0.05
White Oak	1	0.05
Red Ash	1	0.05
London Planetree	1	0.05
Kentucky Coffee Tree	1	0.05
Black Locust	1	0.05
Black Ash	1	0.05
American Elder	1	0.05