Appendix A

Evaluation Table for Prioritizing Watersheds

Evaluation Table for Prioritizing Watersheds

9/29/2004

Watershed Name	Significant existing water quality problems associated with urban stormwater runoff			Significant stormwater conveyance problems associated with urbanization			Significant development pressure, which may negatively impact both water quality and quantity
	Spring sampling of Lakes indicates Phosphorus (P) exceeds PWQO[1] - within the last 5 years [2]	Water quality problems may be attributed to Urban Land Uses	Water quality problems may be attributed to Agricultural Land Uses	Number of Recorded Historical Flooding Events (Low= 1-5; Medium=5-10; High > 10)	High flows may be attributed to Urban Land Uses	High flows may be attributed to Agricultural Land Uses	Low < 3 existing registered plans High > 3 existing registered plans
Cameron	no	n/a	n/a	0	n/a	n/a	0
East Wanapitei River	[3]	n/a	n/a	High	yes	no	0
Emery Creek	no	n/a	n/a	0	n/a	n/a	0
Fairbank	no	n/a	n/a	0	n/a	n/a	0
Kukagami	no	n/a	n/a	0	n/a	n/a	0
Lower Junction Creek	yes	yes	no	Medium	yes	no	High
Lower Spanish River	no	n/a	n/a	0	n/a	n/a	0
Lower Vermilion	[3]	n/a	n/a	High	no	no	0
Mid Vermilion	no	n/a	n/a	High	no	no	0
Nelson River	no	n/a	n/a	0	n/a	n/a	0
Nepewassi	no	n/a	n/a	0	n/a	n/a	0
Onaping River [4]	no	n/a	n/a	Low	no	no	0
Panache	no	n/a	n/a	Low	yes	no	High
Ramsey	yes [3]	yes	no	Low	yes	no	High
Rapid River	no	n/a	n/a	0	n/a	n/a	0
Red Deer	yes	no	no	0	n/a	n/a	0
Roberts River	no	n/a	n/a	0	n/a	n/a	0
Sandcherry Creek	no	n/a	n/a	0	n/a	n/a	0
Spring Creek	no	n/a	n/a	0	n/a	n/a	0
Sturgeon River	no	n/a	n/a	0	n/a	n/a	0
Upper Junction Creek	yes	yes	no	High	yes	no	High
Upper Vermilion	no	n/a	n/a	0	n/a	n/a	0
Wanapitei	no	n/a	n/a	0	n/a	n/a	0
Whitewater	yes	yes	yes	Low	yes	yes	Low
Whitson River	yes	yes	yes	High	yes	yes	High

NOTES:

Denotes Priority Watershed

1) PWQO - Provincial Water Quality Objective for surface water = 20 g/l
2) Data obtained from www.city.greatersudbury.on.ca
3) Surface water potable water source within watershed. Other guidelines apply.
4) The Onaping River Watershed was deemed a priority because of the historical flooding events in the urban areas (ie. Dowling)

Subwatershed Studies Prioritization Table

Watershed Name	Subwatershed Name	Significant existing water quality problems associated with urban stormwater runoff			Significant stormwater conveyance problems associated with urbanization			Significant development pressure, which may negatively impact both water quality and quantity	Comments
		Spring sampling of Lakes indicates Phosphorus (P) exceeds PWQO[1] - within the last 5 years [2]	Water quality problems may be attributed to Urban Land Uses	Water quality problems may be attributed to Agricultural Land Uses	Number of Recorded Historical Flooding Events (Low= 1-5; Medium=5-10; High > 10)	High flows may be attributed to Urban Land Uses	High flows may be attributed to Agricultural Land Uses	Low < 3 existing registered plans High > 3 existing registered plans	
East Wanapitei River	Coniston	n/a	n/a	n/a	Medium	yes	no	Low	
East Wanapitei River	Wahnapitae	n/a[3]	yes	no	Medium	yes	no	Low	Studies have been done for dams, water treatment plant and mine tailings
Lower Junction Creek	Meatbird / Lively	n/a	yes	no	Low	yes	no	Low	
Lower Junction Creek	Mud Lake	yes	yes	no	Low	yes	no	High	
Lower Junction Creek	Simon / McCharles Lake	yes	yes	no	High	no	no	Low	Current public pressure to resolve historical flooding problems in McCharles Lake / Vermillion River area
Onaping River [4]	Dowling	n/a	yes	yes	High	no	no	Low	significant number of flooding events near confluence with Vermilion River
Panache	Richard Lake	no	no	no	Low	yes	no	Low	Development Freeze on creation of new unserviced lots on McFarlane Lake due to poor water quality
Ramsey	Nepahwin / Robinson	yes	yes	no	Low	yes	no	High	Current public pressure to improve water quality of Lake Nepahwin
Ramsey	Ramsey Lake	yes [2]	yes	no	Low	yes	no	Low	Extremely sensitive area; multiple lake uses (including drinking water source) at City's centre; current public pressure to enhance water quality of Minnow Lake
Upper Junction Creek	Copper Cliff	n/a	yes	no	Medium	yes	no	Low	INCO has done a number of studies regarding stormwater quantity and quality for Copper Cliff
Upper Junction Creek	Garson	yes	yes	no	Low	yes	no	Low	
Upper Junction Creek	Junction Creek	yes	yes	no	High [5]	yes	no	High	
Upper Junction Creek	Kelly Lake	yes	yes	no	Medium	yes	no	Low	Several studies have been conducted on erosion issues
Whitewater	Azilda	yes	yes	yes	Low	yes	yes	Low	Development Freeze on creation of new unserviced lots on Whitewater Lake due to poor water quality
Whitson River	Blezard Valley / Val Caron / Hanmer	n/a	yes	yes	High	yes	yes	High	
Whitson River	Chelmsford	n/a	yes	yes	High	yes	yes	Low	
Whitson River	Whitson Lake	yes	yes	yes	Medium	yes	yes	Low	

NOTES;

1) PWQO - Provincial Water Quality Objective for surface water = 20 g/l μ
2) Data obtained from www.city.greatersudbury.on.ca
3) Surface water potable water source within watershed. Other guidelines apply.
4) The Onaping River Watershed was deemed a priority because of the historical flooding events in the urban areas (ie. Dowling)
5) Frequency / significance of flooding events have decreased significantly since construction of dams

Appendix B

Inventory of Dams and Structures

INVENTORY OF DAMS AND STRUCTURES

(Revised 2002)

Stream	Name	UTM N	UTM E	UTM Co-ord	Latitude	Longitude	Height (m)	Surf. Area (ha)	Purpose	Agency	Control	Emerg. Contact	Year Built	Notes
Bannerman Cr.	Bannerman Dam	5188510	454895		46 51 02	81 35 30	10 ft.		Power/Control	Domtar	Logs			
Dublin Creek	Dublin Cr. Levack						1.46			Inco	Logs			
E. Wanapitei R.	E. Wanapitei						3.23		Logging	MNR	Logs			
E. Wanapitei R.	E. Wanapitei Dam			181929			9 ft.		Logging		Logs			Telfer twp.
E. Wanapitei R.	E. Wanapitei Dam			189892			11 ft.		Logging		Logs			Aylmer Twp.
Fairbank Cr.	Ethel Lake	5139710	470725		46 24 44	81 22 51	2.3		Backwater	Inco	Logs	Sam Scola 866-3760		Victoria Mine
Fairbank Cr.	Fairbank Cr.	5141915	472260		46 25 56	81 21 40	2.9		Water supply	Inco	Logs	Sam Scola 866-3761		Crean Hill
Fairbank Cr.	Fairbank Cr.	5138570	470980		46 24 07	81 22 39			Water supply	Inco	Logs	Sam Scola 866-3762		Victoria Mine
Fairbank Cr.	Fairbank Cr.	5143150	472200		46 26 36	81 21 43			Control	Inco	Logs	Sam Scola 866-3761		Crean Hill
Frood	Frood	5150530	497615		46 30 37	81 01 52	1.2			Inco			1965	Improvements 1976
Junction Cr, W Br	Frood	5153580	501355		46 32 16	80 58 56			Flood control	NDCA	Gates			
Whitefish R.	Grant Lake	5139480	500710		46 34 39	80 59 27			Backwater	NDCA	Logs		1977	
Junction Creek	Maley Dam	5154203	505942		46 32 36	80 55 21	7.3	438	Flood control	NDCA	Gates		1970	
Junction Creek	Nickeldale Dam	5152472	501768		46 31 40	80 58 37	7.3	105	Flood control	NDCA	Gates		1980	
Junction Creek	Kelly Lake	5141510	492680		46 25 45	81 05 43	7.3		Backwater	NDCA	None			Improvements 1960 & 1976
Lady MacDonald	Lady MacDonald			952475			5.3		Backwater	Inco	Logs/Control	CCWWTP 682-8294		
Lake Laurentian	Lake Laurentian	5144410	504027		46 27 19	80 56 51		336.78 acres	Backwater	NDCA	Logs		1959	Imp. 1982
Levy Creek	Jutras(Whitewater)	5150780	481630		46 30 44	81 14 22	3.38		Backwater	MNR	Logs			
Lily Creek	Ramsey Lake	5146340	500295		46 28 21	80 59 46	2.05		Water supply	City Sudb.	Logs			
Whitefish R.	McFarlane Lake	5139510	501394		46 24 40	80 58 55			Backwater	MNR	Logs			
Meatbird Cr.	Meatbird								Water supply	Falconbridge	Logs	‹e St. Laurent 692-2697		
Moose Creek	Moose Cr. Levack	5164575	471370		46 38 10	81 22 27	7 t.	15 acres	Water supply	Falconbridge	Logs			
Moose Creek	Moose Cr. Dam 2	5165315	474320		46 38 34	81 20 08	6 ft.	640 acres	Water supply	Falconbridge	Logs			
Moose Creek	Moose Cr. Dam 3	5166890	475240		46 39 25	81 19 25	15 ft.	15 acres	Water supply	Falconbridge	Logs			
Nepahwin Lake	Nepahwin Lake	5144835	499900		46 27 33	81 00 05	1.4		Water supply	NDCA	Logs		1966	Imp. 1994
Nolin Creek	Clarabelle	5149550	496145		46 30 05	81 03 01	2.81		Flood control	NDCA	Culv/gate	CCWWTP 682-8294	1965	To be done by Inco 2001
Onaping River	Windy Lake	5160240	468830		46 35 49	81 24 25	4.11		Backwater	MNR	Logs			
Onaping River	Onaping R.						7.3		Power		Logs			
Overflow Cr.	Onaping Lake						1.76		Backwater	Domtar	Logs			
Ramsey Cr.	Robinson Lake	5144290	496930		46 27 15	81 02 24	1.4	33.9	Backwater	NDCA	Culvert (new)			
Vermilion R.	Wabagishic (Lorne Falls)	5128970	459890		48 18 54	81 31 15	7.3	8	Power	Inco	Gates			
Vermilion R.	Stobie Dam	5153325	478320		46 32 06	81 16 58	3.2	Verm. Lake	Backwater	Domtar	Gates	Gary MacKay		Redesigned 1999
Wanapitei Lake	Wanapitei Dam	5167800	525040		46 39 55	80 40 22	21 ft.		Power	OPG	Logs			
Wanapitei R.	Coniston Dam	5146605	514060		46 28 29	80 49 01	5.29		Power	OPG	Logs			
Wanapitei R.	Stinson Dam	5151855	522315		46 31 19	80 42 33	17.64		Power	OPG	Logs			
Whitson Cr.	Goudreau	5157775	483925		46 34 31	81 12 36			Backwater	NDCA	Logs			
Whitson Cr.	Val Caron	5161035	501490		46 36 17	80 58 50	2.4	1.2	Water supply	Inco	Logs	Dan Hewitt 525-3236		Built in 1960's or earlier
Copper Cliff Cr		5146100	497010		46 28 14	81 02 20			Backwater	City Sudbury	Logs			

OTHER FLOOD CONTROL STRUCTURES (BERMS)

Romford Berm #1	Romford Cr.		6 m	375,000 cu m	Flood Control	NDCA		1997
Romford Berm #2	Romford Cr.		2 m	94,000 cu m	Flood Control	NDCA		1999
Junction Cr. #1	Junction Creek	Garson Twp.	8 m	973000 cu m	Flood Control	NDCA		2001
Riverside Dr., Dowling	Onaping R.		2m x 200 m		Flood Control	NDCA		1985/86
Capreol Berm	Vermilion R.		55 m long		Flood Control	NDCA		1988
Chelmsford	Whitson R.	Belanger St.	74 m long		Flood Control	NDCA		1999

Appendix C

Public Consultation and Meetings Information

PIC #1

People Engaged • Places Defined • Progress Driven

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Une collectivité qui s'engage • Un plan précis • La route du progrès

Greater Grand Sudbury

STORMWATER BACKGROUND STUDY

The City of Greater Sudbury (City) is embarking on a major comprehensive review of its existing Official Plans and the preparation and adoption of a new Official Plan under the Planning Act for the newly amalgamated City. As part of the plan review process, a number of background studies are to be carried out to provide technical information on various critical issues that are to be addressed in the policies and programs of the new Official Plan. The Stormwater Study is one of these background studies.

The City's lakes are among its most valuable assets. In recognition of this, the City has appointed the Greater Sudbury Lakes Improvement Advisory Panel (GSLIAP) and the Ramsey Lake Advisory Panel and encouraged the formation of Lake Stewardship Committees. Stormwater runoff from existing and future human development poses a threat to these lakes due to potential for sediment and pollutants in the runoff. In addition, urbanization can increase the amount of surface runoff and increase the risk of flooding.

The Nickel District Conservation Authority has spent a great deal of effort in the protection of citizens and properties through flood control projects. The City has invested both time and money into its lake water quality program and into the regreening program while the Ministry of Natural Resources has carried out fish stocking programs on a number of area lakes with positive results. It follows that to further enhance the natural environment, the City must adopt effective stormwater management (SWM) policies and programs that address both the quantity and quality of stormwater runoff.

The completed Stormwater Background Study will analyze and identify critical SWM requirements for the next 20 years, identify problem areas and develop a prioritized list of areas requiring further study and prepare an Urban Drainage Policy for the City.

The Stormwater Background Study commenced in September 2003, and is scheduled to be complete by June 2004. As part of the planning process, two Public Information Sessions are being held to present information to, and obtain input from, the public and review agencies. The Public Information Sessions are being coordinated with the ongoing Public Consultation associated with the preparation of the new Official Plan. The Sessions will follow a "drop-in" format with display boards presenting the project information.

This first Public Information Session will present the results from the initial stages of the Stormwater Study. The information to be presented will include:

- The study purpose, scope and an overview of the watersheds within the City
- The key issues, identified challenges and opportunities related to both quantity and quality of stormwater runoff in the City
- The SWM strategies developed to address the challenges and opportunities
- The proposed criteria to be used for prioritizing the watersheds and watershed studies
- A description of the next steps in the study

The session will provide an opportunity for the public to discuss the study, identify and /or confirm major SWM issues facing the City, and share ideas about the prioritization of the City's watersheds. All comments and input received will be reviewed and incorporated in the subsequent phases of the study.

The second Public Information Session is scheduled to be held during May, 2004, and will include a draft Urban Drainage Policy and the recommended prioritized list of future watershed studies that should be undertaken.

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Greater Grand Sudbury

ÉTUDE PRÉLIMINAIRE SUR LES EAUX PLUVIALES

La Ville du Grand Sudbury (Ville) amorce une importante étude globale de ses plans officiels actuels, la préparation d'un nouveau Plan officiel puis son adoption, en vertu de la *Loi sur l'aménagement du territoire,* pour la Ville issue de la récente fusion. Dans le cadre du processus de révision du Plan, bon nombre d'études préliminaires sont entreprises pour recueillir des renseignements techniques sur diverses questions essentielles qui seront abordées dans les politiques et les programmes du nouveau Plan officiel. L'Étude sur les eaux pluviales est l'une de ces études préliminaires.

Les lacs de la Ville font partie de ses biens les plus précieux. C'est pourquoi la Ville a mis sur pied le Comité consultatif du Grand Sudbury sur l'amélioration des lacs (CCGSAL) et le Comité consultatif sur le lac Ramsey. Elle a aussi encouragé la création de comités d'intendance des lacs. L'eau de ruissellement de projets d'aménagement futurs et actuels menace ces lacs puisque des sédiments et des polluants pourraient s'y infiltrer. De plus, l'urbanisation peut augmenter le ruissellement en surface et accroître les risques d'inondation.

Par l'entremise de projets de lutte contre les inondations, l'Office de protection de la nature du district du Nickel a déployé bien des efforts pour protéger les citoyennes et les citoyens ainsi que les propriétés. La Ville a investi du temps et de l'argent dans son Programme de la qualité des eaux lacustres et dans le Programme de reverdissement alors que le ministère des Richesses naturelles a procédé avec succès à des programmes d'ensemencement d'un certain nombre de lacs dans la région. Il s'ensuit que pour améliorer davantage l'environnement naturel, la Ville doit adopter des politiques efficaces de gestion des eaux pluviales et des programmes qui portent sur la quantité et la qualité de l'eau de ruissellement.

L'Étude préliminaire sur les eaux pluviales permettra d'analyser et de déterminer les exigences essentielles de la gestion des eaux pluviales pour les 20 prochaines années. On y cernera aussi les domaines qui posent problème, on y dressera une liste par ordre de priorité des domaines qui exigent une étude plus approfondie et on préparera une politique d'assainissement urbain pour la Ville.

L'Étude préliminaire sur les eaux pluviales a débuté en septembre 2003, et on prévoit qu'elle se terminera en juin 2004. Le processus de planification comprend deux séances d'information qui permettront de transmettre des renseignements aux citoyennes, aux citoyens et aux organismes de révision, et de recueillir leurs commentaires. Les séances d'information publique sont coordonnées avec la consultation publique continue, qui est associée à l'élaboration du nouveau Plan officiel. Durant ces séances « portes ouvertes », on pourra consulter des tableaux d'affichage présentant les renseignements sur le projet.

La première séance de consultation publique présentera les résultats des étapes initiales de l'étude préliminaire. Les renseignements qui seront présentés comprennent :

- l'objectif et la portée de l'étude ainsi qu'un aperçu des bassins hydrographiques de la Ville;
- les questions clés, les défis et les possibilités cernés quant à la quantité et à la qualité de l'eau de ruissellement de la ville;
- les stratégies de gestion des eaux pluviales élaborées pour aborder les défis et possibilités;
- les critères proposés à partir desquels on établira l'ordre de priorité des bassins hydrographiques et des études des bassins hydrographiques;
- une description des prochaines étapes de l'étude.

La séance permettra à la population de discuter de l'étude, de cerner ou de confirmer les principales questions liées à la gestion des eaux pluviales auxquelles la Ville fait face, et de faire part de ses idées pour la priorisation des bassins hydrographiques de la ville. Tous les commentaires et renseignements recueillis seront examinés attentivement et inclus dans les prochaines étapes de l'étude.

La deuxième séance d'information publique est prévue en mai 2004; elle comprendra une ébauche d'une politique d'assainissement urbain et la liste recommandée de prochaines études à entreprendre sur les bassins hydrographiques, classées par ordre de priorité.

STUDY OVERVIEW

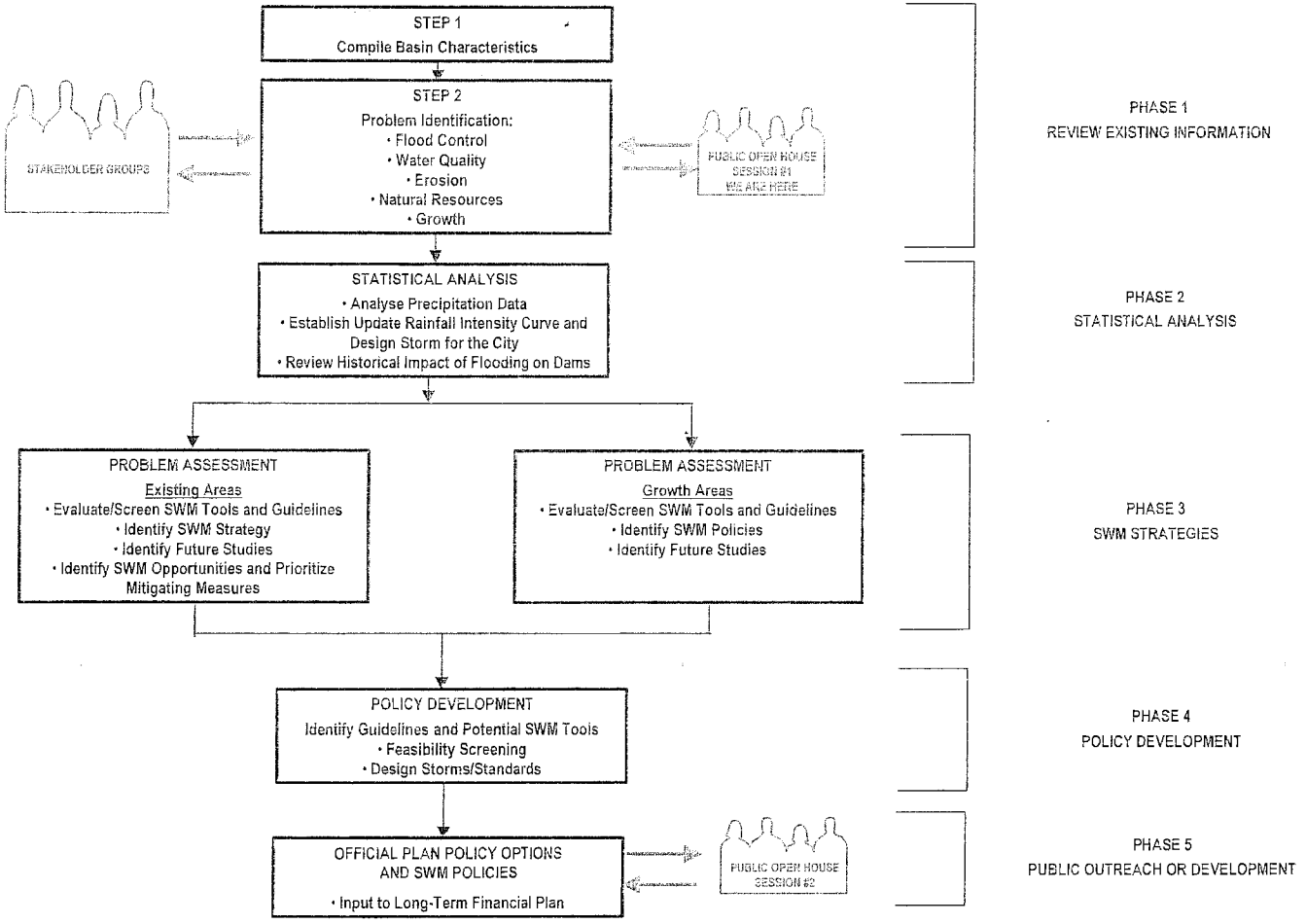
INTRODUCTION

- The City of Greater Sudbury (City) is embarking on a major comprehensive review of its existing official plans and the preparation and adoption of a new Official Plan under the Planning Act for the newly amalgamated City.
- As part of the plan review process, a number of background studies are to be carried out to provide technical information on various critical issues that are to be addressed in the policies and programs of the new Official Plan. The Stormwater Study is one of these background studies.

STUDY PURPOSE

- The Stormwater Background Study will:
  - Analyze and identify critical stormwater management (SWM) requirements for the next 20 years
  - Identify problem areas and develop a prioritized list of areas requiring further study
  - Prepare an Urban Drainage Policy for the City

STUDY PROCESS



KEY ISSUES

DEVELOPMENT OF CONSISTENT CITY-WIDE STORMWATER MANAGEMENT STRATEGIES

- Existing watersheds will be characterized
- Water quality and quantity objectives will be related to overall watershed objectives: drinking water supply, fisheries, recreation, flood control, infrastructure (sewers and facilities) requirements, agriculture, etc.
- Existing problem areas - potential retrofits and opportunities will be identified and prioritized
- For urban growth - Urban drainage policies and master planning requirements will be developed, to be used as a basis for all future stormwater management studies within the City
- Policies and programs will be identified for stormwater quality and quantity management

THE STUDY WILL

- Result in a SWM plan that will support sustainable economic growth and diversification
- Be founded on meaningful public input and stakeholder input (public meetings)
- Recognize public sentiment and values
- Provide guidance for meeting the water quality and quantity objectives, through the identification and prioritization of future SWM studies
- Identify potential mitigation measures for priority water bodies

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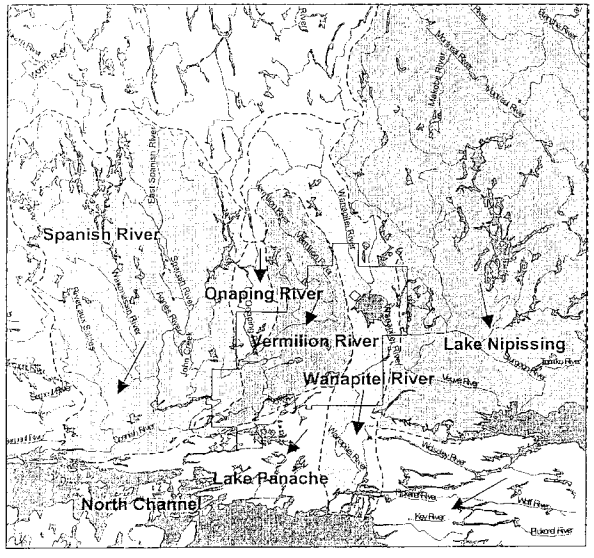
BASINS IN THE CITY OF GREATER SUDBURY

BASINS

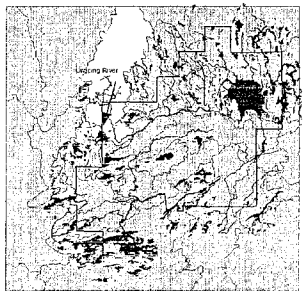
There are six major drainage basins that intersect the City of Greater Sudbury boundary including the Spanish River, Onaping River, Vermillion River, Wanapitei River, Lake Panache and Lake Nipissing basins.



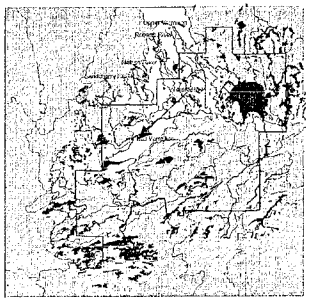
→ Flow direction

Each drainage basin contains many watersheds and sub-watersheds. Each watershed within a specific drainage basin contributes to the runoff (quantity and quality) of the overall basin. Some watershed examples are provided.

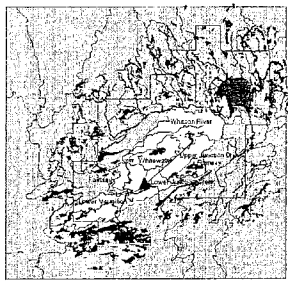
AND WATERSHEDS



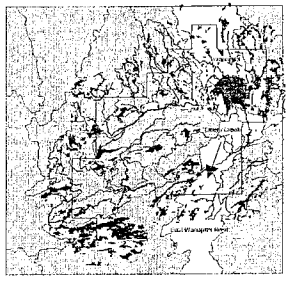
Onaping River



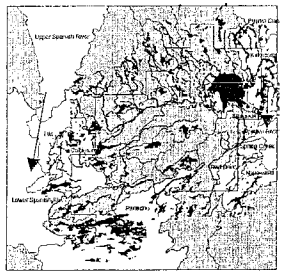
Upper Vermilion



Lower Vermilion



Wanapitei River



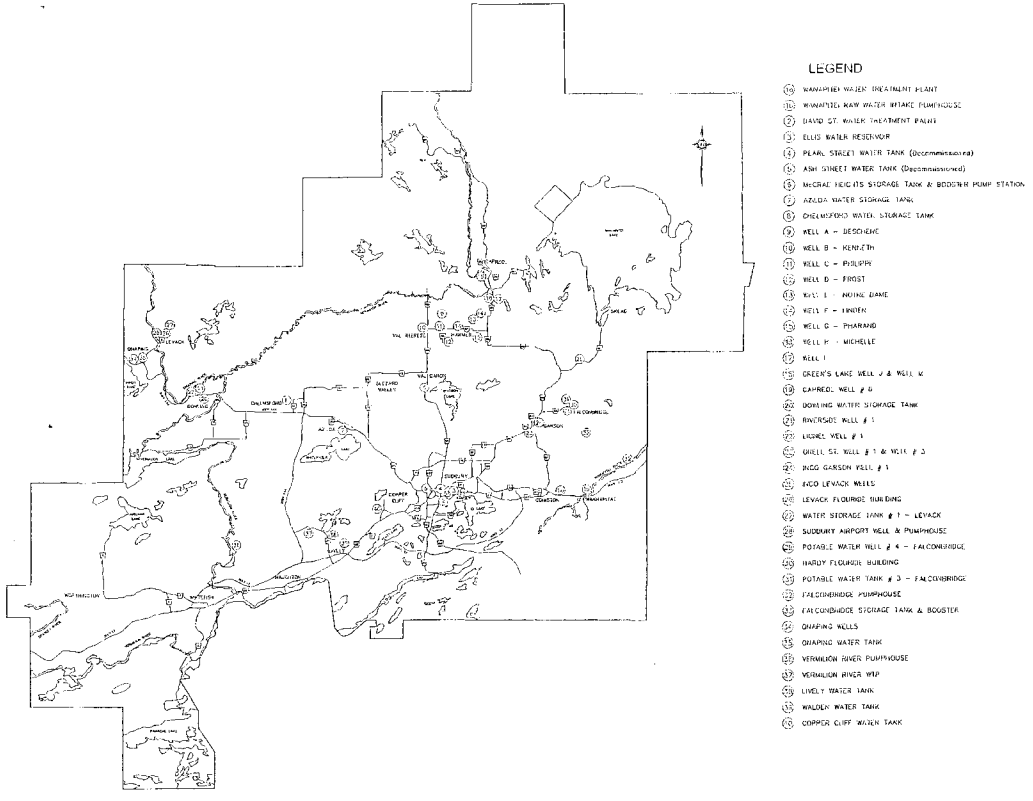
Spanish River, Lake Nipissing

→ Flow direction

PRIORITIZING WATERSHEDS

EVALUATION CRITERIA

- **Primary Beneficial Uses of Water Identified**
  - Municipal and domestic water supplies (lake and well water)
  - Recreational, fisheries, agricultural, industrial uses
- **Existing and Future Land Uses Identified**
  - Residential, agricultural, mining, forest, wetlands
  - Growth potential through planning status and existing Official Plan
- **Flooding history within the Watershed**
  - Located within the watershed which impact on the assimilative capacity and may impact on the water quality of the downstream receivers
- **Sewage treatment outfalls, on site (septic) systems**
- **Industries (i.e. mine tailings)**
  - Located within the watershed which may impact runoff quality
- **Existing water quality issues**
  - As identified by reports and stakeholder inputs



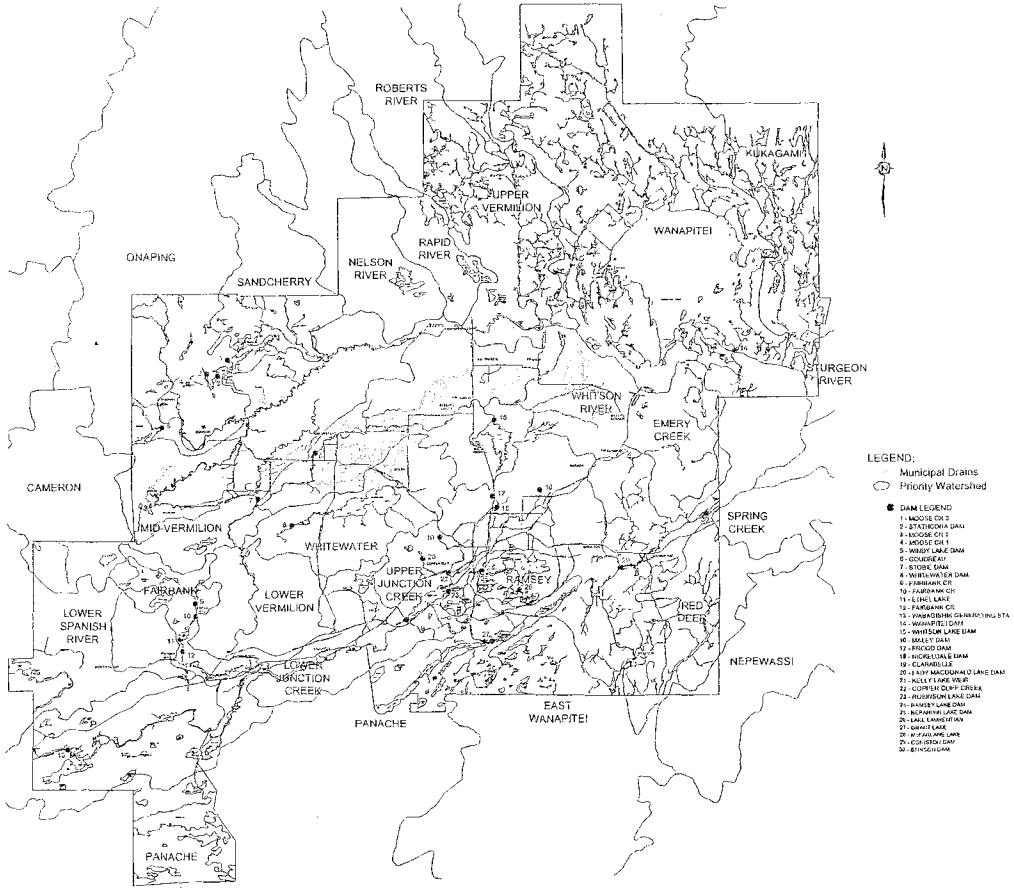
CITY OF GREATER SUDBURY
WATER WORKS FACILITIES

PRIORITY WATERSHEDS

NINE PRIORITY WATERSHEDS HAVE BEEN IDENTIFIED

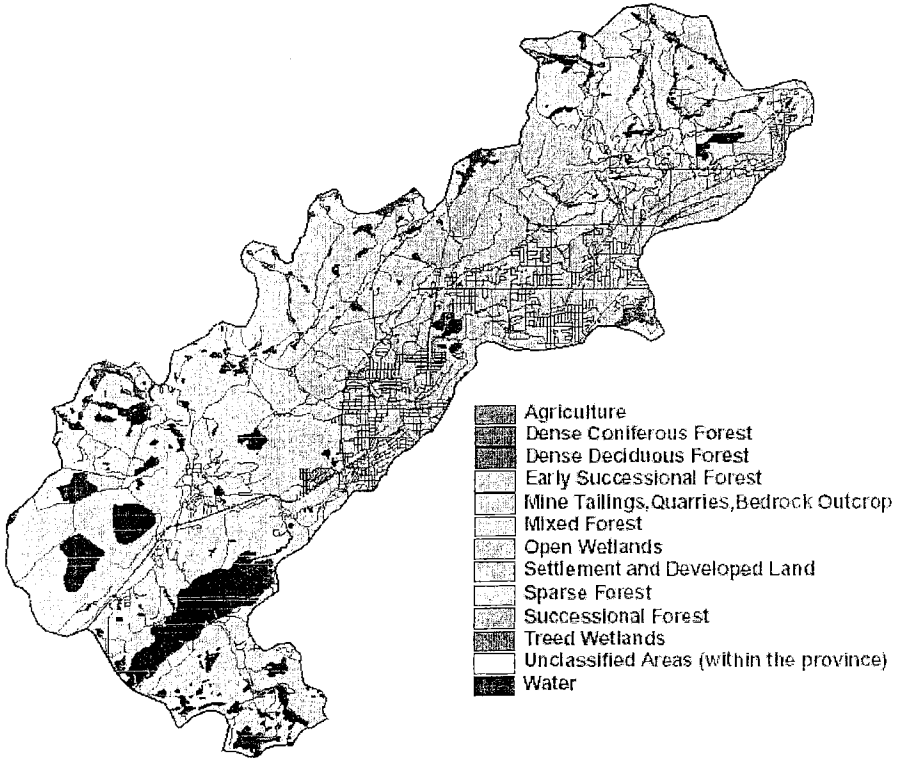
- **Priority Watersheds:**
  - Have significant existing water quality problems associated with urban storm drainage; or
  - Have significant stormwater conveyance problems caused by urbanization; or
  - Have significant development pressure, which may increase the potential for both water quality and quantity issues.

- **Priority Watersheds in the City of Greater Sudbury:**
  - East Wanapitei River
  - Emery Creek
  - Whitson River
  - Whitewater
  - Ramsey
  - Upper Junction
  - Lower Junction
  - Panache
  - Onaping

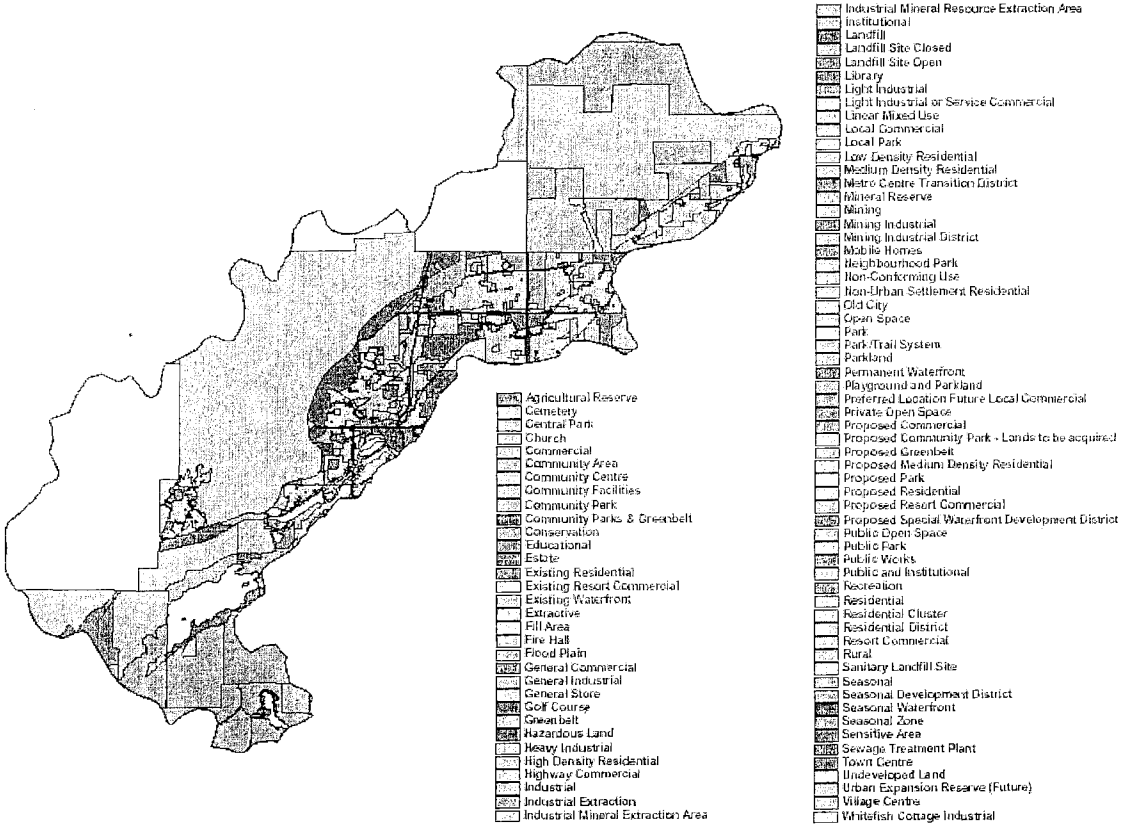


PRIORITY WATERSHED EXAMPLE

UPPER JUNCTION CREEK WATERSHED LAND USE INFORMATION



EXISTING LAND USE



OFFICIAL PLAN LAND USE DESIGNATIONS

STORMWATER MANAGEMENT STRATEGIES

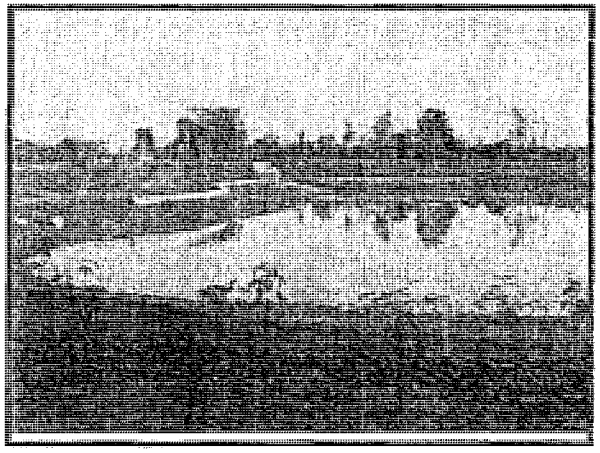
TYPICAL STORMWATER MANAGEMENT STRATEGIES WILL ADDRESS WATER QUANTITY AND QUALITY ISSUES

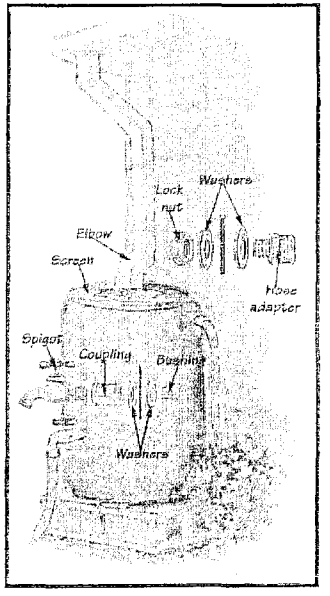
Water Quantity Issues - Typical Strategies Include:

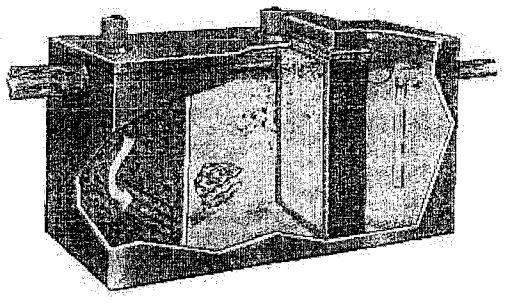
- Improve conveyance by upsizing sewers and culverts
- Dykes and flood protection
- Reduction of peak flows by storing stormwater in ponds
- Reduction of erosion by releasing stormwater over longer periods of time
- Source control - reducing the rate and volume of runoff on site - through such things as rain barrels, roof storage, site grading, retention / use / infiltration of stormwater on site, increasing vegetation through forest canopy restoration

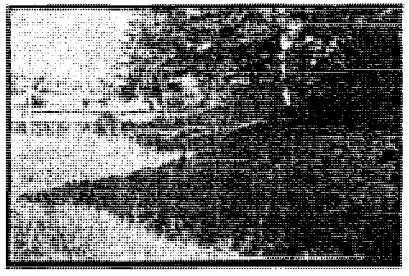
Water Quality Issues - Typical Strategies Include:

- Settling pollutants in stormwater ponds
- Filtering stormwater though swales, buffers, etc.
- Non-structural approaches, and stormwater best management practices
- Site controls for impervious high use areas, such as oil-grit separators, filtering or containment
- Regulatory and public information / education approaches regarding use of herbicides, pesticides, and fertilizers. Education regarding improper dumping and disposal









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THE NEXT STEPS

- Comments received from this Public Open House Session will be considered along with those received from stakeholder groups.
- The existing basin conditions, priority watersheds, priority urban water bodies, mitigating measures for specific water bodies and priority of future SWM studies will be identified for public review and comment later in the study.
- In addition, an Urban Drainage Policy will be developed for the City.
- You are encouraged to contact any of the Project Team members from the City or Earth Tech Canada at any time throughout the study if you have any questions or concerns:

Chris Redmond, P. Eng.
Project Manager
Earth Tech Canada Inc.
1040 Lorne Street South, Unit 1
Sudbury, Ontario, P3C 4R9
Phone: (705) 674-8343
Fax: (705) 674-1694
E-Mail: chris.redmond@earthtech.ca

Paul Baskcomb, MCIP, RPP
Manager of Community and Strategic Planning
City of Greater Sudbury
P.O. Box 5000, Station "A"
200 Brady Street
Sudbury, Ontario P3A 5P3
Phone: (705) 671-2489, Ext. 4306
Fax (705) 673-2200
E-mail: paul.baskcomb@greatersudbury.ca

Ron Norton, P.Eng.
Coordinator of Technical Services
City of Greater Sudbury
P.O. Box 5000, Station "A"
200 Brady Street
Sudbury, Ontario P3A 5P3
Phone: (705) 671-2489, Ext. 2362
Fax (705) 673-5171
E-mail: ron.norton@greatersudbury.ca

PIC #2

CITY OF GREATER SUDBURY
STORMWATER BACKGROUND STUDY

The City of Greater Sudbury (City) is embarking on a major comprehensive review of its existing Official Plans and the preparation and adoption of a new Official Plan under the Planning Act for the newly amalgamated City. As part of the plan review process, a number of background studies are to be carried out to provide technical information on various critical issues that are to be addressed in the policies and programs of the new Official Plan. The Stormwater Study is one of these background studies.

The City's lakes are among its most valuable assets. In recognition of this, the City has appointed the Greater Sudbury Lakes Improvement Advisory Panel (GSLIAP) and the Ramsey Lake Advisory Panel and encouraged the formation of Lake Stewardship Committees. Stormwater runoff from existing and future human development poses a threat to these lakes due to potential for sediment and pollutants in the runoff. In addition, urbanization can increase the amount of surface runoff and increase the risk of flooding.

The Nickel District Conservation Authority has spent a great deal of effort in the protection of citizens and properties through flood control projects. The City has invested both time and money into its lake water quality program and into the regreening program while the Ministry of Natural Resources has carried out fish stocking programs on a number of area lakes with positive results. It follows that to further enhance the natural environment, the City must adopt effective stormwater management (SWM) policies and programs that address both the quantity and quality of stormwater runoff.

The completed Stormwater Background Study will analyze and identify critical SWM requirements for the next 20 years, identify problem areas and develop a prioritized list of areas requiring further study and prepare an Urban Drainage Policy for the City.

The Stormwater Background Study commenced in September 2003, and is scheduled to be complete by June 2004. As part of the planning process, two Public Information Sessions are being held to present information to, and obtain input from, the public and review agencies. The Public Information Sessions are being coordinated with the ongoing Public Consultation associated with the preparation of the new Official Plan. The Sessions will follow a "drop-in" format with display boards presenting the project information.

The first Public Information Session occurred in March 2004 and presented the results from the initial stages of the study. The second Public Information Session will present additional findings of the Stormwater Study including:

- Key issues, challenges and opportunities related to both quantity and quality of stormwater runoff in the City
- SWM strategies to address the challenges and opportunities
- A description of the components of the Urban Drainage Policy for the City
- A list of priority watersheds that warrant more detailed studies

The session will provide an opportunity for the public to review and discuss the study recommendations. All comments and input received will be considered during the preparation of the final documentation for the study.

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Greater Grand Sudbury

Notice of Public Open House Sessions
Meeting No. 2

The Study

The City of Greater Sudbury is developing a single, up-to-date Official Plan that fosters sustainable growth, economic development and a high quality of life to attract people and investment. The City is mandated by the province of Ontario to prepare an Official Plan which provides a broad vision for future growth and development over the next 20 years.

Public Open House Sessions

As part of this project the City is undertaking a series of Background Studies to provide a solid foundation of information upon which to base it's planning for the future. If you would like to speak to staff and project team members about the four Background Studies listed below, you are invited to attend our open house sessions.

1. **Natural Environment** - What categories of natural features or specific natural features do you value? How should we protect our natural environment? Preliminary mapping will be on display.
2. **Agriculture** - The City is working with it's Agricultural Advisory Panel to review the evaluation and designation of Agricultural lands. Other issues under consideration are topsoil preservation and the impact of land severances.
3. **Rural and Waterfront Development** - This study is assessing the extent and potential impacts of unserviced development on rural and waterfront areas.
4. **Stormwater** - This study will identify and characterize major sub-watersheds in the City, identify types of stormwater mitigation measures appropriate in various circumstances and draft an urban drainage policy for the City.

Members of the Public are encouraged to attend this Open House Session and speak to staff and study members and to provide their comments. The Open House format provides an opportunity for the public to interact one-on-one with staff and to come-and-go anytime during the scheduled Open House. If you are unable to attend and would like to speak to staff, or to provide written comments, a list of staff contacts is provided below. Written comments should be addressed to City of Greater Sudbury, P.O. Box 5000, Station "A", 200 Brady Street, Sudbury, Ontario P3A 5P3 or fax : (705) 673-2200

Natural Environment	Stephen Monet, PhD,MCIP, RPP, OALA Coordinator of Environmental Initiatives	City of Greater Sudbury Phone:(705)671-2489 ext. 4297	stephen.monet@greatersudbury.ca
Agriculture	Tin-Chee Wu, MCIP, RPP Senior Planner	City of Greater Sudbury Phone:(705)671-2489 ext. 4298	tinchee.wu@greatersudbury.ca
Rural & Waterfront Development	Mark H. Simeoni, MCIP RPP Senior Planner	City of Greater Sudbury Phone:(705)671-2480 ext. 4292	mark.simeoni@greatersudbury.ca
Stormwater	Ron Norton, P.Eng Co-ordinator of Technical Services	City of Greater Sudbury Phone:(705)671-2489 ext. 2362	ron.norton@greatersudbury.ca

Date	Time	Location
June 1, 2004	1:00 p.m. to 3:00 p.m.	Centennial Arena - Hall 4333 Centennial Road, Hanmer
June 1, 2004	7:00 p.m. to 9:00 p.m.	Lionel Lalonde Centre - Library Room (Former Trillium Centre) 239 Montée Principale, Azilda
June 2, 2004	7:00 p.m. to 9:00 p.m.	Tom Davies Square - Foyer 200 Brady Street

STUDY OVERVIEW

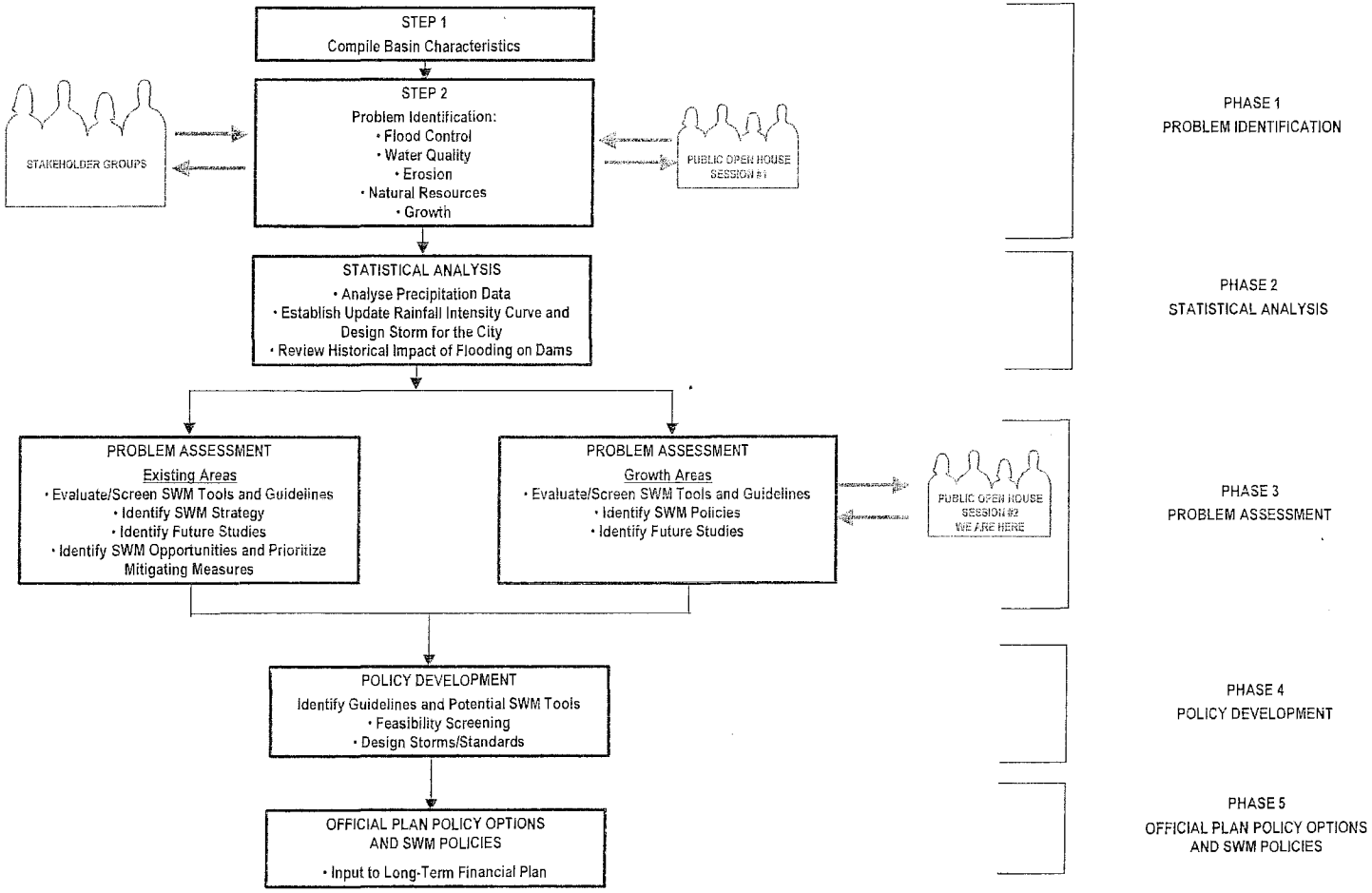
INTRODUCTION

- The City of Greater Sudbury (City) is embarking on a major comprehensive review of its existing official plans and the preparation and adoption of a new Official Plan under the Planning Act for the newly amalgamated City.
- As part of the plan review process, a number of background studies are to be carried out to provide technical information on various critical issues that are to be addressed in the policies and programs of the new Official Plan. The Stormwater Study is one of these background studies.

STUDY PURPOSE

- The Stormwater Background Study will include:
  - Analysis and identification of critical stormwater management (SWM) requirements for the next 20 years
  - Identification of problem areas and development of a prioritized list of areas requiring further study
  - An Urban Drainage Policy for the City

STUDY PROCESS



KEY ISSUES

DEVELOPMENT OF CONSISTENT CITY-WIDE STORMWATER MANAGEMENT STRATEGIES

- Existing watersheds are characterized
- Water quality and quantity criteria are identified, relative to overall watershed objectives
- SWM strategies are developed to address the existing challenges and opportunities
- Urban drainage policies are developed and master planning requirements are identified which will be used as a basis for all future stormwater management studies within the City

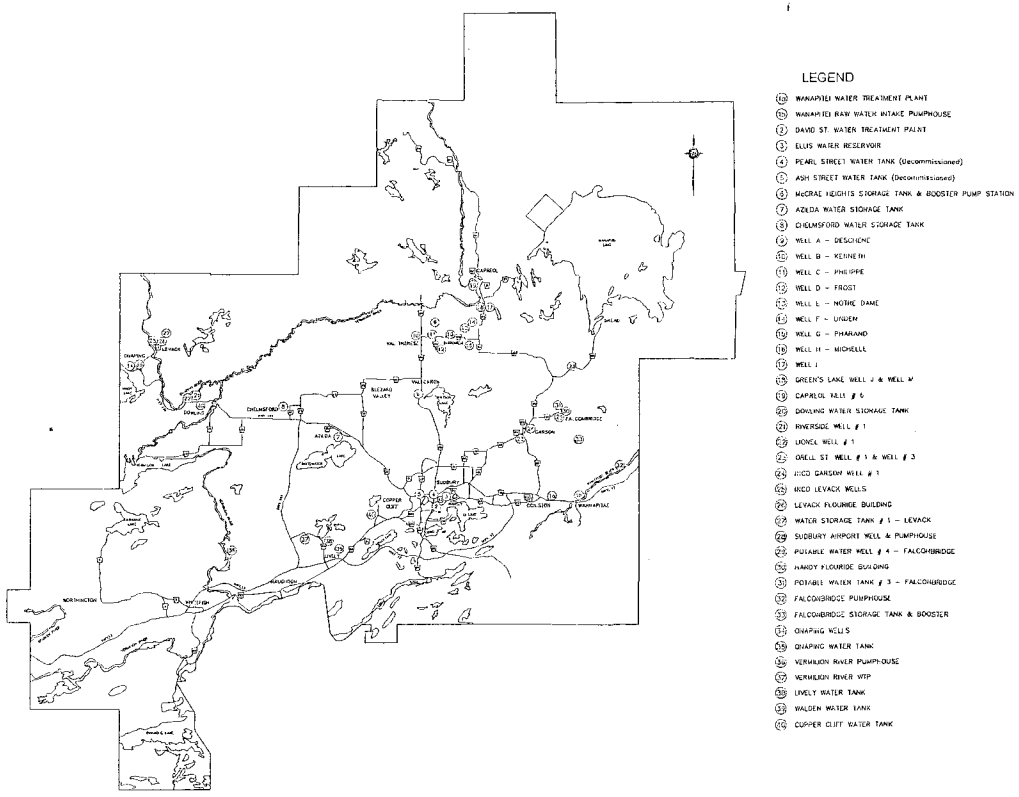
RESULTS OF THE STORMWATER STUDY

- Include a SWM plan that will support sustainable economic growth and diversification
- Are founded on meaningful public input and stakeholder input (public meetings)
- Recognize public sentiment and values
- Provide guidance for meeting water quality and quantity criteria, through the identification and prioritization of future SWM studies
- Identify potential mitigation measures for priority water bodies

PRIORITIZING WATERSHEDS

EVALUATION CRITERIA

- **Existing Water Quality Issues**
- **Flooding History within the Watershed**
- **Existing and Future Land Uses**
  - Residential, agricultural, mining, forest, wetlands
  - Growth potential
- **Primary Water Uses**
  - Municipal and domestic water supplies (lake and well water)
  - Recreational, fisheries, agricultural, industrial uses



CITY OF GREATER SUDBURY
WATER WORKS FACILITIES

PRIORITY WATERSHEDS

PRIORITY VS. NON PRIORITY WATERSHEDS

❖ Priority Watersheds:

- Have significant existing water quality problems attributed to urban stormwater runoff; or
- Have significant stormwater conveyance problems associated with urbanization; or
- Have significant development pressure that may increase the potential for negative impacts upon both water quality and quantity; and
- Require more detailed analysis to determine solutions to the problems listed above.

❖ Non - Priority Watersheds:

- Stormwater management objectives and strategies for these watersheds will be addressed by the Urban Drainage Policy.
- Do not require more detailed analysis

Evaluation Table for Prioritizing Watersheds

Watershed Name	Significant existing water quality problems associated with urban stormwater runoff			Significant stormwater conveyance problems associated with urbanization			Significant development pressure, which may negatively impact both water quality and quantity
	Spring sampling of Lakes indicates Phosphorus (P) exceeds PWQO[1] within the last 5 years [2]	Water quality problems may be attributed to Urban Land Uses	Water quality problems may be attributed to Agricultural Land Uses	Number of Recorded Historical Flooding Events (Low= 1-5; Medium=5-10; High > 10)	High flows may be attributed to Urban Land Uses	High flows may be attributed to Agricultural Land Uses	Low < 3 existing registered plans High > 3 existing registered plans
Cameron	n/a	n/a	n/a	0	n/a	n/a	0
East Wanapitei River	n/a[3]	n/a	n/a	High	yes	no	0
Emery Creek	n/a	n/a	n/a	0	n/a	n/a	0
Fairbank	n/a	n/a	n/a	0	n/a	n/a	0
Kukagami	n/a	n/a	n/a	0	n/a	n/a	0
Lower Junction Creek	yes	yes	no	Medium	yes	no	High
Lower Spanish River	n/a	n/a	n/a	0	n/a	n/a	0
Lower Vermilion	n/a[3]	n/a	n/a	High	no	no	0
Mid Vermilion	n/a	n/a	n/a	High	no	no	0
Nelson River	n/a	n/a	n/a	0	n/a	n/a	0
Nepewassi	n/a	n/a	n/a	0	n/a	n/a	0
Onaping River [4]	n/a	n/a	n/a	Low	no	no	0
Panache	n/a	n/a	n/a	Low	yes	no	High
Ramsey	yes[3]	yes	no	Low	yes	no	High
Rapid River	n/a	n/a	n/a	0	n/a	n/a	0
Red Deer	yes	no	no	0	n/a	n/a	0
Roberts River	n/a	n/a	n/a	0	n/a	n/a	0
Sandcherry Creek	n/a	n/a	n/a	0	n/a	n/a	0
Spring Creek	n/a	n/a	n/a	0	n/a	n/a	0
Sturgeon River	n/a	n/a	n/a	0	n/a	n/a	0
Upper Junction Creek	yes	yes	no	High	yes	no	High
Upper Vermilion	n/a	n/a	n/a	0	n/a	n/a	0
Wanapitei	n/a	n/a	n/a	0	n/a	n/a	0
Whitewater	yes	yes	yes	Low	yes	yes	Low
Whitson River	yes	yes	yes	High	yes	yes	High

NOTES:

Denotes Priority Watershed

1) PWQO - Provincial Water Quality Objective for surface water = 20 μ g/l
2) Data obtained from www.city.greatersudbury.on.ca
3) Surface water potable water source within watershed. Other guidelines apply.
4) The Onaping River Watershed was deemed a priority because of the historical flooding events in the urban areas (ie. Dowling)

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PRIORITY WATERSHEDS

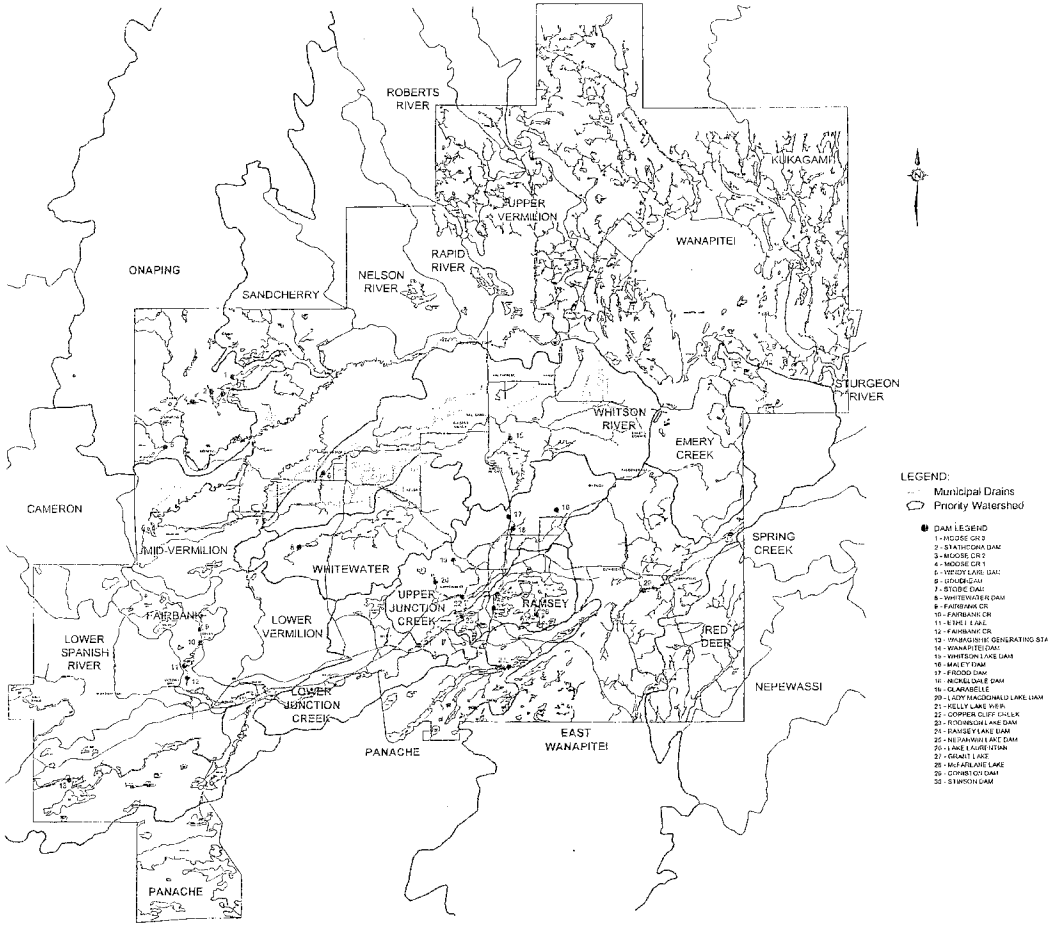
EIGHT PRIORITY WATERSHEDS HAVE BEEN IDENTIFIED

Priority Watersheds in the City of Greater Sudbury:

- East Wanapitei River
- Whitson River
- Whitewater
- Ramsey
- Upper Junction
- Lower Junction
- Panache
- Onaping

Subwatersheds / Urban Waterbodies:

- Each major watershed is comprised of smaller subwatersheds which drain to specific urban waterbodies within the subwatersheds
- The following displays present the urban waterbodies that are located within each priority watershed
- Further analysis is not required for every subwatershed located within the major watersheds. Only those problematic subwatersheds will require further analysis



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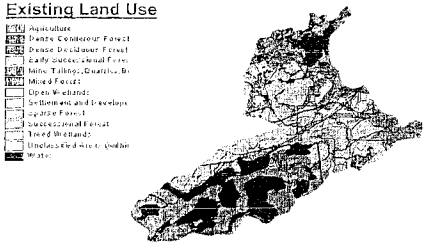
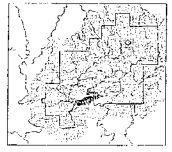
REPORT CARDS FOR PRIORITY WATERSHEDS

Watershed Summary — Lower Junction Creek

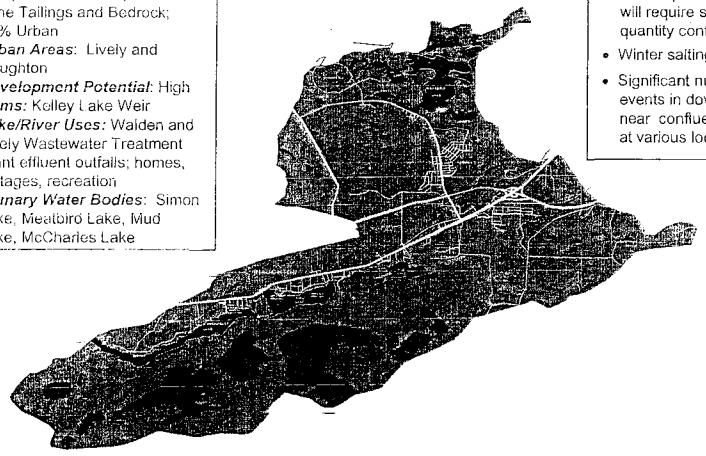
Existing Land Use





Features

Area: 106 sq. km
Existing Land Use: 14% Lake area; 57 % Forested; 18% Mine Tailings and Bedrock; 11% Urban
Urban Areas: Lively and Naughton
Development Potential: High
Dams: Kelley Lake Weir
Lake/River Uses: Walden and Lively Wastewater Treatment Plant effluent outfalls; homes, cottages, recreation
Primary Water Bodies: Simon Lake, Meatbird Lake, Mud Lake, McCharles Lake

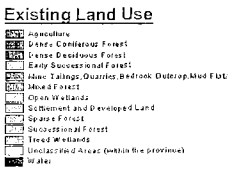


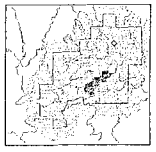
Primary Stormwater Issues

- Impact upon water quality due to uncontrolled stormwater discharges from existing urban areas
- Poor water quality in Junction Creek likely due to uncontrolled stormwater discharges from existing urban areas, wastewater treatment plant effluent and past industrial pollution
- Poor water quality (high nutrient levels) in Simon Lake likely due to the use of lawn fertilizers in urban areas and the wastewater treatment plant effluent
- Poor water quality (high nutrient levels) in McCharles Lake likely due to the use of lawn fertilizers in urban areas
- Growth potential at many different locations will require stormwater quality and quantity control
- Winter salting of roads
- Significant number of historic flooding events in downstream portion of watershed near confluence with Vermilion River and at various locations along the main channel

Watershed Summary — Upper Junction Creek

Existing Land Use





Features

Area: 156 sq. km
Existing Land Use: 3% Lake area; 9% Forested; 69% Mine Tailings and Bedrock; 19% Urban
Urban Areas: New Sudbury, Garson, Copper Cliff
Development Potential: High
Dams: Maley, Frood, Nickeldale, Clarabelle, Lady Macdonald Lake, Copper Cliff Creek, Robinson Lake
Lake/River Uses: Sudbury and Copper Cliff Wastewater Treatment Plants, Garson Sewage Lagoons
Primary Water Bodies: Kelley Lake

Primary Stormwater Issues

- impact upon water quality due to uncontrolled stormwater discharges from existing urban areas
- Poor water quality in Junction Creek and Kelley Lake likely due to uncontrolled stormwater discharges from existing urban areas, wastewater treatment facility effluent and past industrial pollution
- Growth potential at many different locations will require stormwater quality and quantity control
- Winter salting of roads
- Numerous historic flooding events in urban portion of watershed, both along the main channel and in tributaries due to uncontrolled stormwater runoff from urban areas

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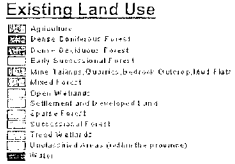
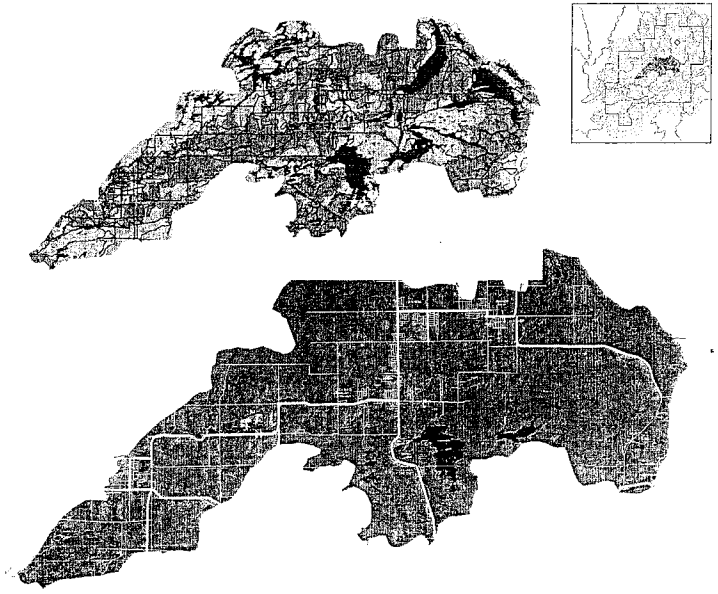
REPORT CARDS FOR PRIORITY WATERSHEDS

Watershed Summary — WHITSON RIVER

Existing Land Use





Features

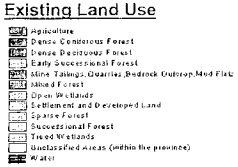
Area: 333 sq. km
Existing Land Use: 3% Lake area; 52 % Forested; 15% Mine Tailings and Bedrock; 30% Urban/Agriculture
Urban Areas: Blezard Valley, McCrea Heights, Val Therese, Val Caron, Hanmer
Development Potential: High
Dams: Goudreau, Whitson Lake
Lake/River Uses: Azilda and Chelmsford Wastewater Treatment Plants
Primary Water Bodies: Whitson Lake, Garson Lake
Other: Municipal wells located in watershed

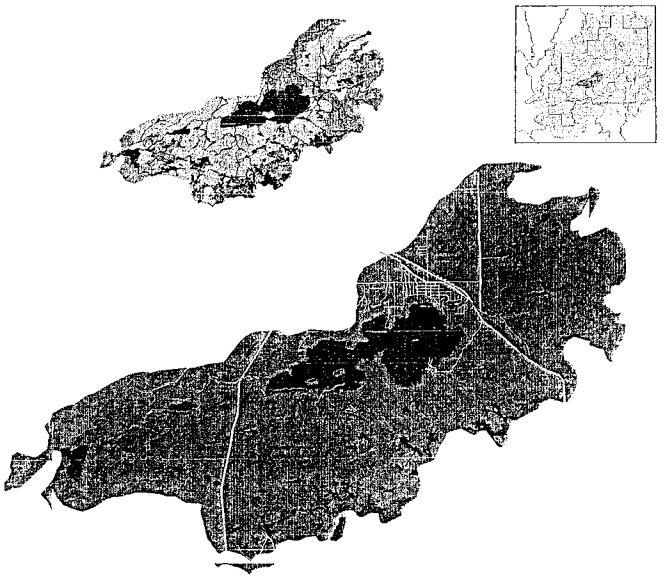
Primary Stormwater Issues

- Impact upon water quality due to uncontrolled stormwater discharges from existing urban areas, runoff from agricultural areas and wastewater treatment plant effluent
- Significant number of historic flooding events along the main channel

Watershed Summary — WHITEWATER

Existing Land Use





Features

Area: 134 sq. km
Existing Land Use: 9% Lake area; 62 % Forested; 21% Mine Tailings and Bedrock; 8% Urban
Urban Areas: Azilda
Development Potential: moderate in Azilda area
Dams: Whitewater
Lake/River Uses: homes, cottages, recreation
Primary Water Bodies: Whitewater Lake, Moore Lake

Primary Stormwater Issues

- Impact upon water quality resulting from uncontrolled stormwater discharges from existing urban areas and runoff from agricultural areas
- Poor water quality (high nutrient levels) in Whitewater Lake likely due to the use of lawn fertilizers in urban areas, agricultural runoff and use of septic systems
- Freeze on creation of new unserviced lots on Whitewater Lake due to poor water quality
- Growth potential in Azilda will require stormwater quantity and quality control
- Winter salting of roads
- Some historic flooding events along the Whitewater Lake tributaries through Azilda due to uncontrolled stormwater runoff from existing urban areas and runoff from agricultural areas

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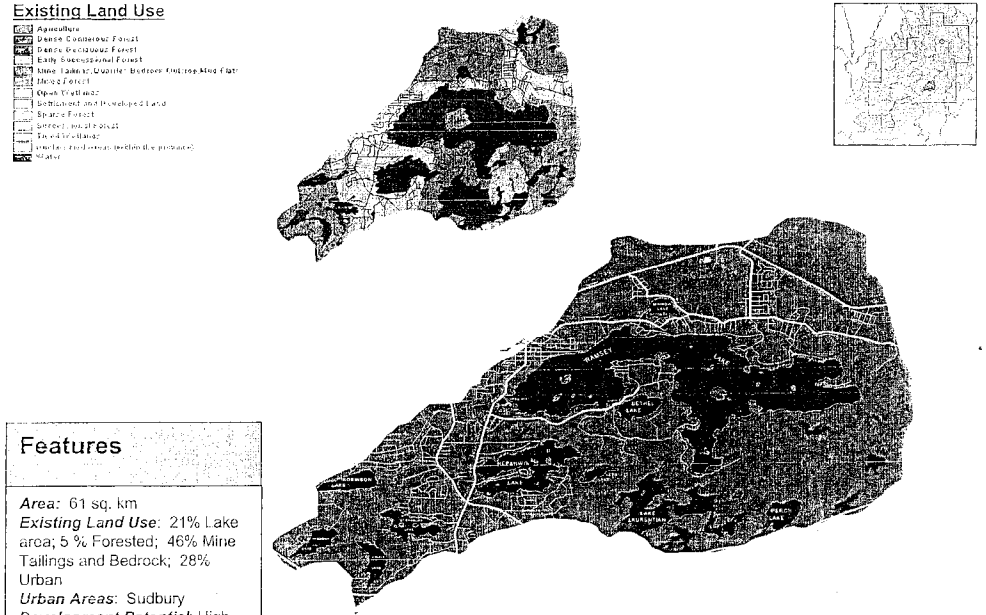
REPORT CARDS FOR PRIORITY WATERSHEDS

Watershed Summary — RAMSEY

Existing Land Use



Features

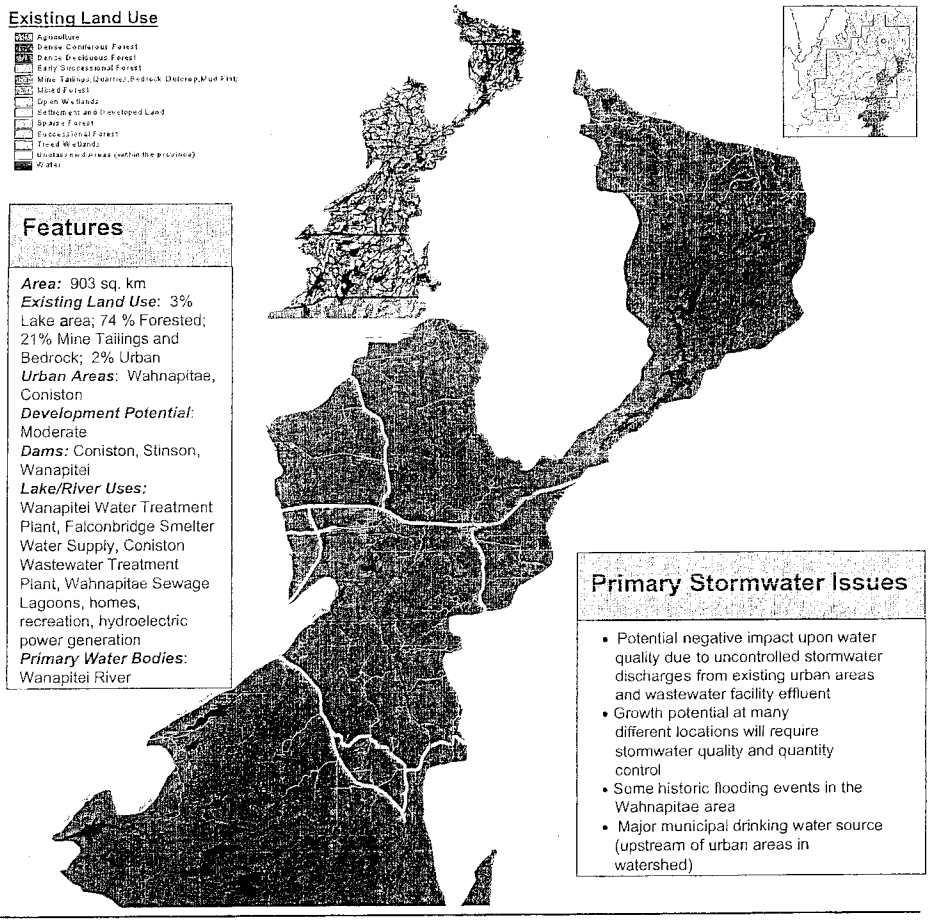
Area: 61 sq. km
Existing Land Use: 21% Lake area; 5 % Forested; 46% Mine Tailings and Bedrock; 28% Urban
Urban Areas: Sudbury
Development Potential: High
Dams: Ramsey Lake (Lily Creek), Nepahwin Lake, Lake Laurentian
Lake/River Uses: David St Water Treatment Plant, homes, recreation
Primary Water Bodies: Ramsey Lake, Nepahwin Lake, St. Charles Lake, Minnow Lake, Robinson Lake, Middle Lake, Hannah Lake, Bennett Lake, Bethel Lake, Lake Laurentian, Perch Lake

Primary Stormwater Issues

- Potential negative impact upon water quality due to uncontrolled stormwater discharges from existing urban areas
- Poor water quality (high nutrient levels) in several lakes likely due to the use of lawn fertilizers in urban areas and past industrial pollution (Minnow Lake)
- Growth potential at many different locations will require stormwater quality and quantity control
- Winter salting of roads
- Some historic flood events within local storm drainage systems due to uncontrolled urban stormwater runoff
- Extremely sensitive area, multiple lake uses at City's center
- Major municipal drinking water source

Watershed Summary — EAST WANAPITEI RIVER

Existing Land Use



Features

Area: 903 sq. km
Existing Land Use: 3% Lake area; 74 % Forested; 21% Mine Tailings and Bedrock; 2% Urban
Urban Areas: Wahnapitae, Coniston
Development Potential: Moderate
Dams: Coniston, Stinson, Wanapitei
Lake/River Uses: Wanapitei Water Treatment Plant, Falconbridge Smelter Water Supply, Coniston Wastewater Treatment Plant, Wahnapitae Sewage Lagoons, homes, recreation, hydroelectric power generation
Primary Water Bodies: Wanapitei River

Primary Stormwater Issues

- Potential negative impact upon water quality due to uncontrolled stormwater discharges from existing urban areas and wastewater facility effluent
- Growth potential at many different locations will require stormwater quality and quantity control
- Some historic flooding events in the Wahnapitae area
- Major municipal drinking water source (upstream of urban areas in watershed)

People Engaged - Places Defined - Progress Driven

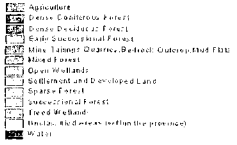
Official Plan officiel

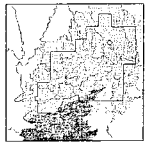
Une collectivité qui s'engage - Un plan précis - La route du progrès

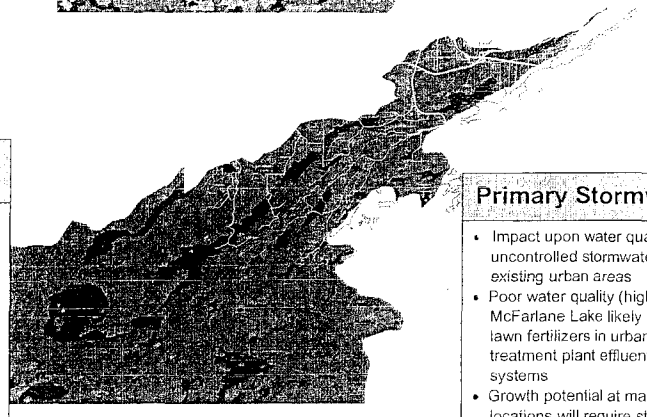
REPORT CARDS FOR PRIORITY WATERSHEDS

Watershed Summary — PANACHE

Existing Land Use







Features

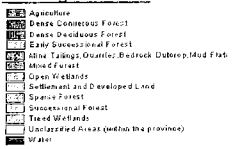
Area: 1380 sq. km Partly within the City of Greater Sudbury)
Existing Land Use: 18% Lake area; 74 % Forested; 7% Mine Tailings and Bedrock; 1% Urban
Urban Areas: Southern portion of Sudbury
Development Potential: High-Algonquin Road watershed in Sudbury
Dams: Grant Lake, McFarlane Lake
Lake/River Uses: *McFarlane Wastewater Treatment Plant,* homes, cottages, recreation
Primary Water Bodies: McFarlane Lake, Richard Lake, Long Lake, Clearwater Lake, Makada Lake, Silver Lake

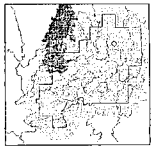
Primary Stormwater Issues

- Impact upon water quality due to uncontrolled stormwater discharges from existing urban areas
- Poor water quality (high nutrient levels) in McFarlane Lake likely due to the use of lawn fertilizers in urban areas,wastewater treatment plant effluent and use of septic systems
- Growth potential at many different locations will require stormwater quality and quantity control
- Winter salting of roads
- High potential for flooding in urbanized portion of the watershed, due to uncontrolled stormwater runoff from development and existing stormwater infrastructure
- Freeze on creation of new unserviced lots on McFarlane Lake due to poor water quality

Watershed Summary — ONAPING

Existing Land Use





Features

Area: 780 sq. km
Existing Land Use: 6% Lake area; 92 % Forested; 1% Mine Tailings and Bedrock; 1% Urban
Urban Areas: Dowling, Onaping, Levack
Development Potential: Low
Dams: Moose Creek 1, 2 and 3, Strathcona, Windy Lake
Lake/River Uses: Dowling and Levack Wastewater Treatment Plant effluent outfalls
Primary Water Bodies: Onaping River

Primary Stormwater Issues

- Potential negative impact upon water quality due to uncontrolled stormwater discharges from existing urban areas
- Significant number of historic flooding events in downstream portion of watershed near confluence with Vermilion River

STORMWATER MANAGEMENT STUDIES

STORMWATER MANAGEMENT PHILOSOPHY

✧ **The Importance of the City's lakes:**

- The City's lakes are among its most valuable assets as evidenced by:
  - The City's appointment of the Greater Sudbury Lakes Improvement Advisory Panel (GSLIAP) and the Ramsey Lake Advisory Panel
  - The City's encouragement of the formation of Lake Stewardship Committees and investment of both time and money into its lake water quality program
- It follows that to further enhance the natural environment, the City must adopt effective stormwater management (SWM) policies, practices and programs that will address both the quantity and quality of stormwater runoff.

✧ A New Perspective:

- Until recently, the stormwater management philosophy was to convey stormwater to the downstream receivers (lakes and watercourses) as efficiently as possible, without significant on site quantity or quality control
- The Stormwater Study will provide the basis for effective stormwater management (both **quantity** and **quality**) within the City for the next 20 years for both existing and new development areas

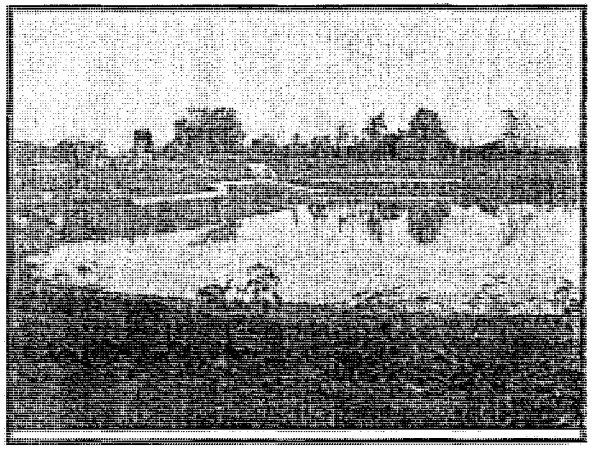
✧ **The Prioritized Subwatershed Studies will:**

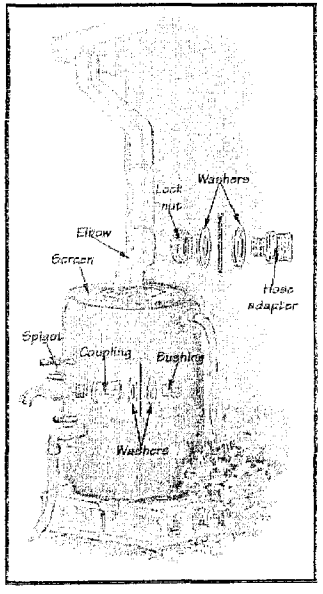
- Determine at a localized level:
  - The existing stormwater quantity (flooding) and quality issues within the watershed
  - The effects of increased levels of development on the quantity and quality of stormwater within the watershed
  - The impacts of both the high frequency (1 in 5 year) and low frequency (1 in 100 year / Regional) rainfall / snowmelt events on the watershed
- Effect strategies and solutions for quantity and quality control of stormwater in a fully developed watershed which will minimize the risk and effects of:
  - Flooding on public and private property;
  - Erosion and sedimentation of water courses; and
  - Runoff pollution in drainage channels and watercourses

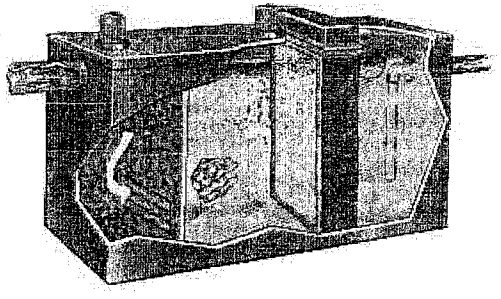
STORMWATER MANAGEMENT STRATEGIES

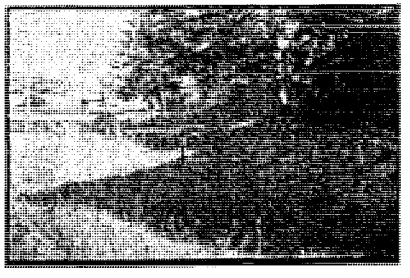
TYPICAL STORMWATER MANAGEMENT STRATEGIES WILL ADDRESS WATER QUANTITY AND QUALITY ISSUES

- **Water Quantity Issues - Typical Strategies Include:**
  - Improving conveyance by upsizing sewers and culverts
  - Providing dykes and flood protection
  - Reducing peak flows by storing stormwater in ponds
  - Reducing erosion by releasing stormwater over longer periods of time
  - Providing source control by reducing the rate and volume of runoff on site. Examples of source control measures are: rain barrels; roof storage; site grading; retention / use / infiltration of stormwater on site; and increased vegetation through forest canopy restoration
- **Water Quality Issues - Typical Strategies Include:**
  - Settling pollutants in stormwater ponds
  - Filtering stormwater through swales, buffers, etc.
  - Providing site controls for impervious high use areas, such as oil-grit separators, filtering or containment
  - Implementing regulatory and public information / education initiatives regarding the use of herbicides, pesticides and fertilizers









URBAN DRAINAGE POLICY

THE URBAN DRAINAGE POLICY WILL IDENTIFY DESIGN STANDARDS AND DISCUSS STORMWATER MANAGEMENT STRATEGIES

- **Typical Design Standards Include:**
  - Updated rainfall intensity curve for the Sudbury area
  - Design criteria applicable to Sudbury
  - Acceptable design tools (i.e. computer software)
- **Typical Strategies Include:**
  - Site controls that must be considered for impervious high use areas, such as oil-grit separators, filtering or containment
  - Source control alternatives that must be considered for new development
  - Non-structural approaches and stormwater best management practices; including a review of state-of-the-art practices and recommendations applicable to Sudbury.
  - Phasing and cost sharing options for facilities
  - Regulatory and public information / education approaches regarding use of herbicides, pesticides, and fertilizers
  - Policies and requirements for master drainage plans and functional stormwater management plans for new subdivisions

People Engaged · Places Defined · Progress Driven
Official Plan officiel
Une collectivité qui s'engage · Un plan précis · La route du progrès

THE NEXT STEPS

- Comments received from this Public Open House Session and stakeholder groups will be considered during the preparation of the Study Report.
- The final Stormwater Background Study report will include:
  - An overview of watersheds in the City;
  - A prioritized list of subwatersheds that warrant more detailed studies and the estimated costs for these studies;
  - Key issues and identified challenges and opportunities related to both quantity and quality of stormwater runoff in the City;
  - SWM strategies to address these challenges and opportunities;
  - SWM design requirements for future development in the City;
  - An Urban Drainage Policy for the City; and
  - Direction for the inclusion of the Stormwater Policy in the Official Plan
- You are encouraged to contact any of the Project Team members from the City or Earth Tech Canada at any time throughout the study if you have any questions or concerns:

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Appendix D

Rainfall Analysis

Rain Gauge Location: Science North

	Maximum rainfall intensities (mm/hr)								
year	5 min	10 min	15 min	30 min	60 min	120 min	360 min	720 min	1440 min
1959	-	-	67.2	40.6	20.3	10.2	3.5	2.2	
1960	-	-	75.2	44.2	23.9	13.2	5.3	3.5	
1961	-	-	-	27.4	15.2	9.7	4.0	5.5	
1962	-	-	60.8	40.6	22.4	14.4	6.4	4.0	
1963	-	-	18.4	15.8	11.2	9.3	5.6	3.9	
1964	-	-	28.4	15.8	14.2	11.8	4.6	3.2	
1965	-	-	69.2	37.0	22.9	11.5	4.0	4.0	
1966	-	-	49.6	24.8	18.0	10.6	4.1	3.1	
1967	-	-	37.6	18.8	16.0	9.3	5.8	3.4	
1968	-	-	91.6	50.8	28.4	16.7	6.1	3.9	
1970	-	-	68.0	47.8	40.6	24.2	11.6	8.2	
1986	87.6	67.2	59.2	38	20.2	10.1	3.8	2.5	
1987	69.6	59.4	42.8	23.6	12.6	7	2.4	1.3	
1988	-	-	-	-	-	-	-	-	
1989	88.8	55.8	42	21	10.5	5.3	2.2	1.7	
1990	142.8	103.8	69.2	34.6	17.3	8.65	5.6	4.6	
1991	45.6	33.6	24.8	13	12.1	11.4	6.9	3.8	
1992	57.6	56.4	48.4	25.4	15.4	9.95	4.0	2.2	
1993	-	-	-	-	-	-	-	-	
1994	134.4	90	67.2	42.4	28.1	14.25	6.3	3.4	
1995	91.2	89.4	76	46	27.9	17.6	8.6	4.8	

Rain Gauge Location: **Sudbury Airport**

	Maximum rainfall intensities (mm/hr)								
year	5 min	10 min	15 min	30 min	60 min	120 min	360 min	720 min	1440 min
1971	51.6	39.6	29.6	18.8	13.2	8.0	5.4	3.6	1.8
1972	186.0	143.4	100.4	73.6	50.3	30.9	12.0	6.8	3.9
1973	122.4	71.4	50.8	27.0	14.0	8.5	4.7	3.2	1.6
1974	88.8	79.2	56.8	41.6	26.9	13.7	5.5	3.6	1.9
1975	45.6	34.8	33.6	22.4	14.5	9.9	4.2	2.7	1.4
1976	91.2	73.2	58.8	32.6	16.3	10.1	6.3	4.7	3.5
1977	97.2	76.2	56.8	38.0	24.6	13.5	7.2	5.8	3.8
1978	91.2	64.8	48.4	32.6	21.6	14.1	6.6	4.9	2.6
1979	87.6	49.8	45.2	26.2	15.4	10.0	5.7	3.6	2.2
1980	52.8	30.6	20.8	14.8	12.4	9.5	4.6	2.5	2.0
1981	118.8	72.0	54.4	32.6	22.3	19.5	10.0	5.1	2.5
1982	44.4	28.8	28.4	22.0	14.3	11.0	5.4	3.2	1.7
1983	78.0	75.0	64.8	34.0	17.3	10.4	5.9	3.6	1.9
1984	118.8	66.0	45.6	24.0	18.4	13.7	5.5	3.6	1.9
1985	93.6	58.2	56.0	44.6	32.8	19.4	9.3	4.6	2.3
1986	51.6	38.4	32.0	19.0	12.6	7.0	3.9	2.0	1.2
1987	62.4	61.2	58.4	48.8	31.4	18.8	6.3	3.2	
1988	142.8	94.2	70.8	41.2	29.6	18.2	6.2	3.1	
1989	165.6	110.4	101.2	80.6	44.4	22.3	7.4	5.1	
1990	70.8	46.8	36.0	22.8	18.6	12.6	6.7	5.1	
1991	70.8	51.6	49.2	34.6	25.3	13.1	5.0	2.7	
1992	88.8	59.4	42.8	24.4	15.8	9.3	5.2	3.4	
1993	75.6	49.8	47.2	33.4	17.1	8.8	2.9	1.5	
1994	67.2	58.2	58.0	38.8	20.6	11.7	5.6	3.3	
1995	85.2	75.0	69.2	63.4	34.4	17.3	5.8	2.9	
1996	51.6	50.4	41.2	29.2	17.6	9.7	3.9	2.5	
1997	94.8	80.4	67.6	47.6	24.2	13.5	9.5	5.9	
1998	152.4	109.2	92.4	56.0	35.0	27.5	10.7	5.4	
1999	147.6	101.4	85.6	46.8	23.4	13.4	6.5	4.2	
2000	76.8	60.6	51.6	31.2	17.7	12.0	5.8	3.0	
2001	61.2	45.0	34.8	27.4	17.3	10.7	5.8	3.1	

Sudbury Airport Rain Gauge- Statistical Analysis of 5 Minute Peak Rainfall

SUDBURY AIRPORT

Year	5-minute peak rainfall intensity (mm/hr)
1971	51.600
1972	186.000
1973	122.400
1974	88.800
1975	45.600
1976	91.200
1977	97.200
1978	91.200
1979	87.600
1980	52.800
1981	118.800
1982	44.400
1983	78.000
1984	118.800
1985	93.600
1986	51.600
1987	62.400
1988	142.800
1989	165.600
1990	70.800
1991	70.800
1992	88.800
1993	75.600
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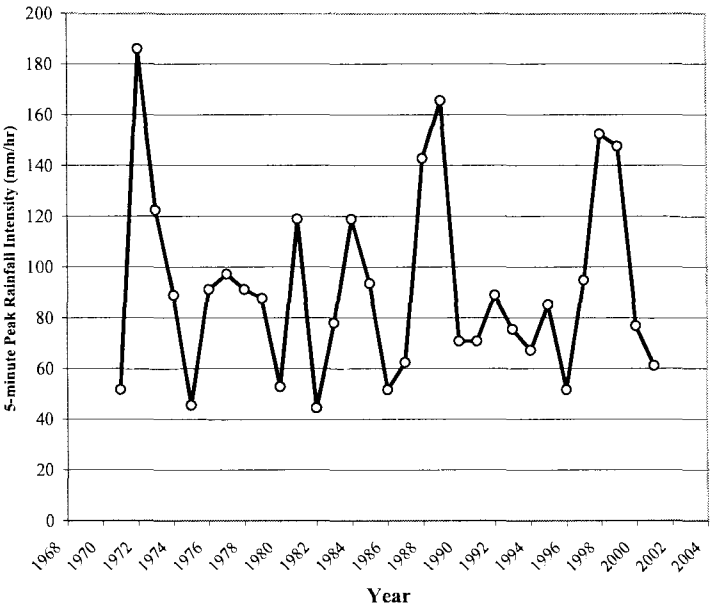
1995	85.200
1996	51.600
1997	94.800
1998	152.400
1999	147.600
2000	76.800
2001	61.200



5-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

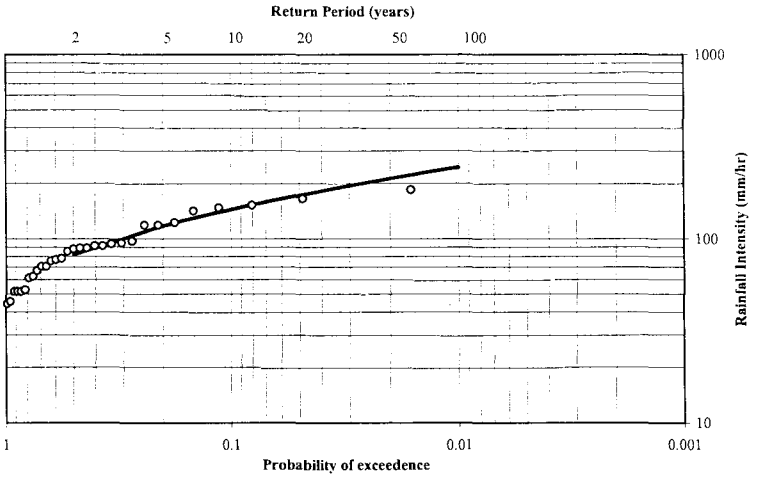
Statistical Analysis

Mean = 91.4
Standard Deviation = 36.9
3 parameter Log-normal Distribution
A = 26.718
M = 4.009 = mean of series (x - A)
S = 0.590 = standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x - a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

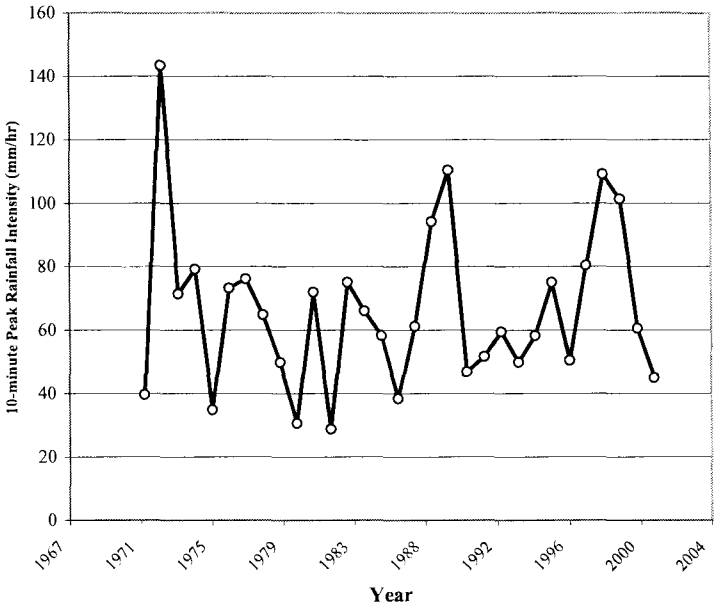
Return Period (years)	Rainfall Intensity (mm/hr)
100	244
50	212
20	172
10	144
5	117
2	81.8



Sudbury Airport Rain Gauge- Statistical Analysis of 10 Minute Peak Rainfall

SUDBURY AIRPORT

Year	10-minute peak rainfall intensity (mm/hr)
1971	39.600
1972	143.400
1973	71.400
1974	79.200
1975	34.800
1976	73.200
1977	76.200
1978	64.800
1979	49.800
1980	30.600
1981	72.000
1982	28.800
1983	75.000
1984	66.000
1985	58.200
1986	38.400
1987	61.200
1988	94.200
1989	110.400
1990	46.800
1991	51.600
1992	59.400
1993	49.800
1994	58.200
1995	75.000
1996	50.400
1997	80.400
1998	109.200
1999	101.400
2000	60.600
2001	45.000



10-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

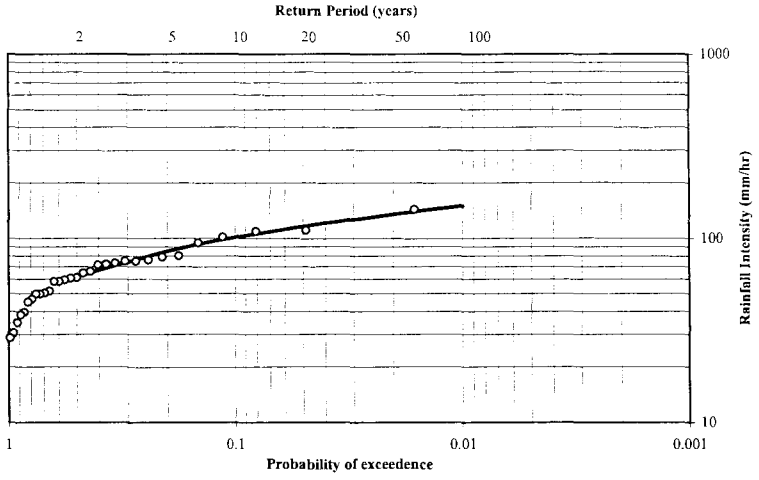
Statistical Analysis

Mean =	66.3	
Standard Deviation =	25.6	
3 parameter Log-normal Distribution		
A =	1.012	
M =	4.107	= mean of series (x - A)
S =	0.386	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

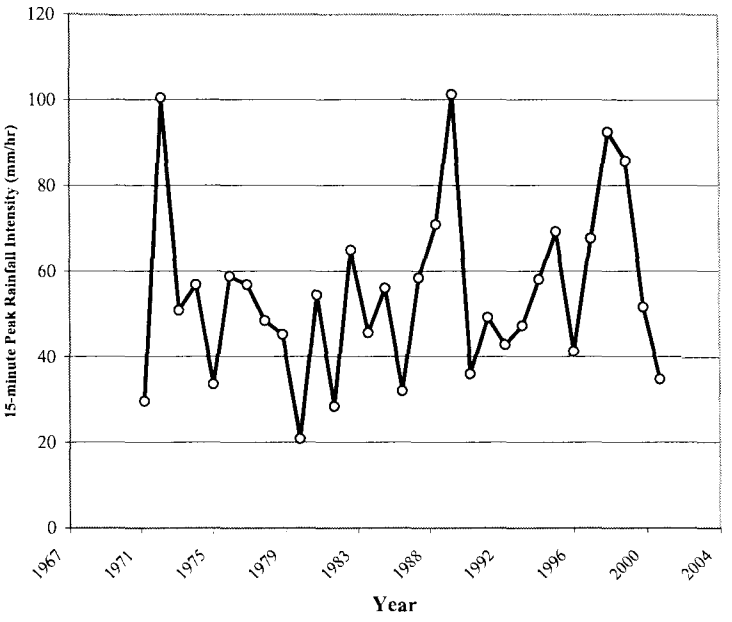
Return Period (years)	Rainfall Intensity (mm/hr)
100	150
50	135
20	116
10	101
5	85.1
2	61.8



Sudbury Airport Rain Gauge- Statistical Analysis of 15 Minute Peak Rainfall

SUDBURY AIRPORT

Year	15-minute peak rainfall intensity (mm/hr)
1971	29.600
1972	100.400
1973	50.800
1974	56.800
1975	33.600
1976	58.800
1977	56.800
1978	48.400
1979	45.200
1980	20.800
1981	54.400
1982	28.400
1983	64.800
1984	45.600
1985	56.000
1986	32.000
1987	58.400
1988	70.800
1989	101.200
1990	36.000
1991	49.200
1992	42.800
1993	47.200
1994	58.000
1995	69.200
1996	41.200
1997	67.600
1998	92.400
1999	85.600
2000	51.600
2001	34.800



15-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

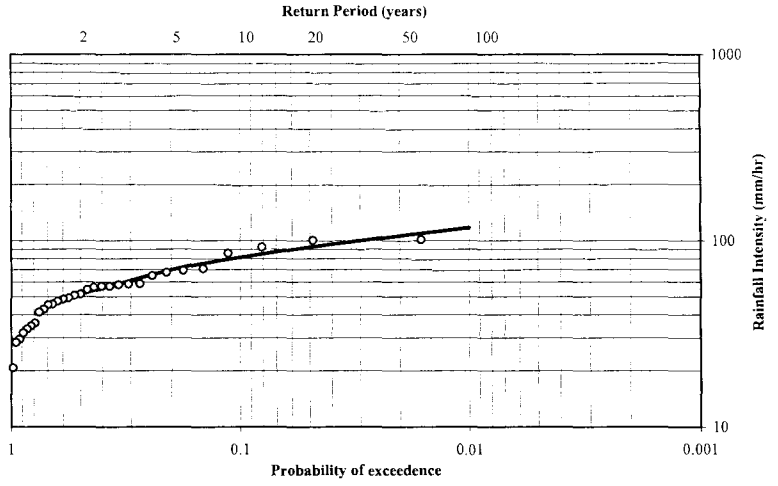
Statistical Analysis

Mean =	54.5	
Standard Deviation =	20.2	
3 parameter Log-normal Distribution		
A =	-8.809	
M =	4.100	= mean of series (x - A)
S =	0.315	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

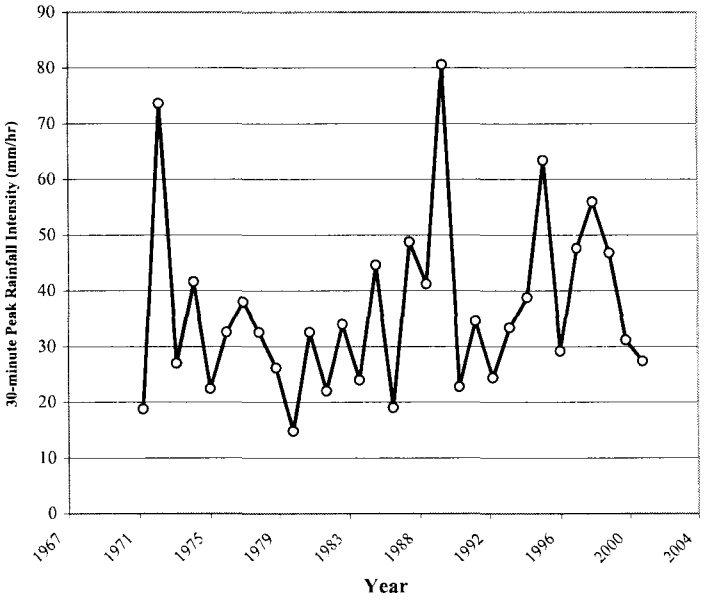
Return Period (years)	Rainfall Intensity (mm/hr)
100	117
50	106
20	92.5
10	81.5
5	69.8
2	51.5



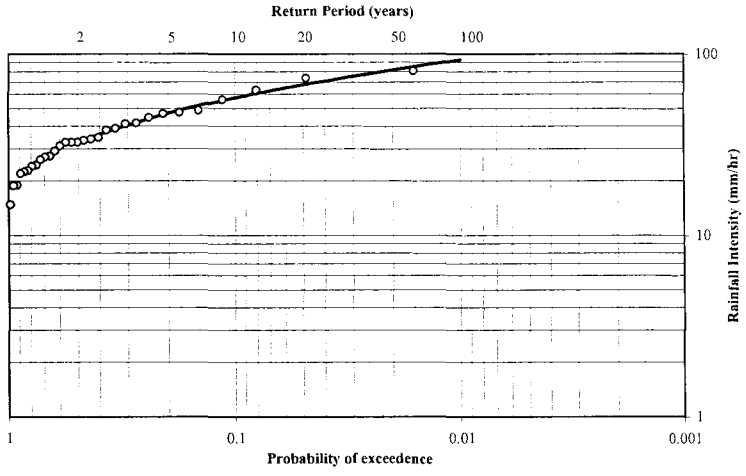
Sudbury Airport Rain Gauge- Statistical Analysis of 30 Minute Peak Rainfall

SUDBURY AIRPORT

Year	30-minute peak rainfall intensity (mm/hr)
1971	18.800
1972	73.600
1973	27.000
1974	41.600
1975	22.400
1976	32.600
1977	38.000
1978	32.600
1979	26.200
1980	14.800
1981	32.600
1982	22.000
1983	34.000
1984	24.000
1985	44.600
1986	19.000
1987	48.800
1988	41.200
1989	80.600
1990	22.800
1991	34.600
1992	24.400
1993	33.400
1994	38.800
1995	63.400
1996	29.200
1997	47.600
1998	56.000
1999	46.800
2000	31.200
2001	27.400



30-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution



Statistical Analysis

Mean =	36.5	
Standard Deviation =	15.6	
3 parameter Log-normal Distribution		
A =	6.751	
M =	3.266	= mean of series (x - A)
S =	0.512	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

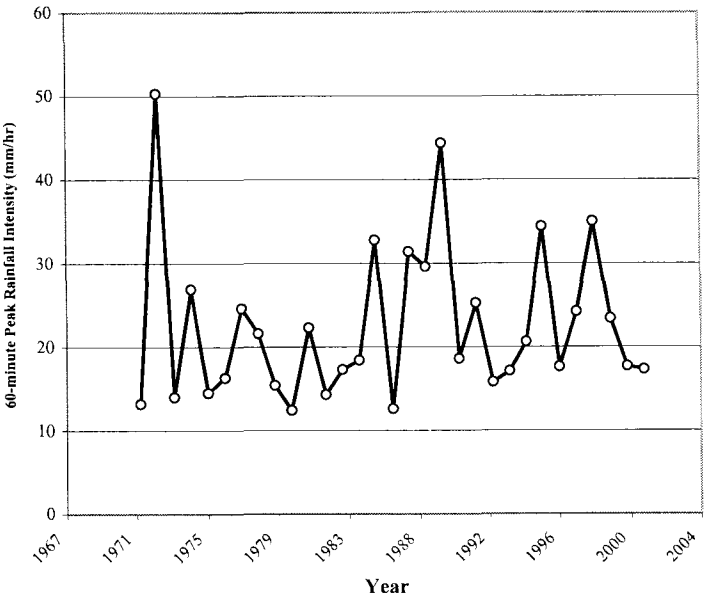
$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

Return Period (years)	Rainfall Intensity (mm/hr)
100	93
50	81.7
20	67.6
10	57.2
5	47.1
2	33

Sudbury Airport Rain Gauge- Statistical Analysis of 60 Minute Peak Rainfall

SUDBURY AIRPORT

Year	60-minute peak rainfall intensity (mm/hr)
1971	13.200
1972	50.300
1973	14.000
1974	26.900
1975	14.500
1976	16.300
1977	24.600
1978	21.600
1979	15.400
1980	12.400
1981	22.300
1982	14.300
1983	17.300
1984	18.400
1985	32.800
1986	12.600
1987	31.400
1988	29.600
1989	44.400
1990	18.600
1991	25.300
1992	15.800
1993	17.100
1994	20.600
1995	34.400
1996	17.600
1997	24.200
1998	35.000
1999	23.400
2000	17.700
2001	17.300



60-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

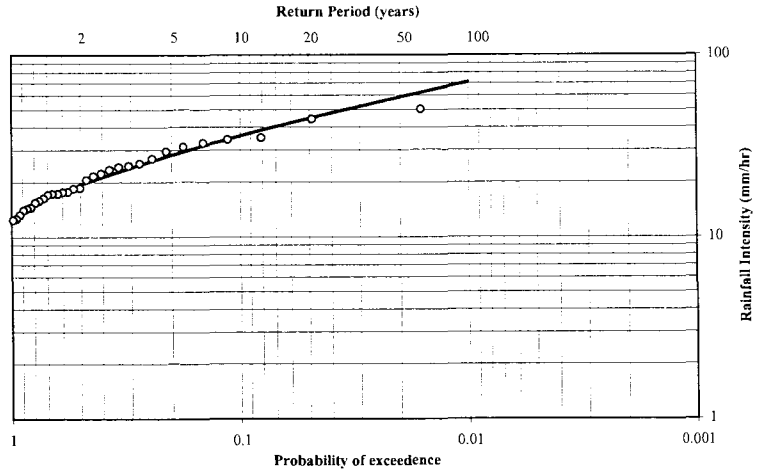
Statistical Analysis

Mean =	22.6	
Standard Deviation =	9.33	
3 parameter Log-normal Distribution		
A =	10.843	
M =	2.151	= mean of series (x - A)
S =	0.834	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x - A)S\sqrt{2\pi}} e^{-\frac{[\ln(x-A)-M]^2}{2S^2}}$$

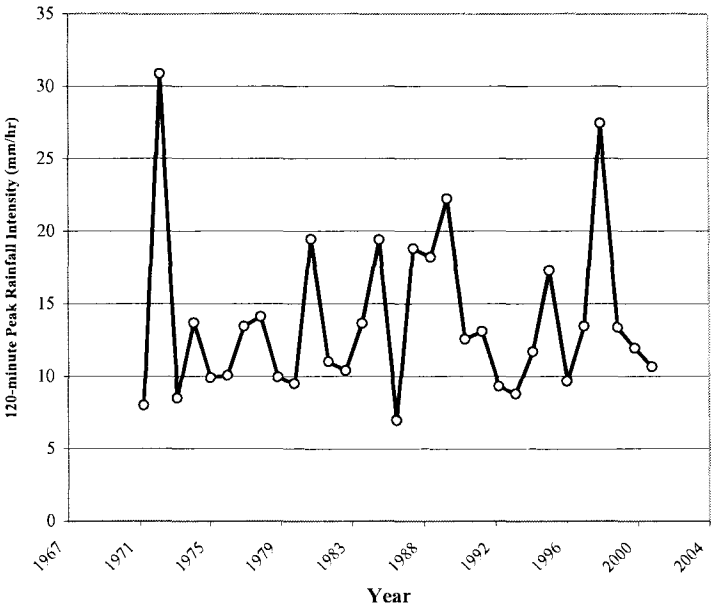
Return Period (years)	Rainfall Intensity (mm/hr)
100	70.7
50	58.5
20	44.8
10	35.9
5	28.2
2	19.4



Sudbury Airport Rain Gauge- Statistical Analysis of 120 Minute Peak Rainfall

SUDBURY AIRPORT

Year	120-minute peak rainfall intensity (mm/hr)
1971	8.000
1972	30.850
1973	8.500
1974	13.700
1975	9.900
1976	10.050
1977	13.450
1978	14.100
1979	9.950
1980	9.500
1981	19.450
1982	11.000
1983	10.400
1984	13.650
1985	19.400
1986	6.950
1987	18.800
1988	18.200
1989	22.250
1990	12.550
1991	13.100
1992	9.300
1993	8.800
1994	11.700
1995	17.300
1996	9.650
1997	13.450
1998	27.450
1999	13.350
2000	11.950
2001	10.650



120-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

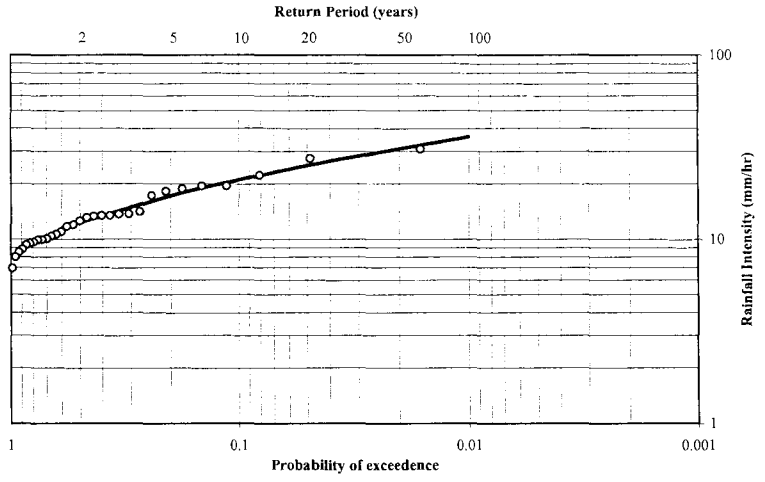
Statistical Analysis

Mean = 13.8
Standard Deviation = 5.6
3 parameter Log-normal Distribution
A = 5.477
M = 1.920 = mean of series (x - A)
S = 0.643 = standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

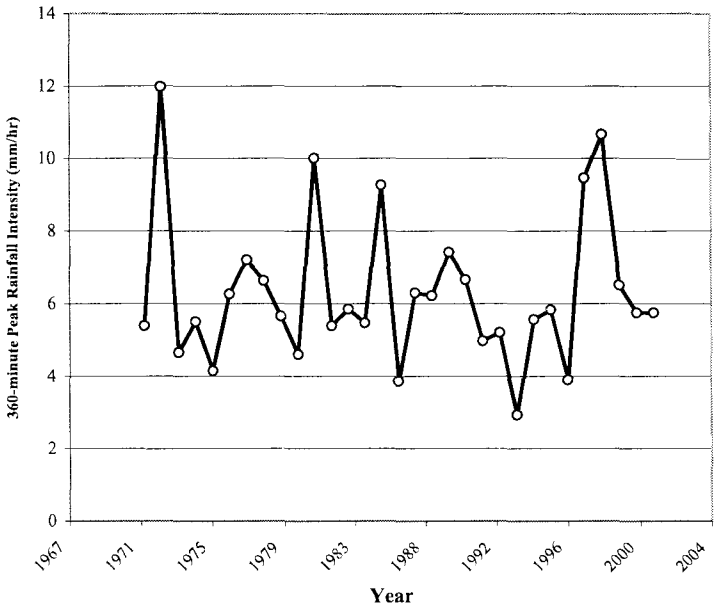
Return Period (years)	Rainfall Intensity (mm/hr)
100	35.9
50	31
20	25.1
10	21
5	17.2
2	12.3



Sudbury Airport Rain Gauge- Statistical Analysis of 360 Minute Peak Rainfall

SUDBURY AIRPORT

Year	360-minute peak rainfall intensity (mm/hr)
1971	5.383
1972	11.983
1973	4.650
1974	5.500
1975	4.150
1976	6.267
1977	7.200
1978	6.633
1979	5.650
1980	4.600
1981	10.017
1982	5.383
1983	5.850
1984	5.467
1985	9.267
1986	3.867
1987	6.300
1988	6.217
1989	7.417
1990	6.667
1991	4.967
1992	5.200
1993	2.933
1994	5.567
1995	5.833
1996	3.900
1997	9.467
1998	10.667
1999	6.517
2000	5.750
2001	5.750



360-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

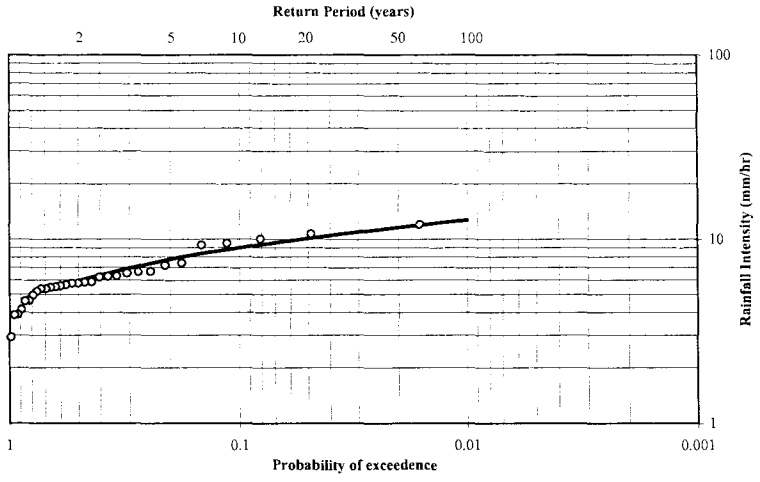
Statistical Analysis

Mean = 6.29
Standard Deviation = 2.06
3 parameter Log-normal Distribution
A = 0.901
M = 1.619 = mean of series (x - A)
S = 0.365 = standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

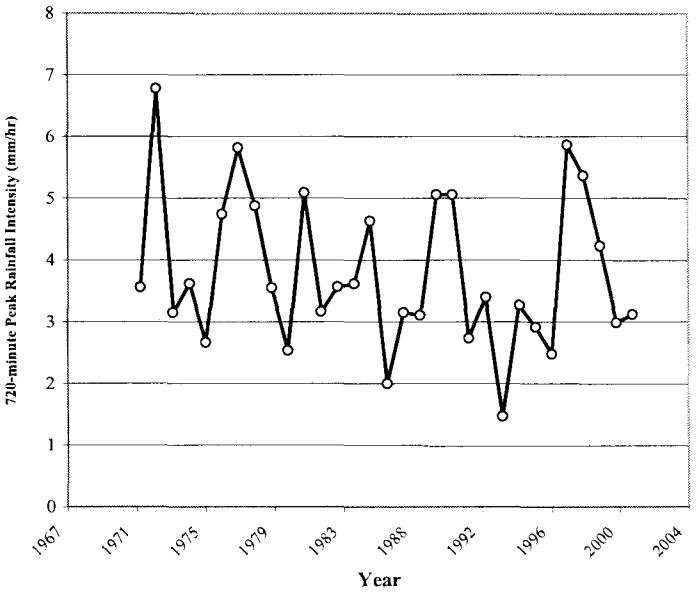
Return Period (years)	Rainfall Intensity (mm/hr)
100	12.7
50	11.6
20	10.1
10	8.97
5	7.77
2	5.95



Sudbury Airport Rain Gauge- Statistical Analysis of 720 Minute Peak Rainfall

SUDBURY AIRPORT

Year	720-minute peak rainfall intensity (mm/hr)
1971	3.558
1972	6.775
1973	3.150
1974	3.617
1975	2.667
1976	4.742
1977	5.817
1978	4.875
1979	3.550
1980	2.533
1981	5.092
1982	3.167
1983	3.567
1984	3.617
1985	4.633
1986	2.000
1987	3.150
1988	3.108
1989	5.058
1990	5.058
1991	2.733
1992	3.400
1993	1.467
1994	3.267
1995	2.917
1996	2.475
1997	5.867
1998	5.367
1999	4.225
2000	2.983
2001	3.117



720-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

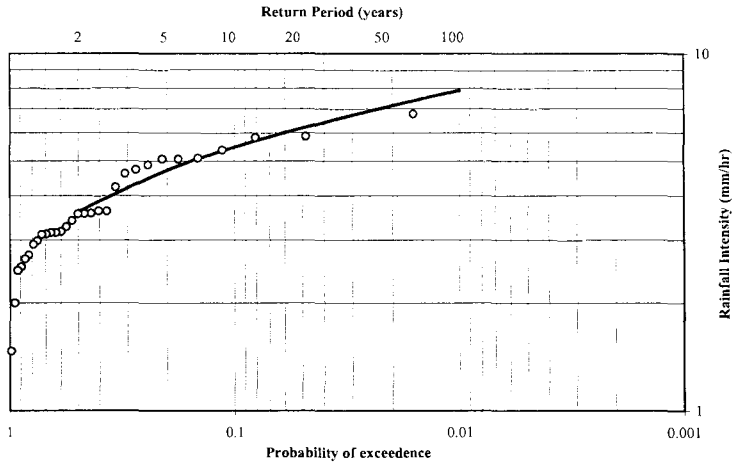
Statistical Analysis

Mean =	3.79	
Standard Deviation =	1.28	
3 parameter Log-normal Distribution		
A =	0.868	
M =	1.006	= mean of series (x - A)
S =	0.405	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed. ie.

$$p(x) = \frac{1}{(x - a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

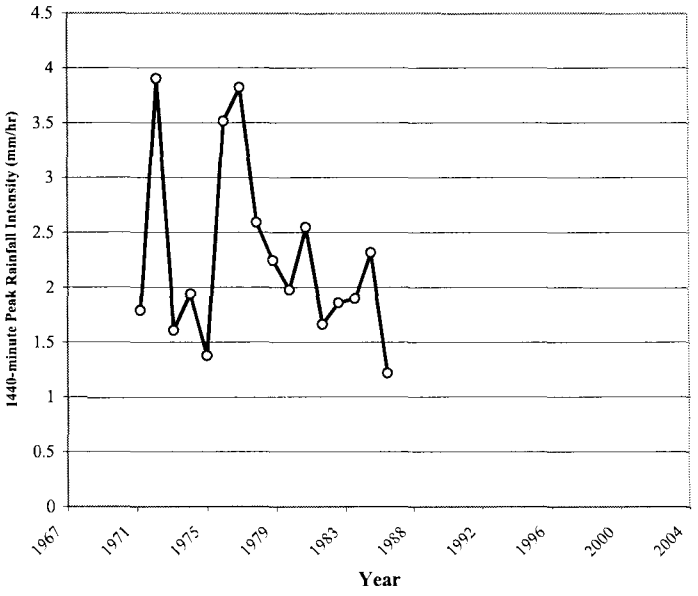
Return Period (years)	Rainfall Intensity (mm/hr)
100	7.88
50	7.15
20	6.19
10	5.46
5	4.71
2	3.6



Sudbury Airport Rain Gauge- Statistical Analysis of 1440 Minute Peak Rainfall

SUDBURY AIRPORT

Year	1440-minute peak rainfall intensity (mm/hr)
1971	1.788
1972	3.904
1973	1.608
1974	1.938
1975	1.375
1976	3.513
1977	3.821
1978	2.592
1979	2.246
1980	1.975
1981	2.546
1982	1.663
1983	1.858
1984	1.896
1985	2.317
1986	1.217
1987	
1988	
1989	
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	



1440-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

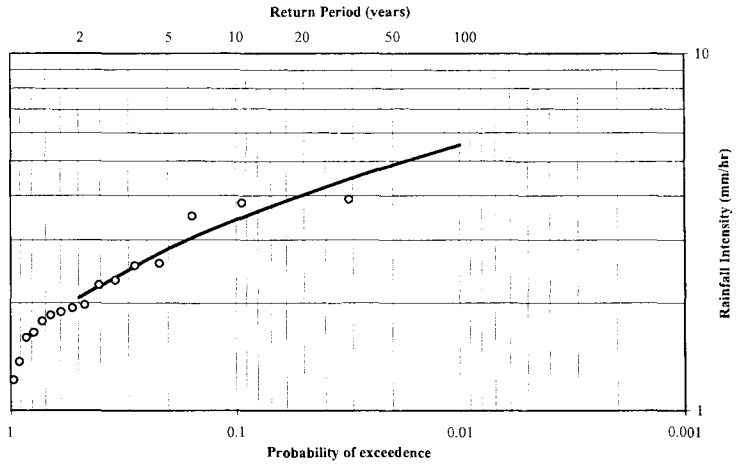
Statistical Analysis

Mean =	2.27	
Standard Deviation =	0.83	
3 parameter Log-normal Distribution		
A =	0.818	
M =	0.221	= mean of series (x - A)
S =	0.572	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

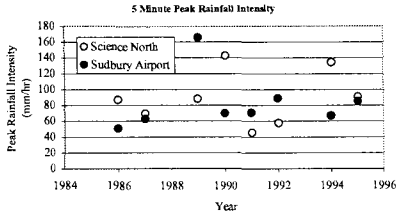
$$p(x) = \frac{1}{(x - A)S\sqrt{2\pi}} e^{-\frac{[\ln(x-A)-M]^2}{2S^2}}$$

Return Period (years)	Rainfall Intensity (mm/hr)
100	5.54
50	4.86
20	4.02
10	3.42
5	2.84
2	2.07



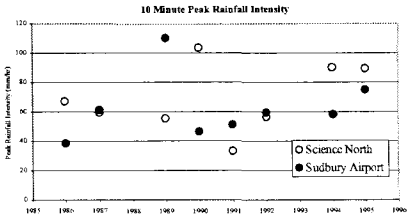
5 min intensity

Year	Science North	Sudbury Airport
1986	87.6	51.6
1987	69.6	62.4
1989	88.8	165.6
1990	142.8	70.8
1991	45.6	70.8
1992	57.6	88.8
1994	134.4	67.2
1995	91.2	85.2
average	89.7	82.8
SD	34.2	35.5



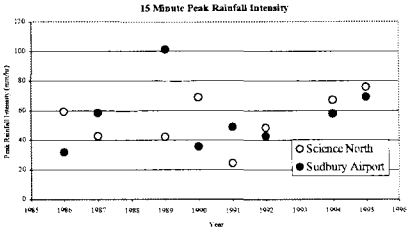
10 min intensity

Year	Science North	Sudbury Airport
1986	67.2	38.4
1987	59.4	61.2
1989	55.8	110.4
1990	103.8	46.8
1991	33.6	51.6
1992	56.4	59.4
1994	90	58.2
1995	89.4	75.0
average	69.5	62.6
SD	23.1	22.1



15 min intensity

Year	Science North	Sudbury Airport
1986	59.2	32.0
1987	42.8	58.4
1989	42	101.2
1990	69.2	36.0
1991	24.8	49.2
1992	48.4	42.8
1994	67.2	58.0
1995	76	69.2
average	53.7	55.9
SD	17.2	22.1



30 min intensity

Year	Science North	Sudbury Airport
1986	38	19.0
1987	23.6	48.8
1989	21	80.6
1990	34.6	22.8
1991	13	34.6
1992	25.4	24.4
1994	42.4	38.8
1995	46	63.4

60 min intensity

Year	Science North	Sudbury Airport
1986	20.2	12.6
1987	12.6	31.4
1989	10.5	44.4
1990	17.3	18.6
1991	12.1	25.3
1992	15.4	15.8
1994	28.1	20.6
1995	27.9	34.4

120 min intensity

Year	Science North	Sudbury Airport
1986	10.1	7.0
1987	7	18.8
1989	5.3	22.3
1990	8.65	12.6
1991	11.4	13.1
1992	9.95	9.3
1994	14.25	11.7
1995	17.6	17.3

360 min intensity

Year	Science North	Sudbury Airport
1986	3.8	3.9
1987	2.4	6.3
1989	2.2	7.4
1990	5.6	6.7
1991	6.9	5.0
1992	4.0	5.2
1994	6.3	5.6
1995	8.6	5.8

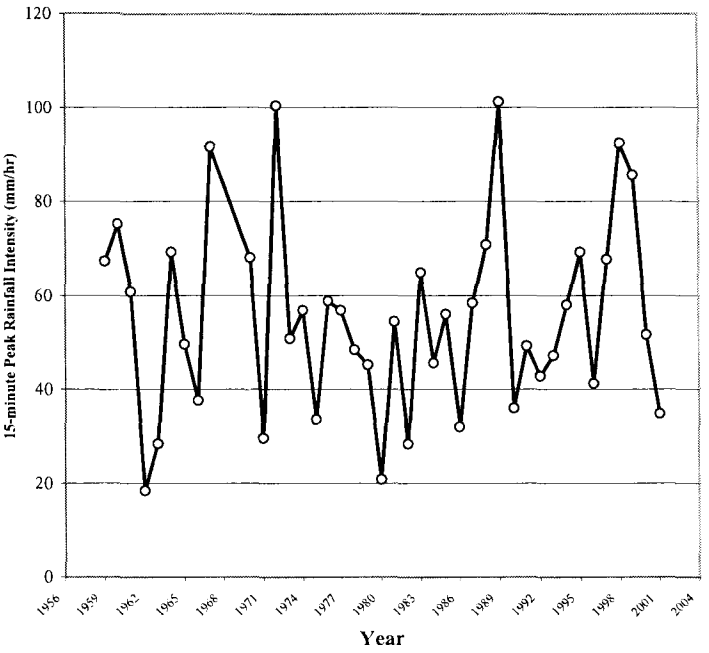
720 min intensity

Year	Science North	Sudbury Airport
1986	2.1	2.0
1987	1.3	3.2
1989	1.7	5.1
1990	4.6	5.1
1991	3.8	2.7
1992	2.2	3.4
1994	3.4	3.3
1995	4.8	2.9

Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971) Statistical Analysis of 15 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	15-minute peak rainfall intensity (mm/hr)
1959	67.200
1960	75.200
1961	60.800
1962	18.400
1963	28.400
1964	69.200
1965	49.600
1966	37.600
1967	91.600
1970	68.000
1971	29.600
1972	100.400
1973	50.800
1974	56.800
1975	33.600
1976	58.800
1977	56.800
1978	48.400
1979	45.200
1980	20.800
1981	54.400
1982	28.400
1983	64.800
1984	45.600
1985	56.000
1986	32.000
1987	58.400
1988	70.800
1989	101.200
1990	36.000
1991	49.200
1992	42.800
1993	47.200
1994	58.000
1995	69.200
1996	41.200
1997	67.600
1998	92.400
1999	85.600
2000	51.600
2001	34.800



15-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

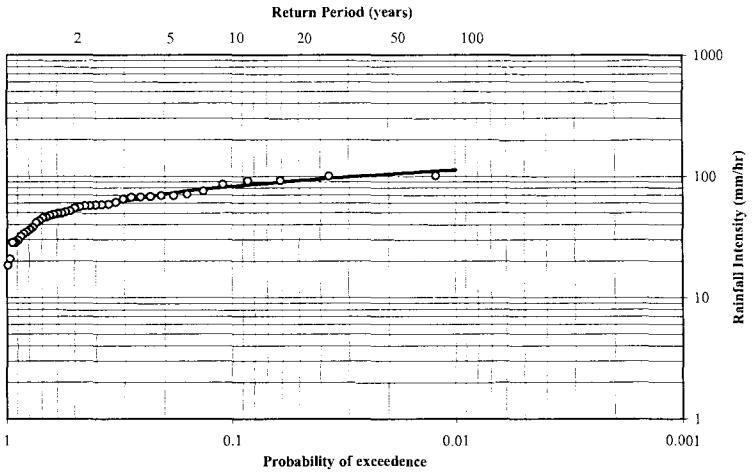
Statistical Analysis

Mean = 55
Standard Deviation = 20.6
3 parameter Log-normal Distribution
A = -43.371
M = 4.567 = mean of series (x - A)
S = 0.209 = standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x - a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

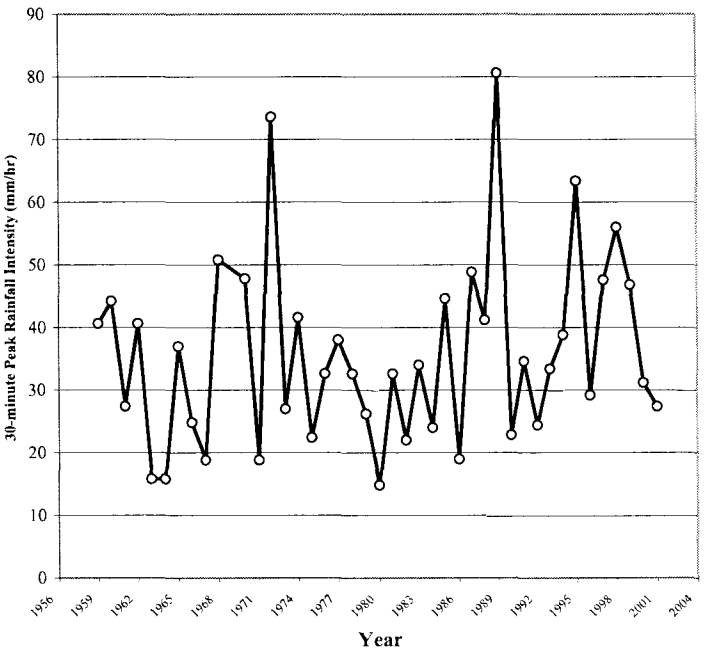
Return Period (years)	Rainfall Intensity (mm/hr)
100	113
50	104
20	92.4
10	82.5
5	71.4
2	52.9



Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971) Statistical Analysis of 30 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	30-minute peak rainfall intensity (mm/hr)
1959	40.600
1960	44.200
1961	27.400
1962	40.600
1963	15.800
1964	15.800
1965	37.000
1966	24.800
1967	18.800
1968	50.800
1970	47.800
1971	18.800
1972	73.600
1973	27.000
1974	41.600
1975	22.400
1976	32.600
1977	38.000
1978	32.600
1979	26.200
1980	14.800
1981	32.600
1982	22.000
1983	34.000
1984	24.000
1985	44.600
1986	19.000
1987	48.800
1988	41.200
1989	80.600
1990	22.800
1991	34.600
1992	24.400
1993	33.400
1994	38.800
1995	63.400
1996	29.200
1997	47.600
1998	56.000
1999	46.800
2000	31.200
2001	27.400



30-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

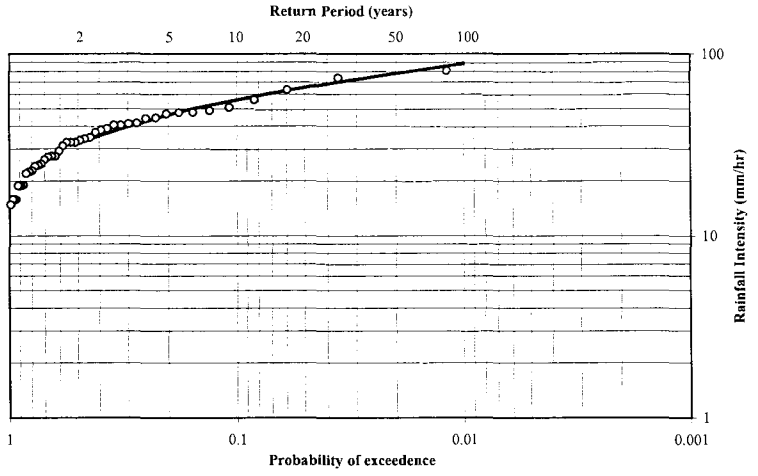
Statistical Analysis

Mean =	35.6	
Standard Deviation =	14.9	
3 parameter Log-normal Distribution		
A =	3.074	
M =	3.381	= mean of series (x - A)
S =	0.456	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

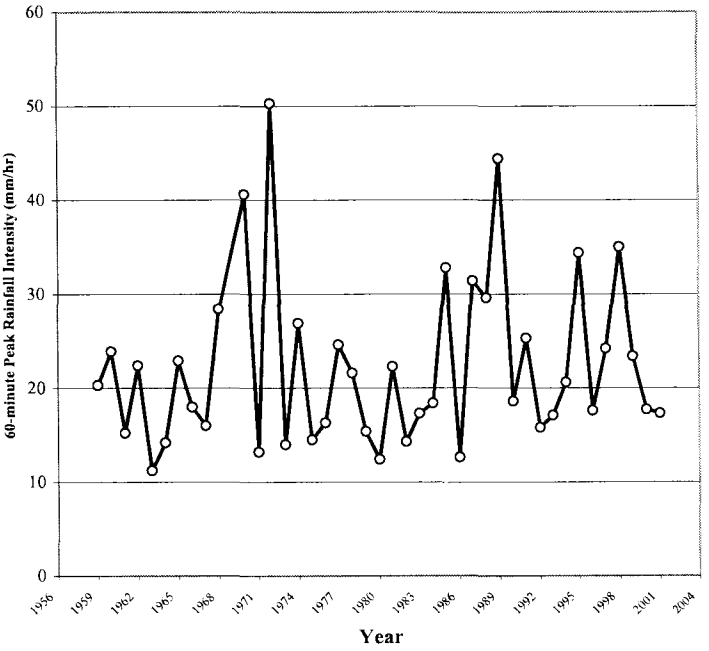
Return Period (years)	Rainfall Intensity (mm/hr)
100	88
50	78.1
20	65.3
10	55.8
5	46.2
2	32.5



Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971) Statistical Analysis of 60 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	60-minute peak rainfall intensity (mm/hr)
1959	20.300
1960	23.900
1961	15.200
1962	22.400
1963	11.200
1964	14.200
1965	22.900
1966	18.000
1967	16.000
1968	28.400
1970	40.600
1971	13.200
1972	50.300
1973	14.000
1974	26.900
1975	14.500
1976	16.300
1977	24.600
1978	21.600
1979	15.400
1980	12.400
1981	22.300
1982	14.300
1983	17.300
1984	18.400
1985	32.800
1986	12.600
1987	31.400
1988	29.600
1989	44.400
1990	18.600
1991	25.300
1992	15.800
1993	17.100
1994	20.600
1995	34.400
1996	17.600
1997	24.200
1998	35.000
1999	23.400
2000	17.700
2001	17.300



60-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

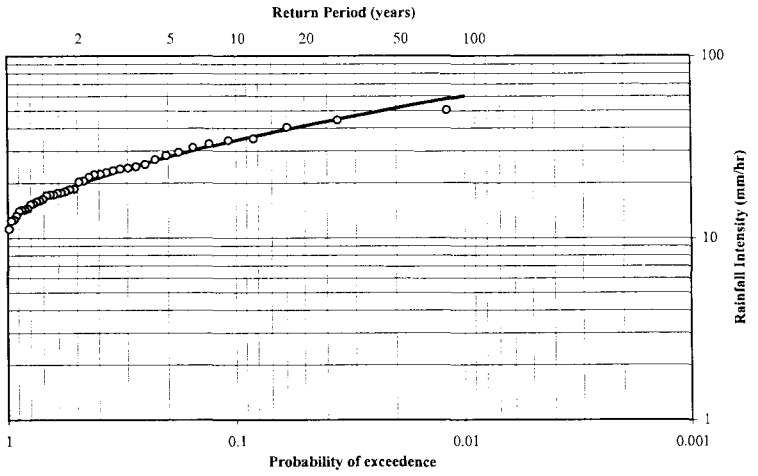
Statistical Analysis

Mean =	22.2	
Standard Deviation =	8.96	
3 parameter Log-normal Distribution		
A =	9.082	
M =	2.359	= mean of series (x - A)
S =	0.676	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-A)S\sqrt{2\pi}} e^{-\frac{[\ln(x-A)-M]^2}{2S^2}}$$

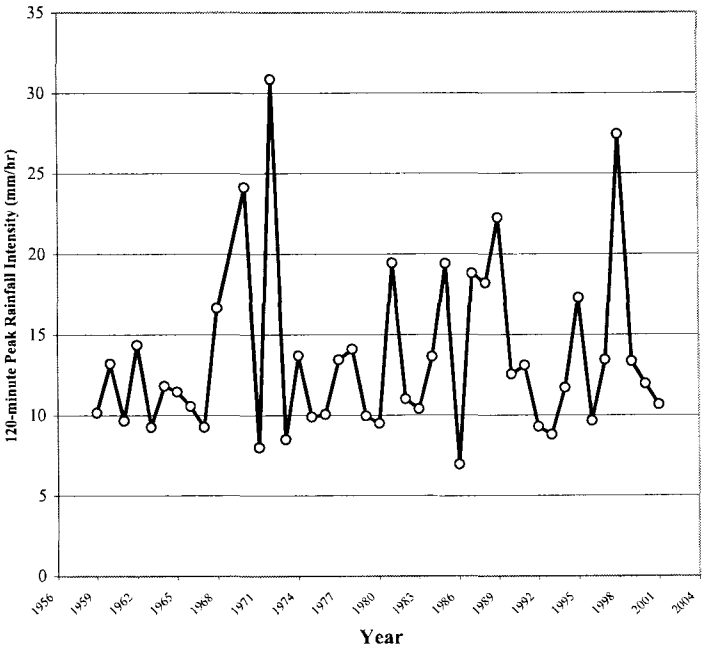
Return Period (years)	Rainfall Intensity (mm/hr)
100	60.1
50	51.5
20	41.3
10	34.3
5	27.8
2	19.7



Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971)
Statistical Analysis of 120 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	120-minute peak rainfall intensity (mm/hr)
1959	10.150
1960	13.200
1961	9.650
1962	14.350
1963	9.250
1964	11.800
1965	11.450
1966	10.550
1967	9.250
1968	16.650
1970	24.150
1971	8.000
1972	30.850
1973	8.500
1974	13.700
1975	9.900
1976	10.050
1977	13.450
1978	14.100
1979	9.950
1980	9.500
1981	19.450
1982	11.000
1983	10.400
1984	13.650
1985	19.400
1986	6.950
1987	18.800
1988	18.200
1989	22.250
1990	12.550
1991	13.100
1992	9.300
1993	8.800
1994	11.700
1995	17.300
1996	9.650
1997	13.450
1998	27.450
1999	13.350
2000	11.950
2001	10.650



120-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

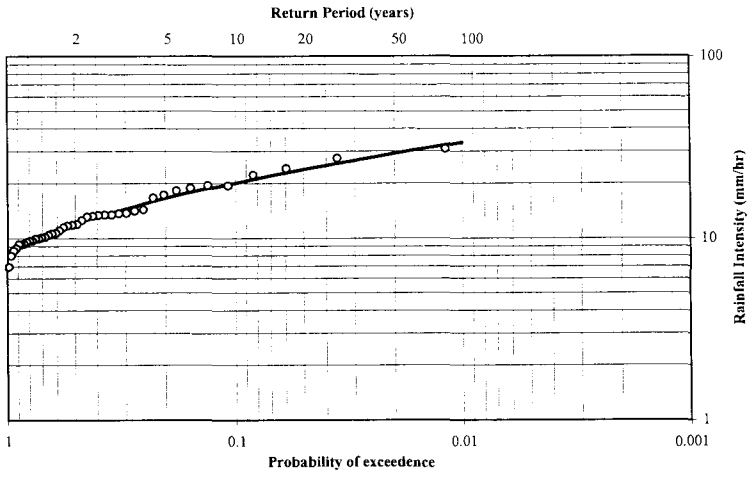
Statistical Analysis

Mean =	35.6	
Standard Deviation =	14.9	
3 parameter Log-normal Distribution		
A =	3.074	
M =	3.381	= mean of series (x - A)
S =	0.456	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

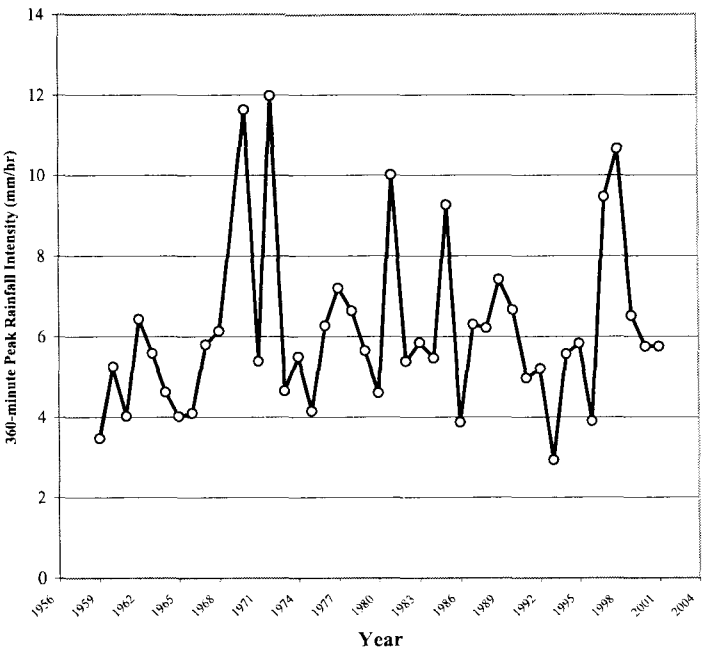
Return Period (years)	Rainfall Intensity (mm/hr)
100	33.5
50	29.2
20	23.8
10	20.1
5	16.6
2	12.1



Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971)
Statistical Analysis of 360 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	360-minute peak rainfall intensity (mm/hr)
1959	3.467
1960	5.250
1961	4.017
1962	6.433
1963	5.583
1964	4.617
1965	4.017
1966	4.100
1967	5.800
1968	6.133
1970	11.633
1971	5.383
1972	11.983
1973	4.650
1974	5.500
1975	4.150
1976	6.267
1977	7.200
1978	6.633
1979	5.650
1980	4.600
1981	10.017
1982	5.383
1983	5.850
1984	5.467
1985	9.267
1986	3.867
1987	6.300
1988	6.217
1989	7.417
1990	6.667
1991	4.967
1992	5.200
1993	2.933
1994	5.567
1995	5.833
1996	3.900
1997	9.467
1998	10.667
1999	6.517
2000	5.750
2001	5.750



360-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

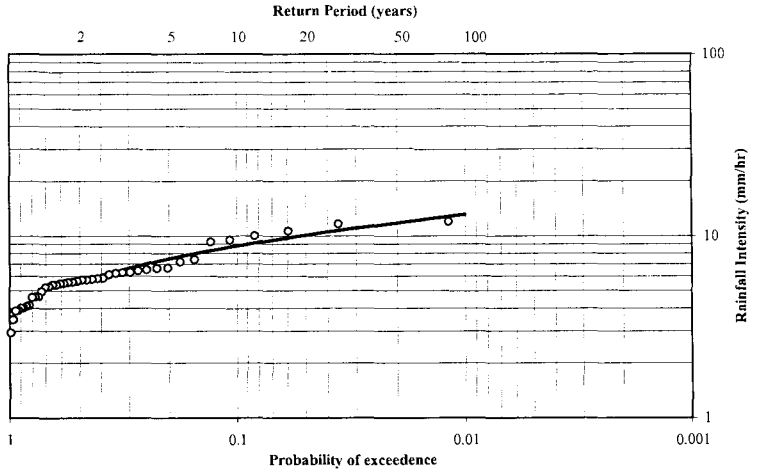
Statistical Analysis

Mean =	6.1	
Standard Deviation =	2.11	
3 parameter Log-normal Distribution		
A =	1.632	
M =	1.398	= mean of series (x - A)
S =	0.446	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-a)S\sqrt{2\pi}} e^{-\frac{[\ln(x-a)-M]^2}{2S^2}}$$

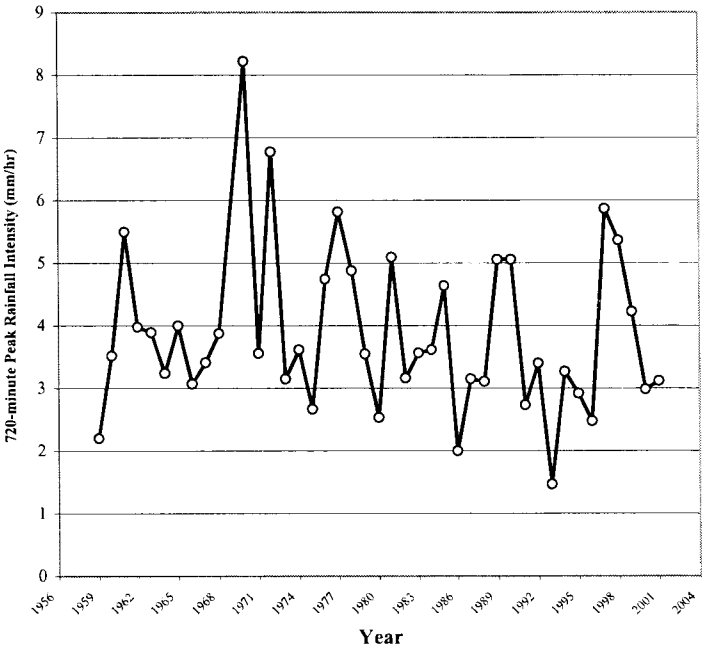
Return Period (years)	Rainfall Intensity (mm/hr)
100	13.1
50	11.8
20	10.1
10	8.8
5	7.52
2	5.68



Sudbury Airport Rain Gauge (post 1971) Combined with Science North (pre 1971)
Statistical Analysis of 720 Minute Peak Rainfall

SUDBURY AIRPORT (post 1971) + SCIENCE NORTH (pre-1971)

Year	720-minute peak rainfall intensity (mm/hr)
1959	2.200
1960	3.520
1961	5.500
1962	3.980
1963	3.890
1964	3.240
1965	4.000
1966	3.070
1967	3.410
1968	3.875
1970	8.220
1971	3.558
1972	6.775
1973	3.150
1974	3.617
1975	2.667
1976	4.742
1977	5.817
1978	4.875
1979	3.550
1980	2.533
1981	5.092
1982	3.167
1983	3.567
1984	3.617
1985	4.633
1986	2.000
1987	3.150
1988	3.108
1989	5.058
1990	5.058
1991	2.733
1992	3.400
1993	1.467
1994	3.267
1995	2.917
1996	2.475
1997	5.867
1998	5.367
1999	4.225
2000	2.983
2001	3.117



720-minute Rainfall Data - With Best Fit 3 Parameter Log-Normal Distribution

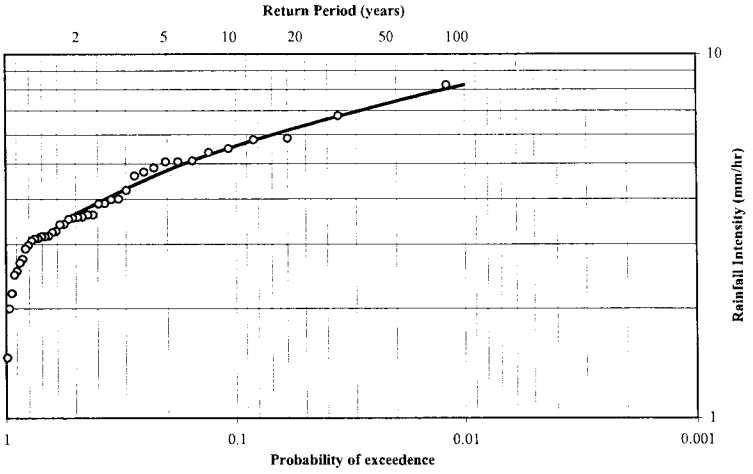
Statistical Analysis

Mean =	3.93	
Standard Deviation =	1.29	
3 parameter Log-normal Distribution		
A =	1.058	
M =	0.948	= mean of series (x - A)
S =	0.439	= standard deviation of series (x - A)

where - the logarithms of (x - A) are normally distributed, ie.

$$p(x) = \frac{1}{(x-A)S\sqrt{2\pi}} e^{-\frac{[\ln(x-A)-M]^2}{2S^2}}$$

Return Period (years)	Rainfall Intensity (mm/hr)
100	8.22
50	7.41
20	6.37
10	5.59
5	4.79
2	3.64



City of Greater Sudbury

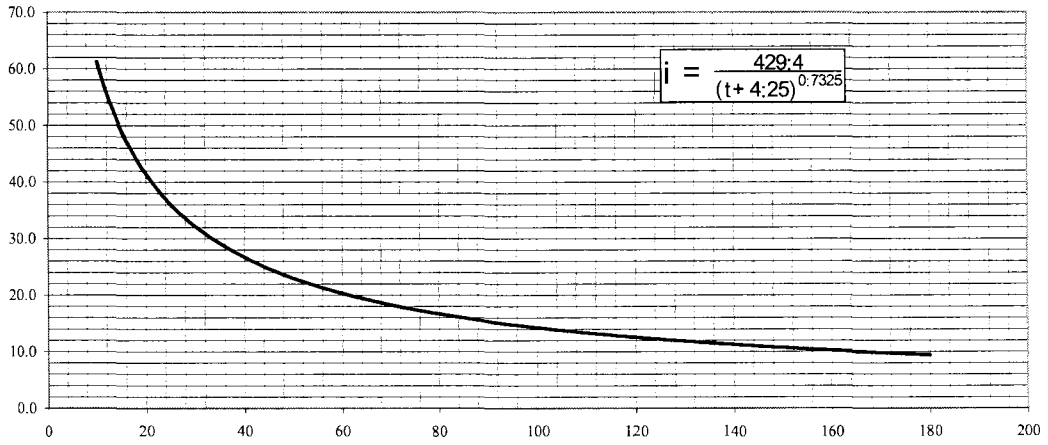
Design Rainfall Equation

Return Interval (years)	a	b	c
2	429.4	4.25	0.7325
5	600.9	4	0.7375
10	726.6	3.94	0.74
20	847	3.94	0.74
50	986.3	3.75	0.7375
100	1092.2	3.66	0.735

$$i = \frac{a}{(t+b)^c}$$

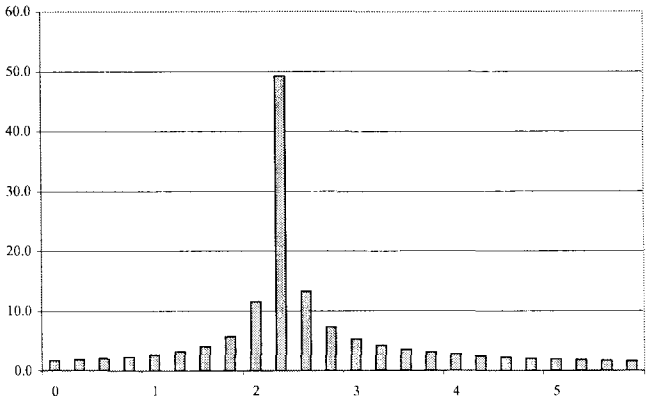
where i = rainfall intensity (mm/hr)
t = rainfall duration (minutes)

2-Year Storm



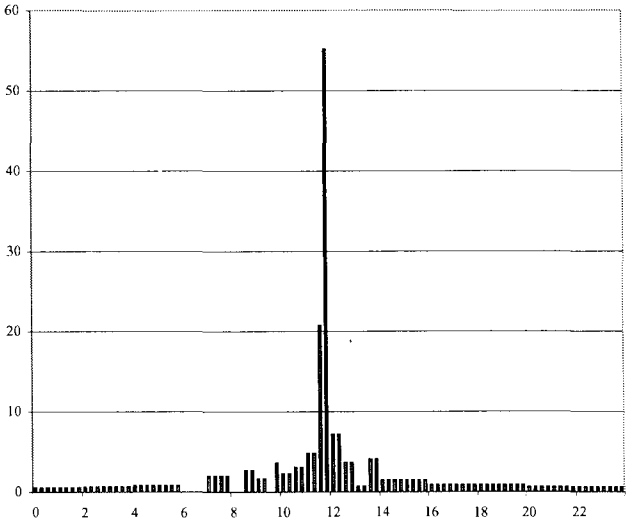
2-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	1.7	3.25	5.2
0.50	1.8	3.50	4.2
0.75	2.0	3.75	3.5
1.00	2.3	4.00	3.0
1.25	2.6	4.25	2.7
1.50	3.2	4.50	2.4
1.75	4.0	4.75	2.2
2.00	5.7	5.00	2.1
2.25	11.5	5.25	1.9
2.50	49.2	5.50	1.8
2.75	13.3	5.75	1.7
3.00	7.3	6.00	1.6

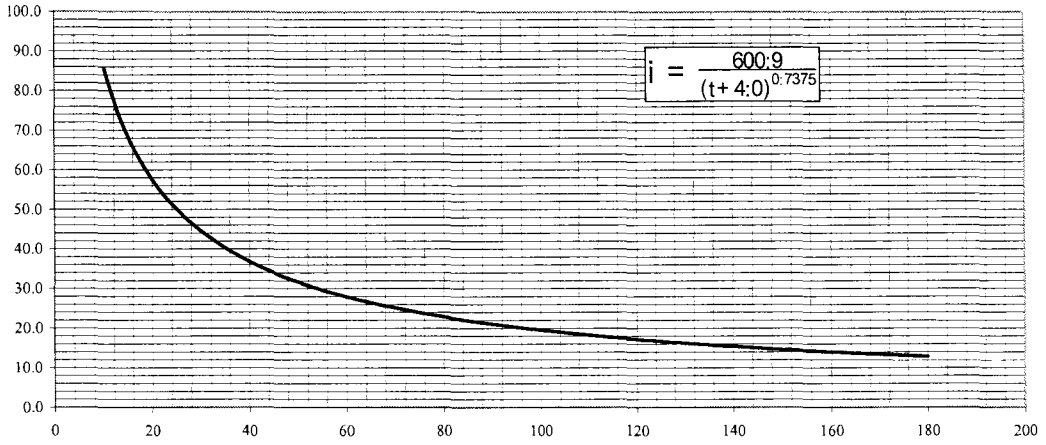


2-Year, 24-hour SCS Storm Hyetograph
15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	0.5	6.25	0.0	12.25	7.2	18.25	0.9
0.50	0.5	6.50	0.0	12.50	7.2	18.50	0.9
0.75	0.5	6.75	0.0	12.75	3.7	18.75	0.9
1.00	0.5	7.00	0.0	13.00	3.7	19.00	0.9
1.25	0.5	7.25	2.0	13.25	0.7	19.25	0.9
1.50	0.5	7.50	2.0	13.50	0.7	19.50	0.9
1.75	0.5	7.75	2.0	13.75	4.1	19.75	0.9
2.00	0.5	8.00	2.0	14.00	4.1	20.00	0.9
2.25	0.6	8.25	0.0	14.25	1.5	20.25	0.6
2.50	0.6	8.50	0.0	14.50	1.5	20.50	0.6
2.75	0.6	8.75	2.7	14.75	1.5	20.75	0.6
3.00	0.6	9.00	2.7	15.00	1.5	21.00	0.6
3.25	0.6	9.25	1.6	15.25	1.5	21.25	0.6
3.50	0.6	9.50	1.6	15.50	1.5	21.50	0.6
3.75	0.6	9.75	0.0	15.75	1.5	21.75	0.6
4.00	0.6	10.00	3.6	16.00	1.5	22.00	0.6
4.25	0.8	10.25	2.3	16.25	0.9	22.25	0.6
4.50	0.8	10.50	2.3	16.50	0.9	22.50	0.6
4.75	0.8	10.75	3.1	16.75	0.9	22.75	0.6
5.00	0.8	11.00	3.1	17.00	0.9	23.00	0.6
5.25	0.8	11.25	4.8	17.25	0.9	23.25	0.6
5.50	0.8	11.50	4.8	17.50	0.9	23.50	0.6
5.75	0.8	11.75	20.8	17.75	0.9	23.75	0.6
6.00	0.8	12.00	55.2	18.00	0.9	24.00	0.6

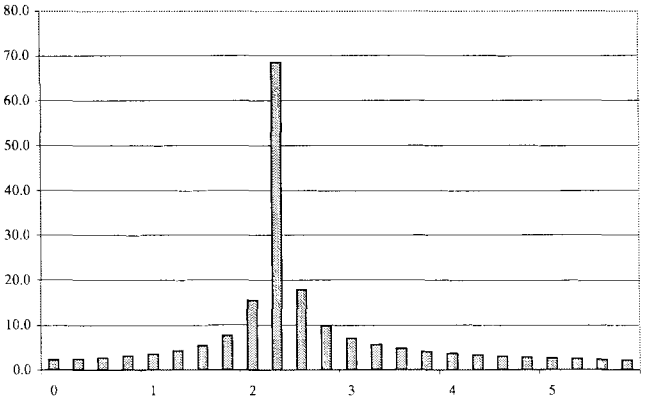


5-Year Storm



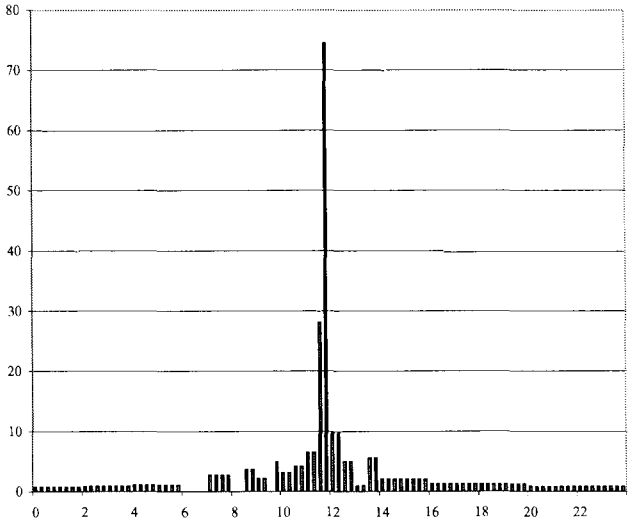
5-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	2.2	3.25	7.0
0.50	2.4	3.50	5.6
0.75	2.7	3.75	4.7
1.00	3.1	4.00	4.1
1.25	3.5	4.25	3.6
1.50	4.2	4.50	3.3
1.75	5.4	4.75	3.0
2.00	7.6	5.00	2.8
2.25	15.5	5.25	2.6
2.50	68.5	5.50	2.4
2.75	17.9	5.75	2.3
3.00	9.8	6.00	2.1

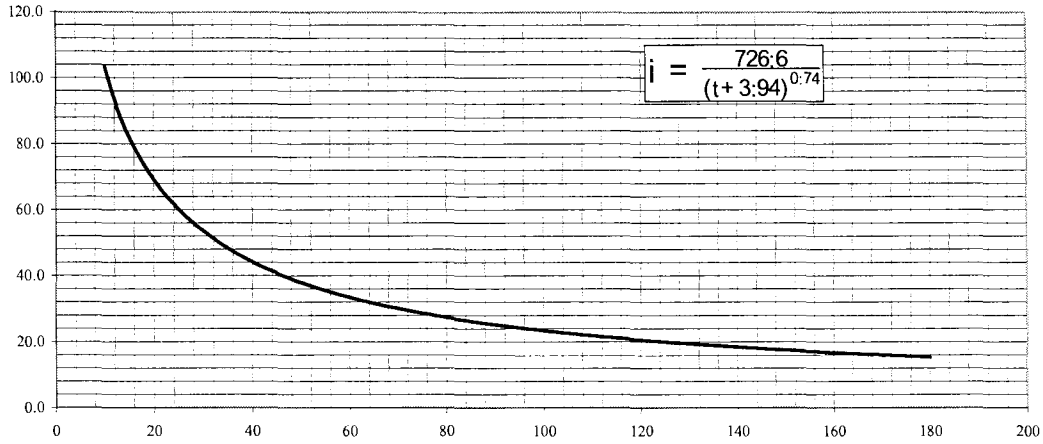


5-Year, 24-hour SCS Storm Hyetograph
15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	0.7	6.25	0.0	12.25	9.7	18.25	1.2
0.50	0.7	6.50	0.0	12.50	9.7	18.50	1.2
0.75	0.7	6.75	0.0	12.75	5.0	18.75	1.2
1.00	0.7	7.00	0.0	13.00	5.0	19.00	1.2
1.25	0.7	7.25	2.7	13.25	0.9	19.25	1.2
1.50	0.7	7.50	2.7	13.50	0.9	19.50	1.2
1.75	0.7	7.75	2.7	13.75	5.5	19.75	1.2
2.00	0.7	8.00	2.7	14.00	5.5	20.00	1.2
2.25	0.9	8.25	0.0	14.25	2.0	20.25	0.8
2.50	0.9	8.50	0.0	14.50	2.0	20.50	0.8
2.75	0.9	8.75	3.6	14.75	2.0	20.75	0.8
3.00	0.9	9.00	3.6	15.00	2.0	21.00	0.8
3.25	0.9	9.25	2.2	15.25	2.0	21.25	0.8
3.50	0.9	9.50	2.2	15.50	2.0	21.50	0.8
3.75	0.9	9.75	0.0	15.75	2.0	21.75	0.8
4.00	0.9	10.00	4.9	16.00	2.0	22.00	0.8
4.25	1.1	10.25	3.1	16.25	1.2	22.25	0.8
4.50	1.1	10.50	3.1	16.50	1.2	22.50	0.8
4.75	1.1	10.75	4.2	16.75	1.2	22.75	0.8
5.00	1.1	11.00	4.2	17.00	1.2	23.00	0.8
5.25	1.1	11.25	6.5	17.25	1.2	23.25	0.8
5.50	1.1	11.50	6.5	17.50	1.2	23.50	0.8
5.75	1.1	11.75	28.0	17.75	1.2	23.75	0.8
6.00	1.1	12.00	74.4	18.00	1.2	24.00	0.8

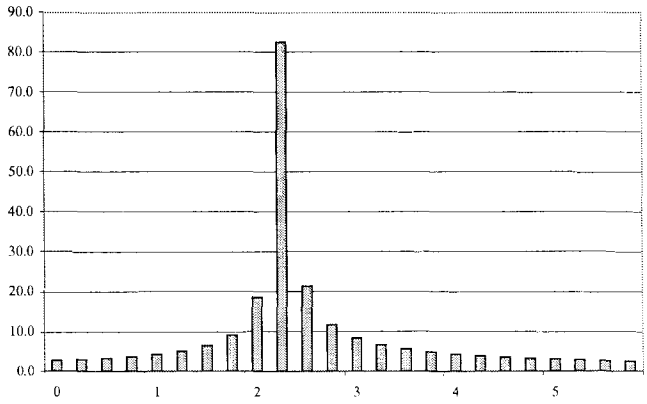


10-Year Storm



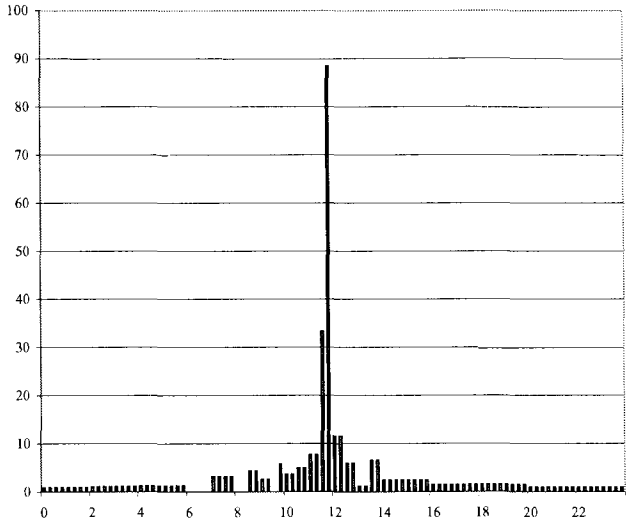
10-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	2.6	3.25	8.3
0.50	2.9	3.50	6.6
0.75	3.2	3.75	5.6
1.00	3.6	4.00	4.8
1.25	4.2	4.25	4.3
1.50	5.0	4.50	3.9
1.75	6.3	4.75	3.5
2.00	9.0	5.00	3.3
2.25	18.5	5.25	3.0
2.50	82.4	5.50	2.8
2.75	21.3	5.75	2.7
3.00	11.6	6.00	2.5

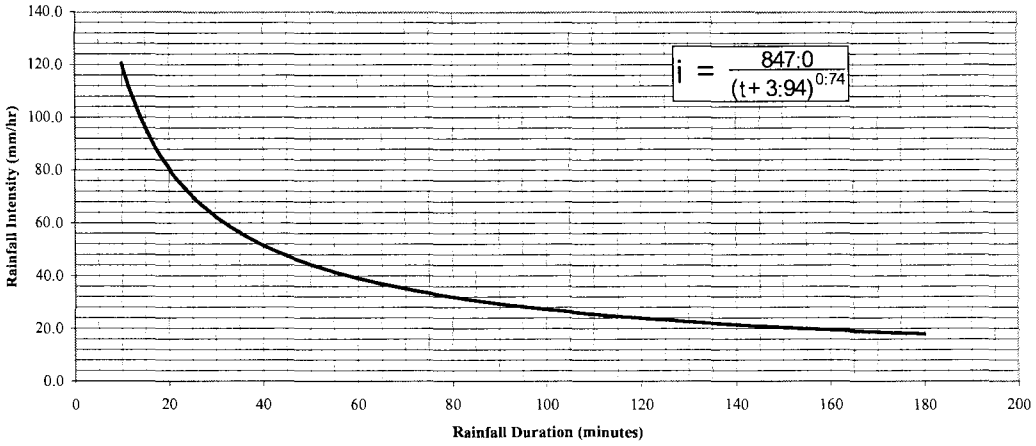


10-Year, 24-hour SCS Storm Hyetograph
15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	0.9	6.25	0.0	12.25	11.5	18.25	1.4
0.50	0.9	6.50	0.0	12.50	11.5	18.50	1.4
0.75	0.9	6.75	0.0	12.75	5.9	18.75	1.4
1.00	0.9	7.00	0.0	13.00	5.9	19.00	1.4
1.25	0.9	7.25	3.2	13.25	1.1	19.25	1.4
1.50	0.9	7.50	3.2	13.50	1.1	19.50	1.4
1.75	0.9	7.75	3.2	13.75	6.6	19.75	1.4
2.00	0.9	8.00	3.2	14.00	6.6	20.00	1.4
2.25	1.0	8.25	0.0	14.25	2.4	20.25	1.0
2.50	1.0	8.50	0.0	14.50	2.4	20.50	1.0
2.75	1.0	8.75	4.3	14.75	2.4	20.75	1.0
3.00	1.0	9.00	4.3	15.00	2.4	21.00	1.0
3.25	1.0	9.25	2.6	15.25	2.4	21.25	1.0
3.50	1.0	9.50	2.6	15.50	2.4	21.50	1.0
3.75	1.0	9.75	0.0	15.75	2.4	21.75	1.0
4.00	1.0	10.00	5.8	16.00	2.4	22.00	1.0
4.25	1.3	10.25	3.7	16.25	1.4	22.25	1.0
4.50	1.3	10.50	3.7	16.50	1.4	22.50	1.0
4.75	1.3	10.75	5.0	16.75	1.4	22.75	1.0
5.00	1.3	11.00	5.0	17.00	1.4	23.00	1.0
5.25	1.3	11.25	7.7	17.25	1.4	23.25	1.0
5.50	1.3	11.50	7.7	17.50	1.4	23.50	1.0
5.75	1.3	11.75	33.3	17.75	1.4	23.75	1.0
6.00	1.3	12.00	88.4	18.00	1.4	24.00	1.0

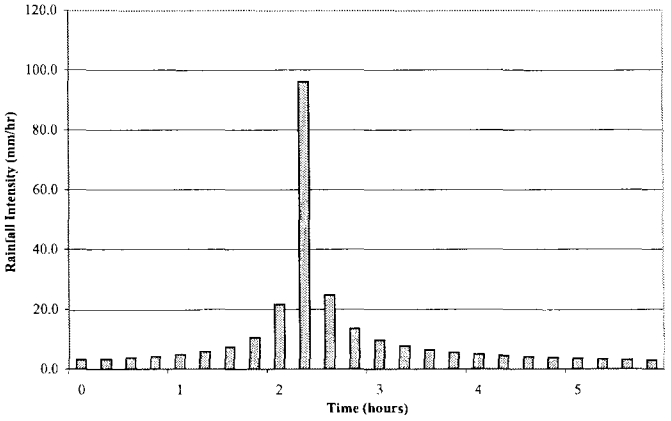


20-Year Storm



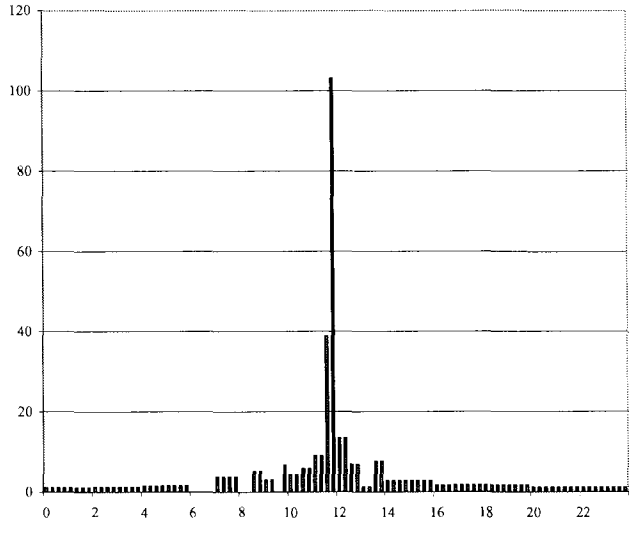
20-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	3.1	3.25	9.7
0.50	3.4	3.50	7.7
0.75	3.7	3.75	6.5
1.00	4.2	4.00	5.6
1.25	4.9	4.25	5.0
1.50	5.8	4.50	4.5
1.75	7.4	4.75	4.1
2.00	10.5	5.00	3.8
2.25	21.5	5.25	3.5
2.50	96.1	5.50	3.3
2.75	24.8	5.75	3.1
3.00	13.6	6.00	2.9

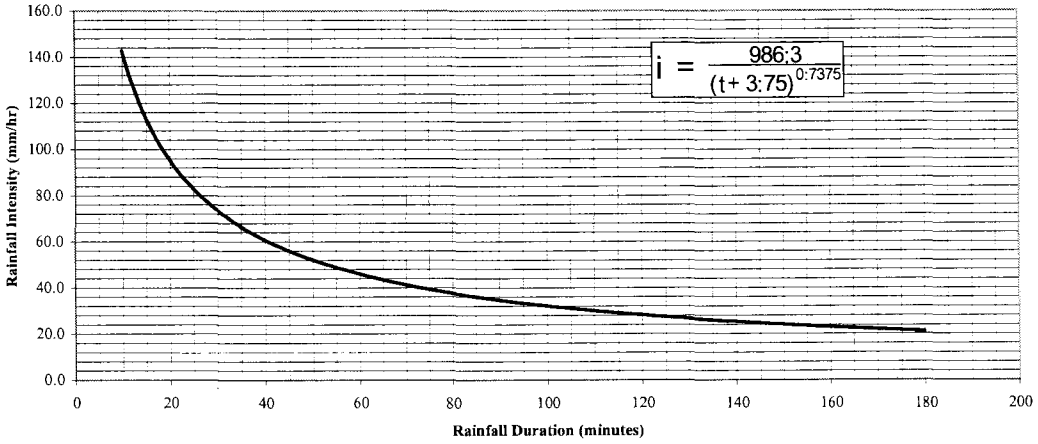


20-Year, 24-hour SCS Storm Hyetograph
15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	1.0	6.25	0.0	12.25	13.4	18.25	1.7
0.50	1.0	6.50	0.0	12.50	13.4	18.50	1.7
0.75	1.0	6.75	0.0	12.75	6.9	18.75	1.7
1.00	1.0	7.00	0.0	13.00	6.9	19.00	1.7
1.25	1.0	7.25	3.7	13.25	1.3	19.25	1.7
1.50	1.0	7.50	3.7	13.50	1.3	19.50	1.7
1.75	1.0	7.75	3.7	13.75	7.7	19.75	1.7
2.00	1.0	8.00	3.7	14.00	7.7	20.00	1.7
2.25	1.2	8.25	0.0	14.25	2.8	20.25	1.1
2.50	1.2	8.50	0.0	14.50	2.8	20.50	1.1
2.75	1.2	8.75	5.0	14.75	2.8	20.75	1.1
3.00	1.2	9.00	5.0	15.00	2.8	21.00	1.1
3.25	1.2	9.25	3.0	15.25	2.8	21.25	1.1
3.50	1.2	9.50	3.0	15.50	2.8	21.50	1.1
3.75	1.2	9.75	0.0	15.75	2.8	21.75	1.1
4.00	1.2	10.00	6.7	16.00	2.8	22.00	1.1
4.25	1.5	10.25	4.3	16.25	1.7	22.25	1.1
4.50	1.5	10.50	4.3	16.50	1.7	22.50	1.1
4.75	1.5	10.75	5.8	16.75	1.7	22.75	1.1
5.00	1.5	11.00	5.8	17.00	1.7	23.00	1.1
5.25	1.5	11.25	9.0	17.25	1.7	23.25	1.1
5.50	1.5	11.50	9.0	17.50	1.7	23.50	1.1
5.75	1.5	11.75	38.8	17.75	1.7	23.75	1.1
6.00	1.5	12.00	103.0	18.00	1.7	24.00	1.1

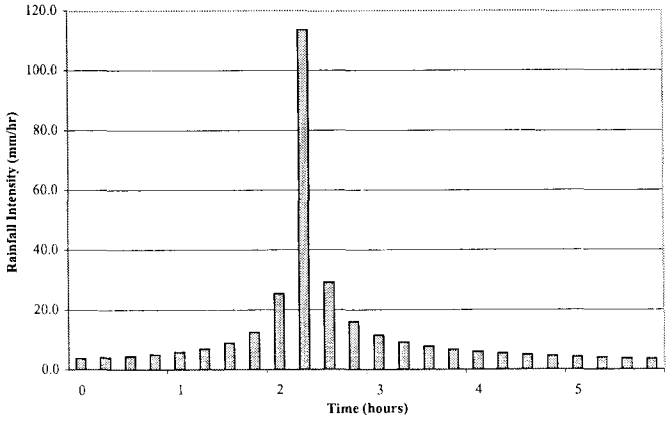


50-Year Storm



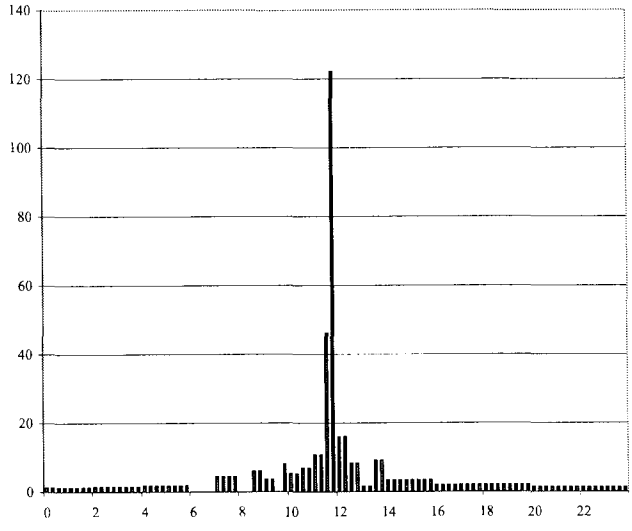
50-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	3.6	3.25	11.5
0.50	4.0	3.50	9.1
0.75	4.4	3.75	7.7
1.00	5.0	4.00	6.7
1.25	5.8	4.25	5.9
1.50	6.9	4.50	5.3
1.75	8.8	4.75	4.9
2.00	12.5	5.00	4.5
2.25	25.3	5.25	4.2
2.50	113.5	5.50	3.9
2.75	29.1	5.75	3.7
3.00	16.0	6.00	3.5

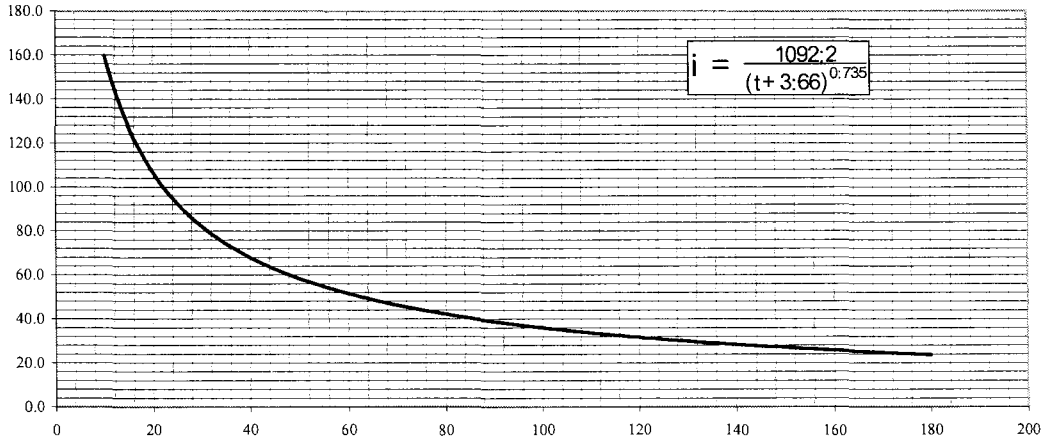


50-Year, 24-hour SCS Storm Hyetograph
15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	1.2	6.25	0.0	12.25	15.9	18.25	2.0
0.50	1.2	6.50	0.0	12.50	15.9	18.50	2.0
0.75	1.2	6.75	0.0	12.75	8.2	18.75	2.0
1.00	1.2	7.00	0.0	13.00	8.2	19.00	2.0
1.25	1.2	7.25	4.4	13.25	1.5	19.25	2.0
1.50	1.2	7.50	4.4	13.50	1.5	19.50	2.0
1.75	1.2	7.75	4.4	13.75	9.1	19.75	2.0
2.00	1.2	8.00	4.4	14.00	9.1	20.00	2.0
2.25	1.4	8.25	0.0	14.25	3.3	20.25	1.3
2.50	1.4	8.50	0.0	14.50	3.3	20.50	1.3
2.75	1.4	8.75	6.0	14.75	3.3	20.75	1.3
3.00	1.4	9.00	6.0	15.00	3.3	21.00	1.3
3.25	1.4	9.25	3.5	15.25	3.3	21.25	1.3
3.50	1.4	9.50	3.5	15.50	3.3	21.50	1.3
3.75	1.4	9.75	0.0	15.75	3.3	21.75	1.3
4.00	1.4	10.00	8.0	16.00	3.3	22.00	1.3
4.25	1.8	10.25	5.1	16.25	2.0	22.25	1.3
4.50	1.8	10.50	5.1	16.50	2.0	22.50	1.3
4.75	1.8	10.75	6.9	16.75	2.0	22.75	1.3
5.00	1.8	11.00	6.9	17.00	2.0	23.00	1.3
5.25	1.8	11.25	10.6	17.25	2.0	23.25	1.3
5.50	1.8	11.50	10.6	17.50	2.0	23.50	1.3
5.75	1.8	11.75	46.0	17.75	2.0	23.75	1.3
6.00	1.8	12.00	122.2	18.00	2.0	24.00	1.3

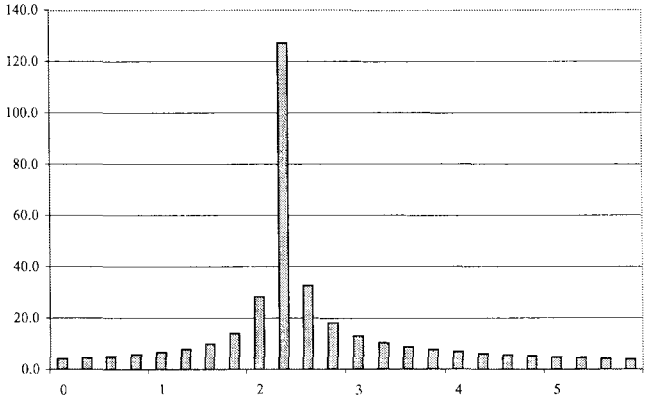


100-Year Storm



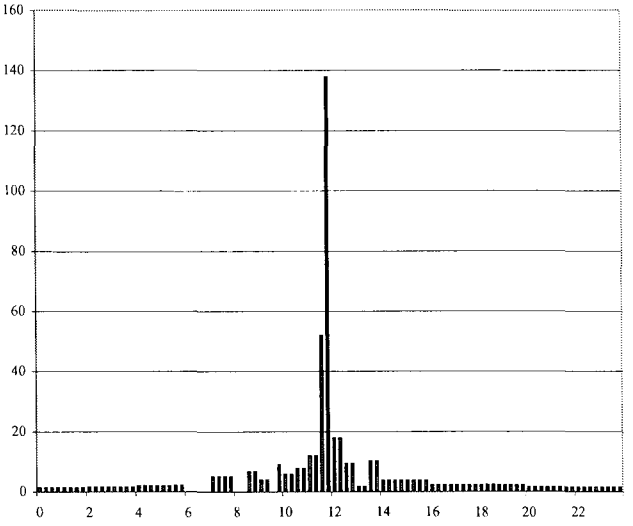
100-Year Chicago Storm Hyetograph
6 hour duration, 15 minute time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	4.1	3.25	12.9
0.50	4.5	3.50	10.3
0.75	5.0	3.75	8.7
1.00	5.7	4.00	7.5
1.25	6.5	4.25	6.7
1.50	7.8	4.50	6.1
1.75	9.9	4.75	5.5
2.00	14.0	5.00	5.1
2.25	28.3	5.25	4.8
2.50	127.1	5.50	4.5
2.75	32.6	5.75	4.2
3.00	18.0	6.00	4.0



100-Year, 24-hour SCS Storm Hyetograph
15 minute time step

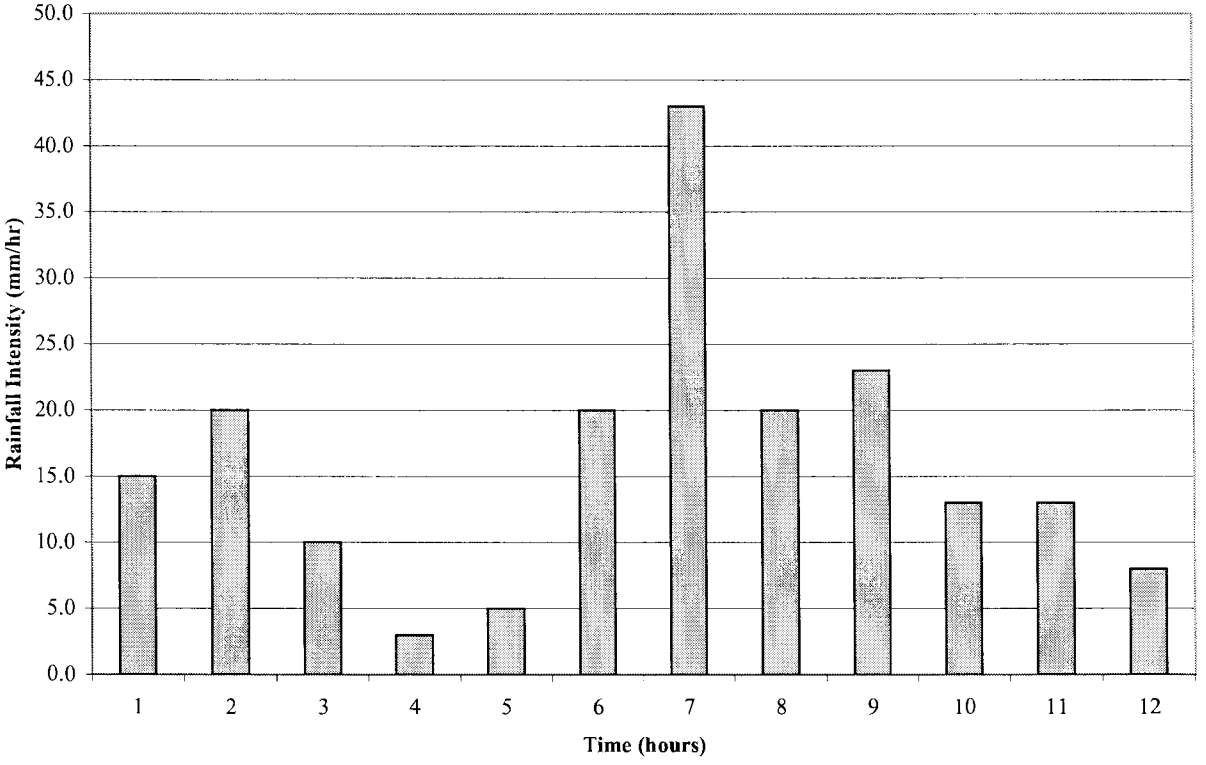
Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
0.25	1.4	6.25	0.0	12.25	18.0	18.25	2.2
0.50	1.4	6.50	0.0	12.50	18.0	18.50	2.2
0.75	1.4	6.75	0.0	12.75	9.2	18.75	2.2
1.00	1.4	7.00	0.0	13.00	9.2	19.00	2.2
1.25	1.4	7.25	5.0	13.25	1.7	19.25	2.2
1.50	1.4	7.50	5.0	13.50	1.7	19.50	2.2
1.75	1.4	7.75	5.0	13.75	10.2	19.75	2.2
2.00	1.4	8.00	5.0	14.00	10.2	20.00	2.2
2.25	1.6	8.25	0.0	14.25	3.7	20.25	1.5
2.50	1.6	8.50	0.0	14.50	3.7	20.50	1.5
2.75	1.6	8.75	6.7	14.75	3.7	20.75	1.5
3.00	1.6	9.00	6.7	15.00	3.7	21.00	1.5
3.25	1.6	9.25	4.0	15.25	3.7	21.25	1.5
3.50	1.6	9.50	4.0	15.50	3.7	21.50	1.5
3.75	1.6	9.75	0.0	15.75	3.7	21.75	1.5
4.00	1.6	10.00	9.0	16.00	3.7	22.00	1.5
4.25	2.0	10.25	5.7	16.25	2.2	22.25	1.5
4.50	2.0	10.50	5.7	16.50	2.2	22.50	1.5
4.75	2.0	10.75	7.7	16.75	2.2	22.75	1.5
5.00	2.0	11.00	7.7	17.00	2.2	23.00	1.5
5.25	2.0	11.25	12.0	17.25	2.2	23.25	1.5
5.50	2.0	11.50	12.0	17.50	2.2	23.50	1.5
5.75	2.0	11.75	51.9	17.75	2.2	23.75	1.5
6.00	2.0	12.00	137.8	18.00	2.2	24.00	1.5



Timmins Storm

Timmins Storm
1 hour time step

Time (hours)	Rainfall Intensity (mm/hr)	Time (hours)	Rainfall Intensity (mm/hr)
1.00	15.0	7.00	43.0
2.00	20.0	8.00	20.0
3.00	10.0	9.00	23.0
4.00	3.0	10.00	13.0
5.00	5.0	11.00	13.0
6.00	20.0	12.00	8.0



SHORT DURATION RAINFALL INTENSITY - DURATION FREQUENCY DATA FOR SUDBURY RAIN GAUGES
BASED ON RECORDING RAIN GAUGE DATA FROM SUDBURY AIRPORT FOR THE PERIOD - 1971 - 2001
BASED ON RECORDING RAIN GAUGE DATA FROM SUDBURY SCIENCE NORTH FOR THE PERIOD - 1959 - 1970