Université de Montréal

Pure Water in the City
Covering the Reservoirs on Mount Royal

Par

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Mémoire présenté à la Faculté des études supérieures
en vue de l'obtention du grade de
Maîtrise ès sciences appliquées (M.Sc.A.) en aménagement
(option conservation de l'environnement bâti)

Avril, 2002

Université de Montréal
Faculté des études supérieures

Ce mémoire intitulé :

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Covering the Reservoirs on Mount Royal**

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RÉSUMÉ

La question du pourquoi et du comment l'eau a disparue du paysage urbain est explorée dans cette étude des réservoirs à ciel ouvert du système d'approvisionnement en eau potable de la ville de Montréal. Une étude de cas de trois réservoirs, le McTavish (à ciel ouvert de 1856 à 1948), Côte-des-Neiges (de 1893 à 1938) et Vincent d'Indy (de 1915 à 1964), considère comment la forme et la fonction des réservoirs ont changé, alors qu'évoluaient les rapports entre facteurs environnementaux, moyens technologiques et préoccupations sociales dans la ville en croissance. Répondant aux avantages et défis de la topographie urbaine, ces réservoirs ont été construits sur les flancs du mont Royal. Le potentiel offert par ces réservoirs d'élargir le noyau de conservation de la montagne est exploré dans une reconsidération de leur situation dans la ceinture de sites institutionnels qui circonscrivent le cœur de ce principal paysage naturel et culturel de la ville.

Un virage dans les développements de l'aqueduc, passant des questions quantitatives à des questions qualitatives, relié à la montée des perspectives de la santé publique et de l'environnement, était à l'origine du mouvement de couvrir les réservoirs. Toutefois, le coût élevé de la reconstruction des basins en boîtes de béton armé recouvert de pelouse et l'absence de règlements exigeant des toits sur les réservoirs, ont mené à des délais de plusieurs décennies. Par ailleurs, dans la ville en pleine expansion, l'augmentation de la capacité de stockage d'eau demeurait au moins aussi importante que la garantie de la qualité de l'eau. L'éthique d'efficacité qui en résulta est traduite dans les paysages des réservoirs transformés, pour lesquels les fonds et l'aménagement furent négligeables.

Des conséquences imprévues mais cruciales de cette transformation sont examinées : la dissociation de l'approvisionnement d'eau de l'écosystème urbain; la perte de visibilité de l'aqueduc; la reconnaissance réduite de sa valeur collective; la responsabilité ambiguë de ces espaces ouverts et, comme conséquence, un manque d'entretien; la dissimulation de l'aqueduc et d'autres fonctions techniques dans le paysage de la montagne et le manque d'intégration des réservoirs dans les plans de conservation de la montagne.

Mots clé: Réservoirs d'eau potable- Histoire- Conservation- Mont Royal- Paysage

SUMMARY

The questions of how and why water has disappeared in the urban landscape are explored in this study of the uncovered reservoirs of the Montreal water supply system that were destined to be covered. A case study of three reservoirs, the McTavish (open from 1856 to 1948), the Côte-des-Neiges (from 1893 to 1938), and the Vincent d'Indy (from 1915 to 1964), considers how the form and function of these reservoirs changed, as the relationship between environmental factors, technological means and social concerns evolved in the developing city. In response to advantages and challenges of the city's topography, the reservoirs were built on the flanks of Mount Royal. The potential the reservoirs offer to expand the mountain's conservation core is explored in a reconsideration of their situation within a belt of institutional properties that delimit the heart of this principal natural and cultural landscape of the city.

A shift in the focus of water supply development from quantitative to qualitative concerns, related to the rise of both public health and environmental perspectives, was a principal incentive to covering water supply reservoirs. Nevertheless, the expense of rebuilding the basins as reinforced concrete boxes covered in earth and sod, and the lack of regulations requiring covers on all reservoirs, lead to the process being delayed for decades. Furthermore, the city was in full expansion throughout this period, so that the pressure to increase the capacity of water storage rivalled that of guaranteeing water quality. The resulting focus on efficiency is embodied in the landscapes of the transformed reservoirs, in which little funds or planning resources were invested.

Certain unplanned but critical consequences of this transformation are examined: the disassociation of water supply from the urban ecosystem; the loss of visibility of the waterworks; the decreased recognition of their collective value; the confusion about responsibility for these open spaces and a related lack of upkeep; the concealment of water supply and other technological functions in the mountain landscape; and the lack of integration of the reservoir sites in plans for the mountain's conservation.

Key words: Water supply reservoirs-History-Conservation-Mount Royal-Landscape

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LIST OF ABBREVIATIONS

AWWA	American Water Works Association
ANQ- Viger	Archives Nationales du Québec- Viger Building
BAPE	Bureau des audiences publiques sur l'environnement
BNQ- AF/Holt/ SS	Bibliothèque Nationale du Québec - Aégidius-Fauteux/ Holt/ Saint Sulpice Buildings
CDN	Côte-des-Neiges
CCMPBC	Comité consultatif de Montréal pour la protection des biens culturels
CUM	Communauté Urbaine de Montréal
EP	Bibliothèque de l'École Polytechnique de Montréal
MU-BL	McGill University Library- Blackader-Lauterman
MU-PSE	McGill University Library- Physical Sciences and Engineering
MU-MR	McGill University Library- McLennan-Redpath
MW & P Co.	Montreal Water and Power Company
MWW	Montreal Water Works
UM-AM	Université de Montréal- Bibliothèque d'aménagement
UM-LSH	Université de Montréal- Bibliothèque des Lettres et Sciences humaines
USEPA	United States Environmental Protection Agency
VDI	Vincent d'Indy
VM-GDA	Ville de Montréal- Gestion des documents et des archives
VM-SHDUM	Ville de Montréal- Service de l'habitation et du développpement urbain
VM-SI	Ville de Montréal- Service des immeubles
VM-TP	Ville de Montréal- Travaux publics

ACKNOWLEDGEMENTS

The research and writing of this mémoire would not have been as enjoyable or worthwhile, without the support of a great many individuals and organisations:

- Sylvia Dowd, who generously lent me the personal papers of her father, Francis V. Dowd, third generation waterworks man, and brought history alive to me through many of her own memories of waterworks related events.
- Dany Fougères, the generous historian of the Montreal waterworks, who helped me to develop my subject, to grasp the archival material involved and not the least, share an unusual passion for the hidden world of urban infrastructure.
- The professors that taught and inspired me in the last three years, in particular Susan Bronson, Michèle Dagenais and Jean-Claude Marsan. Jean-Claude Marsan, my research director, deserves a special remark for his patience, encouragement and faithful belief in me. Together with co-director Peter Jacobs, their constructive comments and questions guided me towards a much clearer path.
- Daniel Chartier of the city's park services and Michel Gagné of the public works department, who encouraged me to believe that this research would be needed.
- My colleagues at Les Amis de la montagne and Le Centre de la montagne, with whom I explored many other sides of the mountain and shared many enjoyable Smith House lunchtimes after days of solitude in writing. I particularly appreciated being given the opportunity to test my preliminary results in a public conference organised by the Centre.

On a more personal level, there are very many friends on two continents who by sharing my interest in water, in the urban landscape and the history of Montreal, Berlin, and many other cities, inspired me to take this interest seriously. Their influence and encouragement is interwoven throughout the text.

My family has been my most constant and helpful support throughout this adventure. This mémoire is dedicated to the memory of my father Milton John Ross (1929-2001).

INTRODUCTION

This study began as a query about the absence of water in the modern urban landscape, which lead to an investigation into how and why water has disappeared in the city. Current harbour, canal and river rehabilitation projects illustrate a renewed interest in seeing and enjoying water in the city. At the same time, in older cities like Montreal, the dilapidated state of centenary waterworks call for major reinvestment in their upkeep or replacement.[1] Altogether it is time to reconsider the impact of industrialisation on the urban landscape, of this period that brought great change in the places and forms of water in the city: as river and lake fronts became docks and harbour fronts, streams and creeks became canals and sewage conduits, and underground pipes that brought water into every house and property replaced the fountains or wells at the centre of public spaces.

Water supply systems represent a particular series of problems and perspectives to reconsider. In contrast with many other functions developed in the industrial era that have lost their importance or original function, the vital role of waterworks for the city has actually intensified. Furthermore, as private wells and smaller separate systems were abandoned, the essential character of the public or municipal system increased. Incorporating constant technological developments, increasing standards and changes of municipal borders, the water supply systems of older larger cities are rarely preserved in earlier historical forms. The forms of the resulting sites illustrate the evolution of the waterworks in relation to the city's growth.

At the same time, water itself has changed. Once sufficient sources of water for collective supply were found, and productive pumps were put into place to ensure the large quantities of water now required, emphasis shifted to obtaining better water quality. The increased understanding of the relationship between water quality and public health, and eventually that of the environment, lead to standards that seek to control the quality of the

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[1] The most recent studies suggest $1,6 billion will have to be invested over the next twenty years. "20 year plan to fix city's water network," *The Gazette*, March 30, 2002, A3; Bureau d'audiences publiques sur l'environnment (BAPE), *L'eau, une resource à protéger, à partager et à metre en valeur, Rapport de la Commission sur la gestion de l'eau*, tome II, (Québec: Gouvernement du Québec, 2000), 96-98; Ville de Montréal, *La gestion de l'eau à Montréal (Livre Vert),* (Montréal: Ville de Montréal, 1996), 14-15.

water produced. In order to meet these standards, the increasingly polluted natural sources of water were filtered and treated in an armada of chemical and mechanical processes. The end result was what we now call “pure” water. But water treatment and quality control were not enough to satisfy the quest for pure water. The focus on purity also had an impact on the presence of water in the landscape. Once water started to be transformed and improved it became important to protect it; water was now an expensive product in itself. The visible presence of pure water in the city disappeared, existing only within the controlled environment of the water supply system.

For a long time the reservoirs of the modern water supply’s distribution system remained a weak link in the effort to control water quality. Before environmental pollution was recognised as a concern, the reservoirs of the older large cities of North America were built as open basins. Often built directly in excavated rock with minimal waterproofing, such reservoirs were as likely to admit ground water and to accumulate rain or snow as to contain treated water intended for consumption. These huge structures were expensive to rebuild as waterproof containers, and so there were long delays before they were finally covered. By covering the open reservoirs, not only was water quality control improved, but the city also lost a visible collective water element as part of its supply system, and a relatively large visible water surface disappeared from the landscape.

This is what happened in Montreal, where three of the city’s covered reservoirs are on sites once occupied by open basins. This study proposes to explore how and why these open reservoirs were covered, in order to understand the factors and reasons that lead to the disappearance of one of the collective forms of water in the urban landscape. Although it is evident that protecting pure water from the dangers of a contaminating environment was critical, it took over fifty years to cover the reservoirs. In the absence of standards or regulation requiring that all open reservoirs be covered, the decision to do so would be based on accumulation of factors that were not all related to water quality.

The reservoirs considered in this study are located on Mount Royal. The mountain is a principal landscape element of the city, whose elevation provided the opportunity to situate the earliest of the city’s major reservoirs above the city, and thus to profit from gravity for distribution. As the city grew, and moved up the hill and all around the reservoirs, pressures of different kinds lead to the open reservoirs being rebuilt as solid concrete boxes buried under earth and covered in grass. The function of these sites was partly concealed, and the associated pumping stations became the most prominent symbols of the waterworks on the mountain.

In recent times, the battle to conserve the mountain's natural features has tended to pit nature against the more technological forms of the city's development. Antennas and automobiles have invaded a protected natural environment, representing the encroachment of the city within the mountain's green core. The reservoirs are elements of an essential function whose technological development has also had an impact on this environment. Looking at the reservoirs within the mountain landscape challenges us to rethink our relationship to technology in such a context. Covered basins of treated water are one of the particular forms we have given to nature in the city. Through our continued use of the river as source and outlet, the water supply system remains interconnected with the larger eco-system. Looking at the function of the reservoirs within the context of the mountain's defended landscape could thus help us better understand the dynamic relationship between the environment, technology and society.

The study is divided into five principal parts, which will focus on the development of an approach to the landscape of water supply, a description and history of the Mount Royal reservoirs, an analysis of the reasons why the reservoirs were covered, a brief consideration of factors that had a major impact on their reconstruction, and finally a suggestion of the unplanned consequences of covering the reservoirs on the landscape.

The interest in considering the evolving story of the form and function of the reservoirs on Mount Royal is threefold:

- To explore how our relationship to water has changed in the city. In particular, how the introduction of water quality standards that lead to water being transformed into a product "purer" than the water found in nature itself, may have contributed to the disconnection of nature and the city.

- To help understand the nature of the decisions embedded in the resulting landscape of the waterworks. In particular, how decisions that took place in the shift of emphasis from water quantity to water quality, may have lacked consistent reasoning, but still had important, if unplanned repercussions on the landscape.
- To help understand the place of the reservoirs in their actual form in the context of Mount Royal landscape, and in particular, the potential they might offer to revaluate the relationship between technology and nature in the city.

By linking urban history and urban ecology, it is hoped to strengthen our understanding of the relationship of heritage conservation to natural conservation, and to stimulate our sense of how the strategies of each can work together.

CHAPTER I
The landscape of water supply

Before looking specifically at the Mount Royal reservoirs and how and why their particular landscapes evolved, certain broader questions that are raised by this study should be addressed. How has the landscape perspective been addressed in historical studies of urban water supply? What has been written about how and why the place of water in the city has evolved? What do conservation studies on related subjects suggest are the values particular to waterworks to consider in further planning for these sites?

1. 1 Literature review

Readings of a broad range of texts, intended to help understand these questions, have helped developed the study's analytical structure. They can be divided into three sections: histories of water supply, works that consider the evolving place of water in the city, and works that help situate the waterworks within conservation studies and planning.

1.1.1 The landscape perspective in histories of urban water supply

Within Montreal, Canadian and larger contexts, the history of urban water supply has only recently begun to be addressed.[2] Studies of the built heritage of specific water supply systems are rare. In the Canadian context, the interest of looking at a specific landscape of water supply has been suggested by Steven Mannell's study of the R.C. Harris Filtration Plant in Toronto, which connects architectural and landscape forms to the engineering process of this major site of Canadian public works history.[3] None of the major sites of the Montreal waterworks have been the subject of an equivalent study. Existing studies have mainly considered the architectural character of the pumping stations.[4] The urban network that connects and gives meaning to all the pumping stations

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[2] The first and still the only broad study is Letty Anderson, "Water Supply," in *Building Canada, A History of Public Works,* Ed. Norman Ball, (Toronto: Toronto University Press, 1988), 195-220.

[3] Steven Mannell, "The Palace of Purification," *Journal of the Society for the Study of Architecture in Canada*, 24.3 (1999): 18-26.

[4] Giulio Maffini, *The McTavish Pumphouse*, student paper for "Arch 4", (Montreal: McGill University, 1970), n.p. Archives of Blackader Library; Guy Pinard, "L'aqueduc de Montréal," "L'usine

and filtration plants is generally neglected. How these sites function as large-scaled engineered landscapes has yet to be explored.

Heather Campbell's study of the McTavish reservoir site offers a phenomenological interpretation of one of the Montreal's principal water supply landscapes.[5] Her use of cognitive mapping "to reappropriate (sic) … an ambiguous and contradictory site like the Waterworks imposed on the land within a dominant instrumentalism" suggests one approach to dealing with the visible landscape of the waterworks. It also reveals the difficulties of interpreting such a site without sufficient historical documentation.[6] In particular, the technical function of the site is misinterpreted, e.g. it is assumed that the reservoir's original function was a response to epidemics and then suggested that this is somehow obsolete. Recognition that the site's pumps and reservoirs continue to serve a vital but changed role in the distribution of the city's water supply is also lacking. Without reference to the long series of changes in form and function to the site over its century and a half history, the attempt to analyse and criticize a suggested technological bias to the site's development remains instinctive and lacks conviction.

The principal reference for the early history of the Montreal waterworks is Dany Fougères' recent study of the establishment of the municipal service from 1796 to 1865.[7] Demonstrating that the history of the water supply of Montreal is of particular interest because of the precocity of attempts at providing collective supply, and the complexity of the evolving framework of municipal power in relation to the development of public

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Atwater de l'aqueduc de Montréal," "Les stations de pompage de l'aqueduc," in *Montréal: Son histoire, son architecture,* volume 3, (Montréal: La Presse, 1989), 339-386.

[5] Heather Robin Campbell, *The Montreal McTavish Waterworks, An Accidental Sacred Site,* (Montreal: Concordia University, Department of Art History, Thesis, 1997).

[6] Her principal reference for the history of the waterworks is the 5 page history in F. Clifford Smith, *The Montreal Water Works, Its History Compiled from the Year 1800 to 1912,* (Montreal: no publisher, April 1913), an important if unreferenced document with information now being verified and revised in current studies. E.g. In Smith's time, the focus on public health was clear, whereas at the time that the McTavish was first built (1853-56) the focus was on fire-fighting and street cleaning.

[7] Dany Fougères, *Histoire de la mise en place d'un service urbain public: l'approvisionnement en eau potable à Montréal, 1796-1865*, (Montréal: UQAM-INRS Urbanisation, Département d'études urbaines, Thèse, 2001).

supply, this study presents highly valuable social and technical history, and unearthed archival resources to which this study has referred extensively.

Fougères' objectives did not however include documenting the related built forms of this period, which include the McTavish reservoir, one of the three this study considers. All the same, many of the themes developed in his analysis, including the importance of the original geographic context of the city, and the challenges of planning within an evolving unplanned context, are critical to developing a framework of this study's questions about the related landscape.

> Le service montréalais -ses composantes, du site de prélèvement de l'eau à la distribution en réseau- devait d'abord épouser et/ou confronter le territoire donné, c'est à dire sa topographie et le potentiel hydrologique qu'il renfermait. Ce territoire constitue la toile de fond sur laquelle le service se déploie et sa principale règle de jeu.[8]

To Fougères' demonstration that the early history of the Montreal waterworks is rich in social and technical questions, this study's questions suggest these early attempts and complex frameworks left a lasting impact on the built environment. The landscape question can help develop an environmental perspective to compliment the social and technological perspectives upon which Fougères' analysis is built.

Another principal study on the history of the Montreal waterworks is Ginette Gagnon's enquiry into the period from 1890 to 1914, when the need for water purification was established.[9] Her documentation of the rise of emphasis on water purity in relation to public health concerns is of particular interest for this study, as is her account of the developing importance of the perspectives of both hygienists and sanitary engineers within the city's institutions, and her references to the role of the private water companies that continued to serve parts of the city and its suburbs up until 1927. Her analysis of this critical period in the history of the system's development suggests that there has generally been a bias in favour of expansion rather than improvements, or an emphasis on

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[8] Fougères, *Histoire*, (2001), 46-47.

[9] Ginette Gagnon, *L'aqueduc de Montréal au tournant du siècle (1890-1914): l'établissement de la purification de l'eau potable*, (Montréal: Université de Montréal, Département d'histoire, mémoire, 1998).

increasing the quantity of water available (including water storage capacity) even when it was clear that improving water quality was essential for public health.[10] The state of disrepair of the existing reservoirs is related to demands for increased capacity.[11] The decisions to invest in works that resolved water quality problems only followed a crisis.[12]

Despite a few other valuable studies on specific periods or perspectives of the history of water supply in Montreal, there remains no complete picture of the system's physical development as the city grew and technologies and standards evolved.[13] There are in fact few all-inclusive studies of the water supply system of individual cities, throughout their history, and including the question of their built form.[14] Histories of water supply technologies tend to highlight only a specific period in each city's history.[15] In fact, the combined physical and social contexts of each city are unique enough to have played a significant role in each system's development. As a result, each city's system presents a unique landscape of accumulated sites.

Concerned as they are with municipal, technical and public service history, or possibly social geography, historical studies of the water supply of specific cities have not yet

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[10] Gagnon, *L'aqueduc…,* (1998), 165.

[11] Gagnon, *L'aqueduc…,* (1998), 18.

[12] A crisis/decision cycle is also suggested in Dany Fougères, "Le public et le privé dans la gestion de l'eau potable à Montréal depuis le XIXe siècle," in *L'eau, l'hygiène publique et les infrastructures*, Louise Pothier (dir.), (Montréal: Groupe PGV, collection Mémoires vives, 1996) 47-63.

[13] Louise Pothier, "Réseaux d'eau potable et d'eaux usées, l'hygiène publique dans la société montréalaise (1642-1910)" in *L'eau, l'hygiène publique et les infrastructures*, Louise Pothier (dir.), (Montréal: Groupe PGV, collection Mémoires vives, 1996) 25-45; Poitras, Claire. "Construire les infrastructures d'approvisionnement en eau en banlieue montréalaise au tournant du XX e siècle; le cas de Saint-Louis."*Revue d'histoire de l'Amérique français* 52.4 (printemps 1999): 507-531.

[14] Laure Beaumont-Maillet, *L'eau à Paris*, (Paris: Hazan, 1991) covers the entire history of the Paris water supply systems, including most of the major sites. More typically, covering only the earlier periods of New York and Philadelphia are Gerard T. Koeppel, *Water for Gotham, A History,* (Princeton (N.J.), Princeton University Press, 2000) and Tuomi Forrest, *Clean Green Machine: Philadelphia's Fairmount Water Works, 1800-1860,*< http://xroads.virginia.edu/~CAP/WW/home.html>, (22/11/00).

[15] Nelson Manfred Blake,*Water for the Cities, A History of the Urban Water Supply Problem In the United States,*(Syracuse (NY): Syracuse University Press, 1956); F. L. Small, *The Influent and the Effluent, The History of Urban Water Supply and Sanitation*, (Saskatoon: Modern Press, 1974); Letty Anderson, "Water Supply," in *Building Canada, A History of Public Works,* Ed. Norman Ball, (Toronto: Toronto University Press, 1988) 195-220.

fully engaged the impact of geographic context, the physical patterns and the built forms of water supply.[16] But starting at the largest geographic scale, the importance of the development of water supply within a specific physical environment is clear. The history of larger cities often contains the story of parallel systems that would eventually converge as city and suburbs merge.[17] Climate, which transforms a city's hydrological situation throughout the year, is rarely mentioned, except with regards to extreme conditions like the Canadian arctic.[18]

This very brief overview has shown that the landscape perspective is all but absent from histories of urban water supply, in particular those about Montreal, that have mainly considered social and technological developments. A significant new overview of the history of urban sanitation by Martin V. Melosi, suggests how a third, environmental perspective, should also be considered, a perspective that introduces questions about water supply that reflect both the natural processes it depends on and the evolving relationship of society to the environment.[19] The environmental perspective suggests the necessity of seeing the entire sanitation pattern of the city, including water supply, sewages, drainage and waste disposal, as part of the interconnected urban eco-system.

1.1.2 The evolving place of water in the industrialised city

The neglect of the physical landscape of water supply in historical studies is perhaps not so surprising. The water supply system of a large modern city is part of the underground world of urban infrastructure that occupies kilometres of conduits concealed beneath the city's streets. These underground forms take advantage of the ground as substructure and

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[16] Paul-André Linteau, *Maisonneuve ou comment des promoteurs fabriquent une ville, 1883-1918*, (Montréal: Boréal Express, 1981), 123-146; John Hagopian, "The Political Geography of Water Provision in Paris, Ontario, 1882-1924," *Urban History Review*, 23.1 (November 1994): 32-51; Claire Poitras, "Construire les infrastructures…", (1999): 507-531.

[17] W.V. Aird, *The Water Supply, Sewerage and Drainage of Sydney*, (Sydney: Metropolitan Water Sewerage and Drainage Board, 1961); Ann Durkin Keating, "Many Systems: Water Provision in Nineteenth Century Chicago," in *Water and the City: The Next Century,* Ed. Howard Rosen and Ann Durkin Keating, (Chicago: Public works Historical Society, 1991): 91-104.

[18] Letty Anderson, "Water Supply," (1988), 216.

[19] Martin V. Melosi, *The Sanitary City, Urban Infrastructure in America from Colonial Times to the Present*, (Baltimore: The John Hopkins University Press, 2000).

insulation, and the logic of following the pattern of streets to connect to and serve every property in the city.[20]

The discreet presence of water supply in the public domain belies the radical transformation of the urban landscape that it brought about. Universal water supply contributed to the disappearance of water itself from the urban landscape. In the modern city water mainly flows below the ground in built forms, alongside storm water and sewage conduits built to canalize creeks and channel away the increasing quantities of water consumed in the industrialised city.[21] The advantages of the underground systems are balanced by certain disadvantages: the possibility of pipe breakage in poorly built or maintained roads, the difficulty of detecting and repairing defects, and not the least, the greatly diminished presence of water in the city.

Alongside the physical changes to the urban landscape, the hidden infrastructure of the modern sanitary city introduced the framework for a whole series of changes in the social landscape: from the privatization of water usage to the promotion of a domestic and bodily hygiene ethic.[22] These changes are expressed discretely throughout the built landscape in functions that exploit and integrate water supply in every aspect of public life.[23] The consequences of the development of modern urban water supply have been profound, transforming our relationship to nature and a whole series of rituals of public and private life. Although water supply systems generally represent the earliest and some of the most important collective municipal investments, practically defining the origins of public works, the human relationship to water has become increasingly private, even hidden, as many water functions disappeared from the public domain.[24] Few traces

[20] Sabine Barles et André Guillerme, *L'urbanisme souterrain*, (Vendôme: Collection que-sais-je, Presses universitaires de France, 1995), 22-23.

[21] Anne Whiston Spirn, *The Granite Garden, Urban Nature and Human Design,* (New York: Basic Books, 1984), 130.

[22] Jean-Pierre Goubert, *La conquête de l'eau, L'avènement de la santé à l'âge industriel*, (Paris: Hachette, 1986), 65-96, 171; Ivan Illich, *H2O, Les eaux de l'oubli,* (Paris: Lieu Commun, 1988 (1985)), 137-145.

[23] Asa Briggs, *Victorian Cities,* (Berkeley, Ca.: University of California Press, 1993 (1963)), 16.

[24] Goubert, *Conquête*, (1986), 77-96.

remain of the celebrations of nature or civic pride once associated with collective fountains, the symbolic expression of deep-rooted social patterns now replaced by the individual domestic equipment that is considered essential to modern standards of living.

One of the consequences of this hidden landscape of water usage is that our perception of the relationship between water supply and the natural water cycle has been dulled.[25] Water supply is now part of a completely controlled environment. This can be related to the broader development of controlled climates as an ideal: air-conditioned work and living spaces, interior swimming pools, greenhouses, all emphasize the possibility of overcoming natural climate and conditions. Out of doors, pesticides and machinery make it possible to manicure the landscape as carefully as an interior space. In this context, a perfectly controlled water supply, in terms of taste, smell and temperature, even if it was dependant on chemical treatment, developed as an ideal. That chemicals could be unhealthy was not initially a concern. (**Figure A.25**, page XXIV in Appendix 1).[26]

Perhaps in reaction to this controlled relationship to water and nature in general, there is a renewed human need for a relationship to water as part of nature, and the insight that experiencing water in the open environment brings to the meanings of life.[27] More recently environmental preoccupations have reawakened public awareness of water as an element of the eco-system, and renewed the potential place for water in the public domain. Once wastewater started to be treated and polluted rivers revived, the potential of recreational water spaces could be rediscovered.[28] A renewed interest in finding a place for water in the city has lead to the revitalization of riverfronts, the "daylighting" of covered streams, and the discovery of new uses for disaffected canals and harbour fronts.

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[25] Michael Hough, *City Form and Natural Process*, (London: Croom Helm, 1984), 108; Robert L. Thayer, *Gray World, Green Heart, Technology, Nature and the Sustainable Landscape,* (New York: John Wiley & Sons, Inc., 1994), 78-79.

[26] All figures beginning with A are to be found in Appendix 1.

[27] Anne Whiston Spirn, *The Granite Garden,* (1984), 130.

[28] Jean Landry, "Après deux ans: Où en est le projet du Montréal Bleu?" *Sur la montagne, Bulletin d'information du Centre de la montagne* 12, (Summer 1997): 8-9.

Yet it remains that the water running in the city's pipes, the result of visionary collective investments in the city's development has little presence in the public domain.

1.1.3 The waterworks as a heritage and planning issue

The potential value of renewed forms of water in the city should be connected to the roles and meanings that water has had throughout history, as part of the sacred and profane, the domestic, working and social rituals of human life. Water supply has a rich history, in which the value of water as a necessity, a product and a symbol are all present at once. Although the forms have changed, new meanings continue to take their root in a rich heritage of natural and cultural values. Reconnecting the individual experiences of water to the tradition of collective experiences may also help identify the value of public works now taken for granted. It is possible that through lack of recognition, these sites suffer from a lack of maintenance or basic acts of conservation.

In studies of engineering, industrial and urban heritage, the heritage value of the landscape of water supply is beginning to be suggested and remind us of both the civic value of these collective investments and their essential role as support structure for the entire city.[29] But the commemoration of water supply as a work of engineering is only one perspective, which emphasises the technological history of its development. Even now obsolete technical systems are the records of the city's struggles to grow. Older cities reflect how their water supply system developed at a time when the sources and topography in their more natural form played a greater role. The resulting waterworks of the modern system may still embody these earlier situations.

Many systems are only valued as heritage once they are no longer used, and then even more so if they haven't been too radically changed from their original form. What is the relative value of a system that has changed many times over but continues to serve a city

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[29] Historic Sites and Monuments Board of Canada, *Commemorating Engineering Achievements, Framework document,* November 1994; Paul Bernard, Michel Jobin, Nicole Dorion et François Dubé, *Bilan du Patrimoine, Transport, communication et services publics: Série 4000 et Fonction commerciale: Série 5000*, (Québec: Publications du Québec, 1999) 138-147; Ministère de la culture et de la communications du Québec et Ville de Montréal, *Le patrimoine de Montréal, document de reference,* (Montréal: MCCQ/ Ville de Montréal, 1998) 67-69.

in its renewed form? As ongoing functions, public utilities like the waterworks are a living kind of heritage, whose conservation must be integrated into continued planning and development. This continues to be the case today, and as the sites are maintained or even potentially redesigned, their potential to reflect their accumulated heritage should be reconsidered. For one thing, the consequences of the concealment of their function should be taken into account. It has been suggested that some types of infrastructure have greater potential for integration and visibility in the landscape.[30] Is there not greater potential for certain sites of the water supply system to be given more intentional visibility, such as the pumping stations, treatment plants and reservoirs, all large sites of valuable city property?

Thayer categorises industrial landscapes in terms of their acceptability: specific types of materials, social or historic associations are more easily accepted.[31] One could propose that water supply has the potential to be perceived as a relatively positive technology, not only on the basis of its "purity" associations but also in relation to increased interest in water issues. The functioning sites of the waterworks offer a potential place to make the public aware of how this essential urban technology works.

Understanding the relationship between a city's unique natural form and the solutions to water supply problems can have benefits for both the city's form and the system itself, by working with nature instead of against it. The potential for improved urban design through the re-integration the city's water supply and sewage as part of the natural cycle of water has been suggested.[32] But it is a challenge to apply ecological planning theory to existing cities, where the systems were built over decades with increasingly durable materials.

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[30] Michel Gariépy, "L'analyse du paysage au sein de l'évaluation environnementale ou l'aménagement à l'ère de la rectitude politique," in *Le paysage territoire d'intentions,*dir. Philippe Poulladouec-Gonidec, Michel Gariépy et Bernard Lassus, (Montréal: Éditions Harmattan, 1999), 104; George Farhat, "Paradoxes du paysage infrastructurel." *Les cahiers de la recherché architecturale et urbaine, Paysages contemporains.* Paris: Éditions du patrimoine, (avril 2000), 35-44.

[31] Robert L. Thayer, *Gray World, Green Heart, Technology, Nature and the Sustainable Landscape,* (New York: John Wiley & Sons, Inc., 1994), 54-55, 140-141.

[32] Hough, *City Form …*, (1984), 78-108; Spirn,… *Granite Garden,* (1984), 130, 142-168.

The fact that the waterworks were considered major public works when built was often expressed in the architecture of the related buildings. But the integration of these works of civil engineering of an enormous scale into the city's pattern of development has had such a lasting impact that we don't see it.[33] In the context of major reinvestment in public infrastructure being called for, the potential value of the landscape associated with these systems deserves to be reconsidered. Mannell suggests that the visible civic role of such public works complexes was, in the context of post war economics and an increasingly production oriented engineering profession, replaced by an "aspiration to invisible omnipresence," reflected in the increasing use of the name infrastructure.[34]

1.2 Environmental, technological and social perspectives: An analytical framework for looking at water supply reservoirs

The preceding readings have helped identify a series of perspectives for this study. The study of the landscape of water supply calls on society to reconsider its basic relationship with the environment, to understand how urban development has transformed natural processes, to recognise the consequences for the visible landscape of one of its most important achievements of engineering and scientific knowledge, and to recall the forms and meanings of social needs and patterns related to water that have evolved throughout urban history. Three categories of ideas emerge, which help form an analytical framework: relating the landscapes of the waterworks to the environment or natural processes, to technological developments and to social ideals. The following section considers the reservoirs from these environmental, technological and social perspectives.

1.2.1 The evolving roles of natural sources and topography in water supply storage

Considering the larger geographic scale of the city and its surrounding water sources, Anderson has categorised Canadian water supply development according to the differences of salt-water cities, lake cities, cities on major and minor rivers.[35] A city's location with respect to a predominant water source is one of the major determinants of

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[33] Briggs, *Victorian Cities*, (1963), 16; Jean-Claude Marsan, *Montréal en evolution*, 3rd rev. ed., (Laval (Québec): Éditions du Méridien, 1994), 283.

[34] Mannell, "The Palace of Purification," (1999): 24.

[35] Anderson, "Water Supply," (1988), 207-216.

its water supply strategy. The initial development of each city's system thus reflected its physical context. As systems grew and water quality standards increased, technological solutions developed that overcame the challenges of the natural context.

In addition to the type of source, its quantity and position, and the city's topography all initially had an impact on the varying physical form of development in different contexts.[36] Melosi identifies three types of supply that developed as a result of varying combinations of sources and topography: gravity-fed supply, direct pumping and pumping from elevated storage. The storage function in water supply helps improve upon the natural situation. When a source uphill was insufficient to supply the city and the city had to raise its water, it still looked for ways to store the water above the level of the city, to profit from gravity and provide pressure. Storage of water can help solve problems related to both sources and topography. Water storage tanks on a raised structure could compensate by situating the water above the highest functions of smaller cities. **(Figure 1.1)** As larger quantities of stored water were called for, surface reservoirs were built, a form of construction that required much larger properties.**(Figure 1.2)**

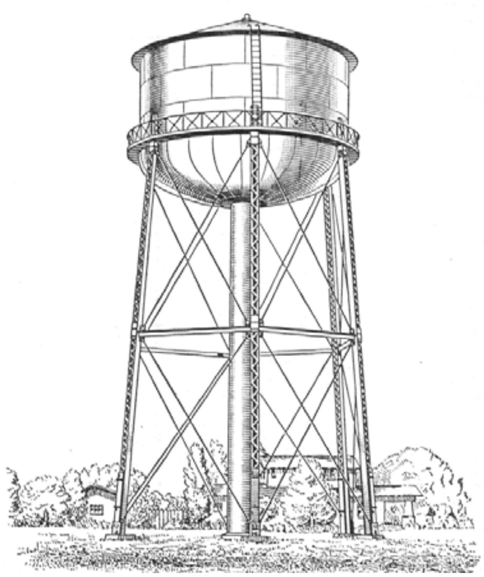

Figure 1.1 Elevated reservoir (steel tank), 1938

(Source: W.A. Hardenbergh, *Water Supply and Purification,* (Scranton, Pa.: International Textbook Company, 1938), 110.)

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[36] Melosi, *The Sanitary City,…* (2000), 130.

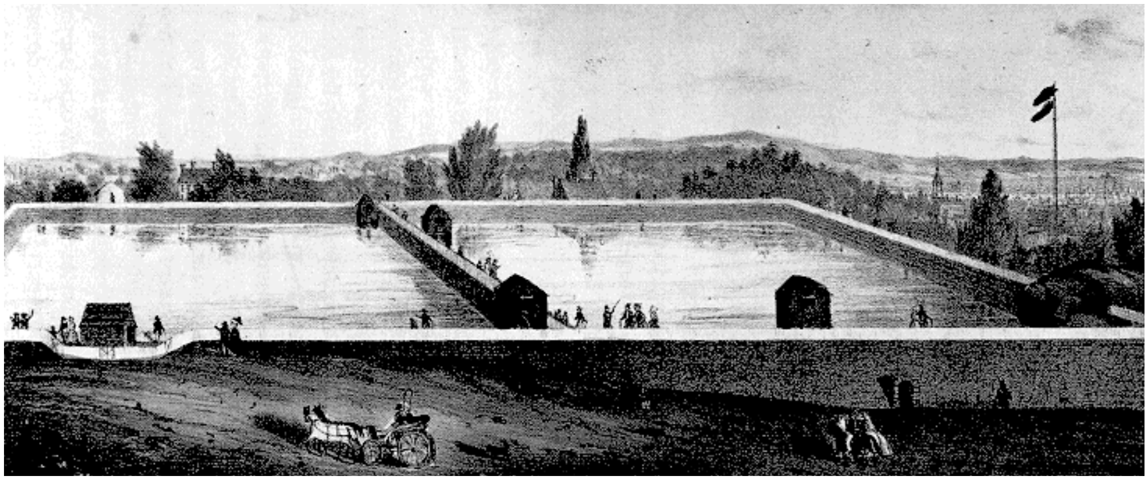

Figure 1.2 Surface reservoir (masonry lined basin), New York, 1842

(Source: Nathaniel Currier (lithograph), Eno Collection, new York Public Library, reproduced in Gerard T. Koeppel, *Water for Gotham, A History*, (Princeton (N.J.): Princeton University Press, 2000), 274.)

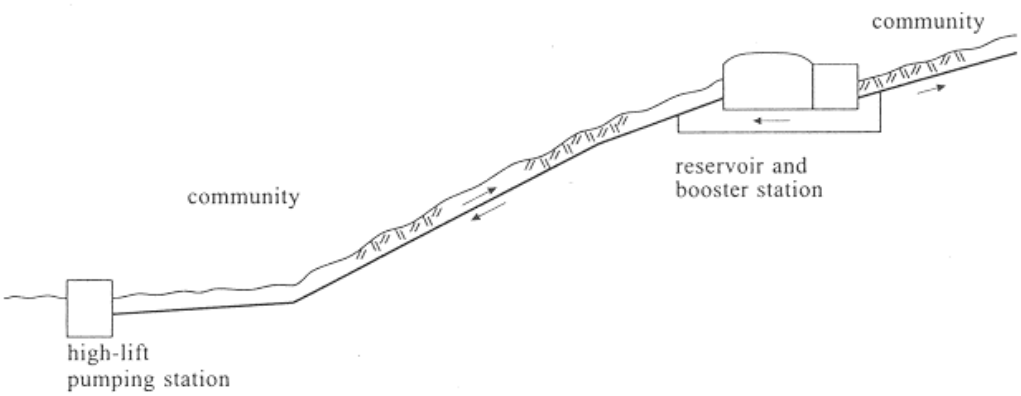

Figure 1.3 Diagram of surface reservoir used as an elevated reservoir, 1999

(Source: François Brière, *Drinking-Water Distribution, Sewage and Rainfall Collection*, (Montreal: Polytechnic International Press, 1999), 86.)

In cities with land available at a high enough level near its centre, surface reservoirs would be built on raised terraces. **(Figure 1.3)** A hybrid of the raised tank and the surface basin, such a situation was considered an unusual advantage, since a more economical surface reservoir could be built and still profit from gravity.

As water supply technology developed, the dependence on natural advantages or ability to overcome disadvantages changed. Stronger pumps and pipes and purification processes overcame problems related to the position of sources. Efficient pumps accelerated the movement of water through the system and storage of water in the reservoirs became less related to long term security or providing natural pressure, and more to efficient use of the pumps (e.g. at night when power was cheaper) and the quality of the service (e.g. ensuring regular pressure or permitting temporary partial closure of the system to carry out repairs). As pumps became the critical element in ensuring a secure system, the storage of pump fuel became the ultimate reserve in the system.

The adoption of a looped plan, made possible with a dependable battery of pumps and valves, that interconnected parts of the system so that water stored anywhere in the system could be called on in an emergency in any part of the city, served to further diminish the importance of the location of sources. **(Figure 1.4)**

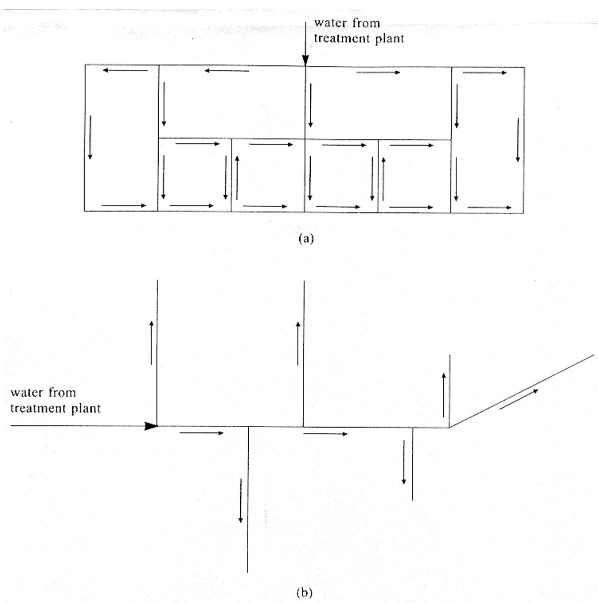

Figure 1.4 Diagram of (a) looped and (b) branching water supply network, 1999

(Source: François Brière, *Drinking-Water Distribution, Sewage and Rainfall Collection*, (Montreal: Polytechnic International Press, 1999), 75.)

The location of reservoirs is nevertheless critical to how they function, since they help the system to adapt to the city's topography. A complex topography would call for multiple reservoirs, positioned in relation to the different parts of the city. Separated pressure zones reduce the area within which pumps and valves work to increase or reduce water flow, breaking down the energy required to reach the highest level, and reducing the work on each level of pumps and valves. Specific reservoirs are then associated with each of these areas.

Sources and topography in the Montreal waterworks

The city of Montreal's physical context, especially with regards to water sources and topography, had no small part in the resulting form of the system. The city is situated on an island in the St-Lawrence River, a river that has been a major player throughout the city's development, including as an unusually abundant source. In addition, although modest in size, the mountain called Mount Royal situated at the middle of the city has been a significant structuring element in the development of water distribution strategies.

Initially water was supplied individually or by water carriers from wells and springs as well as streams that ran down from Mount Royal, initially well away to the northwest of the fortified city down by the river. For the average individual citizen, it was more difficult to obtain St-Lawrence River water, especially during the city's long winter, and it was considered of questionable quality if taken from the shore.[37]

The first attempts at providing a collective form of water supply (1801-1819) tried to profit from mountain springs and the flow of gravity, but without pumps there was insufficient pressure to raise the water up the promontory on which the city was settled.[38] The introduction of pumps made it possible to raise the river's closer more plentiful water to cisterns situated at the highest level of the city. But as the city grew, the city-side intake, even though situated at some distance from the shore, became too polluted and reservoirs further uphill were required.[39]

Throughout the earlier period when collective water supply was focussed on the lower city, wells continued to be used in the higher areas.[40] Wells only became obsolete as

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[37] Fougères, *Histoire…*, (2001), explains in great detail the variety of ways that water was supplied, including by water carriers.

[38] Fougères, *Histoire…*, (2001), 271-72.

[39] According to Illich, this type of shift, from taking the water from sources in the mountain, to bringing water from the river up onto the mountain, reflects a problem that has been a part of water supply since the time of the Romans: the disassociation of water from a specific place. Illich, *H2O…*, (1988), 79.

[40] C.L.Cumming, *The Artesian Wells of Montreal*, (Ottawa: Canada Department of Mines, Geological Survey 60, Memoir 72, 1915). Many more wells are indicated on the Fortifications Surveys of the city of Montreal of 1866-72.

underground sources proved inadequate or became impure, and supply developed in the highest levels, not until the first quarter of the 20th century. The system that was developed in 1852-56 following the take over of the water works by the city of Montreal in 1845 was only intended to supply the area of the city below Sherbrooke Street.

But the city's real potential source, from the Great Lakes to the St-Lawrence, was soon recognised as an unusually pure and abundant resource. Furthermore, it was soon realised that the power of this source could be harnessed to raise the water itself.

The strength of these advantages is reflected in the fact that the city's system today is still largely based on the system built in 1853-56 that brought the river's purer water from above the Lachine Rapids along a canal by gravity to a point to the west of the city, and used water power to raise the supply to reservoirs situated on the mountain's flanks, whence it was distributed by gravity to the city below. **(Figure A.1)**

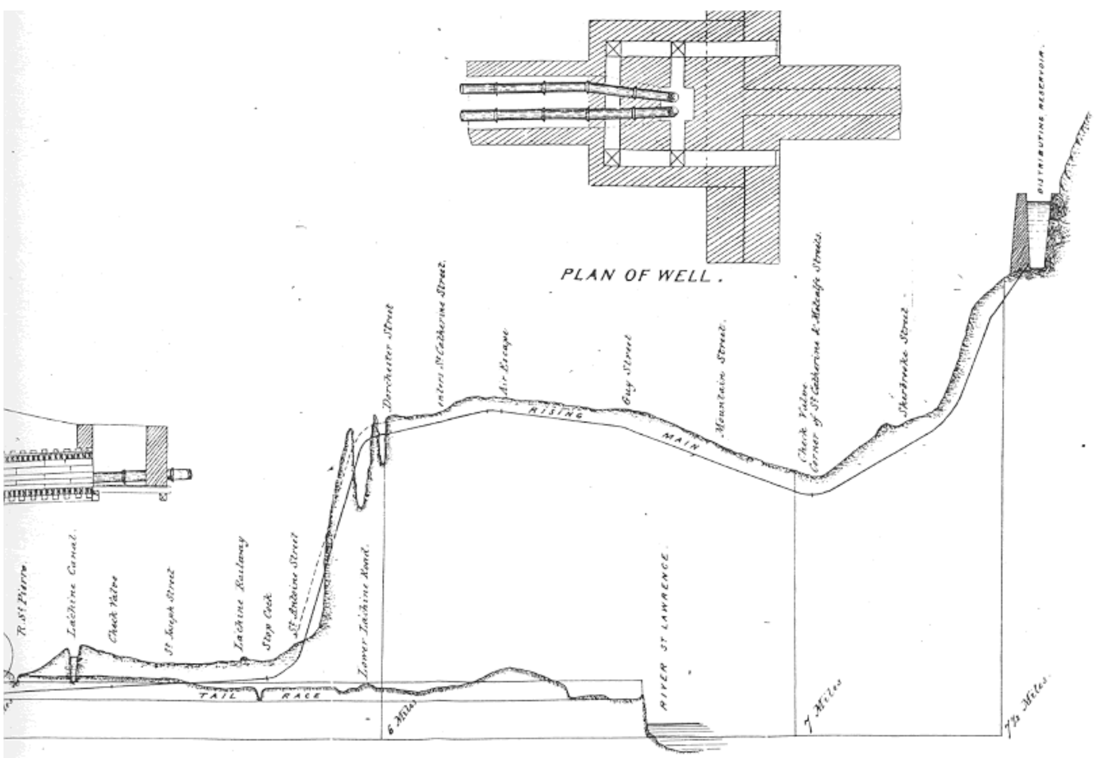

Figure 1.5 Longitudinal section of the aqueduct pumping main and tail race, 1854

(Source: Detail from one of two folded sheets in Comité de l'eau, *Rapport du Comité de l'eau, soumettant les rapports des ingénieurs sur les nouveaux aqueducs de Montréal*, (Montréal: John Lovell, 1854), Bibliothèque Nationale du Québec (BNQ), Édifice St-Sulpice)

The proposals and debate around this first most significant and lasting stage in the development of the city's supply made it clear that both the Saint-Lawrence River and Mount Royal were considered key factors to exploit.[41] **(Figure 1.5)**

As the city developed uphill, and consumption increased, pumps were required to meet demand, but by subdivision of the city into vertical levels, it was still possible to profit from gravity. The fact that the pumps would eventually function on hydro-electricity confirmed the initial recognition that the power of the water could drive the system.

Both the abundance and the purity of the source have been transformed by the gradual transformation of the river into a canal, the poorly controlled consumption of Great Lakes water and the upstream development of industry and cities. Paradoxically, cities with abundant sources, because they are less concerned with wastage, were less motivated to develop efficient or self-cleaning systems. As a result, technical innovation in water supply that considers how to work with the eco-system usually comes from water-poor cities.[42] Montreal is an example of such a city, which because it had an abundance of water, wasn't forced to deal with waste or pollution as quickly as many other large cities.

1.2.2 Water supply storage in relation to technological developments

Two objectives motivated most of the development of water supply technology: increased water quantity (or abundance) and improved water quality (or purity). The quest for abundant and pure water has evolved as the city's needs grew or changed. In most cities the focus was initially on development of an abundant supply of water. Before the development of equipment that would lead to the current high levels of domestic consumption, the large quantities of water were wanted for fighting fires and cleaning streets. In addition to securing adequate sources, in order to meet the demand, emphasis was placed on the development of the distribution system, including better pumps, stronger pipes, and more or larger reservoirs.

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[41] Comité de l'eau, *Rapport du Comité de l'eau, soumettant les rapports des ingénieurs sur les nouveaux aqueducs de Montréal*, (Montréal: John Lovell, 1854), 71.

[42] Hough, *City Form*, (1984), 74.

The reservoir functions can be broadly categorised in relation to either storage (source, time and capacity related) or distribution (or topography related) functions. The storage or reserve function introduces a time factor in the system, ensuring that there is more than enough water in case of a fire or a temporary problem with the main supply, permitting temporary blockages to enable repairs or maintenance, making it possible to limit the use of the supply pumps during the more expensive daytime hours, and providing a way to regulate the difference between supply and demand.[43] The amount of time provided corresponds directly to the size or capacity of the reservoirs, but the amount of time required has varied throughout history. In cities with only one source larger quantities of water might be stored.[44] In older cities like Rome, London and Paris, multiple reservoirs generally corresponded to multiple sources brought to the city from different directions for reasons of variable topography, the unequal development of parts of the city, the development of parallel water companies or the inadequacy of any particular source.

As cities grew and sources became more polluted, and the understanding of the relationship between disease and water developed, the focus shifted to the purity of water. Universal distribution and the development of sanitation equipment greatly increased the demand for water, but the increased effluent contributed to polluting the sources. This lead to a search for purer sources, located further and further away from the city, and to the construction of water treatment plants. As the understanding of industrial pollution developed, standards at the plants were constantly changed. Concern for water quality slowly shifted to the whole environment, the treatment of the city's effluent also became a priority, and sewage plants were built to treat used water.[45]

The modern water supply system is thus the result of an accumulation of developments: expansion, improvement and replacement. Water is now a product of technological

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[43] Public Works Department, *Montreal Waterworks*, (Montreal: Public Works Department, 1959), 20; Ville de Montréal, *L'eau une source …*, (1999), 6-7, 17-18.

[44] Leveson Francis Vernon-Harcourt, *Sanitary Engineering with Respect to Water-Supply and Sewage Disposal,* (London: Longmans, Green, and Co., 1907), 209.

[45] Melosi, *Sanitary City,* (2001), 224-234.

processes, a product whose abundance is ensured by efficient pumps, and purity by laboratory controls. But no matter how modern the standards are that we apply to water supply today, it remains that the systems were built over a period of time that saw an evolution in standards and technology, so that in older cities, the systems in place today are generally an accumulation of historical choices, choices that remain embedded in the resulting landscape.

Melosi suggests that certain decisions embodied in older systems, despite technological change, were permanent, eliminating future choices.[46] Many systems continue to function within a physical framework that expresses a past understanding of nature, level of technological development or expression of social ideals. Many systems were originally designed to be more durable than flexible and incorporate costly investments in now difficult to reverse approaches.

Not all decisions reflected the latest technical knowledge, as a great number of factors come into play in the development of public works. Trépanier has looked at the decisions embedded in public works to suggest how actors with different perspectives manage to reach an effective decision: a temporary positioning of perspectives into a hierarchical order occurs, that may shift in other circumstances.[47] The complexity of social factors makes the process of decision making very hard to predict. In trying to understand these decisions, the identification of group perspectives (hygienists, engineers) is as important as the role of specific individuals (visionaries or ingenious designers). The role of engineers and public health professionals in the introduction of water treatment standards reflects other factors than just their scientific knowledge of the best solutions. In particular, monetary and financial reasoning often prevailed.[48] The dependence on local

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[46] Melosi, *Sanitary City,* (2001), 10-12.

[47] Michel Trépanier, "L'eau, la technique et l'urbain: l'ingénieur n'est jamais seul dans l'univers des infrastructures urbaines," in Louise Pothier (dir.), *L'eau, l'hygiène publique et les infrastructures*, (Montréal: Groupe PGV, collection Mémoires vives, 1996), 75-83.

[48] Gagnon, *L'aqueduc…,* (1998), 4.

resources with regards to materials and labour was also important, as was experience with the local climate.[49]

The adaptation of technological principles to different sites sometimes reflects developments that were difficult to transfer.[50] There was a surprising lack of standards for reservoir quantities or forms of construction, perhaps a reflection of the acceptance of varying local conditions.

Technological developments of the Montreal waterworks

The Montreal waterworks are an older system, whose foundations were laid well before the relationship between water quality and public health or the environment was understood. The abundance of water in the Saint-Lawrence made it seem like the water was pure long after there were problems with water-related diseases. The interest of the Montreal waterworks can be related to issues specific to older systems, where for instance, the obsolescence of certain equipment is confronted by the advantages of acquired conditions. For example, despite the evolution of function and form, most of the reservoirs acquired a permanent position on the same sites, due to acquired advantages like public properties and rights of way. The reservoir sites, the sequence in time and space of their construction, and their transformation, are the traces of the system's expansion and improvement.

As a city dependent on mainly one source of water the reservoirs of Montreal have a particularly important role. In 1872, it was proposed that the City of Montreal build a reservoir able to store enough water for one month.[51] As the city grew and the amount of water consumed grew exponentially, the amount that could be stored grew proportionally less. The multiple reservoirs of the Montreal system did initially correspond to two systems and two intakes, but are now supplied by one source. The abundance of water in

[49] Anderson, "Water Supply," (1988), 204.

[50] Anderson, "Water Supply," (1988), 204.

[51] Lesage, *Rapport Annuel*, Montréal: 1872

the Saint-Lawrence River, which is drawn into the system by an intake southwest of the city, generally removed the pressure from finding any other sources.

The advantage of multiple sources mimicked in the multiple reservoirs is then copied within each reservoir site. All three reservoirs originally consisted of two basins of equal size. Separate containers increased the flexibility of distribution by quantity and over time. In the reconstructed form the McTavish was divided into six cells, while the Vincent d'Indy and CDN reservoirs remained divided in two. **(Figures A.14-15-16)**

Eventually it was realised that there were other advantages to having a good reserve of water. There were often sudden or unforeseen problems with the supply, such as blockages due to frazzle in winter. There continued to be problems with the pumps throughout the development of the system.[52] Thus, whether due to worries about the sources, seasonal events, the productivity of the pumps or the supply of fuel, the storage of water has acquired a symbolic character, providing a sense of security. But as consumption increased tremendously and the amount of time accumulated became relatively less important, both the functional and symbolic values of the reservoir as an emergency reserve were reduced.

The interest of understanding the particular period of time in the history of the waterworks that brought about the covering of the reservoirs is partly to reveal this interplay of intentional and unintentional changes in functions and in form, that appear to following the introduction of higher water quality standards and a change from private to public ownership of part of the city's system. As Gagnon has suggested, although the period is perhaps most characterized by the construction of major filtration and purification works the pressure to expand the system continued to grow.[53]

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[52] Witness the number of different types of pumps that have over the last century and half been introduced into the system: see Anderson, "Water Supply," (1988), 205.

[53] Gagnon, *L'aqueduc…,* (1998), 165.

1.2.3 Water supply in relation to social ideals and power

The traditional meanings of water are rich and varied, including associations of life, birth, death, energy and power, spiritual and moral ideals. Goubert has identified three levels of meaning for water: religious, symbolic and rationalist.[54] The industrialisation of water supply was part of an increasingly rational, collectively defined but individually experienced relationship to water.

> Iron pipes welded fiercely independent households into communities of consumers, thereby giving concrete expression to the notion of a distinct public interest that transcended individual interest.[55]

The meaning of modern water supply has evolved over the course of its development from being a public security and health issue to an environmental one.[56] Water supply systems express public commitment to the importance of water, huge investments and even the birth of the very concept of public works. Water supply can also be related to the development of modern standards throughout the city, in public institutions, housing, industry and commerce. But as supply became universal and was taken for granted in every aspect of urban life, the more symbolic and spiritual meanings of water appear to fade. In industrialised cities water has gone from being a factor of survival to a consumable product, and as a product of an industrial process, water is disassociated from its natural source and the meanings associated with it.[57] The traditional more symbolic and spiritual meanings of water are sublimated if not completely gone. [58]

Bachelard and Illich have suggested that water has always had an ambivalent character, at once ephemeral and eternal, visible and invisible, pure and purifying.[59] The waterworks, the technical embodiment of our continued natural need for water, are the expression of

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[54] Goubert, *Conquête…*, (1986), 35-36.

[55] Christopher Armstrong, H.V. Nelles, *Monopoly's Moment, The Organization and Regulation of Canadian Utilities, 1830-1930*, (Toronto: University of Toronto Press, 1988), 12.

[56] Melosi, *Sanitary City,* (2001), 13, 224-231,

[57] Gaston Bachelard, *L'eau et les rêves, Essai sur l'imagination et la matière*, (Paris: Librairie José Corti, 1942), 155; Illich, *H20…*, (1988), 21-22.

[58] Goubert, *Conquête…*, (1986), 36.

[59] Illich, *H20…*, (1984), 59.

the particular relationship of water to social ideas today. The symbolism of water has shifted. Through scientifically assured standards of water quality and modern measures of personal and public hygiene, the contemporary meaning of water seeks rationality. But the importance associated with this modern perception of water, is rooted in the earlier associations of water with religion and power. Thus, the quest for purity has both scientific meaning and moral or even religious overtones.

Social recognition of the value of water was expressed in important hydraulic works. The monumental works of the Ancient Romans or 19th century Paris reflect the appreciation of the power of water, but were also a symbol of the power of the authorities that put these public works into place.[60] Water supply has nevertheless been just as associated with more common points of distribution: the sources, wells, fountains and basins that would become the focus of public space. These places developed social value partly through the collective usage of water in functions and rituals of both everyday and sacred meaning.[61] **(Figure 1.6)** Water lost this highly visible place in the public domain in the modern forms of collective supply.

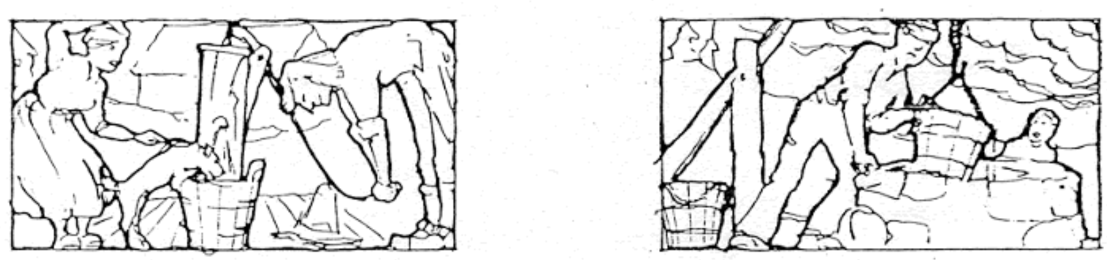

Figure 1.6 The pump and the well, two traditional water supply points, 1937
Drawings for commemorative panels for the entrance door of Côte-des-Neiges pumping station with pump and well (not built).

(Source: Carved Oak Panels In Transom over Entrance Doors, Pumping Station Elevation, Dwg 3571, Approved C.DesBaillets, July 2, 1936, VDM-SI, Côte-des-Neiges pumping station drawing files)

[60] Goubert, *Conquête*, (1986), 97, 213.

[61] Goubert, *Conquête*, (1986), 65-76; Charles D. Jacobson and Joel A.Tarr, "The Development of Waterworks in the United States," *Rassegna* (Aqueducts), 57:1, 1994, 39.

This loss of presence of water can be related to the loss of using the senses to understand water. Where once the quality of water was mainly described in terms of its colour, odour and taste, and every individual was involved in protecting its quality, scientific water quality tests now use vital factors that are invisible, changing our relationship to the water that we see.[62] Our appreciation of the qualities of water depends less on seeing it, and as we see less of it, our potential appreciation of its meaning is reduced.

Bachelard suggests that the importance of seeing water can be related to the fact that water itself helps us to see. Looking at water stimulates active vision, allowing us to dream and making us think.[63] Now that the water we see is often a product of science and industry, and is no longer associated with a specific natural source, the "modern spirit" rationalizes its meaning. Water is pure because of what a sign says. Whether naturally pure or the result of a chemical process, pure water is by its nature an endangered element. We feel uncomfortable when we see it exposed to the environment.[64] Illich suggests that discomfort with seeing water in public space derives from knowing that treated water was wastewater upstream. Water has in fact lost its potential to symbolize purity because it is used to purify us.[65] Thus the two-sided character of water almost requires its separation, such as psychological boundaries between clean and dirty, so that water can continue to symbolize purity while being used to purify.

Specific elements of the water supply system carry specific meanings, meanings that have evolved with their function. Originally large reservoirs symbolized security in case of fires. Although the amount of water a city should store is still affected by insurance company rates, the image of the reservoir has shifted to its primary function of drinking water, and the sense of security is derived from its purity. Few cities developed separate systems for fire and drinking water, but where they did as in Paris, it lead to specific

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[62] Melosi, *Sanitary City,* (2001), 135; Goubert, *Conquête…*, (1986), 40-50, 267-268; Bachelard, *L'eau …*(1942), 155.

[63] Bachelard, *L'eau …*(1942), 39.

[64] Bachelard, *L'eau …*(1942), 158.

[65] Illich, *H2O,…* (1988), 147-149.

types of reservoirs, that physically incorporated this division of water qualities.[66] In ancient Rome, two types of water storage developed in relation to these different functions: the *castellum* or towers for distribution throughout the city, and the *lacus* or large basins for emergency storage.[67]

Both the wide range of cultural meanings traditionally associated with water and recent environmental perspectives that reconsider water supply as elements of the urban eco-system justify the search for opportunities to reconsider our perception of this water. At the same time, as collective forms of use like fountains lost their function, and water consumption and wastage are concerns, new forms reflecting new attitudes are needed. Making use of rainwater instead of drinking water in public place design is one option.[68] Places that confuse the two tend to confuse us.[69]

Social ideals and power in the Montreal waterworks

Fougères has shown how transforming water supply into a public service was a major preoccupation of the city of Montreal in the first decades after the city's incorporation. At the same time Mount Royal was becoming a focus of civic projects and of health, educational and religious institutions. How do these projects relate? How did the mountain's partial preservation and surrounding development affect the reservoir sites? If the mountain represents a certain image of nature in the city, how did the evolving form of the reservoirs, and the perception of water this embodied, affect this image?

Initially profiting from the mountain's position, the form and function of the Mount Royal reservoirs evolved. Their evolution should be related to the evolving role of the mountain in the city, even as the city itself, its borders and landscape, were changing.

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[66] Goubert, Conquête…, (1986), 202.

[67] Frontinus, *The Stratagems and the Aqueducts of Rome,* transl. Charles E. Bennett (Cambridge, Mass.: Harvard University Press, 1925) 335, 365, 421. N.B. Original: Sextus Julius Frontinus, *De aquis urbis Romae*, ca. AD.97

[68] Hough, *City Form*, (1984), 90-93.

[69] Éric Richard, "Is Beaver Lake a Reservoir?" *Sur la montagne, Bulletin d'information du Centre de la montagne* 12, (Summer 1997): 14.

Shortly after the first reservoirs were built, the citizens of Montreal appropriated a large area of the mountain as a park. The approach developed in this major civic project carried out with the help of Frederick Law Olmsted sought to consecrate the mountain's natural characteristics.[70] The mountain offered both an enjoyable and a healthy escape from the developing city. As both a factor and a symbol of urban development, how do the reservoirs, which also sought to exploit the mountain's natural advantages for the public's health, relate to the park?

André Guillerme has suggested that the topographical challenges of water supply, in particular the need to raise water to the highest, often cleanest parts of the city, should be linked to the social stratification that developed in many cities in the 19th century.[71] The occupation of the upper levels of the city by the wealthier elite can also be seen in relation to the greater challenge presented by servicing these areas. Studies of the evolving role of the mountain, and the park, have shown that as access to the mountain-park was "improved" at different moments (by construction of the elevator, the tramline and the autoroute) the mountain's democratic value increased.[72] While the park has been appropriated as a symbolic public space, the value of the reservoir sites as part of an even older civic project has not been integrated into the interpretation of the mountain's public value. Does this have to do with their inherently technical function?

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[70] Frederick Law Olmsted, "Mount Royal, Montreal," in *The Papers of Frederick Law Olmsted, Supplementary Series, Vol. 1, Writings on Public parks, Parkways, and Park Systems*, Charles E. Beveridge and Carolyn Hoffman, editors, (Baltimore: John Hopkins University Press, Baltimore, 1997 [1881]), 364-371.

[71] André Guillerme, "Water for the city," *Rassegna* (Aqueducts), 57:1, (March 1994): 17.

[72] Michèle Dagenais, "Entre tradition et modernité: Espaces et temps de loisir à Montréal et Toronto au XXe siècle," *The Canadian Historical Review*, 82.2 (June 2001): 317-321.

1.3 Three Mount Royal reservoirs: the evolution of a water supply landscape

Figures 1.7 The McTavish reservoir seen from Mount Royal uncovered in 1866

(Source: N-0000120.11, Notman Photo Archives, McCord Museum)

Figures 1.8 The McTavish reservoir seen from Mount Royal covered in 2001.

The reservoirs of Mount Royal have a long and complicated history that nonetheless illustrates a precise case of water disappearing from the urban landscape: as open basins of water that were eventually covered. **(Figures 1.7 & 1.8)** Although their form and function have evolved, they have continued to occupy major sites.

But within the great number of studies of the value of the mountain for the city they have tended to be neglected, disregarded.[73] How the function and form of these reservoirs evolved as the role of sources and topography changed, and the relationship between technology and the environment evolved, has not been documented or analysed as part of the studies of the Mount Royal landscape, or related to the mountain's natural and cultural value or its environmental and social functions, but interpreted as a secondary technical function.[74] Their role of storing water for the city has, for instance, not been related to water storage in nature.

In fact, looking at the reservoirs illuminates the fact that water in general was until recently a neglected element of discussions of this landscape. Although an ecological approach to managing the mountain's landscape has become a priority, in point of fact this is limited to areas within the park, and strategies such as working with the natural movement of water on the mountain are accordingly fragmented by the park's limits.

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[73] Groupe d'intervention urbaine (GIUM), *La montagne en question*, 2 vols., (Montréal: Groupe d'intervention urbaine, 1988); Ville de Montréal, Division des espaces libres et du réseau vert, *Plan de mise en valeur du mont Royal,* (Montréal: Ville de Montréal, 1992); Gilles Ritchot, *Le mont Royal: analyse morphologique et derivation,* (Montréal: Centre de recherches en aménagement et en développement, Étude préparée pour le Service des Loisirs et du développement communautaire de la Ville de Montréal, mai 1988); Nathalie Zinger, *Le mont Royal, paysage et phénomène (de 1850 à 1990),* (Montréal: Université de Montréal, mémoire présentée à la Faculté de l'aménagement, 1990); Bernard Débarbieux, "The mountain in the city: social uses and transformations of natural landform in urban space," *Ecumene* 5.4, (1998): 399-431.

[74] Attempts to integrate the reservoir sites into the interpretation of the mountain's landscape are found in Jean-Yves Benoît,"From the Mountain to the Tap." *Sur la montagne, Bulletin d'information du Centre de la montagne* 12, (Summer 1997): 1, and the exhibition panels of the Smith House exhibition opened in 1999. The exhibition panels relate the reservoirs to other technical functions and focus on the separation of the system into vertical levels, relating the system to its topographical context. In addition, the Centre de la montagne has developed a tour of the mountain and a game for discovering elements of the water supply system hidden in the landscape. Unfortunately, the reservoir theme was not included in the catalogue that accompanies the exhibition. See Maurice Landry, *Mont Royal, le monument naturel*, (Montréal: Centre de la montage, 1997).

Within the park, new retaining basins have been planned that take the pressure off the city's drainage system and encourage the development of new types of landscapes and habitat.[75] Outside the park, the basic topographic reality of the mountain as a source from which water is bound to flow down towards the city, especially in the spring, finds no counterpart in the plans for sites at the bottom of the mountain's slopes.

Looking at how and why the basins were covered could help us understand the issues that have made it difficult to perceive the landscape of the water supply system and perhaps help locate a place to celebrate the value of water supply as part of a natural process, a technical achievement and a social ideal, even offer opportunities for the potential reintegration of its place in the public domain. As one of the principal symbolic spaces of the city, the landscape of Mount Royal was transformed through its appropriation for major parks and cemeteries and as the site of major religious, educational and medical institutions, and civic functions like the fire department and the waterworks.[76] How it came to be that the mountain was used for reservoirs, the different sites that were considered and how they were chosen has not been studied.

1.4 Research questions, hypothesis and methodology

As part of an enquiry into the reasons and ways that water disappeared from the urban landscape, the case of the reservoirs of the Montreal waterworks is of particular interest. Our basic hypothesis is that the story of the evolving form of the reservoirs, from open basins to covered concrete cells, illustrates the complex interplay of natural, technical and social forces that lead to the disappearance of water from the city's landscape. The oldest reservoir was first built in 1853-56, at a time when the combined importance of the St-Lawrence River and the elevated terraces of Mount Royal were well recognised as advantages with regards to sources and distribution. It is one of the oldest reservoir sites still in use in North America, suggesting that its history could provide a record of the evolving interplay of nature and technology throughout an important period in the

[75] Daniel Chartier, "Gérer les eaux du parc du Mont-Royal," *Sur la montagne, Bulletin d'information du Centre de la montagne* 12, (Summer 1997): 13.

[76] GIUM, *La montagne en question*, Vol.1., (1988), 52-53; Jean Décarie, "Histoire inachevée d'une montagne fondatrice," in *Continuité* 76, (printemps 1998): 29-30.

development of water supply technology. The evolving situation of the reservoirs in relation to Mount Royal, a cultural landscape that has become a paradigm of the city's relationship to nature, provides a special opportunity to consider the greater potential role of the reservoirs as an expression of the water supply in the urban landscape.

The basic research questions are twofold:

- Why and how the reservoirs of the Montreal water supply system were covered?
- What impact did this have on the landscape, in particular the mountain?

It is not expected to find one clear reason why the reservoirs were covered, instead we want to understand how the different factors interplayed, and to understand the consequences, intentional or not.

The research is based on the case study model.[77] The unit of study is the type of reservoir that was covered over but still functions. The three such reservoirs in existence will be studied, which built between 1853 and 1915, and covered over between 1938 and 1964, present a broad picture of the landscape of reference in time and space. The three reservoirs also share the characteristic of being located between Mount Royal Park and the developed city, in a contested zone that is partly included in the Mount Royal Heritage Site.

A wide variety of historical sources of information were consulted to establish how these reservoirs were originally built, the factors or the events that lead to their being covered and the form the covering took. This includes plans and city reports and newspaper articles specific to the Montreal reservoirs, and technical manuals of more general value. Although the collections of all of the city's university libraries, the National Library and Archives of Quebec, the City Archives, particular collections (Canadian Centre for Architecture, McCord Museum) were consulted on the basis of a number of key words, the examination of historical sources was not by any means exhaustive. Property title

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[77] Robert K. Yin, *Case Study Research, Design and Methods,* (Beverly Hills, Ca.: Sage Publications, 1984), 113-115.

research was begun for one site but found to be too time consuming for what information it yielded. Apart from a private collection of annual reports and other documents of the water department, the most fruitful sources were the files kept by the city on each reservoir, and historical engineering journals.[78]

The historiography of the Montreal waterworks was reviewed in the first part of this chapter, and includes Fougère's study on the initial period of the company's founding (1796 to 1865),[79] Gagnon's study of events related to purification (1890-1914)[80] as well as a few smaller studies of particular periods and parts of the city.[81] In all of these studies, the history of the reservoirs themselves, or for that matter any of the built elements of the city's water supply system has not been treated either directly or indirectly, except from the most general points of view.[82] Documentation of the history of the three reservoirs is therefore based on original sources, without being exhaustive.

Problems related to historical sources will be addressed within the text itself, but in general, considering the rarity of references to the built landscape of the waterworks, much interpretation and interpolation is necessary. A number of technical texts contemporary to the events that were published in Britain or the USA were consulted; their existence in Montreal libraries suggests that these kinds of books and journals were available or known about at the time of their publication. The iconography of the earlier reservoirs is surprisingly rich. The prominence of one of the sites examined (the McTavish reservoir) has lead to it being documented as a secondary element in the histories of many adjacent functions. Maps, photos and postcards that are of a less technical value but rich in suggestion are also referred to.

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[78] Refer to the detailed explanation of sources in the bibliography. Note that the archives of Outremont and Westmount were not examined.

[79] Fougères, *Histoire…* (2001).

[80] Gagnon, *L'aqueduc…* (1998).

[81] Pothier, "Réseaux…" (1996); Poitras, "Construire…" (1999).

[82] The history of the McTavish site is partly covered in Johanna Schalkwyk, "The Montreal Aqueduct and Waterworks," in *A Topographic Atlas of Montreal*, Jeanne Wolfe and François Dufaux, editors, (Montreal: McGill University School of Urban Planning, 1992), 23-25.

Background work for further heritage studies on the waterworks

> Les ouvrages d'art sont à la fois des supports et des articulations de la structure organisationnelle du réseau urbain… Ils représentent la partie visible des infrastructures et formalisent la rencontre de la technique avec la culture urbaine… Ils ont profondément modelé l'image et le paysage montréalais et expriment, à l'échelle territoriale, son caractère éminemment industriel.[83]

As a study done to fulfill the requirements of a degree in conservation of the built environment, how does this research relate to the methods of heritage and conservation studies? This study belongs to the initial background work that establishes the potential interest of a particular subject.[84] Values to be associated with water supply are suggested in more general heritage studies, e.g. on engineering, industrial and urban heritage. [85] The specific heritage values to be associated with reservoir sites have been related to their technical functions and the architecture of the related pumping stations.

Once the interest of particular waterworks sites is established, a programme of deeper studies should be developed, including historic structure reports on all major sites, and the development of value-based criteria. Further studies should involve a multi-disciplinary study team that reflects the environmental, technical and social perspectives evoked and represented in the literature review.[86]

By linking the study's objectives to this existing area of studies on Mount Royal, a potential area of integration is suggested.[87] This study takes Mount Royal as a cultural

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[83] Ministère de la culture et de la communications du Québec et Ville de Montréal, *Le patrimoine de Montréal, document de reference,* (Montréal: MCCQ/ Ville de Montréal, 1998) 67-69.

[84] Levels of investigation are identified in: "Levels of Investigation" (Section 2) in National Parks Service (United States), *Landscape Lines*, (Wasgton, DC: U.S. Department of the Interior, National Park Service, Park Historic Structures and Cultural Landscapes Program, 1998), 2.

[85] Values associated with water supply are suggested in: Historic Sites and Monuments Board of Canada, *Commemorating Engineering Achievements, Framework document,* November 1994; Paul Bernard, Michel Jobin, Nicole Dorion et François Dubé, *Bilan du Patrimoine, Transport, communication et services publics: Série 4000 et Fonction commerciale: Série 5000*, (Québec: Publications du Québec, 1999) 138-147.

[86] The importance of multi-disciplinary analysis is well illustrated in Fougères, *Histoire…* (2001)

[87] The linking industrial heritage sites to existing heritage projects is suggested in Judith Alfrey and Tim Putnam, *The Industrial Heritage, Managing Resources and Uses*, (London: Routledge, 1992).

landscape "a geographical terrain which as a result of human interaction with the environment exhibit characteristics of, or represent the values of society."[88] In order to adequately evaluate a particular cultural landscape, a study's questions should reflect the totality of the landscape.[89] While the choice of three reservoirs around the mountain seeks to reflect the scale of the mountain, the entire landscape of the waterworks is of course much larger. Ultimately such public works deserve their own recognition, at their own scale. Other sites beyond the landscape of the reservoirs, like the canal and filtration plant, represent equally significant elements of the story of the city's water supply.

The heritage context of the three sites is not identical. The Vincent d'Indy site, formerly within the boundaries of the City of Outremont, was governed by the city's by-law requiring a *Plan d'implanatation et d'intégration architecturales.* The McTavish and Côte-des-Neiges reservoirs, are within the Mount Royal Heritage Site.[90] Because of this municipal designation, any changes to the buildings on these sites must be presented to the *Comité consultative de Montréal pour la protection des biens culturels* (CCMPBC), a committee of experts that advise the municipal council.[91] The criteria relate strictly to architectural heritage, so that proposed changes to the historic pumps or the landscape of the reservoirs themselves are excluded from this process. Evaluation of proposed work on the sites is limited to pumping stations, and only their exterior appearance. It is not clear that municipally owned properties within the Heritage Site go through this process.

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[88] Johanne Fortier, "Cultural landscapes, the Canadian situation" *ICOMOS Landscapes Working Group Newsletter, North American Issue*, 6, 6-7, cited in Cecilia Paine and James R.Taylor, *Cultural Landscape Assessment: A Comparison of Current Methods and their Potential for Application within the Niagara Escarpment, Research Report*, (Guelph, Ontario: Landscape Research Group at Guelph (University of Guelph School of Landscape Architecture), 1995), 32.

[89] World Heritage Bureau, "Operational Guidelines: Establishment of World Heritage List," <http://www.unesco.org/whc/opgulist.htm>, article 40, (11.09.2001).

[90] Created by the City of Montreal in 1987 by virtue of the Quebec *Loi sur les biens culturels.*

[91] According to the most recent information from the City of Montreal, the mandate of the CCMPBC will be absorbed (and revised) within the new *Conseil du patrimoine* (Heritage Council) that has been defined within the revised City Charter, in effect as of January 1, 2002. In the meantime, the CCMPBC continues to operate.

A initial historical evaluation of two of the sites suggested the importance of considering not only the state of repair of the fence surrounding the McTavish site, but the inappropriateness of the use of the Côte-des-Neiges site as a public works yard. [92] But the much older history of the sites has not been considered.[93]

The Vincent d'Indy site is mentioned in the extensive heritage studies of the City of Outremont, without being particularly documented or analysed.[94] An analysis of Vincent d'Indy Street suggests that the presence of the open space of the reservoir has helped maintain a view of the mountain beyond. The covering of the reservoir is mentioned in the section on the history of the city's parks: it is suggested that the resulting park was mainly for the benefit of the Université de Montréal.

[92] Beaupré et Michaud, Architectes, *Site du patrimoine du mont Royal, Principes et critères de restauration, d'insertion et d'intervention*, (Étude coordonnée pour le Service de l'habitation et du développement urbain et pour le Ministère des Affaires culturelles, novembre1989), 80-88.

[93] For example, 1910 pumping station on the Côte-des-Neiges site (out of use since 1938) was radically renovated in the 1980's. The consideration of these sites as part of industrial and public utility history appears to have had no bearing on how the site was developed. The former pumping station is the only remaining building of the Montreal Water and Power Company on a reservoir site.

[94] Pierre-Richard Bisson et associés, architectes, *Le Patrimoine d'Outremont* (Outremont: Ville d'Outremont, 1993), 135 et Fiches signalétiques des rues Vincent d'Indy et Boulevard du Mont-Royal.

CHAPTER II

The evolution of the Mount Royal reservoirs

The interest of the sites of the three reservoirs that were covered can be seen in relation to their position on the mountain, their function in the water supply system and their role in the developing city. The McTavish, Côte-des-Neiges and Vincent d'Indy reservoir sites all occupy prominent sites, the largest municipal properties on the mountain outside the parks and cemeteries that have helped protect a green core on the mountain's summits.[95] They are part of a belt of institutional sites around the mountain that expand the green core while absorbing the pressures of urban development upwards. The development of the water supply system, and the reservoirs, is a reflection of the growth of the city. At the same time, the sites of the reservoirs were initially chosen in part because of natural advantages. While they have continued to occupy these sites, their function and form has evolved as a reflection of the growth and changes of both the system and the city. In order to understand the value of these sites, they should be related to the evolving landscape around them, and their particular contribution to the development of the water supply system situated in relation to the city's development.

2.1 The situation of the reservoirs within the water supply system, the mountain landscape and the city as a whole.

The Montreal water supply system depends on six reservoirs for the distribution of water throughout the city: the McTavish, Côte-des-Neiges, Vincent d'Indy, Summit, Mountain and Châteaufort reservoirs.[96] **(Figures 2.1-2.2)** Within this group, the McTavish has a strategic position in terms of the entire network, Vincent d'Indy represents a particularly large reservoir, and Côte-des-Neiges, while strategic for the mountain, is relatively small.

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[95] The cemeteries are not actually municipal properties, but are defined as public parks within the Charter of the city of Montreal. Furthermore, at the time that these sites were first acquired by the cemeteries in the 1850's, their function was more clearly collective since the parishes that developed them held important positions in the social organisation of the city.

[96] A seventh one, the Rosemont reservoir, originally built to serve a similar function, now functions primarily as a reserve in case of fires or electrical blackouts.

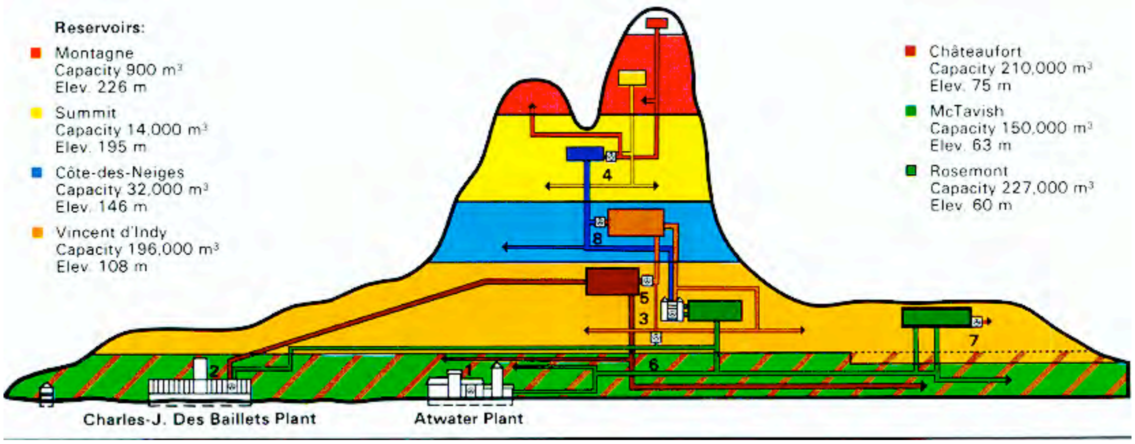

Figure 2.1 Section of Montreal water supply system, 1999

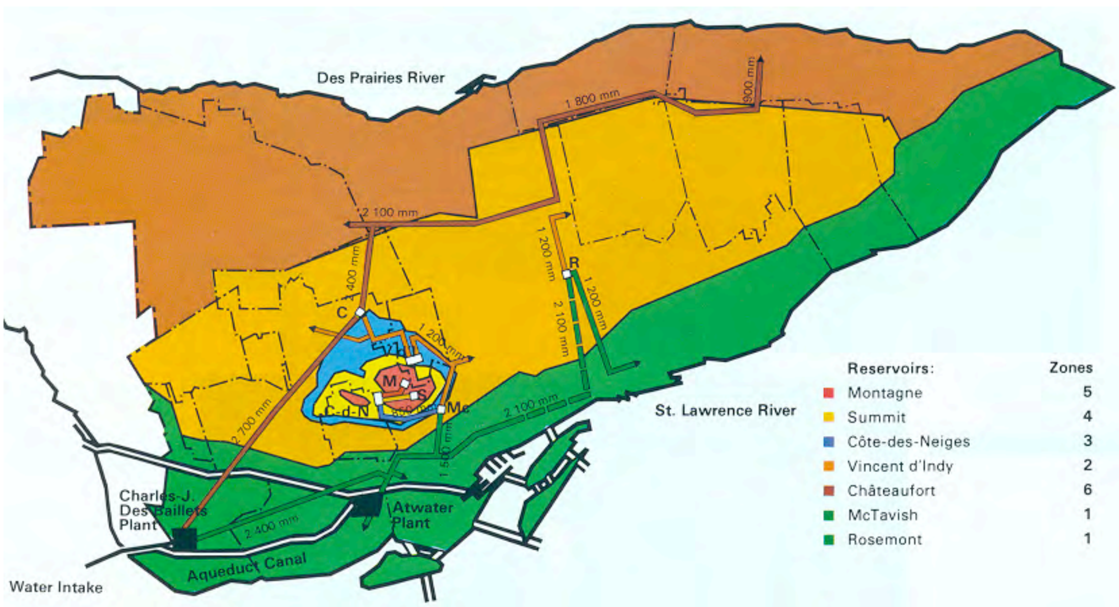

Figure 2.2 Plan of distribution areas of Montreal water supply system, 1999.

(Source: Service des travaux publics, *The Source of Water*, (Montreal: City of Montreal, 1979), 20-21. Note that this brochure was still distributed by the City in 1999).

All together, the six active reservoirs can store 829 900m3 (the equivalent of about 415 Olympic swimming pools) but less than half the amount consumed by the city in one day.[97] With such quantities, only surface built reservoir construction (as opposed to tanks) were feasible. Montreal's surface reservoirs, raised above the city on the flanks of

[97] Ville de Montréal, *L'eau une source*, (1999), 20-21: Total capacity of all reservoirs (excluding Rosemont, which is inactive): 829 900m3. Total average daily consumption 1 773 557m3.

Mount Royal, are an example of the hybrid type of raised surface reservoir **(Figure 1.3, p.17).**

The reservoirs and their associated pumping stations and valves are part of the distribution network of the water supply system.[98] Treated river water is raised by pumps to the reservoirs located in higher-level areas of the city. Typical of a city with strong differences in elevation, the distribution network of the Montreal waterworks is divided into vertical levels. **(Figure 2.1, p.39)** Each reservoir corresponds to an area of the city defined by its upper and lower heights.[99] Pumping stations one level down supply each reservoir. The reservoirs help the high-level pumping stations maintain adequate pressure throughout the network.[100] Valves help control the pressure going down.[101] The situation of the reservoir above the area of the city it serves makes it possible to use gravity to reduce the amount of energy required to distribute water.

The Montreal system is looped system: in an emergency, any reservoir can now serve anywhere in the city. **(Figure 1.4, p.18)** Since the system depends on pumps, and the reservoirs only contain a half day's reserve, the amount of fuel that is in reserve for the pumps is equally critical in an emergency.[102]

While the McTavish, Vincent d'Indy and Châteaufort reservoirs are related to large areas of the city that go well beyond Mount Royal, the Côte-des-Neiges, Summit and Mountain

[98] The Montreal distribution network includes nearly 3000 km of main and secondary conduits, 21 800 valves and13 800 fire hydrants but only 7 reservoirs and 10 pumping stations Ville de Montréal, *L'eau une source indispensable à la vie,* (Montréal: Ville de Montréal, 1999), 18, 24.

[99] The six levels of the city corresponding to the vertical areas served by each reservoir are colour coded. The colour coding has been in existence since at least 1945. **(Figure A.6)**. The covers of fire hydrants are coded the colour of the associated reservoir, so that one can actually read the city's topography by following the changing colour of hydrants.

[100] Brière, *Drinking-Water Distribution,* (1999), 76.

[101] The pumps at McTavish supply the Côte-des-Neiges and Vincent d'Indy reservoirs while those at CDN supply the two reservoirs higher up in the park.

[102] The importance of this factor was realised during the 1998 ice storm, as the city came close to going through its full reserves during blackout of the hydroelectric powered supply pumps.

reservoirs serve smaller higher zones of the mountain. **(Figure 2.2, p.39)** The Summit and Mountain reservoirs, the highest in the system, are concealed within Mount Royal Park.

Through their elevation and position, all the active reservoirs except the Châteaufort can be identified with the landscape of Mount Royal.[103] Mount Royal, actually more of a massif than a mountain, comprises three major summits, located in Montreal, Outremont and Westmount. [104] Otherwise the "borders" of this landscape are difficult to define precisely. The topographical character is perhaps the simplest and clearest reference, and was key in the development of the reservoirs on the mountain. Elevation and position are primary factors for the reservoirs, since they establish the level of water pressure and the paths of connecting pipes. These pipes would generally follow major roads, which generally articulate the most convenient paths within and around this uneven landscape.

All three reservoir sites occupy terraces adjacent to cliffs that result in abrupt changes of level in the landscape. The McTavish and Vincent-d'Indy sites, situated below cliffs on the flanks of the Montreal and Outremont summits, are at the top of areas sloping down towards the city. The Côte-des-Neiges site, situated on a crest in the valley between a cliff below the Westmount summits and a secondary summit on the Montreal side, is in fact almost within the green core, situated close to the edges of Mount Royal and Summit Parks. The relationship of the other reservoirs to the green core is indirect. The McTavish reservoir is close but not adjacent to Mount Royal Park. The Vincent d'Indy reservoir is furthest from park limits but near to properties of the University that have been zoned for conservation use, and that lead to the cemeteries.

The three reservoirs considered here are thus part of the mountain landscape beyond the green core. They are all located in a belt of large institutional properties between the park

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[103] Although one could argue that the Châteaufort reservoir is part of the same topographical pattern because of its elevation, its distance from the mountain's green core removes it from this landscape.

[104] The Montreal water supply system serves fifteen municipalities located on the island of Montreal. As of January 1, 2002 all are part of the new city of Montreal. For the purposes of this study, the impact of the mergers, still in many ways undefined, will not be considered. In any case, Westmount and Outremont will remain as borough territories and the existing boundaries will continue to have effect.

and the city that includes hospitals, universities and colleges, a federal armoury, convents and St-Joseph's Oratory.[105] The heritage value of the various functions and their relatively public character, reinforce the function of these large sites as an intermediary between the denser city and its green core. **(Figure 2.3)**

Although all three reservoir sites are the property of the city of Montreal, one is in Outremont and the varying relationship with municipal boundaries should be noted, since the fate of the reservoir sites may reflect upon these positions. While the McTavish reservoir is located on a prominent site in downtown Montreal, the Côte-des-Neiges reservoir is situated on the border of Montreal and Westmount, and the Vincent d'Indy reservoir is located on the border of Outremont and Montreal. **(Figures A.11-12-13)** The City of Westmount also owned and used property adjacent to the Côte-des-Neiges site for public works functions. The two buildings of the University of Montreal adjacent to the Vincent d'Indy site are generally excluded from development plans for the university that were only negotiated with the City of Montreal.

Responsibility for the reservoir sites is complicated. Although the public works department of the City of Montreal manages the reservoirs and related buildings of all three sites, the surfaces are zoned as parks.[106] **(Figure 2.4)** The upkeep of the grounds of the reservoirs is thus the responsibility of the city's *Service des parcs, jardins et espaces verts*.[107] The McTavish and Vincent d'Indy sites are, however, governed by agreements between the City of Montreal and adjacent universities, who use the reservoir surfaces as playing fields. There is also an Environment Canada weather observation station on the McTavish reservoir.

[105] Two interlinking belts would perhaps be more accurate: one around the Montreal and Outremont summits, another around the Westmount and adjacent Oratory summits.

[106] Note that the City of Outremont zoned the Vincent d'Indy site as institutional (PB-6) but the most recent plans of the City of Montreal show the site as Parc Vincent-d'Indy.

[107] As of January 2002: Service des parcs et loisirs. In Westmount and Outremont boroughs, parks are part of public works

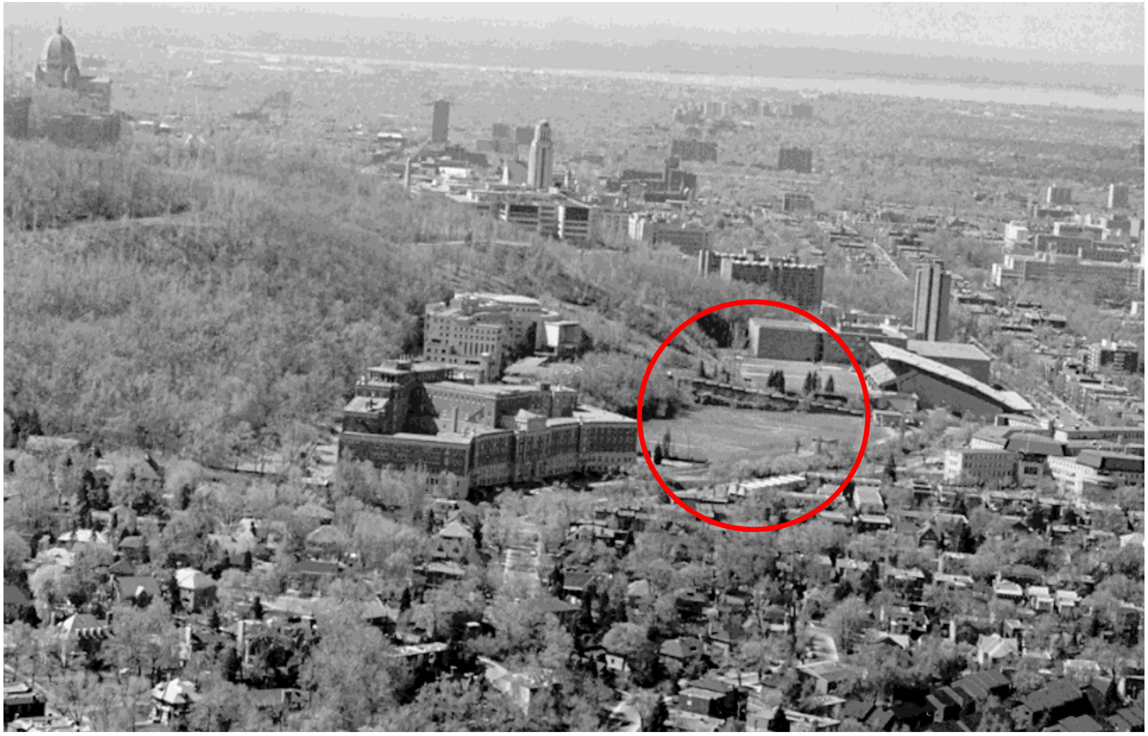

Figure 2.3 Vincent d'Indy reservoir on Mount Royal's northern flanks, 1999
With adjacent institutions (Université de Montréal), the green core above (cemetery in this case) and the residential area below.

(Source: Photo Multi-Pro +Inc, Les Amis de la montagne)

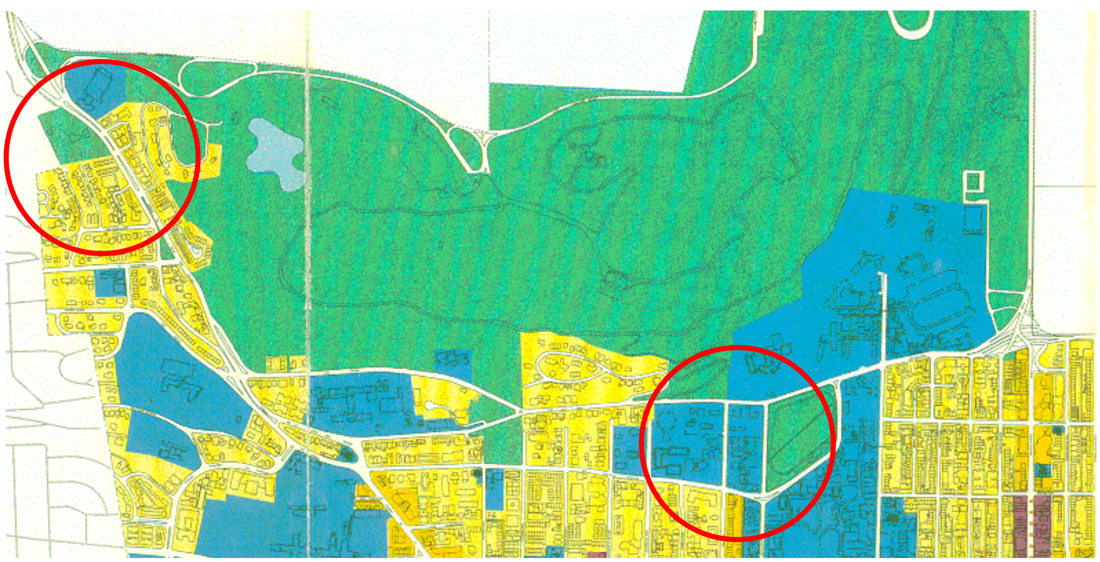

Figure 2.4 Zoning map Ville-Marie District, detail, 1990
Côte-des-Neiges and McTavish reservoirs circled in red, 1990
Green = park / public, blue = institutional, yellow = residential, purple = commercial.

(Source: Ville de Montréal, Service d'habitation et de développement urbain, *Plan directeur d'aménagement et de développpement de l'arrondissment Ville-Marie*, Affectation du sol, 1992)

2.1.1 The form of the reservoirs in the urban landscape

The three reservoirs occupy relatively different sites, and each of the sites is odd-shaped in plan, more of a residual than an intentional form. **(Figures A.11-12-13)** The McTavish and Vincent d'Indy reservoirs occupy the sites completely, but the Côte-des-Neiges reservoir only occupies half of what was originally a much larger site. It is also the smallest of the three reservoirs, while the Vincent d'Indy is the largest.

Nonetheless, due to their form of construction, they share a number of similar characteristics. The grass-covered concrete reservoirs are higher than adjacent streets and properties, with a resulting landscape that is generally flat but not hidden. **(Figure 2.5)** When seen from the surface, the flat open field of grass gives a sense of the enormous quantity of water stored underneath. **(Figure 2.6)** In each case, the adjacent cliff faces of the mountain rising to one side dominate the open plain of grass otherwise only punctuated by ventilators or goal posts. **(Figure 2.7)**

One of the principal ways that the reservoir sites are perceived is from the road. **(Figures 2.5, 2.8)** Even the names of the reservoirs are generally the names of the adjacent roads that identify their position.[108] From the roads it is generally the pumping stations that stand out, in particular for the McTavish and Côte-des-Neiges pumping stations that are located directly on the adjacent roads. Each reservoir had a principal functional relationship to the development of particular street, as the mains connecting the reservoirs to the lower level pumping stations established or followed roads being developed at the time. Eventually, as pumping stations were added, the roads were important for service access and delivery of fuel for earlier steam-driven pumps. The main conduits bringing water to and from the reservoirs remain located under these roads.

Although all three sites were thus well exposed to the increasing impact of the automobile in the city, the Vincent d'Indy is adjacent to relatively quieter roads.

[108] The Côte-des-Neiges reservoir title relates much more to the road than the area of the city, although the supply pipes come up from the west side along Trafalgar Road. The Vincent D'Indy reservoir, initially Outremont and then Bellingham, changed names as the adjacent street was renamed in 1972.

Figure 2.5 Côte-des-Neiges reservoir from Côte-des-Neiges Road, 2001

Figures 2.6-7 Vincent d'Indy reservoir, 1999, McTavish reservoir, 2000

Figures 2.8-9 McTavish reservoir and pumping station from Dr. Penfield Avenue, 2001, Vincent d'Indy reservoir from Vincent D'Indy Avenue, 2000

While the proximity to the roads also makes the reservoir sites relatively accessible, it is automobile traffic that tends to dominate the sites, since the adjacent roads do not integrate substantial pedestrian or cyclist paths.

The borders between the reservoirs and the roads vary. The McTavish site is the only one surrounded on all sides by roads, which serve to isolate it from other functions, and yet also make it more visible as a function in itself. The Vincent d'Indy reservoir, exposed to roads on only two sides, is the only one that is completely enclosed. From behind a fence it is also the most difficult to fathom and the least accessible. **(Figure 2.9)** A fence also surrounds part of the other two, although adjacent grass hills are not fenced off, keeping the sites accessible at all times. The Côte-des-Neiges (CDN) site has the most diverse types of borders. The western part of the fence on the border with the city of Westmount public works site, resembles that of Vincent D'Indy, with brick piers and wrought iron grilles. The street side fence is partly wrought iron with a stone framed entrance gate. **(Figure 2.10)** There is also an exposed concrete wall, on the south side, hidden from the main road and an articulated corner wall, treated ornamentally in stone to connect the pumping station to the reservoir. **(Figures 2.11-12, and 5.9-10, p.126-127)**

The pumping and valve stations, whose architectural interest will not be studied here in any detail, vary greatly in character. The McTavish medieval castle, and the Côte-des-Neiges *Canadien* farmhouse are romantic stylized figures in their respective landscapes, **(Figures 2.8 & 2.13-14)** While the earlier pumping stations appear to disguise their technical function, the later buildings of the Vincent d'Indy site do not appear to express any particular function or idea of the surrounding landscape**. (Figure A.21)** The concealment of function illustrated by the pumping stations is an underlying theme to the story of the reservoirs. Concealing the pumps can be related to the water concealed in the basins as they were covered over. Understanding why the reservoirs were covered may help us understand why the pumping stations were designed as they were.[109]

[109] At the same time, the pumping station architecture should be related to other building of the waterworks or even other municipal services (fire and police departments, park maintenance), but this will be the subject of another study. Most notably, the *Canadien* theme of the Côte-des-Neiges station recurs in a series of buildings built in the park: the Summit reservoir shelter building, and the police and parks services buildings off of Camilien-Houde.

Figure 2.10 Côte-des-Neiges reservoir site entrance gate, 2001

Figures 2.11-12 Côte-des-Neiges reservoir exposed concrete wall, 2000, and stone-faced wall, 2001 (Now also an exposed concrete wall… see figures 5.9-10)

Figures 2.13-14 Côte-des-Neiges pumping station and Vincent d'Indy valve stations, 2001

2.1.2 The evolution of the function(s) of the reservoirs in the water supply system

The function of the reservoirs was explained in chapter I, as broadly related to either storage or distribution. These functions have evolved as the system developed. The shift of focus from water quantity to water quality has had important repercussions for the reservoirs. Although it is still as important to have a sufficient backup supply, storing drinking water too long in a reservoir reduces its quality.[110] Seeking a balance between keeping the water moving and having enough in reserve has shifted the role of the reservoir away from longer term storage or a quantity-based function. On the other hand, the reservoirs continue to play an important role in distribution, helping the city adapt efficiently to its topography. Even then, the looped system and the combined use of pumps and valves, has given the system a certain independence from topography if it should need it in an emergency or during repairs.

It is the fact that water quality is affected when water is stored for too long in the distribution reservoirs that suggests the greatest difference between how these reservoirs should now be seen in relation to their original function. When the reservoirs were first planned in the 1840's to 1870's there were two principal reasons given for the distribution reservoirs: as an emergency reserve for firefighting and to enable distribution by gravity in areas below the reservoirs. Neither of these functions considered the actual quality of water. As the focus of water supply shifted to domestic, commercial and industrial users, all of which required pure water, water quality became more important.

The amount of water that should be stored is still defined by fire departments and affected by fire insurance company rates, even if the principal function of water is for drinking or other uses that require it to be of drinking quality. Is there not a contradiction between standards that call for large quantities of water, and those that emphasise water quality? The incongruity of these two different factors is solved when there are two separate systems, one with treated or finished drinking water and one with less pure water or grey water held in reserve for emergencies as fires, or used by the city for street-

[110] Brière, *Drinking-Water Distribution,* (1999), 85; Beaumont-Maillet, *L'eau à Paris*, (1991), 246.

cleaning.[111] Why should Rosemont reservoir, which now only serves to store large quantities of water in case of fire, be supplied by drinking quality water?

The comparison of the function of the distribution reservoirs with the treatment reservoirs at the filtration plant is instructive. The latter were initially built to provide a place to slow down the process to allow for time-consuming filtration processes, following natural models that benefit from time. Comparing the two types of reservoirs reveals how the function of the distribution reservoirs today appears at odds with the natural function of storage of water, in which the amount of time water is stored can be equated with improved quality.[112] Somewhere along the line, the shift in the function of the reservoir left the reservoirs on the mountain in an awkward position regarding this quantity/ quality question. When the reservoirs were covered, both the control of both water quantity and water quality were improved. Was either reason more decisive?

[111] An example of this approach (Paris) will be discussed in Chapter III.

[112] Hough, *City Form*, (1984), 90-93

2.2 The history of the evolving form and function of the Mount Royal reservoirs

The original construction of the reservoirs as open basins and then their reconstruction in their current covered form took place from 1853 to 1964. This was a period of great changes in the city and society in general, but also in the terms of developments in waterworks and technology. The expansion of the city and the increase in density of users along the original lines of distribution placed increasing demands on the waterworks. Water distribution was improved as pumping technology and pipe manufacturing advanced, electrification was introduced, and concrete and other resistant building materials were developed.[113] A better understanding of the role of water in relation to disease and the impact of upstream pollution on sources, and increasing concern for public health and the environment, lead to water quality standards.[114] Mechanical and chemical processes of filtration and purification were developed to meet these increasing standards. Along with new reservoirs, pumping stations and the network of mains and conduits, the construction of major filtration and purification plants were a major event in this period of development of modern water supply.

The particular impact of these developments on distribution reservoirs is not addressed in histories of the waterworks.[115] Reservoirs, including covered ones, had existed for centuries in different contexts, and their relatively simple function in relation to distribution and storage of water was well understood. If discussed at all in histories of the built form of waterworks it is in the context of developing construction materials, in particular reinforced concrete, and then mainly with regards to elevated tanks.[116] The impact of improved water quality standards on reservoirs only began to be discussed in

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[113] Anderson, "Water Supply," (1988) 195-220.

[114] Melosi, *The Sanitary City,* (2000), 224-234.

[115] The question of reservoirs and the need to cover them does not arise in such major surveys as those of Anderson, Blake, and Melosi. Even in the texts that deal more specifically with the history of water purification, the question does not arise. See M.N. Baker, *The quest for pure water: the history of water purification from the earliest records to the twentieth century*, 2 vol. (New York: American Water Works Association, 1981).

[116] Pierre Fouquet, *Les reservoirs d'eau*, (Paris: Dunod, 1963); André Wogenscky, "Réservoirs," Techniques et architecture, 2.3-4 (mars-avril 1942), 114-119.

professional journals in a period that preceded the complete overhaul of water quality standards in the 1970's-1980's, well after Montreal's reservoirs were covered.[117]

The construction of new and bigger reservoirs and the enlargement of existing ones are related to the exponential increase in consumption of water in this period, which is only partly due to demographic growth. Not only more people inhabited the growing city, more water per person was required. The universal distribution of water quickly lead to flush toilets, sinks and baths, to be followed by washing machines, all of which would increase the amount of water required per person. The development of sewage systems, principally from the 1870's to eliminate the increased water being supplied, needed large quantities of waters to move the waste. Nor to be underestimated are the commercial and industrial consumers, who developed processes that took advantage of the movement and cooling capacities of water.[118] Later still, the development of air conditioning, the increased construction of swimming pools, greenhouses and a myriad of other types of functions all had an impact on the amount and quality of water required.

The reservoirs also reflect the expanding physical size and shape of the city during this period. While a great number of villages and towns were eventually annexed by the City of Montreal, separate municipalities also had an impact on the amount of water required and the form of the distribution network, as specific reservoirs were located in relation to landlocked cities like Westmount and Outremont. Plans to expand the waterworks were initially based on the growth of the city outwards into these areas. New political boundaries eventually transformed the logic of their construction, especially once private companies began to develop a parallel system to serve these areas.

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[117] See note 170.

[118] The proportion of industrial and commercial versus domestic users is difficult to ascertain, since the rates were not applied the same way. For example, in 1899, domestic users paid as a percentage of their rent (7%) plus $1 per bath, while commercial, industrial and institutional users paid a varying rate starting at $0.30 per 1000 gallons consumed. Out of a total of 7,349,480,449 gallons of water consumed, 899,172,811 gallons (about 12% of the total) were sold to private industrial, commercial and institutional users by water metering, including 174,427,141 g. for railroads and 47,231,250 g. for steam engines. The remaining quantity included not only domestic consumption but public consumption (fountains, fire hydrants, street cleaning, etc), which like households, wasn't metered. .J.O.A. Laforest, *Rapport Annuel du Surintendant de L'Aqueduc de Montréal pour l'Année finissante le 31 décembre 1899,* (Montréal: The Montreal Printing and Publishing Company, 1900), ix-1, 66.

The history of water supply in Montreal includes both public and private water supply companies. It was only following incorporation in 1841 that the city of Montreal took over the role of collective supply. From 1801 until 1845 it was in the hands of a series of three private companies. But even from 1845 the municipal supply system only applied within the city limits; private companies or local public supply served villages and towns outside these limits. Until 1928 when it was bought by the city of Montreal, the principal private company, the Montreal Water and Power Company, continued to serve a number of cities like Maisonneuve, Westmount, Outremont, and following the annexation by Montreal of many villages and towns, a third of the Montreal population.[119] The impact of the purchase of the MW & P Co. is perhaps one of the most crucial factors for the period being considered. The company's Côte-des-Neiges and Outremont reservoirs were acquired by the city and integrated in the municipal distribution network.

Other factors to be considered include the development of the city's department of public works, which replaced the water commission, and its relationship to other departments like public health and hygiene and parks. Whose responsibility would the reservoirs be: public works, parks, both or neither? In fact it was the universities adjacent to two of the reservoirs that became the prime users of their covered surfaces.

Finally, major socio-economic and political events like the 1930's depression and the two world wars in the 1910's and 1940's affected all public works related projects, limiting funds and placing priorities elsewhere. The filtration plant planned from 1910 was only completed in the 1920's, in part due to the war. One reservoir reconstruction was the last of a depression era provincially funded make-work programme. But by 1960, $50 million in investments in various improvements to the waterworks had allowed the city to catch up on plans interrupted by the depression and the wars.[120]

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[119] Fougères, "Le public et le privé …," (1996), 56-57.

[120] Montreal Public Works Department, *L'aqueduc de Montréal-Montreal Waterworks*, (Montreal: Public Works Department, 1959), 36.

2.2.1 The construction of open basin reservoirs from 1848 to 1915

A. The Montreal Water Works Reservoirs: Coteau-Baron, McTavish & High-Level

The earliest recorded forms of collective water storage are from before the city took over the role of water supply in 1845, and reflect both the small size of the city and the limited extent of the system. Covered wood cisterns, eventually lined with lead, were built on raised structures, and located at high points of the city, near Guy & Dorchester and Notre-Dame & Berri, then within a house on Notre-Dame near Friponne.[121]

The first known open basin was built in 1848 at Coteau-Baron, on the future site of Square Saint Louis.[122] It was the first reservoir to store river water high above the city, at a height of 130 feet above the St-Lawrence.[123] Although it had a capacity of 3 million gallons, the reservoir was temporarily empty while new pipes were being laid during the fires of July 1852, a costly lesson on the importance of being able to close only part of a reservoir. It continued to be used for emergency reserves until the site was given over to the City's streets department in 1879.[124] Its unused basin became a principal ornamental feature of Square Saint-Louis but then was subsequently reduced to the smaller round basin and the fountain that still stands, a reminder of the site's original public water supply function.[125] The position of the original basin can still be read in the subdivision of the square into three parts. **(Figures 2.15-16)**

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[121] Pothier, "Réseaux…" (1996), 33.

[122] Fougères, *Histoire ...* (2001), 395.

[123] F. Clifford Smith, *The Montreal Water Works, Its History Compiled from the Year 1800 to 1912,* (Montreal: no publisher, April 1913), 15.

[124] Jean De LaPlante, *Les parcs de Montréal,* (Montréal, Méridien, 1990), 51,60.

[125] Little is known about the reservoir's original construction. An unidentified plan for an open basin dated 1836 is located in the city archives along with other early plans of the first private companies. It shows macadamised sloped inside walls and a sand bottom. VM-GDA 1836-1, 87-28 (Microfilm). It is noteworthy that the original conditions of sale of the site to the city stipulated planting trees on the site "Ordered that forest trees be planted on the reservoir ground Côte à Baron in compliance with the agreement entered into stipulated in the deed of sale of the lot of land purchased by the city corporation from A. Delisle Esquire." From the minutes of the City of Montreal Water Committee, April 24th 1852. VM-GDA Serv.21.Div.3 1.1.

Figure 2.15 Saint-Louis Square with reservoir basin, ca. 1895

(Source: Detail from photo reproduced in Jean De LaPlante, *Les parcs de Montréal,* (Montréal: Méridien, 1990), 60; given source: Notman Photographic Archives, McCord Museum.)

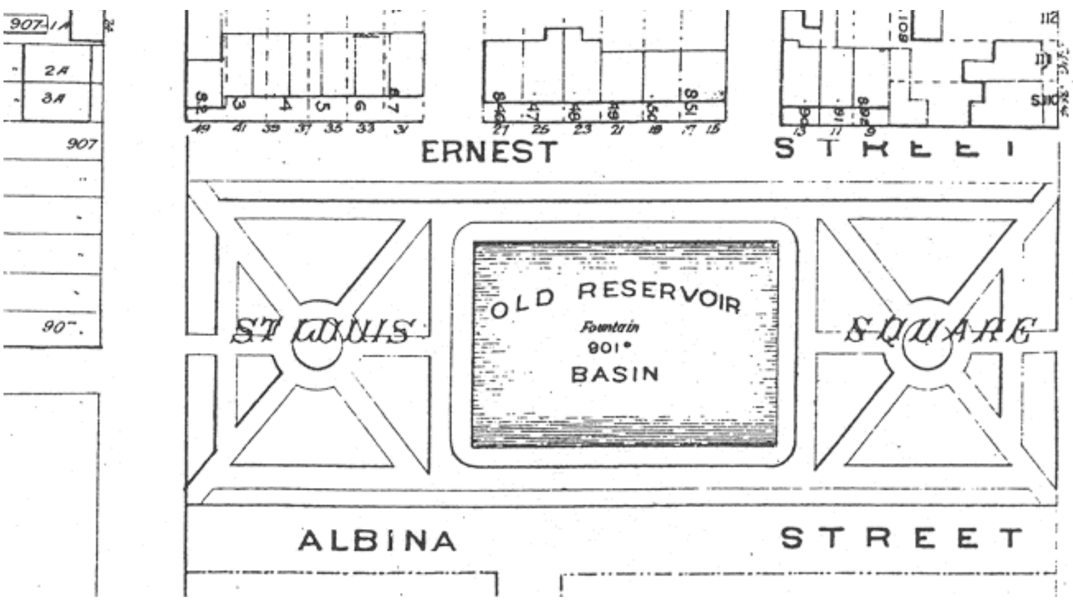

Figure 2.16 Plan of Saint-Louis Square with old reservoir basin, 1910

(Source: Detail from Chas. E. Goad, *Atlas of the City of Montreal*, Volume 1, Plate 31 (St. Louis Ward), 1910 revision, BNQ-Holt)

The McTavish was the next reservoir to be built, between 1853 and 1856, further west and 70 feet higher up the mountain behind the McGill College property. Built as part of the first major municipal waterworks project, it is the oldest of the city's reservoirs to still function, and its role has remained important throughout the development of the distribution network. Its construction is well documented, including discussions about the feasibility of its position and the engineer's preliminary plans and specifications.[126]

The site had already been identified when the engineer Thomas Coltrin Keefer was hired in 1852 to develop a scheme that would take water from beyond the Lachine Rapids to the Gregory farm in the southwest part of the city, from where it would be pumped up to reservoirs situated 200 feet above the harbour level on the flanks of Mount Royal. **(Figures 2.17& 2.18)** The principal justification of the construction of the 13 million gallon mountainside reservoir was as a safety measure for fire protection.[127] Keefer remarked that the city's mountainous topography made it possible to build economical surface reservoirs as high as needed to supply upper levels of the city and obtain required pressure throughout the system. **(Figure 1.5, p.20)** An alternate suggestion was to enlarge the existing reservoir at Coteau-Baron and only add a smaller reservoir at the McTavish site: the slopes of the mountain were said to be too sharp for a large reservoir in relation to areas of the city they could serve, that these should be built lower down.[128]

It was also suggested that the position of the reservoir above the city would protect it from exposure to street dust and that it could be landscaped with a promenade that would offer spectacular views of the whole city, the river and the surrounding countryside. With little further expense adjacent properties would make a handsome park, where fountains and water sprays could be installed to great effect, "combining works of civil engineering with nature's own work, to the greater good of the population."[129]

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[126] Comité de l'eau, *Rapport du Comité de l'eau, soumettant les rapports des ingénieurs sur les nouveaux aqueducs de Montréal*, (Montréal: John Lovell, 1854), BNQ, St-Sulpice Building; Thos. C. Keefer, "Specifications for the Distributing Reservoirs of the Montreal Water Works," Montreal, 1853. (VM-GDA, R3390.2 (microfilm)).

[127] Thomas Coltrin Keefer, "Rapport sur une exploration préliminaire faite dans la vue de fournir de l'eau à Montréal," in Comité de l'eau, *Rapport du Comité de l'eau, …* (1854), 52.

[128] "Rapport de W. J. McAlpine, Ecr., Albany, May 26, 1853," in Comité de l'eau, *Rapport du Comité de l'eau, …* (1854), 88.

[129] "Rapport de John B. Jervis" in Comité de l'eau, *Rapport du Comité de l'eau, …* (1854), 78. Note that Jervis's experience as chief engineer of the Croton Aqueduct (1837-1848) included the planning of the York Hill Reservoir in 1842, incorporated in Central Park, but replaced by the Croton Receiving Reservoir in 1862. See note 134.

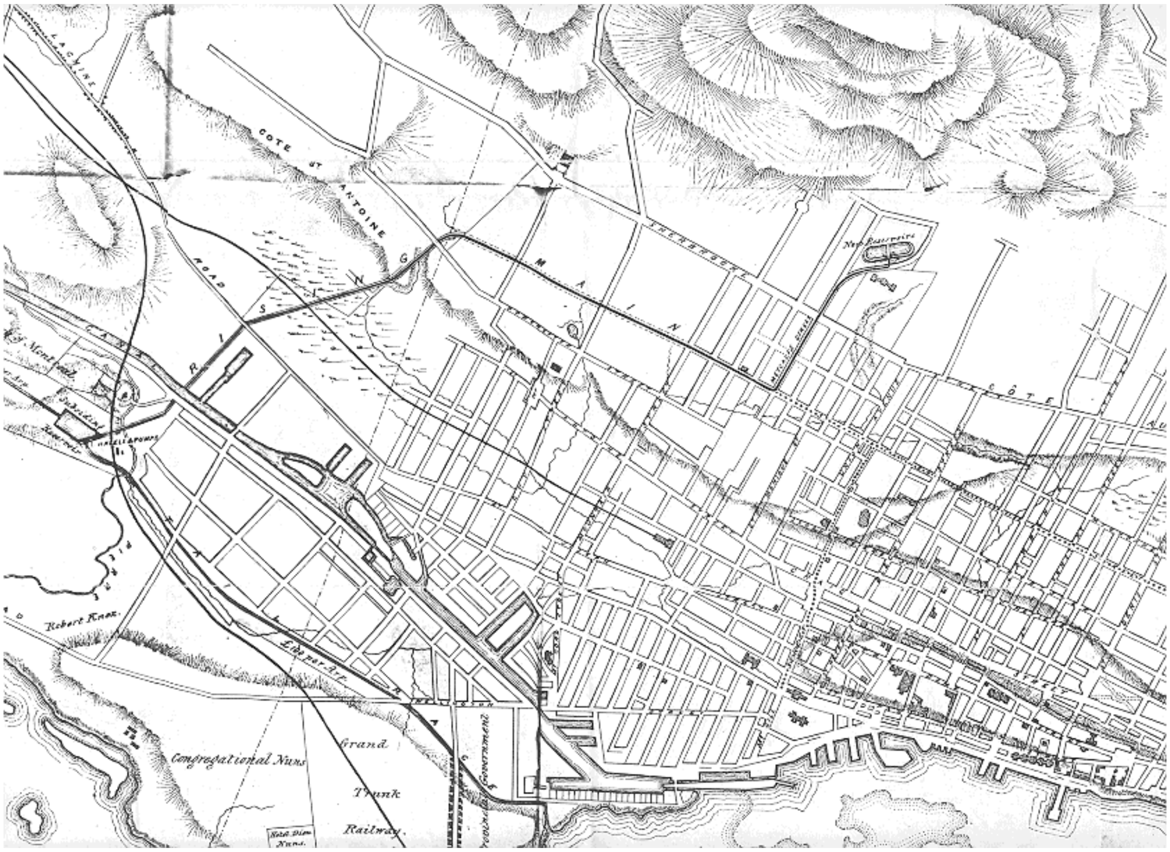

Figure 2.17 New City Water Works, detail, 1854

(Source: Detail from *A Topographical Map of the city of Montreal & Vicinity Shewing (sic) the Line of the New City Water Works 1854*, included as one of two folded sheets in Comité de l'eau, *Rapport du Comité de l'eau,…*(1854), BNQ-SS)

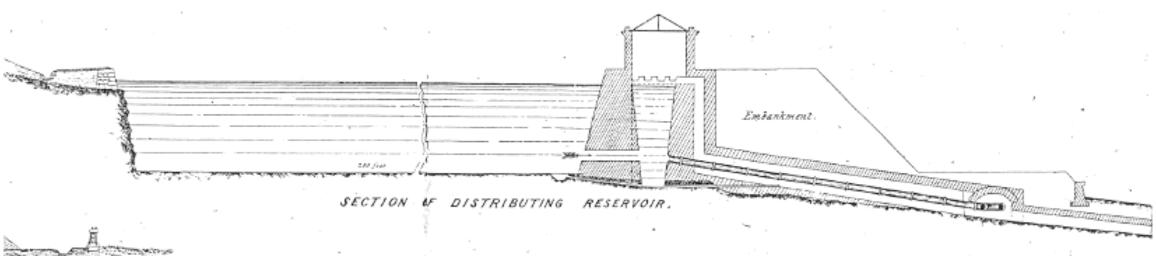

Figure 2.18 Section of distributing reservoir, detail, 1854 (detail)

(Source: Detail from one of two folded sheets in Comité de l'eau, ...(1854), BNQ-SS)

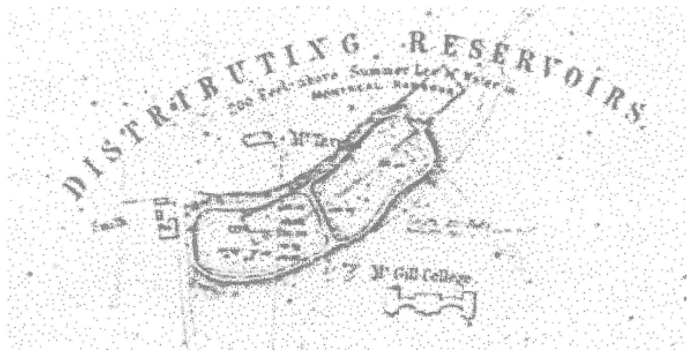

Figure 2.19 The McTavish reservoir as planned, 1853
Showing an initially irregular plan, perhaps based on site conditions.

(Source: Detail from *A Topographical Map Shewing (sic) Plan of Water Supply of Montreal with the Route of the Proposed Aqueduct From the Head of the Lachine Rapids* (Tho. C. Keefer. Engineer. 1853. VM-GDA, 1853-6 (microfilm))

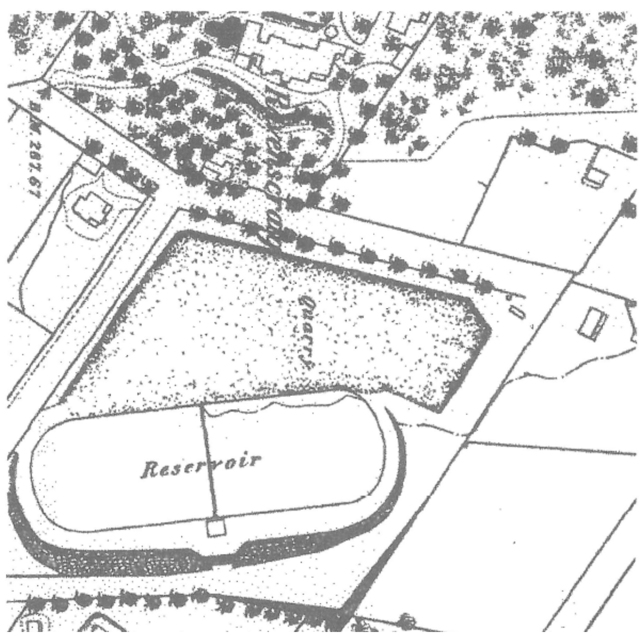

Figure 2.20 The McTavish reservoir as built, 1865
Showing original elliptical plan, soon to be enlarged into area marked "Quarry"

(Source: Detail from Sitwell, Fortification surveys, 1865-71, BNQ-Holt)

Although the McTavish was originally a symmetrically planned elliptical basin in two identical sections, soon afterwards it was enlarged to more than double the capacity and took on an irregular shape that occupied the maximum area of the site. Indeed the need to enlarge the reservoir kept the area a dangerous and dusty quarry for many years to come.

Figure 2.21 "Montreal from Mount Royal," 1866 (detail of Figure 1.7)
With the McTavish reservoir in the foreground.

(Source: N-0000.120.11, Notman Photographic Archives, McCord Museum)

Figure 2.22 "McTavish Reservoir M.W.W." ca.1873
Original elliptical form with quarry for extension to northwest (right in photograph)

(Source: J.G. Parks Photographer, inserted looseleaf in Louis Lesage, *Report on the Proposed Enlargement of the Montreal Water Works together with an Historical sketch of the Works up to the Present Date,* (Montreal: J.Starke & Co., Printers, 1873), in Dowd collection)

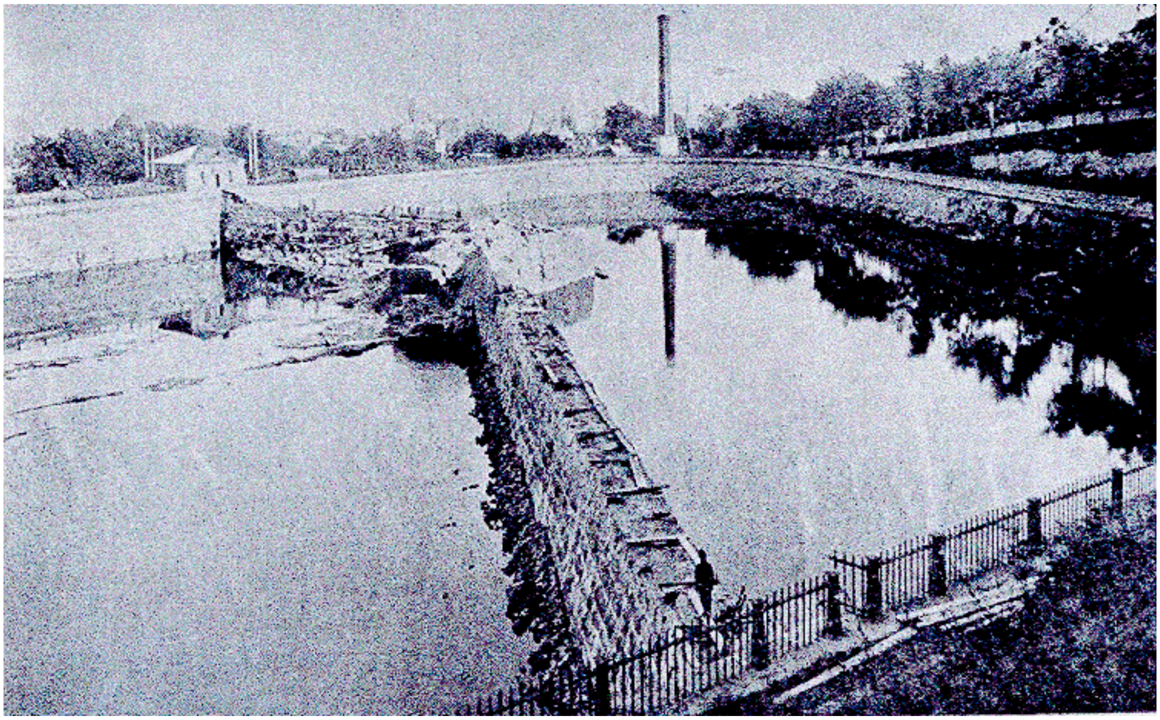

Figure 2.23 "Montreal- Réservoir McTavish", 1899

(Source: *Le monde illustré*, (9 septembre 1899), 297, in BNQ- AF)

The need to expand the system as the city grew and water consumption increased is reflected in the reservoirs in two ways: the enlargement of existing ones and the construction of new ones positioned to serve new areas. The enlargement and improvement of the McTavish, whose position remained of unquestioned value throughout the development of the system, lead to it becoming a construction site again and again. During its extension that began ca. 1871, Louis Lesage, superintendent of the Waterworks, calculated that it would take 14 years to complete the excavation of the site, and remarked on the need for a faster construction process for future reservoirs. The northern part of the site may have involved more difficult conditions for excavation, as is suggested by the initial proposed irregular shape **(Figure 2.19)**. Photographs of the open basin in its extended form show a large rocky mass in the middle of the dividing wall, what appears to have been an impediment during construction.[130] **(Figure 2.23)** The

[130] This rock is mentioned in the 1940's when the reservoir is completely rebuilt: "Le mur de division en maçonnerie fut démoli et l'ilôt de roc mine; on en retira quelque 16,000 verges cubes de roc." Charles-J. DesBaillets, "Le reservoir McTavish," *Métropole*, septembre 1947, n.p. (VM-GDA, R3390.2 (microfilm)).

resulting form was a combination of the original ellipse within an expanded polygon, with a break in the dividing wall where the rock was not removed.

Figure 2.24 "Plan Showing the Proposed Enlargement of the Montreal Water Works, in accordance with the report of the Superintendant dated February 1873"
McTavish reservoir (black circle) and seven possible reservoir sites (red circles), from left to right:

A north of Côte-Saint Antoine Road
B west of Décarie in Notre-Dame-de-Grâce
C west of Côte-des-Neiges Road ***(built 1893)***
D east of Côte-des-Neiges Road (within Mount Royal Park) ***(site of Beaver Lake)***
E north end of Peel Street (within Mount Royal Park)- ***(built 1875)***
F west of Bleury Street –soon to be named Park avenue- (within Mount Royal Park)
G east of Bleury Street (in Fletcher's Field)

(Source: VM-GDA, 1873-3, c.139 (microfilm))

In addition to the plans to double the McTavish in size, the city began to consider the possibility of building other reservoirs on the mountain. Plans from 1873 identified seven new sites. **(Figure 2.24)** Sites for two reservoirs were sought: one at about the same level as the McTavish and another higher level one. The Côte-St-Antoine site was proposed as a principal new lower level reservoir with a total capacity of 227 million imperial gallons, while the other three sites described were alternate sites for a higher-level reservoir ranging from 27 to 117 million imperial gallons. All of these proposals were enormous in comparison with the McTavish, still only 13 million imperial gallons. Three of these sites would have transformed plans for Mount Royal Park.[131]

The discussion of these different sites in related reports of the Waterworks reveal the factors that affected the choice of sites: the position in relation to the development of the city and existing access roads, the area available, the character of the soil and its suitability to basin construction, and the cost of the property or its ownership by the city (in particular as part of Mount Royal Park properties).[132]

Of the many proposed sites from the 1870's for a much larger reservoir on the mountain, the only one referred to in histories of Mount Royal Park is the one east of Côte-des-Neiges Road on the Smith property, that was integrated in Frederick Law Olmsted's plans for Mount Royal Park of 1877.[133] **(D in Figure 2.24, Figure 2.25)** Despite the fact that Olmsted was asked against his better judgement to incorporate the reservoir into his plans right up until the park's inauguration in 1876, this was perhaps the least favoured

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[131] The two sites off of Park Avenue, the future Côte Placide and Jeanne Mance Park, are not discussed in reports. The site corresponding to Jeanne-Mance Park would come back again later in studies that looked at the possibility of a gravity supply for the city since the site was considered a likely location for a northern supplied reservoir. Charles Legge, Ecr., "Sur les systèmes projetés pour l'approvisionnement de la Ville de Montréal, par gravitation", [1873]; Herring & Fuller Consulting Engineers, *Report on an Improved Water Supply for the City of Montreal,* (Montreal, July 2, 1910).Later still in 1951, when a reservoir to serve the east end of the city was being planned in Rosemont, it was decided to only build half the planned area at Rosemont, and the other half at the Jeanne-Mance Park site "Rosemount Reservoir Plan Halved, One Planned in Jeanne-Mance Park," *The Gazette*, February 26, 1952. This was never carried out.

[132] Louis Lesage, "Rapport sur l'agrandissement du reservoir de la rue McTavish," in *Rapport annuel du Surintendant de L'Aqueduc de Montréal pour l'annéee finissant le 31 janvier 1871,* (Montréal: Les Presses de Louis Perrault & Cie., 1871), 44; Louis Lesage, *Report on the Proposed Enlargement of the Montreal Water Works together with an Historical sketch of the Works up to the Present Date,* (Montreal: J.Starke & Co., Printers, 1873), 11-14.

[133] Frederick Law Olmsted, "Mount Royal, Montreal," in *The Papers of Frederick Law Olmsted, Supplementary Series, Vol. 1, Writings on Public parks, Parkways, and Park Systems*, Charles E. Beveridge and Carolyn Hoffman, editors, (Baltimore: John Hopkins University Press, Baltimore, 1997 [1881]), referred to as the "Côte-des-Neiges Reservoir" 406-409; David Bellman, "Frederick Law Olmsted and a Plan for Mount Royal Park," Mount Royal Montreal, Canadian Art Review Supplement no.1 December 1977, (Montreal: McCord Museum, 1977), S31-43; also in more recent references (GIUM, Zinger).

site of the three being considered.[134] It presented disadvantages in terms of position, and some disadvantages in terms of the suitability of its ground for construction. It was thought that the latter could be improved by locating the reservoir alongside a natural ledge of rock, shown in the 1873 plan to be along the northern edge of the property, something which Olmsted's formal design did not integrate. Olmsted considered a naturalistic pond shaped reservoir, but preferred the geometrical shape with a hard edge illustrated in his final proposal suggesting that "the real character of the reservoir as an artificial storage of water should plainly appear".[135] **(Figure 2.25)** The proposed capacity was 87 to 117 million imperial gallons, but the position of the reservoir did not correspond to an area of the city that required such a capacity. If this site were chosen, it would in fact mainly have been for park purposes.

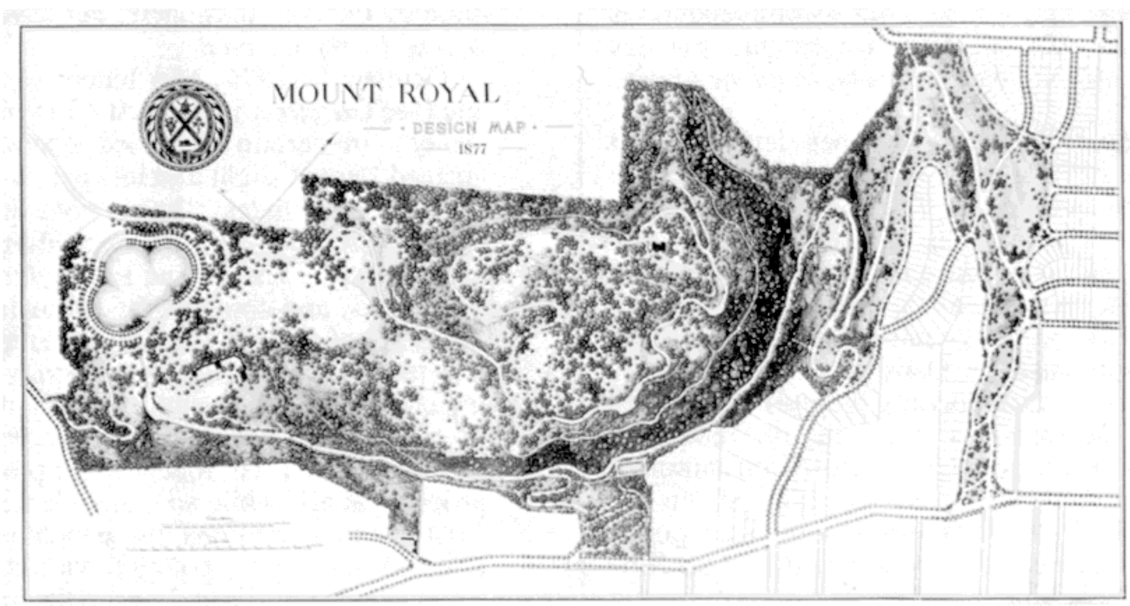

Figure 2.25 "Mount Royal Design Map," 1877
With proposed "Côte-des-Neiges Reservoir"on far left.

(Source: Frederick Law Olmsted, reproduced in David Bellman, editor, *Mount Royal Montreal,* (Montreal: McCord Museum, 1977), S35.)

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[134] Olmsted's negative reaction to having to integrate the reservoir within the park is documented in his letters to Lesage and Nelson, Mount Royal Park Commissioner. See next note. But securing open and hygienic land for reservoirs was the motivation behind a number of American park projects in the 19th century, most notably Fairmount Park in Philadelphia. **(Figure A.22)** Certainly a significant element of his design of Central Park was the replacement of the rectangular York Hill reservoir with the new Croton Receiving Reservoir (1862), which was given a much more naturalistic shape.

[135] Letter from Frederick Law Olmsted to Louis Lesage, July 5th 1876, . (VM-DGA: Olmsted Papers Reel 56:460).

In the engineers' report, a site on the other side of Côte-des-Neiges Road was actually preferred, presenting natural advantages for the construction of a smaller but better positioned reservoir. **(C in Figure 2.24)** However, while it was thought that this site could hold 27 million imperial gallons, the reservoir eventually built on it twenty years later was considerably smaller, holding only seven million imperial gallons.

Ultimately only one high level reservoir was developed in 1875 as an open basin 212 feet above the McTavish, not far to the west at the top of Peel Street. It was an even smaller reservoir, only containing one and three quarter million of gallons. Since there were plans to build a much bigger reservoir to serve higher levels of the city, it was considered a temporary measure. Situated at a height of 413 feet above the harbour, it served the houses that had been built above Sherbrooke Street, and was supplied by a pumping station added to the McTavish site. It was said to be "like the McTavish and built in the solid rock"[136] and was used for much longer than intended. It is still shown in use in a 1920 plan of the system, and appears in a 1930 aerial photograph as a water surface. **(Figures A.4-5)** Beyond its technical function, this reservoir's historical importance was as an element of the landscape of Mount Royal Park. For nearly sixty years, it occupied a prominent position alongside the Olmsted designed path. Its presence in this context is well recorded in numerous photographs and post cards. **(Figure 2.26 and A.18-19-20)**

Figures 2.26 Post card view of the High-Level reservoir, ca. 1912

(Source: Author's post card collection)

[136] F. Clifford Smith, *The Montreal Water Works,* (1913), 17. Thomas W. Le Sage, "The Municipal Water Supply of Montreal," *The Journal of the American Waterworks Association*, 7.6 (November 1920): 897, gives 422 feet.

B. The Montreal Water and Power Reservoirs: Côte-des-Neiges and Outremont

Instead of going ahead with plans in the western part of the city for an enormous reservoir off Côte-Saint-Antoine Road, the McTavish reservoir at lower level and the High-Level reservoir at the top of Peel Street served the city until the tiny Cedar reservoir was built to serve even higher levels of development around 1911.[137] **(Figures A.2-3)** Outside the city limits, the creation of the Montreal Water and Power Company in 1892 was the key factor in the development of new reservoirs.[138]

Figure 2.27 "Franchise Territory of the Montreal Water and Power Co.," 1922
Central area with Côtes-des-Neiges and Outremont reservoirs circled in red.

(Source: VM-GDA, 1922-3 (microfilm))

[137] Lesage, "The Municipal Water Supply of Montreal," (1920): 897. The Cedar reservoir is now the highest reservoir of the Montreal water works at a height of 550 ft and a capacity of 200 000 gallons.

[138] Although the company existed as the Montreal Island Water & Electric before, they did not develop any waterworks before 1892. Claire Poitras, "Construire les infrastructures…" (1999): 507.

During the course of its existence from 1892 to 1928, the Montreal Water and Power Company (MW & P Co.) supplied a large area of the island of Montreal, including at one time or another: Westmount, Outremont, Maisonneuve, Côte-St-Paul, De Lorimier, St-Henri, Ste-Cunégonde, St-Louis and St-Denis. **(Figure 2.27)** The reservoirs built by the MW & P Co. were part of a completely separate distribution system that the company built to serve the areas with which it had contracts. **(Figure A.3)** As with the municipal system, it positioned the reservoirs on the flanks of Mount Royal, but in relation to the areas of the city it served, the sites chosen were further north and east.

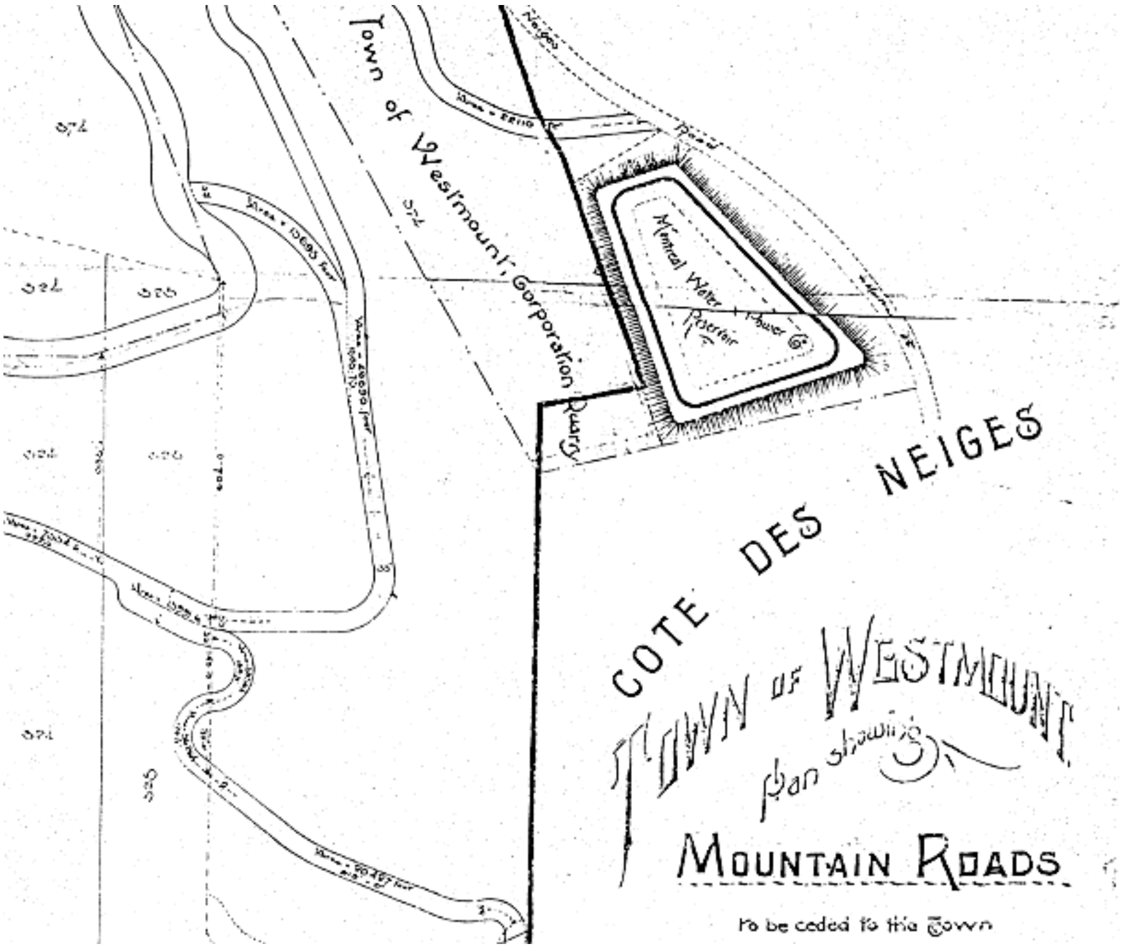

Figure 2.28 Montreal Water and Power Company reservoir, 1895

(Source: “Town of Westmount Plan Showing Mountain Roads to be Ceded by Various Proprietors,” VM-GDA, 1890-5 (microfilm))

The Côte-des-Neiges (CDN) reservoir was built on the site identified in the 1873 proposals for future reservoir sites **(C in Figure 2.24, p.60)**. The MW & P Co. acquired it on March 24, 1893 and construction of the reservoir began soon after.[139] The basin was built quite differently from the McTavish, since the site formed an almost natural basin, and no rock excavation was required.[140] Its sides were sloped and covered in cement slabs that evened out and solidified the supporting earth. The resulting wedge-shaped plan held 7,5 million imperial gallons of water. Original plans show one basin that was eventually divided by a wall. **(Figures 2.28)**. Plans from the evaluation of the site in 1915 show the site surrounded by a fence with brick piers and an entrance gate and steps leading to the top of the basin.**(Figure A.21)** The brick fence partly still exists.

With a water level of 476 feet above the river, the CDN reservoir was then the highest in the system. A pumping station added around 1910 on the northwest side of the reservoir would make it possible to develop the system to the north and west, including the Westmount and Outremont reservoirs.[141] **(Figure A.3)**

The company acquired the Outremont reservoir site (Vincent D'Indy) in 1909. It was the biggest one that had been built to date. Considering the amount of excavation that was carried out, 379 860 cu. yards of rock alone, one can imagine that the construction was relatively long.[142] The reservoir was still under construction in 1915.[143] It was built as two basins divided by a concrete partition wall. **(Figure 2.29)** The surrounding walls were built of concrete, or at least the rock face was covered in cement. **(Figure 2.30-31)**

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[139] Information about this first reservoir is obtained from the 1873 proposals, city or insurance plans from 1893 onwards, a series of plans drawn to evaluate the property as part of a water-rate dispute in 1915, the 1928 deed of sale to the city of Montreal and photographs taken during the demolition of this reservoir and its reconstruction in 1938.

[140] *Appraisal invoice of No.3: Clarke Avenue Pumping Station, Mountain Pumping Station, Cote des Neiges Reservoir, the Outremont Reservoir of the Montreal Water and Power Co.,* 1915, VM-GDA: P46/C3.3.- A:54-02-02-02.

[141] The Westmount tank, for which few references have been located, at a top elevation of 660.50 feet, was probably located in Summit Park.

[142] *Appraisal invoice of No.3…*(1915), P46/C3.3.- A:54-02-02-02. The capacity was in the area of 40,000,000 gallons.

[143] *Appraisal invoice of No.3…*(1915), P46/C3.3.- A:54-02-02-02

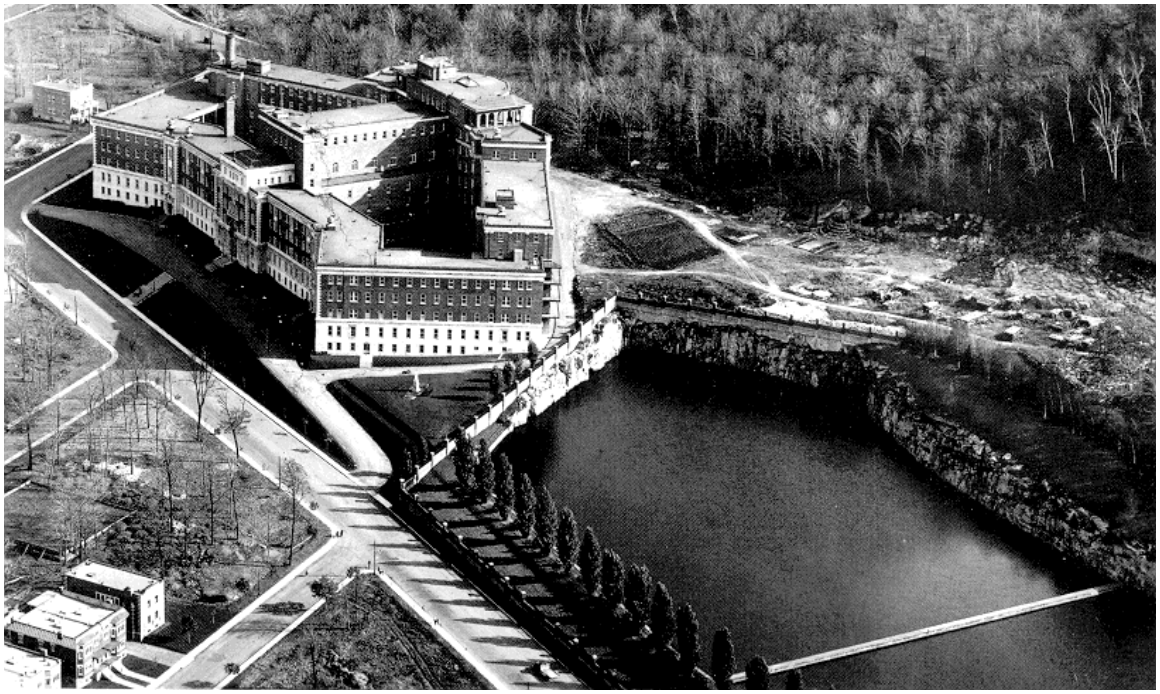

Figure 2.29 Outremont reservoir, ca 1930

(Source: Archives des Soeurs des Saints-Noms-de-Jésus-et-de-Marie, reproduced in André Croteau, Dinu Bumbaru et Claude Jasmin, *Outremont 1875-2000*, (Outremont: Société d'histoire d'Outremont, 2000), 61)

Built on a site that was not identified in the 1873 proposals, the Outremont reservoir reflects the urban expansion of the turn of the century that provided the MW & P Co. with a growing clientele. The height of 387 feet was high enough for the area served by the company that went from Ste-Cunégonde in the southwest to adjacent Outremont to Maisonneuve in the east. Adjacent to the site was a quarry and by 1925 a convent. The Outremont reservoir was the last of the city's reservoirs to be built as an open basin.

Figures 2.30-31 Outremont basin being cleaned, ca. 1951

(Source: Francis V. Dowd private archive)

2.2.2 A turning point: water purification and filtration

The question of covered reservoirs was first raised in Montreal in 1910, in relation to increasing concerns about the means to improve and control water quality. Although urban salubrity and public health helped motivate the development of water and sewage services throughout the nineteenth century, and the relationship between water and disease was well understood since the 1870's, the St-Lawrence River continued to be perceived as a relatively pure source until studies began to show that the fast moving current was not acting as the natural purifier it was thought to be.[144] Its quality as a source was increasingly diminished by the development of cities and industries upstream that used the river as an outlet for sewage and waste. The river has a limited capacity to absorb and transform pollutants.

The situation reached a crisis with the typhoid fever epidemic of 1909-1910, a deadly disease usually contracted from organic waste. In 1909 and the first three months of 1910, 315 people died from it in Montreal. The figures for different neighbourhoods suggest that the problem was worse in areas supplied by the MW & P Company, whose intake was much closer to the shore and the city.[145] All the same, the quality of the municipally supplied water was equally problematic, illustrated by the fact that in 1909 the Royal Victoria Hospital announced that it would build its own artesian well to ensure the purity of the hospital's supply.[146]

The municipal administration was becoming more involved in public health issues, hiring health and sanitation professionals.[147] But faced with the epidemic, American engineers were hired to advise the city on solutions to improving the quality of the city's water. Their 1910 report provides a thorough picture of the state of the municipal supply, and to

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[144] Various reports and the city's historic attempts to deal with the pure water issue are referred to in Smith, *The Montreal Water Works, ...*(1913), 20-35; Gagnon, *L'aqueduc ...*(1998), 144-154.

[145] Herring & Fuller Consulting Engineers, *Report on an Improved Water Supply for the City of Montreal,* (Montreal, July 2, 1910), 67-68.

[146] "Royal Victoria Will No Longer Use City Water: Hospital Constructs its Own Plant to Avoid Danger of Disease," *The Star*, June 1, 1909. (Information provided by David Theodore and Annmarie Adams, McGill University, School of Architecture).

[147] Gagnon, *L'aqueduc ...*(1998), 151.

some extent of the MW & P Co., which supplied one third of the city's population following annexations of areas served by the private company. The need for immediate measures such as "purification" by addition of hydrochloride of lime, were confirmed. Equally urgent was the need for a filtration and treatment plant, but the estimated cost of this plant was high enough to merit studying sources other than the river.[148]

The Herring & Fuller report presents an ambivalent picture of the importance of covered distribution reservoirs, but the first record of this question in the Montreal context. It is suggested that any new reservoirs to be built following the introduction of filtration and purification processes should be covered, although in most North American cities, existing reservoirs are not usually covered.

The earliest reservoirs directly associated with the improvement of water quality are those that were built as part of the filtration plant from 1910 to 1930 to contain slow sand filtration beds. **(Figure 2.32)**

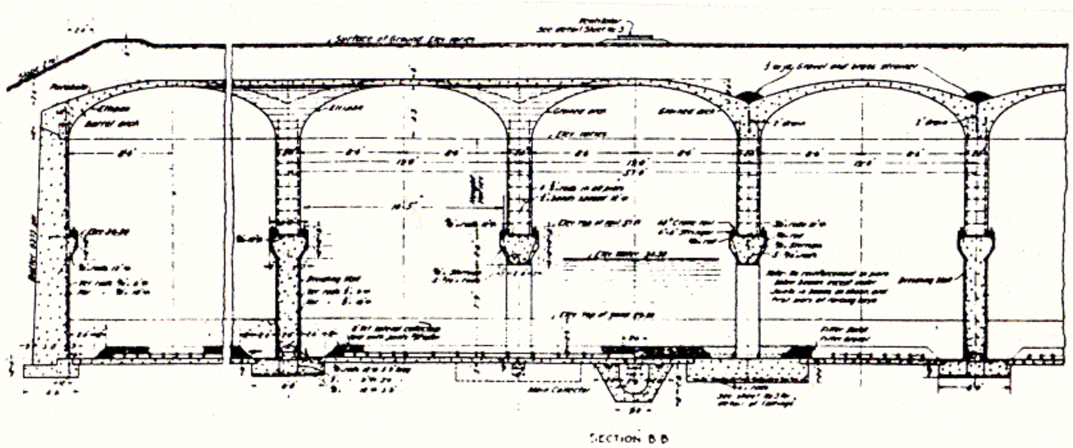

Fig. 7—Details of Final Filters, Montreal Filtration Plant.

Figure 2.32 Atwater filtration plant: Section through reservoir for filtered water

(Source: Field, Frederick E., "The City of Montreal Filtration Works." *The Contract Record*. January 26, 1916, 77).

[148] In particular, the possibility of finding a purer source of water north of the city in the Laurentians was considered, but never retained, because of the cost of such long-distance constructions, and the relative quantity it could provide. Furthermore, such a project would have involved expropriating areas that were already relatively widely settled or used by the forest industry.

These were the first major underground reservoirs in Montreal, and their concrete construction was innovative for Montreal but already widely used elsewhere: relatively closely spaced concrete columns supported vaulted concrete slabs upon which earth was applied as insulation.

Despite the urgency of the situation that required introducing filtration as soon as possible, the war of 1914-1918 and other factors delayed these constructions. Chlorination was the main treatment for still some time. The city's engineers also argued for other solutions to the water quality problems, such as moving the intake further out into the river. George Janin, supervising engineer of the waterworks, continued to flaunt the city's natural advantages long after laboratory tests showed that the state of the river was deteriorating.[149]

Once the purification and filtration processes were introduced, the water in the system became "pure" again, purer now than the actual source. **(Figure A.25)** Removing the pollution in the river water had been the principal initial concern. What happened to water afterwards, while running through the system, was apparently not as immediate a concern. The open reservoirs could and would wait.

[149] George Janin, "The Water Supply Problem of Montreal," *The Canadian Engineer*, January 14, 1910, 25-28. His Canadian colleagues considered this position unprofessional and unscientific. See Editor's introduction to the article cited above.

2.2.3 The covering of the reservoirs from 1938 to 1964

As suggested in the Herring & Fuller report, any new reservoirs that the city built after it began to treat water were built as closed containers. The first covered distribution reservoirs were relatively small ones hidden within the landscape of Mount Royal Park: the Cedar Reservoir (200 000 imperial gallons) was probably built around 1911, and the Mountain Reservoir (180 000 imperial gallons) in 1931.[150] It would take much longer for the existing reservoirs to be covered, beginning only in 1938, and completed in 1964.

If the introduction of filtration and purification processes was delayed by the war of 1914-1918, subsequent improvement and development of the system was affected by the City of Montreal's expropriation of the Montreal Water and Power Company in 1928. At a cost of $14 million dollars, the acquisition of the MW & P Co. would have an impact on the city's plans and resources.[151] This takeover had become an increasing necessity, due to the difference between the company's rates and those of the municipal system, the need for consolidation of expansion plans, and problems with the company's water quality. The majority of cases of typhoid fever in 1909-10 were in areas of the island it served, possibly due to the location of its intake closer to the shore and to the city.[152]

No study exists of the physical impact of the combination of these two companies, but the problematic intake of the MW & P Co. was abandoned. The reservoir sites would be maintained and plans for new reservoirs suspended. Taking over the existing reservoirs was a principal economic advantage of the merger of the public and private systems.

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[150] Lesage, "The Municipal Water Supply of Montreal," (1920): 897, for date of Cedar construction. A capacity of 200 000 gallons for both reservoirs is indicated on the 1945 section.

[151] The city had acquired the right to take over the company in 1909, in the full swing of annexations that included many areas served by the company. The city did not intend to renew contracts in these areas, so that it was eventually to the private company's advantage to sell. The 1928 price was considered scandalous considering the 1914 evaluation of $8,5 million. See Fougères, "Le public et le privé …," (1996), 56-57.

[152] St-Henry & St-Denis: 441/37 and 235/31 cases/deaths respectively. Herring & Fuller, *Report on an Improved Water Supply,* (1910), 9.

> By adding the reservoirs of the Montreal Water and Power Company to those of the city, the storage capacity of these reservoirs would be increased from 39,000,000 gallons to 91,000,000 gallons, or more than 100 percent.[153]

A reservoir planned in Notre Dame de Grâce would no longer be built. The fusion of the two systems resulted in major reorganization including that the Côte-des-Neiges and Outremont reservoirs would be supplied by pumps at the McTavish station, an increasingly strategic distribution point for the entire system. **(Figure A.6)** Before that time, the Outremont reservoir was supplied by the pumps at Côte-des-Neiges, supplied itself by the pumping station on Clarke Avenue in Westmount. **(Figure A.3)**

Amidst this reorganization and the onset of the 1929 economic depression, the state of the distribution reservoirs, and their impact on water quality, was not a primary concern. The first proposals to cover the existing reservoirs only came in 1932-1935, when waterworks chief engineer Charles J. Des Baillets expressed his concern about the state of the McTavish: its leaking walls needed repair, to protect the pure water in the reservoir from adjacent groundwater and prevent wasting it through leaks in the other direction.[154] **(Figure 2.33)** When rebuilding the base and walls, a roof might as well be added.

Figure 2.33 The McTavish reservoir, 1929
State of the masonry wall along Carleton Road (now Dr. Penfield Avenue)

(Source: Photothèque *LaPresse,* reproduced in Pinard, *Montréal…*(1989), 361)

[153] "Engineers' View of Water Merger," *The Gazettte*, February 16, 1927.

[154] "Les reparations à faire au réservoir de la rue McTavish," *Le Canada*, 26 septembre 1935.

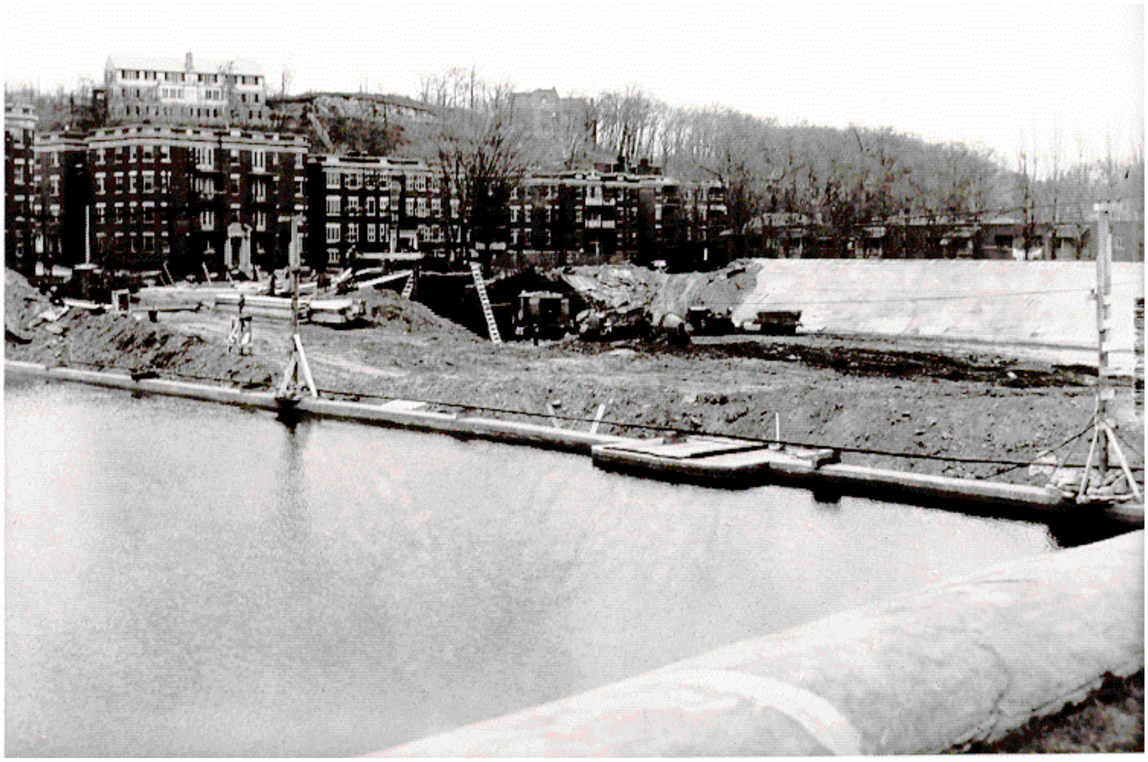

Figure 2.34 Côte-des-Neiges reservoir being demolished, 1938

(Source: ANQ- Viger, Fonds Conrad Poirier, P48, P2813)

The first reservoir to actually be covered was Côte-des-Neiges in 1938-39. Ten years after being acquired by the city, this site that had served as a distribution node leading to the Outremont and Westmount reservoirs, would now become the transfer point for mains leading to the network being developed in the park, including the supply of Beaver Lake, being built at almost exactly the same time.[155] The new reservoir had about the same capacity as the one it replaced, but was otherwise quite different from the wedge-shaped basin laid out parallel to Côte-des-Neiges Road from north to south. A compacter deeper and higher squarer box was built across the width of the southern part of the site. **(Figure 2.34)**

[155] These two projects can also be linked as two of the last make-work projects of the depression before the beginning of the war of 1939-45

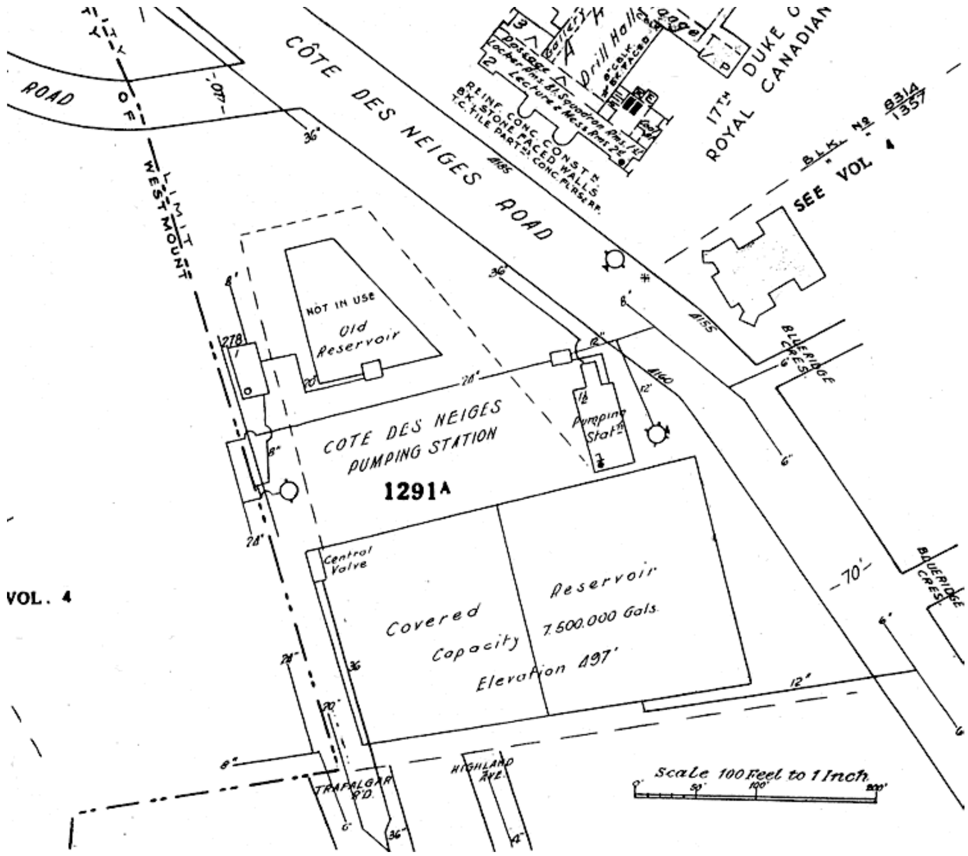

Figure 2.35 Côte-des-Neiges reservoir site, 1955

(Source: *Underwriter's Fire Insurance Plan,* Montreal, Volume 7, April 1955, Sheet 759-4, BNQ-Holt (microfilm)).

Two reasons explain this more efficient occupation of the site: the northern half of the original basin could continue to be used while the new reservoir was being built, and it was originally intended that this northern part could also be transformed into a reservoir to effectively double the capacity of the site. A new pumping station was built directly on Côte-des-Neiges Road and the old pumping station on the western side of the site was eventually abandoned. **(Figures 4.2, p.107, A.22, 5.13, p.128)** During construction, newspaper articles relate that there were plans to transform the roof of the reservoir into a public park.[156]

[156] "New Cote des Neiges Reservoir To Have Park Built on Top of It," *The Gazette*, July 11, 1938. Once this section was complete, a city councillor had hopesof making the now empty northern section of the old reservoir into a swimming pool, using the abandoned pump house as a bathing pavilion but these ideas were never retained. "Seigler Has Plans for Old Reservoir, Alderman Suggests Using Cote des Neiges Shell as Swimming Pool," *The Gazette*, July 20, 1939.

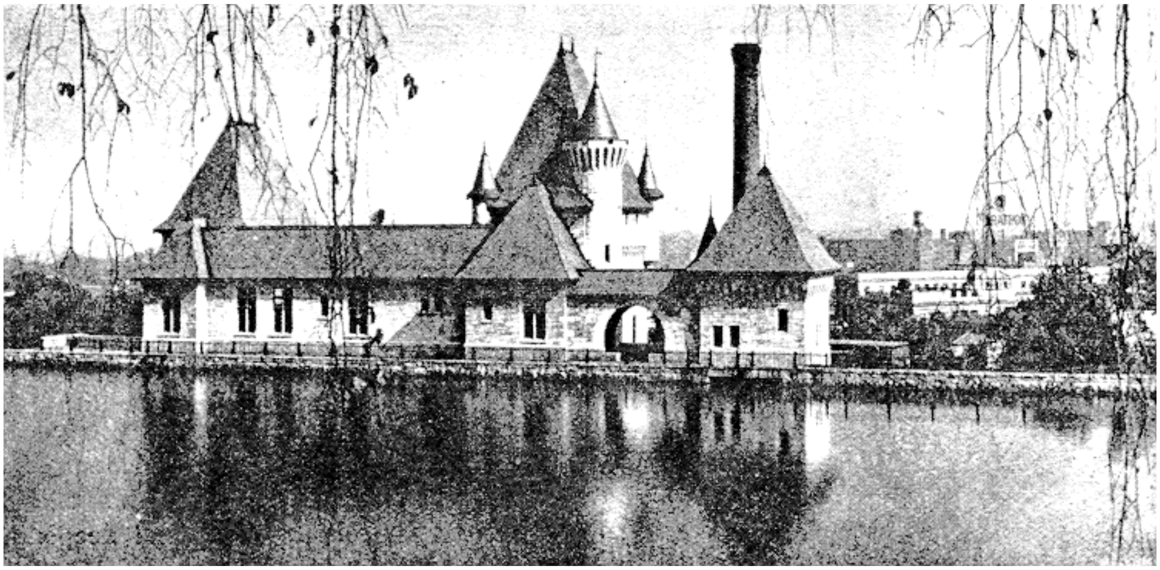

Figure 2.36 McTavish reservoir and pumping station, ca. 1937

(Source: Charles-J. DesBaillets, "Historical Background and Important Features of the Montreal Waterworks, Described for the Benefit of Those Attending the Convention of the Canadian Section, A.W.W.A," *Engineering and Contract Record*, April 14, 1937, 15.)

The McTavish reservoir was next to be covered in 1947-48. The story of how this reservoir was covered is well documented, since Des Baillets published a comprehensive report of the site's history and the work underway in 1947.[157] Perhaps ironically, he also reveals his appreciation of the calming effect of the reflections of the pumping station, also built under his mandate, in the artificial lake of the open basin.[158] **(Figure 2.36)** However the problems with the existing basin, the oldest of the reservoirs with parts of it on the south dating from 1853, had called for major repairs since at least the early 1930's. By 1945, it appears to almost have been a question of preventing disaster. But the greatest urgency expressed was to reinforce the base and retaining walls, not to cover the basin. In fact, the city's engineers were asked by the municipal council whether the covering could not be put off to a later date.[159]

[157] Charles-J. DesBaillets, "Le reservoir McTavish," *Métropole*, septembre 1947, n.p. (VDM-GDA R.3390.2) See Appendix 3 for an extensive quotation from this article, describing the reconstruction.

[158] "Reflétant sa silhouette dans les eaux calmes du réservoir, elle ajoute au décor déjà très joli de ce quartier quelque chose de reposant."

[159] "Concordia fera reconstruire le reservoir de la rue McTavish," *Le Devoir*, November 6, 1945

Like the new Côte-des-Neiges reservoir, the new McTavish was compacter. Set within the basin that had been carved out of the rock, it was narrower but higher. It was also subdivided into six cells, which would increase its flexibility, now even more important as its role as a distribution node expanded in the increasingly complex network. The cells were built with passages between them, for visual control of leakage. **(Figure A.15)**

Figure 2.37 McTavish reservoir reconstruction, ca. 1950
With new concrete wall and trace of old stone wall on south side

(Source: Dowd collection)

Shortly after reconstruction began, plans were announced to use the roof as a botanical garden for McGill University.[160] Those who saw the opportunity to create a public park or playing ground contested this idea.[161] But both garden and park ideas were put aside, as had been the case with the plans for the roof of Côte-des-Neiges. One might suggest that considering the cost of reconstruction, there was no place for expensive "luxuries" like landscaping. The reconstruction of the McTavish cost more than $1,5 million dollars in 1948, just one of many major post war expenditures that probably left few resources for any but the most practical requirements. On the other hand, perhaps the grass cover was considered enough of an improvement. In any case, further plans for the site were kept discreet. Perhaps not so surprisingly, since Des Baillets had once declared that any

[160] "Capped Reservoir to Become Site of New Botanical Garden," *The Montreal Star,* July 13, 1946.

[161] "Public Park Over Reservoir Facing Counter-Proposals," *The Montreal Herald*, September 22, 1948.

aesthetic features intended in the design of public works should be concealed in the plans or risk being eliminated by municipal councillors.[162]

The last reservoir to be covered was the Vincent d'Indy - Bellingham (formerly Outremont) in 1964-65. A major factor was the construction of convent and university buildings all around the site.[163] The convent of the Sisters of the Holy Names of Mary and Joseph had been built just after the original reservoir in 1925, but otherwise the area remained quite isolated until the expansion of the convent and the university on three sides of the site in the 1950's and 60's. Compared to the McTavish and Côte-des-Neiges sites, the roads beside this reservoir were relatively quieter, and pollution from automobile traffic might not have seemed to be as pressing a concern.

Despite its very large size, the reconstruction maintained the original the division in two basins or cells. The same elevation of the water was also maintained, but the capacity was somewhat reduced from 45 to 43,2 million imperial gallons.[164] The raised level of the roof in relation to the original surrounding fence is probably the result of the height of the roof itself. Although the original ornamental brick and wrought iron fence and formal entrance gateway were kept, valve stations were added with little consideration of the site's potential as a park, so that the view towards the open field and the mountain beyond is blocked as one enters the gates by a building that floats at the forefront. **(Figures 2.9, p.45, 2.14, p.47)**

Unlike Côte-des-Neiges or McTavish no plans existed for a public park. From even before the reservoir reconstruction was complete, the Université de Montréal obtained a lease to use of the roof as a playing field for $1. To the $2,7 million that the city budgeted

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[162] "Basing his observations on his experience in Montreal, C.J. DesBaillets, chief engineer of the Montreal Water Board, said that it is often necessary to keep municipal councils in the dark concerning the details if it is desired to carry out any aesthetic treatment; otherwise the scheme may be disapproved or subjected to aldermanic jealousies," in "Pumping Stations for Small Communities," *Engineering and Contract Record*, March 30, 1938, 16.

[163] "Le reservoir Bellingham rénové et recouvert." *Le Devoir*. January 5, 1961.

[164] At a maximum height of 32' it is much deeper than the two other reservoirs that are 18' (Côte-des-Neiges) and 24' (McTavish) respectively.

to cover the reservoirs, the university intended adding $150 000 for landscaping of a running track and playing field.[165]

> In 1940, C.J. DesBaillets, then Engineer-in-Chief of the Montreal Waterworks, set out the coming tasks in five points: to build a new water intake, to enlarge the filtration plant, to lay new master mains, to cover the open reservoirs, to build new storage reservoirs. All that is now "water over the dam." …
>
> There remain no open reservoirs in the territory. The last to be covered was the Bellingham reservoir, which has a capacity of 45 million gallons and was entirely reconstructed in 1964. The new Rosemont reservoir (50 million gallons) was built in 1960. The old McTavish reservoir was reconstructed in 1948; the Summit reservoir on Mount Royal, dates from 1957. In 1955, new reservoirs for filtered water were constructed at the filtration plant…
>
> In 1967, the Montreal waterworks is certainly more than centenarian; just by new construction and all-round updating it is also completely rejuvenated and ultra-modern.[166]

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[165] "Terrain de piste et pelouse au-dessus du réservoir Bellingham," *La Presse*, (3 février 1965) "…La ville se dégage de toute responsabilité relativement aux accidents pouvant survenir sur ce terrain et résultant de l'utilisation du terrain par l'université…l'université s'engage à utiliser le terrain à des fins sportifs uniquement et a ne pas y donner de spectacles payants ni à sous-louer ce terrain. Cependant elle pourra en permettre l'usage à des tiers à la condition que les seules charges qui leur seraient imposées seraient les frais particuliers à un tel usage, tels ceux de gardiennage, de nettoyage et de consommation de services. Enfin, l'université s'engage également à payer tout montant de taxe qui pourrait être imposé par la ville d'Outremont et qui serait dû à l'existence de la piste aménagée à cet endroit. "

[166] Dominique Beaudin, *L'aqueduc de Montréal/ Montreal Waterworks*, (Montreal: Public Works Department, 1968), 43.

	McTavish	Côte-des-Neiges	Vincent-d'Indy
Historical name(s)			Outremont /Bellingham
Capacity (m3/ imperial gallons)	150 000m3 (33 000 000 gallons)	32 000m3 (7 110 000 gallons) planned 14 000 000	196 000m3 (43 200 000 gallons)
=x Olympic pools	75	16	98
Pumps	9	4	5
Height (m/ ft) of water in reservoir above the river/ harbour	63m (231,17feet)	146m (497 feet)	108m (387,38 feet)
El. Floor/ overflow	206,5'/ 231,17	479'/ 497'	354,6'(ave.min)/387,25'
Water height	24,67'	18'	+/- 32,6' (sloped base)
No of cells	6	2	2
Position (city, roads)	Montreal downtown Dr.Penfield (McGregor/ Carleton) /Pine Avenues	Montreal, on border of Westmount Côte-des-Neiges Road Belvedere Road	Outremont, on border of Montreal Mont-Royal Boulevard Vincent d'Indy Street
Function (in relation to city position)	Equilibrates zone 1 (south part of the island below 45m) Distribution "node"	Equilibrates zone 2 (centre of island between 30 and 85m)	Equilibrates zone 3 (around Mount Royal between 85 and 115m)
Colour code (hydrants)	Green	Blue	Orange
Supplied by	Atwater and C.J. DesBaillets stations	McTavish pumping station	McTavish pumping station
Supplies pumping stations at	Côte-des-Neiges Vincent d'Indy & Rosemont reservoirs	Mountain & Summit reservoirs	No other reservoir
Date of construction	1853-56, 1861-77, 1899, 1932 (extension, repairs)	Property acquired March 24, 1893	Property acquired July 19, 1909
Public or private original builders	City of Montreal	Montreal Water & Power Company Bought by city in 1928	Montreal Water & Power Company Bought by city in 1928
Cost of construction	$410 375.	Not found	Not found
Evaluation		In 1915: $168 955	In 1915: $572 587.76
Site area/ land value		187 240 sq.ft value: $234 050 (1915)	352 015 sq.ft value: $228 809 (1915)
Date of cover	1947-49	1938-39	1964-65
Cost of reconstruction	$1,573,481.	Contract $327,000. Estimate $350,000.	Estimated $2,700,000.
Use today (surface)	Rutherford Park/ Sports field (Agreement with McGill University) Env. Canada station	On reservoir: none Adjacent site: public works	Sports field (Agreement with Université de Montréal)
Zoning (usage)	Park	Park	Park?
Heritage status	Mount Royal Heritage Site (pumping station)	Mount Royal Heritage Site (pumping station)	None
Principal adjacent functions today	University Hospital	Public works (Montreal & Westmount) Armoury, Housing Snow dump	Convent University Housing

TABLE 2.I

Summary of information about the three reservoirs

CHAPTER III

Why the reservoirs were covered

This chapter explores the reasons why the three Mount Royal reservoirs were covered. The documents contemporary to the events that were examined include municipal reports of the City of Montreal, local newspapers, national engineering journals and English, French and American water supply handbooks and technical manuals. The language of the arguments given in these texts may be as significant as the ideas.[167] What do the reasons given at the time tell us about how water as part of the water supply system was perceived? How do the reasons relate to the categories elaborated in chapter I, that is, to environmental factors, technological means and social concerns?

Although many references to covering the reservoirs were found, the subject was nevertheless of minor importance. There are far more references in local newspapers than in the national technical journals. In the journals addressing a wider Canadian context, covering existing open reservoirs, a situation only faced by older cities, did not merit as much coverage as the developments faced by all cities like the introduction of filtration and purification processes. Then again, younger cities never built open reservoirs. By the 1930's when the three reservoirs in this study began to be rebuilt, the reinforced concrete underground reservoir was the norm.[168] Engineering journals presumably no longer reported on such constructions once they became common, and reconstruction of an existing site did not command as much interest as new developments. Even so, the covered reservoir is still only mentioned as an option, and not an ideal or even an inevitability, even in the texts reporting on new reservoir construction.[169]

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[167] A selection of quotations concerning the reasons and means of covering reservoirs are included in Appendix 2.

[168] In 1916, for instance, a book on water supply systems across Canada was filled with construction photos of Winnipeg's first major reservoir, an 18 000 000 imperial gallon covered reservoir. Leo G. Denis, for the Committee on Waters and Water-Powers, *Water Works and Sewerage Systems of Canada*, (Ottawa: Commission of Conservation of Canada, 1916).

[169] "Reservoirs and Water Storage." *Engineering and Contract Record*. April 19, 1939, 20; Dr. Albert E. Berry, "Developments in Canadian Waterworks Practices 1850-1940," *Water and Sewage*, (December 1940): 9-19.

It is only quite recently that the question of the water quality in open reservoirs was addressed as a major issue, in a series of studies and reports ca.1974-83.[170] Water quality standards have, over the last century, become increasingly restrictive, but these standards were easier to apply to new construction than existing sites. The covering of existing reservoirs has in fact remained in the realm of recommendations, despite regulations concerning the covering of new reservoirs.[171] Thus no thorough studies existed when Montreal's reservoirs were being covered in the 1930's to 1960's. The experts based their arguments on a mixture of experience and observations about the specific conditions of each reservoir. Thus, the financial resources available to those in charge of the Montreal water works were able to influence the decision of when and if to cover the reservoirs.

It is also important to consider the context of the publications. Whereas a local newspaper report might seek to explain anything that cost taxpayers money, and the basis of comparison would be other public works and priorities, a technical article in a journal intended for engineers and building contractors would tend to focus on the biggest, most visible and most expensive developments. Thus in a national article about the Montreal water works published just before the reconstruction of the reservoirs began, the recently completed filtration plant, the reorganization of the system following the purchase of the MW & P Co. and the construction of new pumping stations are emphasised. References to the reservoirs are few, focussing only on their limited capacity, and the need to build new ones to "permit more uniform pumping and consequently greater economy". The need to cover the reservoirs and the related work already planned is not mentioned.[172]

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[170] James C. Pluntze, "Health aspects of Uncovered Reservoirs," *Journal of the American Water Works Association*, (August 1974): 432-437; Stephen W. Bailey and Edwin C. Lippy, "Should All Finished Water Reservoirs Be Covered?" *Public Works,* (April 1978): 66-70; John J. Morra, "A Review of Water Quality Problems Caused By Various Open Distribution Storage Reservoirs," *Journal of the New England Water Works Association*, (1980), 94 (4):316-321; AWWA Committee Report, "Deterioration of water quality in large distribution reservoirs (open reservoirs)," *Journal of the American Water Works Association*, (June 1983.): 313-318.

[171] United States Environmental Protection Agency (USEPA), *Uncovered Finished Water Reservoirs Guidance Manual*, USEPA 815-R-99-011 (USA, Office of Water, April 1999), 1-5.

[172] Charles-J. DesBaillets, "Historical Background and Important Features of the Montreal Waterworks, Described for the Benefit of Those Attending the Convention of the Canadian Section, A.W.W.A," *Engineering and Contract Record*, April 14, 1937, 21-22.

3.1 Covered reservoirs in Constantinople and Paris- but not in North America

> Or il est bien évident, pour ceux qui connaissent le climat de cette contrée, qui connaissent surtout le vent violent qui soufflé souvent à Nîmes, vent qui soulève des flots de poussière et même de gravier, il est bien évident, disons-nous, que les constructeurs du *castellum* n'hésitèrent pas longtemps pour savoir s'ils fermeraient (sic)de toute par leur *castellum*. –Les eaux des fontaines d'Airan et d'Eure arrivaient dans l'ancienne cité par une canalisation fermée; or, pour conserver à ces eaux toute leur limpidité, il fallut de toute nécessité fermer le *castellum*.[173]

Why weren't Montreal's reservoirs covered in the first place? Before reservoirs, water was collected and stored in covered cisterns and tanks. Even wells and sources traditionally have some form of roof. Yet open reservoirs were built in many large North American cities, from New York to Pittsburgh to Toronto. In 1997 there were still an estimated three hundred open reservoirs out of 10 000 water storage facilities in the USA.[174] With the development of large-scaled reservoirs this common sense covering was left aside, presumably for economic and technical reasons, although perhaps also because in the less densely populated, and not yet very industrial cities of North America, factors like environmental pollution were not yet as critical.

Throughout history protected or covered water storage was inevitably a strategic factor for cities that developed in a hot climate, or through years of war and siege. There are quite ancient models of covered reservoirs. Constantinople built covered reservoirs as early as the 6th century.[175] The vaulted masonry roofs supported on closely spaced columns of these monumental structures established a constructive form that varied little until the introduction of reinforced concrete in the 20th century. **(Figure 3.1)**

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[173] Ernest Bosc, *Dictionnaire raisonné d'architecture et des sciences qui s'y rattachent*, (Paris: Librairie de Firmin-Didot et Cie., 1877), 413. An explanation of why the Romans would have covered their water towers (*castellum*) as a matter of common sense.

[174] EPA, 1999, 1-3; It would be interesting to have a geographic breakdown of the areas where open reservoirs were built, to evaluate the importance of the climate factor. Compare for instance with the same period of early urban development in Sydney (Australia) where large scaled covered reservoirs were built. Aird, *The Water Supply… of Sydney*, (1961), 64-66.

[175] Stéphane Yerasimos and Pierre Pinon, "Istanbul: Aqueducts, Cisterns, Fountains and Dams," *Rassegna (Aqueducts),* 57:1 (March 1994): 54-59.

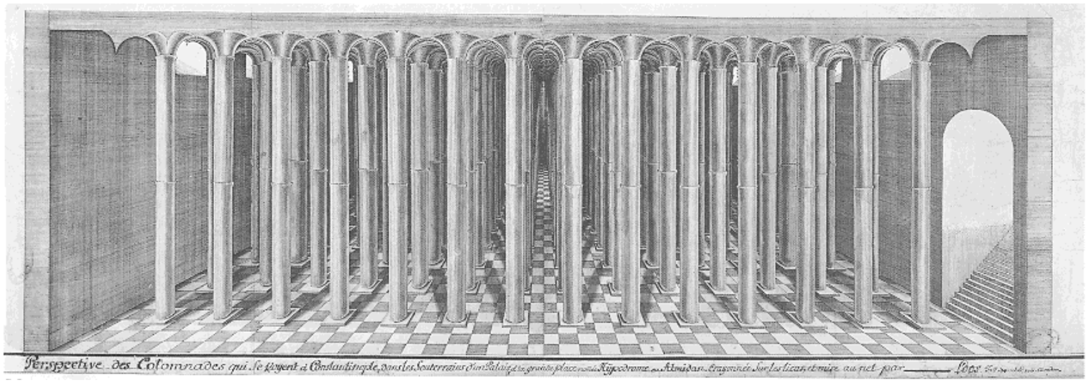

Figure 3.1 The reservoir of the Atmidan Hippodrome, Constantinople

(Source: Cornelius Loos, reproduced in *Rassegna (Aqueducts),* 57:1 (March 1994): 58)

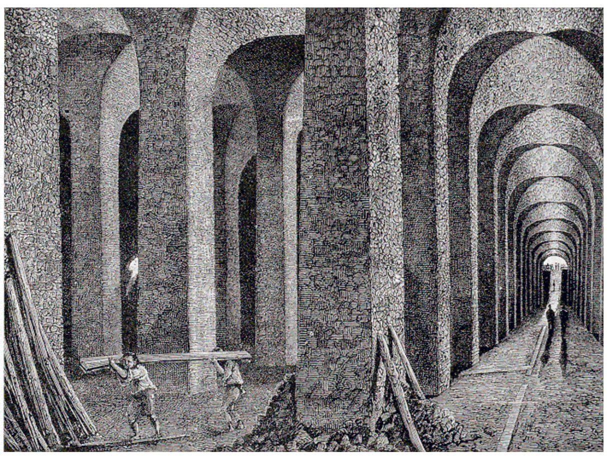

Figure 3.2 Montsouris reservoir under construction, Paris, 1874

(Source: Reproduced in Laure Beaumont-Maillet, *L'eau à Paris* (Paris: Hazan, 1991), 190)

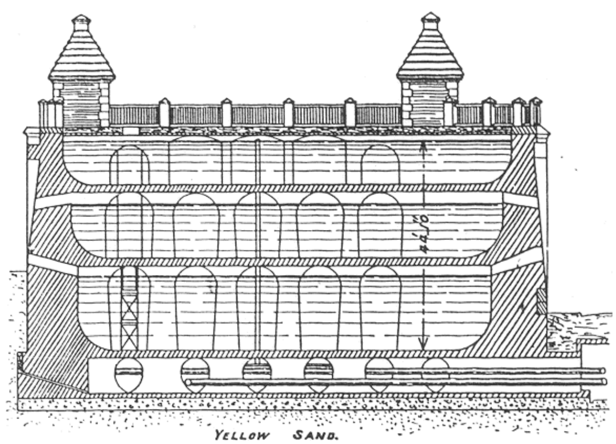

Figure 3.3 Montmartre multi-storey reservoir, section, Paris, completed ca.1890
Bottom two levels with river water, top level with spring water

(Source: Leveson Francis Vernon-Harcourt, *Sanitary Engineering with Respect to Water-Supply and Sewage Disposal* (London: Longmans, Green, and Co., 1907) 217.)

By the 19th century, monumental covered reservoirs were also being built within denser industrialised cities like Paris. Water was brough by gravity from a variety of uphill sources to the multi-storey Menilmontant and Montsouris covered reservoirs built in 1863-65 and 1869-74.[176] **(Figure 3.2)** The reasons given for covering the water are both related to the effect of sunshine and the fact the water in these reservoirs came from spring fed rivers: to protect such water, considered particularly susceptible to vegetable growth that gives water a sour taste, and to keep the water at a cool temperature. The subdivision of the reservoir in horizontal levels was thereby also possible, something particular to the Paris situation. Spring water for domestic use was stored on top and river water for firefighting and street cleaning on bottom. **(Figure 3.3)**

An earlier proposal from 1853 that was not built is also worth noting in relation to what happened in Montreal: it was suggested that Seine River water be pumped into a series of reservoirs excavated in the hill of Montmartre whence it could be distributed by gravity throughout the city. But while some critics were concerned about the quality of the river's water, Hausmann argued against this system because it would depend on pumps to raise the water, and the gypsum soil of the hill would affect the quality of the water.[177]

Comparison with these Paris models is instructive as regards to both the water and topography. In comparison with an older bigger city like Paris, Montreal's situation was quite different. In the 19th century, the reservoirs located on Mount Royal were not really in the city, and the St-Lawrence River was only considered polluted along its shores. Montreal's water was from a surface source exposed to the elements and the atmosphere the length of the river's course, and delivered by an open conduit that cut through part of the city. No concern was ever expressed about the geological composition of Mount Royal, in which the reservoirs were excavated. In fact, the mountain's sedimentary and igneous rock was considered relatively impervious and thought to contribute positive

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[176] Beaumont-Maillet, *L'eau à Paris*, (1991), 246.

[177] Beaumont-Maillet, *L'eau à Paris,* (1991), 168-169. There continued to be many proponents of the Seine as the best source for the city, and it does along with water from the Marne continue to provide ca. 40% of the city's supply, but treated river water is still secondary in value to the spring waters. Beaumont-Maillet, *L'eau à Paris,* (1991), 238-241

minerals to both underground and surface waters.[178] On the other hand, although similar concerns about dependence on pumps were expressed, the possibility of using waterpower to raise the water instead of coal-driven steam made the kind of large-scale gravity-supplied systems of Paris less interesting in Montreal. Finally, no distinction was ever made in storing cleaner drinking water from water for firefighting.

3.2 Reasons given for covering the Montreal reservoirs

The first recorded indication of reasons to cover the reservoirs in Montreal comes from the report by American engineers hired in 1910 to study improvements to Montreal's water supply, especially with regards to water quality. They linked the covering of new reservoirs with the installation of filtration plants. Reservoirs are to be covered

> "for the purposes of keeping the filtered water cool in summer time and free from contamination from dust and leaves; and partly to protect it from growths of algae and other microscopical (sic) organisms, which while not injurious to health are frequently the source of quite objectionable tastes and odors." [179]

The arguments are similar to those given for covering water reservoirs in Paris, that is: protecting the water and keeping it cool. But Montreal's source of water is surface water, which theoretically does not require as much protection from the sun. In fact, algae also form in surface originated waters. The distinction between surface and underground water is perhaps less important than texts imply. And the temperature facture was different: keeping the water from freezing was just as important. Although concern about controlling the temperature was only related here to summertime, when the reservoirs were finally covered, winter conditions were, not so surprisingly in Montreal, considered at least as critical. Finally, and perhaps most significant, covering was only recommended for new reservoirs. The report explains that it is the custom in American cities is to leave existing reservoirs uncovered following filtration.

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[178] Cumming, *The Artesian Wells of Montreal*, (1915), 21-23.

[179] Herring & Fuller, *Report on an Improved Water Supply…*(1910), 67-68.

Technical manuals from this period recall the same reasons for covering reservoirs:

- Maintaining an equitable water temperature (summer and winter)
- Protecting the water from impurities/ pollution (especially in towns)
- Preventing the growth of algae (especially for underground or filtered waters).[180]

In 1935, when Chief Engineer Charles J. DesBaillets recommended rebuilding the McTavish reservoir with a roof, the factor of climate was particularly important: exposing the reservoir to winter freezing had important economic repercussions. As much as 35 inches of ice might form on the surface of the reservoir, significantly reducing its capacity. The only permanent remedy was to surround the reservoir with a reinforced concrete wall, connected by a slab roof and covered with earth fill protection. This protection would be "contre le gel et la pollution des eaux et, par ricochet, contre l'abaissement de la capacité d'emmagasinement du réservoir."[181] Similarly, when the first new covered reservoirs were being built as part of the filtration plant, their earth banked cover was described as a protection against cold weather, and not the sun's rays.[182]

Thus in Montreal, covering as a means of regulating the temperature and preventing freezing appears more important than of preventing algae due to sunshine. But while the sun might affect both water quality and water quantity (through algae and evaporation), the winter problems were only related to lost quantities due to freezing. Although the effect of evaporation due to sunlight was not mentioned as a factor, the levels of water, rain, snow and melting snow in the McTavish were recorded each month throughout the year.[183]

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[180] Vernon-Harcourt, *Sanitary Engineering* ...(1907), 211-213; S. Gray, *Reinforced Concrete Reservoirs and Tanks*, 4th edition, (London: Concrete Publications Ltd, 1960 (1931)), 100.

[181] "Les réparations à faire au réservoir de la rue McTavish," *Le Canada,* 26 septembre 1935.

[182] Smith, *The Montreal Water Works, ...*(1913), 33.

[183] J.O.A. Laforest, *Rapport Annuel du Surintendant de L'Aqueduc de Montréal pour l'Année finissante le 31 décembre 1899,* (Montréal: The Montreal Printing and Publishing Company, 1900), 37.

Figure 3.4 "Montreal from Mount Royal Park," detail, ca. 1870
Winter view of the snow covered reservoir

(Source: Detail of MP-0000.152.6 Notman photographic archives, McCord Museum)

Freezing water was also said to increase the cracking in the basin walls and the bottom slab, leading to losses. The loss of water due to either freezing or evaporation was further related to both the energy wasted pumping water that never gets beyond the reservoirs, and the chemicals wasted because it was eventually thought that the reservoir water must receive a second dose of chlorine. Thus, when one looks at the specific arguments used in Montreal, a rationale develops that focuses on preventing waste or promoting efficiency.

The 1910 report had suggested that the decision about what to do with exiting reservoirs should be linked to other decisions, in particular considering the possibility that the city might rebuild its plant completely. In fact, when the time finally came to cover the reservoirs, it was always presented in the context of completely rebuilding and modernizing the reservoirs, primarily to improve their capacity. The advantage of protecting the water from pollution was generally mentioned after the prevention of losses.[184] Infiltration through decrepit walls was another great concern, as the bad state of the walls might mean a reservoir could not be filled to its full capacity. Thus, the cover itself was only an aspect of how the reservoir was rebuilt but not the prime reason.

Despite DesBaillets's frequent recommendations to have the McTavish rebuilt between 1932 and 1935, the first reservoir to be covered is the Côte-des-Neiges reservoir. The way the work planned for this reservoir was described illustrates the emphasis on increasing efficiency and capacity:

[184] "Cette perte serait évitée, s'il y avait une couverture au-dessus de l'eau, sans compter que les microbes en suspension dans l'air ne pourraient y tomber." In "Les réparations à faire au réservoir de la rue McTavish," *Le Canada,* 26 septembre 1935

> Contracts are ready for replacing an entirely unsatisfactory existing reservoir and pumping station by new works of greater capacity…The storage capacity of the existing reservoirs is too small to provide an adequate supply in case of emergency, and also to permit of more uniform pumping and consequently greater economy.[185]

There was no reference to the fact that the reservoirs would be covered, or that rebuilding the reservoirs was connected to improving water quality.

No records have been found about the arguments that were used specifically for the Côte-des-Neiges reservoir. One can only presume that there was no difference from reasons given for the McTavish, since by 1937 the city intended to cover all the reservoirs :

> It is understood that the city of Montreal has under consideration a plan providing for the coverage of all the municipal reservoirs. Concrete roofs will be erected. This will assure the ultimate protection and will result in reduced costs.[186]

Written in reaction to the sight of one of the reservoirs being cleaned, the "ultimate protection" probably referred to the algae that was said to "contain bacteria." Nevertheless, the same article explained that the reservoir had surprisingly little algae and "although it gives the water an unnatural taste it is not dangerous and there is no cause for alarm." In 1939, a list of sites to be visited by city councillors on the Montreal Water Board's annual tour of the works described the Côte-des-Neiges reservoir as already covered, while stating that both the McTavish and Outremont must also be covered for "reasons of exterior pollution."[187]

The reconstruction of the CDN reservoir was primarily explained in terms of the capacity increase from 7 to 14 million gallons. Originally planned in two phases, the second phase was never built, so that the capacity of the reservoir is still only 7,1 million. The fact that the reservoir would employ 100 men for at least 200 days was also emphasised.[188]

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[185] Charles-J. DesBaillets, "Historical Background and Important Features of the Montreal Waterworks," *Engineering and Contract Record*, April 14, 1937, 21-22.

[186] "Reservoir Emptied to Remove From Bottom Moss-Like Growth Giving Water Strange Taste," *The Montreal Standard*, September 11, 1937.

[187] "L'aqueduc de Montréal, la visite du 2 août," *Le Devoir*, July 28, 1939.

[188] "Cote des Neiges Reservoir Enlarged," *The Gazette*, May 11, 1938.

Although it was evoked that covering was common elsewhere,

> The Côte-des-Neiges reservoir, now being enlarged and renovated at a cost of $350 000, will be covered in and topped by a public park….Although this is common practice in other cities, it will be something new for Montreal, and will undoubtedly enhance the appearance of the huge water supply base on the mountainside.[189]

no references to studies or standards being applied were made in justifications for the work made public. Specific references to government regulations or professional or trade standards recommending covering the reservoirs were absent from the documents examined for all three reservoirs. In contrast, in Toronto in the 1960's water commissioners evoked the American Water Works Association (AWWA) standards to justify covering the Rosehill reservoir. The AWWA was "on record as endorsing the principle of covering and enclosing distribution system water which will be consumed by the public without further filtration."[190]

One might ask why the Côte-des-Neiges reservoir was covered first. The McTavish reservoir, waited a further ten years to be covered. The Côte-des-Neiges reservoir, built in 1893 but acquired by the City of Montreal in 1928, was perhaps in a worse state of repair. Although much older, the McTavish was partially repaired in 1929-32, and had just acquired a new pumping station. Possibly even more critical was that the reconstruction of the Côte-des-Neiges reservoir was related to the construction of a new pumping station. It might be related to the shift in function from supplying the Outremont reservoir to mainly supplying the reservoirs in Mount Royal Park and Beaver Lake. Another factor might be that it was built with funds from a make work programme, one of the last such projects as the country was about to enter a wartime economy. Its reconstruction budget may have been much smaller than that of the much larger and older McTavish, and may have corresponded to the amount of money made available through the programme.

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[189] "New Cote des Neiges Reservoir To Have Park Built on Top of It," *The Gazette*, July 11, 1938.

[190] Toronto City Archives, "Water and the Public Domain," *Pipe Dreams, The Web Exhibit, A Metro Archives Exhibit,*< http://www.city.toronto.on.ca/archives/pipedreams/cover.htm>, (November 19, 2001).

Before such civic projects were completely abandoned for the period of the war, the covering of the McTavish was brought up again in relation to a proposal to build a civic centre in the western part of the city, at which time pollution was evoked as the main reason to protect filtered water.[191]

The covering of the McTavish reservoir finally began as part of a complete reconstruction on November 28, 1945, in a plan that was also intended to increase its capacity, since its state of disrepair prevented it from holding more than 25 million gallons, although it could theoretically hold 40 million. The explanation given in a lengthy article about the history of the reservoir's many transformations illustrates the greater importance of other factors than the cover, such as concerns about losses and insecurity to neighbouring properties due to infiltration:

> Depuis longtemps, l'étanchéité des murs du réservoir McTavish laissait à désirer; de nombreuses infiltrations s'étaient produites, affectant de façon sérieuse leur solidité, et devenant un danger pour les propriétés avoisinantes aussi bien que pour la vie des citoyens. De plus la glace en hiver aggravait chaque année la situation. Le vent la neige et la fumée, transporteur de germes, polluaient à nouveau les eaux stériles qu'il recevait des filtres du Bas-Niveau, à tel point qu'une nouvelle stérilisation au chlore était nécessaire. [192]

Concerning the cover itself, the ice & pollution factors remained most important, while the emphasis on pollution increased. By the 1940's pollution from auto emissions would have started to reach the area all around the McTavish reservoir. Arguments regarding the need for extra chemicals, and implicitly the associated waste and cost, were repeated. Other articles repeated the same arguments: preventing an expensive second chlorination and improving the reservoir's holding capacity.[193] When asked whether a cover could wait, DesBaillets said that it would be much more economical to do it at the same time.[194]

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[191] "Le centre civique dans l'ouest, au bassin McTavish," *La Presse*, November 28, 1939. The civic centre would sit on top of the covered reservoir. While concern for salubrity of the reservoir was expressed, the main arguments against the project reflected an unresolved dispute about situating the civic centre in the East or West end of the city.

[192] DesBaillets, "Le reservoir McTavish,"*Métropole*, (1947), n.p. (VM-GDA, R3390.2) A longer section of the text is reproduced in Appendix 3.

[193] "Montréal aura une eau plus potable," *La Presse,* February 24, 1945.

[194] "Concordia fera reconstruire le reservoir de la rue McTavish," *Le Devoir*, November 6, 1945.

The potential value of the cover for the surrounding context was also mentioned.

> …(Le toit) sera recouvert d'une couche de 3 pieds de terre afin de la protéger contre la gelée d'hiver; on y sèmera du gazon, on y plantera des allées, en un mot on en fera un parc des plus attrayants, qui jettera une note de gaieté vis-à-vis l'hôpital Victoria et le quartier universitaire de McGill.[195]

The present rooftop function of university playing fields was not however what the engineers recommended when the McTavish was being covered. Concern about the ventilators and maintenance access lead them to prefer the use of the site as a botanical garden for McGill University's botany department rather than a public park or playing field.[196] Public access would have been limited to walks around the site, a position some disagreed with, considering that the site's usage should remain in the public domain. The city argued that the botanical garden, in addition to its educational value, would be a beauty spot for citizens and draw tourists to a part of the city lacking such attractions.

Despite the arguments used, that all the reservoirs must be covered for hygienic and economic reasons, for another fifteen years the Outremont reservoir still saw no greater transformation than its first name change, becoming the Bellingham, until it would be renamed again as the Vincent d'Indy reservoir. Even after the war, the city's public works department's long-term plans include the covering of Bellingham reservoir in a far off phase III, related again to increasing its capacity.[197] The covering of this last reservoir was clearly not a priority and a decade passed before the subject came up again. In the meantime, plans for two other underground reservoirs were made in parks in Rosemont and St-Louis, the Summit reservoir was built in Mount Royal Park and the plans to extend the Côte-des-Neiges reservoir were recalled.[198] Substantial expansions to the system remained more important than repairs or transformations of an existing reservoir.

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[195] DesBaillets, "Le reservoir McTavish," *Métropole*. (1947), n.p. (VM-GDA)

[196] "Public Park Over Reservoir Facing Counter-Proposals," *The Montreal Herald*, September 22, 1948.

[197] "City Plans Three-Phase Program To Boost Water Pumping 50 p.c.," *The Gazette*, July 26, 1952.

[198] "Des millions dépensés pour extensionner le service de l'aqueduc," *La Presse*, November 21, 1953.

Figures 3.5-3.6 Outremont basin being cleaned ca. 1951
Ground water leakage in the south wall is clearly visible in empty east basin.

(Source: Dowd collection)

The factor that changed the situation of this last open reservoir was the construction of new buildings adjacent to the site by the the Soeurs des Saints-Noms-de-Jésus-et-de-Marie and the Université de Montréal in the late 1950's and early 1960's. Lucien L'Allier, director of public works, thought this would affect the quality of water in the reservoir.[199] But as before, the emphasis was on the general state of disrepair of the reservoir, related conduits and equipment, and on losses due to leakage. The south wall, essentially exposed rock, was particularly problematic. **(Figure 3.5)** The cover was part of a complete package of proposed renovations that would completely modernize the reservoir.[200] Otherwise, one article reported that covering is "la meilleure précaution à prendre pour ne pas retrouver dans l'eau, plantes et bestioles marines."[201] **(Figure 3.6)**

As with the McTavish, the adjacent university was involved in the plans for what to do with the cover, obtaining the use of the site for $1 for track and playing fields, promising to invest $150,000 in related landscaping.[202] The objections raised concerning such usages at the McTavish did not seem to have arisen on this site on the Outremont side of the mountain, where public parks were already more numerous.

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[199] "Le reservoir Bellingham rénové et recouvert," *Le Devoir*, January 5, 1961.

[200] "Le vieux reservoir Bellingham modernisé," *Dimanche-Matin*, November 22, 1964.

[201] "Le réservoir Bellingham," *Le Petit Journal*, week of July 26, 1964.

[202] "Terrain de piste et pelouse au-dessus du réservoir Bellingham," *La Presse*, February 3, 1965.

3.3 An analysis of the reasons, factors & means for covering the reservoirs

The reasons why it is said that the reservoirs were covered are more numerous and varied than one might at first have imagined, and difficult to disassociate from factors like the climate, and means like the technical or financial resources that were particular to the Montreal situation. On the whole, it appears that the relationship between the environmental, technological and social perspectives that we wish to understand could be described as an interplay of these reasons, factors and means. Looking back over the survey of documents presented in 3.1 & 3.2, an attempt is made to categorize the arguments given for covering the reservoirs according to this grid in Table 3.I.

Although this study has not attempted to provide a thorough comparison of the situation in Montreal with that of other cities, it has been instructive to consider the reasons why reservoirs were covered both in older cities, and in other North American cities. Some of the reasons why the reservoirs in Montreal were covered can be related to traditional reasons for covering water: protecting water from the effects of climate, or human settlement. If the same reasons applied in most situations, perhaps it is the factors and means that distinguish why or how the reservoirs in one particular city, or even part of the city were considered. Water quality was a concern everywhere, but it could be achieved through different means, and this was ultimately reflected in the way that water quality standards have been written: they describe a product and not the means.

For example, while climate is clearly a factor everywhere, it is a factor of varying character and importance. Most of the technical texts considered in order to understand the development of scientific arguments for covering the reservoirs were published in the USA and England, where the largest cities have a relatively longer summer than Montreal, and the problem of algae would have been relatively more important than that of ice or snow. One American text even suggests that reservoirs only need to be covered in the Southern States.[203] The relative importance of winter conditions in arguments used in Montreal is not at all surprising; it is just less typical of the textbook examples.

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[203] Hardenberg, *Water Supply …*, (1938),107.

Montreal's specific natural advantages, the river as a source and the mountain as a place to locate the reservoirs, are also difficult to compare with elsewhere. Nevertheless, from even a superficial comparison with Paris, it becomes clear that the abundance of the source and the relative isolation of the mountain were factors that delayed concern about water quality, not only in the reservoirs but also throughout the system.

Since it took so long to cover the reservoirs, the importance of different reasons evolved. Water quality was clearly the theoretical initial reason, but it took an accumulation of reasons to finally justify the large public investments involved. In fact, the reasons why they weren't covered in the first place were also those to delay their eventually being covered: economics and isolation. They weren't covered from the beginning because resources were limited. The original construction profited from the form and strength of the ground as much as possible. Adding a roof and the hundreds of piers and arches or columns and beams required to support it would have added considerably to the cost, perhaps reducing how large a reservoir could be built. The relative isolation of the reservoirs when first built, which diminished concerns about pollution or contamination, remained a factor for at least one of the reservoirs until surprisingly late in the city's development.

The reasons why the reservoirs eventually were covered can be related to both quantitative and qualitative factors, to both reducing losses and protecting purity. The fact that the reservoirs were always covered as part of a complete renovation of their site, in which the walls and base would also be rebuilt of more impermeable concrete, so that infiltration or contamination in connection to the adjacent ground could be eliminated and related losses eliminated, reflects the way these quantitative and qualitative objectives combined together. The following sections will nevertheless attempt to distinguish the environmental, technological and social perspectives.

Environmental factors

The continued belief in the quality of Montreal's water, even as scientific knowledge about the levels of pollution in the Saint Lawrence River and related disease became known, is somewhat surprising. Surface waters (streams, rivers, lakes) were generally considered more suspicious than underground waters (springs, sources, wells), as they were often contaminated from other uses. The continued construction and use of wells by many of the institutions and industries of the city even after the waterworks were well developed reflects the prevailing preference for the natural qualities of underground water.[204]

Water from an underground source was also preferred because it rested there at a cool and even temperature, and was generally free from plant and animal life. The concern about algae, insects and other signs of life is one of the paradoxes reflected in the discussions of drinking water. Although water itself is a symbol of life, it is preferred that drinking water contain no such signs of life. Surely the argument might have been made that a certain amount of plant and animal life was a good sign, for example that treatment has not made the water toxic in some way. Instead, seeing the algae, occasional fish or insects floating on leaves only created a negative image.

An analysis of the Rosehill reservoir cover-up in Toronto suggested that we have forgotten how to read signs of life positively.

> … the notion that animal and plant life is bad for drinking water contrasts sharply with the views of civil engineers from earlier times. As late as 1898, engineers took the view that "the presence of a moderate quantity of living plants is favourable to the purity of water in reservoirs, provided there are also animals enough to consume them, so that they may not die and decompose, and that a proper balance is kept amongst the animals of different kinds."[205]

Perhaps the difference between seeing plants and animals as part of a natural lake or in a reservoir basin is that in the former they are part of an entire eco-system, a presumably balanced chain of production and consumption, while in the man-made basin, they appear foreign, unlikely to survive or missing the balancing elements that prevent them having a contaminating effect.

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[204] Cumming, *Artesian Wells*, (1915). An economic factor must also be considered: a private well was not subject to commercial water-usage taxes or metering. But eventually well waters on the island of Montreal would be declared undrinkable.

[205] Toronto City Archives, "Water and the Public Domain," *Pipe Dreams, The Web Exhibit, A Metro Archives Exhibit,*< http://www.city.toronto.on.ca/archives/pipedreams/dom.htm>, (November 19, 2001).

Of all the reasons and factors cited, the problem of algae is the one that appears to have had the least scientific bite. The problem was usually described as being one of taste. Algae make the water smell and taste "bad," i.e. in comparison to purer water with a more mineral taste. This distaste is not unimportant, but as a reason to cover the reservoirs it was not as critical. Perhaps it was less critical in Montreal, where summer was relatively shorter. Perhaps also, people had less other options than they do today, and were more used to drinking water with different tastes. In any case, water was moving ever more rapidly through the reservoirs, and algae could be removed.

On the other hand, one reason never mentioned in Montreal is the impact of birds on the water. Situated on Mount Royal and near to large green areas that drew major bird populations, it is surprising that this is never mentioned. Only dust and leaves are referred to as falling from above. In contrast, the flight migration patterns of birds over Toronto are said to have been a major factor that lead to the covering of the Rosehill reservoir, and in more recent studies, contamination of water by bird droppings is considered a major problem of such exposed basins.

The fact that different types of water (underground vs. surface) have different forms of storage (wells vs. lakes) in nature, suggests other basic differences in the choices that cities with different water sources had to face. Montreal's river water supply would naturally be exposed, and surface storage considered acceptable, especially if the area was isolated and or part of a natural self-cleaning environment like the mountain. However, once the water was treated it became a different kind of water, more like the ultra-pure spring waters usually found underground.

Technological means

As explained in Chapter I, the developments of water supply are essentially responses to problems of water quality or quantity. Once water was treated it became part of a controlled technological process that sought to exclude any variations or unpredictable elements due to the environment. It also became more valuable, as so many resources had been invested in producing it.

Covering a reservoir is a fairly low technology kind of solution, which however became a greater construction challenge as larger reservoirs were built. In Montreal, the reservoirs were initially built in such a way that would take advantage of the mountain's height and solidity, excavated in the rock, but also taking advantage of natural terraces. As pumps became more important than gravity for distribution and there were constant problems with leakage and infiltration, aggravated by the freeze-thaw action of ice and the temperature change of the water, the rock basin and masonry walls that completed the reservoir appeared inadequate. The development of reinforced concrete would not only offer solutions to how to cover the reservoirs, but perhaps even more important, a better way to contain them.

The principal technological change reflected in the transformed reservoirs is this change from a mixture of natural rock and built masonry to a poured in place reinforced concrete box. The cover itself is not particularly innovative, although there are of course advantages to concrete columns and slabs in terms of space (over heavy masonry piers and vaults) and material (over wood and steel in a wet environment). The concrete slab's theoretically impervious surface could also then be covered with insulating earth and covered in grass.

With the introduction of reinforced concrete construction, it was presumed that the problems of leaky exposed reservoirs would be "solved". However, the emphasis in the presentation of the advantages of this technological change was clearly on capacity rather than purity. Increased efficiency and capacity, objectives common to most engineering problems, appear to have had a clearer role than improved quality, something mainly achieved through the treatment process at the filtration and purification plant, for which the cover would be but a secondary help.

Also important to understand are the reasons why there were no regulations requiring that the reservoirs be covered. The standards developed for water quality testing, which defined the results required and not necessarily the means, allowed a certain flexibility in solutions. Many cities sought other means to control reservoir water quality when faced with the cost of rebuilding the reservoirs. The options varied depending on the size, form and position in the city of the original basin. Nevertheless, the "difficulty in clearly quantifying public health benefits" was a second principal reason why they weren't covered.[206] Without solid scientific proof of the impact of all open reservoirs on water quality, the authorities lacked precise quantitative arguments to do so.

In the beginning of the move to improve water quality, city engineers continued to flaunt the "natural purity" of the St-Lawrence River, as an argument for instance to build an intake further out in the river rather than add filtration facilities. After the filtration plants were built, they were in a position to take this approach throughout the system.

Social concerns

The arguments used to justify covering the reservoirs reflect a shift in the value of water supply from when the reservoirs were first built. When first built, the reservoirs were a security measure, until public health and the environment became of increasing concern. Society could only afford to be concerned for public health if it had the resources, and a battle for resources was developing between the needs of the existing city and the desire to expand the city. At a time when expansion and development were seen as signs of social progress, funds for maintaining the infrastructure of the older parts of the city were more difficult to justify. While the open reservoirs waited to be covered, three new reservoirs were built. Significantly, two of these were actually higher up, reflecting the development of large institutions and housing estates around the mountain. The Cedar and Summit reservoirs were directly associated with the development of the hospitals and apartment buildings on the mountain's southern flanks.[207]

The difficulty of finding funds to maintain public works as opposed to building new ones is part of a major debate that is still going on today, although the solutions being considered have evolved to include privatization and public-private arrangements. The recent crisis has been related back to similar crisis in the past that lead to major

[206] USEPA, *Uncovered Finished Water Reservoirs*, … (1999), 1-4.

[207] "L'aqueduc de Montréal, Programme de travaux de $10,000,000," *Le Devoir*, April 14, 1953.

reorganization because of over investment in expansion.[208] During the period when the reservoirs demanded major reconstruction funds, the system was reaching its first such crisis. The particular nature of some the decisions reflect that one could not imagine that this was part of an ongoing cycle of reinvestment. The decision to build in concrete is a symbolic example: its solidity gave the impression of offering permanent solutions.

Another element of related importance, to both the pressures of development and the lack of funds, was the relationship between covering the reservoirs and the takeover of the two reservoirs of the Montreal Water and Power Co. It was shown in Chapter II that obtaining these reservoirs was considered a major advantage in the takeover. The calculation of their value for the city had not included the need to rebuild these reservoirs a few years later. The focus at the time of the takeover was on the increased capacity and not the quality of water in the private system's reservoirs.

There does not appear to have been as much fear about the water, its quality, and the impact of this on public health, as there was fear that the reservoir walls would collapse and flood the city. Such incidents did occur more than once, and were often alluded too, but the most recent such incident, from the Vincent d'Indy reservoir in the early 1990's, shows that such dangers were not solved by rebuilding and covering the reservoirs. In fact, the most frequent such floods occurred not due to leaky reservoirs but due to broken mains and pipes.

The absence of references to other security concerns is surprising. Neither the dangers of drowning accidents nor of people throwing things into the water ever arises.[209] The fences built around the reservoirs seemed to suffice. This should be compared with the story of the Rosehill reservoir in Toronto, where extra fencing was added in wartime and the cover was related to fears of cold-war enemy action.[210]

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[208] Dany Fougères, "Le public et le privé dans la gestion de l'eau potable à Montréal depuis le XIXe siècle," in *L'eau, l'hygiène publique et les infrastructures*, Louise Pothier (dir.) (Montréal: Groupe PGV, collection Mémoires vives, 1996), 48.

[209] There is a letter from Hugh Allan reminding the MWW to build a fence around the McTavish during the construction of the reservoir. Quoted in Maffini, *The McTavish Pumphouse*…, (1970), n.p.

Missing in the discussion: the role of the mountain

The development of the city up the mountain was also critical factor: isolation had been a major advantage when the reservoirs were first built. As the institutional, residential and other functions developed, this clean environment became more polluted and unacceptable as a place for pure water. There was both increased pressure for the water to be protected, but also pressure to prevent leakage from the reservoirs to adjacent properties. It is worth noting that none of the articles examined that discuss the situation of the reservoirs relate their position to the park. The mountain is mentioned often enough, but the reservoir function is never related to the idea of the natural reserve. Even when they were covered over, and there were plans to make their covers into public green spaces, no connection is made between the potential of these spaces and the mountain. The idea of expanding the public space of the mountain through such peripheral open space was not an objective. Certain comments on the added value that the McTavish as a green space could bring to downtown almost suggest that the mountain is not considered to be an accessible public space in the middle of the city. The types of uses being proposed for the roof, playing fields and botanical gardens, are related to a lack of amenities in this part of the city.

Perhaps most surprising in Montreal, is that considering the developing value of the mountain as a site of civic meaning, the reservoirs do not seem to have been appropriated in a way that would ensure that their transformation reflected their collective value. Of the principal functions associated with the mountain, the parks, the cemeteries, the hospitals, the universities, the convents and the residential areas, it is only the universities that reacted to the opportunity of the reservoirs within the landscape. The open basins do not appear to have become important to local residents, in the way they did in Toronto and Pittsburgh, where there was resistance to their being covered. The only concern in Montreal was with what function the covered reservoirs should have as public property. The interpretation of these large institutional sites as part of a green belt around the mountain was not yet developed. In fact, the continued development within these sites has generally resisted the restrictions that such an interpretation implies.

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[210] Toronto Archives, "Water and the Public Domain… ".

The impact of nearby incompatible functions is only an issue with the last reservoir in the 1960's. The proximity of the Royal Victoria Hospital to the McTavish is never mentioned, although some effect occurred in the other direction: it was decided to situate the hospital further to the east, and then only allow certain kinds of hospital uses on the property.[211] The adjacent quarries (to all three sites) was never an issue, but then, since the reservoirs were either in the stone or built with masonry, an occasional falling rock would not really have seemed a problem. The quarries were probably all no longer in use by the time trucks would have brought increased pollution.

To summarize, beyond the three principal reasons usually given for covering the reservoirs, that is to prevent the growth of algae or invasion of other forms of plant and animal life, to keep the water temperature constant, and to protect the water from pollution or malicious dangers, in Montreal certain factors were particularly important: the winter climate and the effect of ice, and a general emphasis on the improvement of reservoir capacity rather than on water purity.

Throughout the development of reasons to cover the reservoirs, the meaning of these basins of water is changing. There is an increased dependence on the purity of treated water, and perception of its fragility, the need to separate it from the environment. When faced with the comparatively more impervious concrete, there is a loss of faith in the solidity of stonewalls. There is a concession of civic properties to semi-private usage, as public works reservoirs become university playing fields. Clearly the circumstances within which the reservoirs were covered are as important to understand as the reasons.

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[211] Archives of the Royal Victoria Hospital - O. Marin Notary - "The city of Montreal & RVH (Stephens, Abbott)," Montreal, 15 October 1888. In which an exchange of properties between the city and the hospital is made, on account of the initial hospital site being too close to the reservoir. "And whereas objections have been made to the erection of such a hospital on the above site on account of the vicinity of the Montreal water reservoir, and whereas Sir Donald A. Smith and Sir George Stephen the founders of the said hospital have offered to remove the objection based upon the said alleged danger to the water supply by providing another site for the hospital on condition that the said "City of Montreal" will confirm the lease of the present site in favour of the said "Royal Victoria Hospital" provided no building for the treatment of patients be erected on the said land and provided the said city will erase from the homologated plan of the said city the road projected to pass through the proposed site, etc...." (Information provided by David Theodore and Annmarie Adams, McGill University, School of Architecture).

	Environmental factors	**Technological means**	**Social concerns**
Historical	Climate Plant and animal life	Temperature control Evaporation control	Protection (war or siege) Taste
Roman Nîmes	Wind, dust		
Constantinople	Sunlight		War
Toulouse	Sunlight:Vegetation, reptiles	Temperature control	
Paris	Sunlight-underground waters more fragile		
Technical manuals (1907-1938)	Protecting underground water from sunlight Preventing growth of algae Protection against pollution Protection against contamination from surrounding ground	Protecting filtered water from contamination, from dust & impurities Regularising temperature (reducing fluctuations) Uniformity Protection against bacteria associated with algae Preventing blood-worm infestation	Preventing (birds, animals &) human beings from throwing things in the water Preventing malicious pollution Prevention of disease: Protection against bacteria associated with algae Preventing blood-worm infestation Preventing typhoid fever epidemics (due to leaks in reservoirs) Protecting from nearby habitation
Toronto Rosehill reservoir	Protection from birds, reference to bird migration paths	Eliminating second chlorination	Economic savings Standards (AWWA) Protection from nuclear fallout Protection of pollution from auto emissions Cost effective protection of public health
Montreal in general	Keep water cool in summertime Free from contamination with dust and leaves Protect from growth of algae and other microscopical organisms Restrict growth of aquatic life		Objectionable tastes and odors Prevent any change in the flavour
Filtered water reservoirs at Atwater plant	Protection against cold weather		To beautify surroundings

	Environmental factors	Technological means	Social concerns
McTavish	Protection against ice and freezing (winter) Protection against pollution Keeping river water pure	Prevent losses due to cracks (efficiency), and ice or evaporation Improving storage capacity Eliminating second chlorination and double expenses Preventing disaster	Economics- preventing waste Make use of space for park, botanical garden, civic centre Improve appearance Beautification Smoothing over its rugged outlines Ultimate protection against bacteria Eliminating insalubrity
Côte-des-Neiges		Improve capacity New pumping station	Make work project Use of cover for park
Vincent d'Indy	Counteract wind-born pollution Preventing marine life and plants	Eliminating second chlorination Improving capacity General state of disrepair (*vétusté*)	Adjacent construction of university buildings Add park, playing field Healthier Modernizing University sports field
Bailey & Lippey (1978)		Increased operation and maintenance cost	Public Health Taste and odour
EPA standards (1999)	Preventing: Algal growth Plant growth Bird and animal waste Insects and fish Airborne deposition (wind, rain, snow) Turbidity Particulates Surface water run-off Ground water intrusion	Loss of chlorine residual and poor hydraulic circulation characteristic of large open reservoirs Contamination due to the purification process Disinfection by-products Nitration of chloraminated waters Corrosion of distribution system	Public health standards Water quality degradation attributed to contamination from both internal and external sources Control of pathogens due to: Coliform & other bacteria growth Metal pollutants Taste and odour Human activities: Swimming, discarding debris, deliberate contamination

TABLE 3.I

Summary of reasons for covering the reservoirs

CHAPTER IV

Materials, costs & delays in the creation of a controlled landscape for pure water

This chapter will consider the form of the covered reservoirs, and the costs and delays involved in their construction, in order to understand the particular role of materials and construction technology in relation to economic and other factors as they affect the reservoirs.[212] Reservoirs reconstructions were major construction sites employing hundreds of people. They required strategic planning of continued use of the existing reservoirs while the new ones were constructed. Rebuilt in an era that saw the development of many new building materials, the covered reservoirs reflect the ideals and expectations associated with these new materials: easy maintenance, efficiency and modernity. But the cost of reconstructing the reservoirs was quite significant, from $350 000 for the Côte-des-Neiges in 1938, to $1,5 million for the McTavish a decade later, and finally $2,7 million for the Bellingham in 1964.[213] Despite widespread recognition of the importance of water quality standards as a public health factor, the open reservoirs remained a "weak link in the protection of potable drinking water."[214] The choice of materials, the costs and delays involved, are all elements to bear in mind in considering the impact that covering reservoirs had on the landscape.

4.1 The complete isolation of treated water from the environment

Although early 20th century textbooks on water supply systems suggest many different ways of covering reservoirs, including lightweight roofs of wood or metal on a wood or steel structure, the only solution ever envisaged in Montreal involved rebuilding all sides of the storage basin in reinforced concrete.[215] The solid new concrete roof supported on

[212] A full description of the reconstruction of the McTavish reservoir, as reported by Charles J. DesBaillets, the engineer in charge of the works, is included in Appendix III.

[213] Compare with the estimated cost of $125 000 for covering the McTavish and High-level reservoirs in 1910!

[214] AWWA Committee Report, "Deterioration of water quality in large distribution reservoirs (open reservoirs)," *Journal of the American Water Works Association*, (June 1983.): 313.

[215] These early lightweight roofs anticipated the solutions at the end of the 20th century. Floating membranes are preferred to cover large reservoirs, offering economic advantages and reversibility. USEPA, *Uncovered Finished Water Reservoirs….* (1999), 4-13-4.17.

hundreds of concrete columns was strong enough to support a layer of earth intended to provide thermal insulation from both winter freezing and summer heat. None of the original rock basin remained in contact with water, since the purpose of the reconstruction was to seal off the reservoir from the surrounding environment, and infiltration was now considered dangerous, whether due to seeping of ground water of uncontrolled quality, or because of the danger to surrounding properties of leakage from the reservoirs. Isolation and control of the water in the reservoirs finalised the process begun at the filtration plant. Furthermore, it implicitly declared that the environment of the reservoir sites was now considered to offer potential contamination, reflecting a changing interpretation of the mountain and its environment. It should in fact be noted that the majority of contaminants originally listed were natural elements like leaves, and insects. In addition, exposure to sunlight, snow and rain, also natural elements, was considered problematic. In separating treated water from nature, an inversion of values associated with water on the mountain and in the urban landscape in general was occurring that will be discussed further in 5.1.

4.2 A burial in modern materials: reinforced concrete boxes and grass fields

Covering the reservoirs resulted in a landscape that remains essentially unchanged: vast grass covered tumulus conceal an inner structure of reinforced concrete, and most of all, the immense bodies of water within. Since they were rebuilt in their present form, the reservoirs appear to have taken definitive shape, no longer to be improved upon or enlarged. In fact, the reservoirs represent huge investments of materials and labour, as the excavated rock basin was filled with a completely separate closed box structure and then buried below ground.

Although the original reservoir constructions were all different, they were all rebuilt, since none of the original basins were considered waterproof enough. The walls of the McTavish, built earlier, were a combination of excavated rock and masonry. The masonry walls were vertical on the inside, slightly cantered on the outside. The walls of the Côte-des-Neiges reservoir were sloped, cement coated stone on a gravel base. The vertical walls of the Vincent d'Indy were partly in concrete, partly in excavated rock.

The oldest of the reservoirs, the McTavish, was transformed more than once. Not only had it been enlarged and its bottom solidified with concrete, but a series of pumping stations were added, demolished and expanded.[216] Then, when the reservoirs were covered, it wasn't simply a question of adding a roof. New concrete slabs, walls, columns and roofs were built within the previously excavated areas. Slightly smaller in footprint, these new basins were higher than the original. Less concrete was used for a higher narrower volume while raising the effective pressure level of the water. The visual impact was derived from a surface higher than surrounding roads and fences. The projecting walls were reinforced from the outside by an earth berm, covered in grass to stabilize its surface. The result in each case is a flat grass field with sloped sides.

Reinforced concrete and grass were the basic materials used to transform these landscapes. Reinforced concrete was considered an ideal modern material because of its strength and capacity to provide a waterproof seal.[217] By the 1930's reinforced concrete had become the wonder material of works of civil engineering, used for everything from roads to bridges, from pipes and culverts to retaining walls, planters and benches.[218] The use of reinforced concrete for the reservoirs fits completely within this system: as elements of public works that should be durable, economical and modern in appearance. But in this case, the concrete was concealed. **(Figures 2.12, p.47, 4.2, A.21)**

[216] DesBaillets, "Le réservoir McTavish," *Métropole*, (1947), n.p. (VM-GDA)

[217] Nevertheless, both engineers and architects were long preoccupied with concrete dilation problems related to large surfaces and the weight of large volumes of water. W.S. Gray, *Reinforced Concrete Reservoirs and Tanks*, 4th edition, (London: Concrete Publications Ltd, 1960 (1931)), 73; André Wogenscky, "Réservoirs," *Techniques et Architecture*, 2.3-4 (March-April 1942): 115-6. The variety of solutions developed in concrete water towers in Europe in the 1930's to 70's reflect the ongoing attempt to resolve these problems. Pierre Fouquet, *Les reservoirs d'eau*, (Paris: Dunod, 1963).

[218] "The Use of Concrete in Waterworks Structures," *Engineering and Contract Record*, (April 12, 1939), 39-41; Charles J. DesBaillets, "Reinforced Concrete Pressure Pipe for the Montreal Water Works," *Engineering and Contract Record*, (March 30, 1938), 29-36.

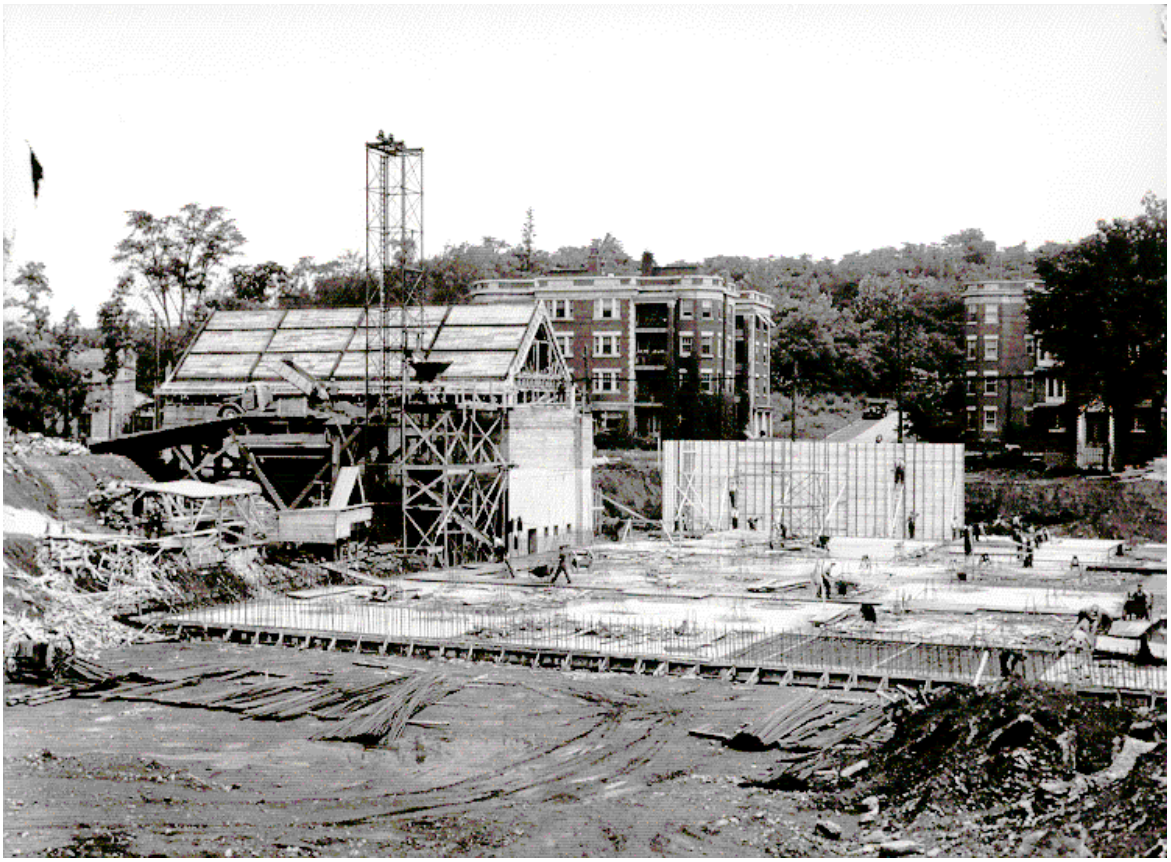

Figure 4.1 Côte-des-Neiges reservoir and pumping station reconstruction, 1938

(Source: ANQ-Viger, Fonds Conrad Poirier, P48, P2878)

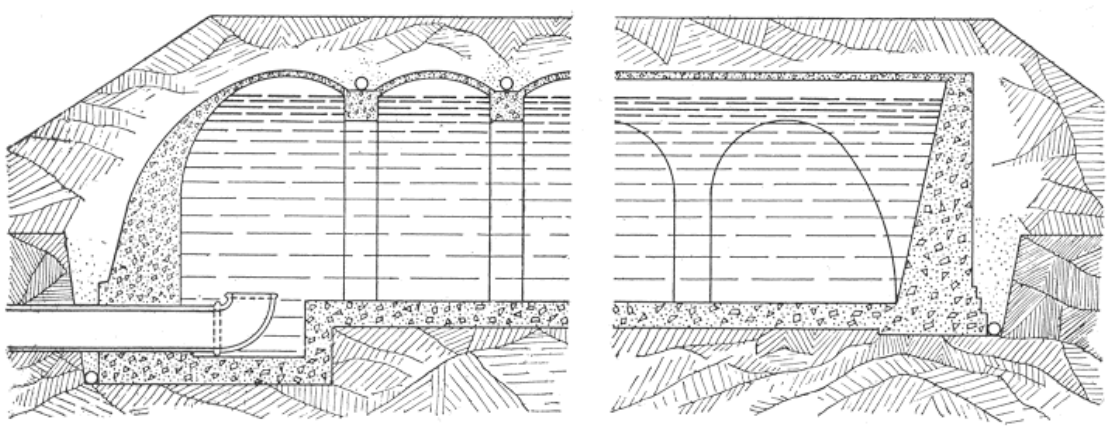

FIG. 26. — COVERED UNDERGROUND RESERVOIR OF CONCRETE MASONRY.

Figure 4.2 Textbook illustration of a concrete covered reservoir, 1909

(Source: Paul Gerhard, *The Sanitation, Water Supply and Sewage Disposal of Country Houses*, (New York: D. Van Nostrand Company, 1909), 153.)

Figure 4.3 Côte-des-Neiges reservoir site lawn, 2001

The reservoirs were to be covered over in sod, to create fields of grass or lawns, a type of landscape that took on a particular importance in the modern landscape as a clean and easy to maintain cover, ideal for such large surfaces, and made possible by the increasing use of lawn-mowers, sprinklers, fertilizers and herbicides. At the same time, the development of such highly-controlled lawn landscapes can be associated with the development of organised sports that required perfect control of the playing surface: flat, even, and regular in shape, eventually even a particular shade of green.[219] In the twentieth century, the lawn can be seen as the epitome of the controlled landscape, of nature tamed to suit a rational environmental aesthetic while providing a semblance of harmony and recalling pastoral ideals of earlier forms of lawns.[220] Often used in large public spaces, the lawn also acquired a particular symbolic value as a collective form of landscape, representing access and democracy. At the same time, it is also the minimal landscape, and has been associated with minimum budgets and design.

[219] The relationship between sports and the development of the modern lawn aesthetic is described in "The American Lawn, Surface of Everyday Life," Canadian Centre for Architecture, 1998.

[220] Alexander Wilson, *The Culture of Nature*, (Toronto: Between the Line, 1991), 93.

How did this approach fit in relation to the mountain? The mountain's function, despite the park title given to it, has from the time of Olmsted and again in the last fifteen years, been seen to provide the city with a wild green core, uncultivated but maintained, gradually becoming more cultivated towards the city. Lawns have only a limited place in this landscape. But access has also been a major issue in the development of the mountain's meaning for the city, and interestingly the area around Beaver Lake being redesigned in this same period incorporated major lawn surfaces. The advantage of the fields of grass over the fenced in open basins was that it made the sites more accessible, opening up their potential as parks. At the same time, the concrete and grass smoothed out the scars of the excavated basins, hiding the major transformation of the natural topography that the reservoirs had involved.

> The McTavish Street Reservoir, Montreal's water bowl… is undergoing a face-lifting operation, preparatory to having a cover placed over it.
> Its rugged outlines are being smoothed over with thousands of tons of concrete, which will not only strengthen the reservoir but will save huge quantities of water from seeping away into rock crevices. The cover of this huge 30,000,000- gallon bowl, which will take another year to complete, will be no ungainly sight, according to the present plans for its beautification. [221]

4.3 Delays and the lack of standards for existing reservoirs

Perhaps the most surprising discovery in this story was how long it took for the covering of the reservoirs to take place. First, from the initial decision to filter the water and the related recommendation to cover the reservoirs in 1910 to the first cover-up in 1938, and from then to the last to be covered in 1965. This is more than fifty years, so long that all the players and expertise, all the political, economic, management and social contexts would have changed. What does this length of time suggest? Was covering not an essential action? What eventually allowed it to become at least relatively more important, i.e. so that it became a priority?

The emphasis on costs that was so important in the arguments given for covering the reservoirs also contributed to the delays in their eventual reconstruction. No standards were ever introduced that actually obliged the city to cover the reservoirs; ultimately the

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[221] "Capped Reservoir to Become Site of New Botanical Garden," *The Montreal Star*, July 13, 1946

cost advantages must have outweighed the cost disadvantages. According to the USA Environmental Protection Agency, "many reservoirs remained uncovered due to the capital cost of covering them and the difficulty in clearly quantifying the public health benefits of covering." [222]

As a means of eliminating external and internal sources of contamination, the covering of open reservoirs is generally associated with the improvement of water quality standards. While a certain number of studies have shown that open reservoirs do incur water quality deterioration, no studies have shown that open reservoirs lead to unacceptable water quality. No studies are referred to that indicated that reservoirs must be covered. Water quality standards are product oriented, so that for instance, water leaving the reservoirs must be tested. If an exiting reservoir is uncovered and the water leaving it still meets standards, than there is nothing obliging a water supplier to cover it.[223]

To this day covering has generally remained voluntary for existing reservoirs, as was originally suggested in the Herring & Fuller report of 1910 referred to in chapters II & III.[224] Although in the USA certain states have legislated that a reservoir must be either covered or abandoned many others have no such regulations, and as a result, some cities have never covered their reservoirs. This is apparently due to prohibitive costs in the larger cases, and controlled water quality for smaller units. In other words, when the costs have been prohibitive, as is the case with larger reservoirs, only economic advantages eventually had the force to counterbalance economic disadvantages. The EPA report suggests that covering reservoirs larger than 20 million gallons with a fixed concrete cover is prohibitive in terms of construction costs.[225] In retrospect only the Côte-des-Neiges reservoir was smaller at 7 million gallons.

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[222] USEPA, *Uncovered Finished Water Reservoirs….* (1999), 1-4.

[223] In Quebec no regulations concerning even new distribution reservoirs have been located. Cf. *Règlement sur la qualité de l'eau potable, Loi sur la qualité de l'environnement du Québec,* Chapitre II, filtration et désinfection. Art. 8 specifies that the water leaving finished water reservoirs must be tested for residual chlorine.

[224] Herring & Fuller, *Report on an Improved Water Supply…*(1910), 67-68.

4.4 The bottom line of costs and the vagueness of quantities

In Chapter III it was shown that although reservoir covering can generally be associated with improving water quality, in Montreal the arguments given for the reconstruction work that included covering the reservoirs, were even more likely concern a desire to reduce losses and waste. Concern about the reduced capacity of a leaky reservoir was mentioned before concerns about water quality. Cracked walls were also considered a security threat because of potential floods. The related wasted energy to supply the pumps, and concern about extra chlorine that had to be added at the reservoirs, was also mainly expressed in terms of cost. Wastage was presented as a problem in terms of money rather than energy or other resources. Questions of protecting water quality and public health were invoked less often than any of these cost-related concerns.

The lack of standards to actually oblige the city to cover the reservoirs allowed them to wait until cost advantages outweighed cost disadvantages. Reconstruction became more justified when it was clear that it solved more than one problem. In the meantime, the situation of each reservoir worsened, and when it became an emergency due to greater fears of collapse than of contamination (McTavish) or when the funds became more readily available (Bellingham), reconstruction, including the roof, was carried out.

How could it be that it took so long for such important work to be carried out? Gagnon has shown that in the earlier period of the introduction of water treatment, public health concerns became a decisive factor in the context of a crisis, an epidemic as it were.[226] Despite increasing expertise amongst hygiene and sanitary engineering professionals and the introduction of provincial health standards, the investment in better water testing laboratories, trained staff and the entire filtration and purification plant, depended on political decisions, on the financial capacity and priorities of the municipal administration. A lack of financial resources was a major factor throughout the story of how Montreal's reservoirs were built and rebuilt. Is it possible that the engineers in charge of the waterworks adjusted to this context, and learned to argue their needs in

[225] The cost of a concrete cover is given as $US 21 to 29 sq.ft whereas the floating covers that are now more common cost $US 1.50-2.50. USEPA, *Uncovered Finished Water Reservoirs*…. (1999), 4,17.

[226] Gagnon, *L'aqueduc*… (1998), 6.

terms of the financial repercussions? At the same time, since they lacked conclusive scientific justification of the need to cover the reservoirs, perhaps they had no choice but to develop the other quantitative arguments instead.

Despite the emphasis on costs, the specific figures related to the wastage are never given. If the cost of covering the reservoirs was weighed against the cost of not covering them, no public discussion of this balance sheet has been located. While some of the costs of not covering them could be related to losses, wasted energy and added chemicals, the difficulty of quantifying the public health benefits of covering the reservoirs, as suggested by the EPA study, is perhaps a reason why this cost argument was never fully articulated. The shift in emphasis from water quantity to water quality, to which we have linked to the original reasons given for covering the reservoirs, had perhaps not really taken place. The construction of new reservoirs throughout the period we have examined demonstrates that the waterworks remained under as much pressure to expand the system as to improve the quality of water. Solidifying or improving the capacity of existing reservoirs responded to this factor as much as to the need for greater control of the quality of water in the reservoirs.

But the question of reduced or increased capacity is argued on a vague basis. At no time does there appear to have been a clear mastery of the capacity that the reservoirs should hold. As the function shifted away from storage for emergencies (larger volumes for longer periods of time), and water would ideally in fact not spend too much time in the reservoirs, the value of each reservoir's capacity was never correspondingly revised.

In retrospect, the capacity question as an incentive to rebuild appears based on debatable logic.[227] For example, the McTavish reservoirs now holds 33 million gallons, although it could have held over 40 million if its uncovered form had been reinforced but maintained. Similarly, the Côte-des-Neiges reservoir now only holds 7,1 million gallons although it was planned for 14 million gallons. The Rosemont reservoir only holds 50

[227] There are curiously no references to the fact that the compacter form of the McTavish and Côte-des-Neiges reservoirs raised the effective pressure level of the water, which might also have been an objective of the reconstruction.

million gallons although it was planned to either build it as 100 million gallons or build another one in Jeanne-Mance Park of 50 million gallons that was not built. Today the Rosemont reservoir is not even used as a distribution reservoir. In other words not only has the emphasis on quantities lacked convincing development, but the related emphasis on cost and wastage, questions that can in theory be defended in figures, generally remained theoretical.

As we have seen, the relative importance of the quantity of water in the reservoirs has changed, and water is stored for much less time than was originally intended. In fact, as the reservoirs were being covered the amount of time the water could be stored diminished: as part of the development of higher water quality standards, it was realised that storing water was detrimental to water quality. It is perhaps then ironic that the most prevalent arguments given for covering the reservoirs had to do with maintaining their maximum capacity, since just this characteristic appears to have been losing in importance in their overall value for water supply.

In the different texts examined for this study, how quantities or sizes of reservoirs were determined is never clear. In fact, in the earliest period of great discussions about reservoirs (ca. 1872) the texts reveal that there was not that much scientific basis to the rational behind choosing one site or another. The size of the available site was evidently a factor, but was the site chosen because of its size, or the reservoir made so big because of available space? Although raising technical questions that are beyond the scope of this study and its questions, the apparently arbitrary nature of the quantity factor as part of the original choice of sites should be verified. The possibility that smaller reservoirs might suffice, or that the larger reservoirs could be located elsewhere in the city would surely have major implications for both the resources required to maintain them, and the potential use and value of the sites. The story of the Côte-des-Neiges site illustrates what can happen when the decision to not build to planned capacity is never really taken. The remainder of the site was gradually appropriated without plans for other functions.

Costs were a very real factor, related to very real problems of limited resources and ultimately, the need to minimize wastage of both expensive treated water and energy. But cost concerns as expressed in the decision to cover the reservoirs, appear to have more generally reflected a developing driving ethic of productivity and efficiency, than any absolute proof in numbers. This ethic would moreover have other repercussions that were not necessarily planned, but of importance for the landscape. The resulting landscapes of the reservoirs embody this increasing pre-occupation with efficiency, perhaps to the detriment of any other potential value they might have had.

CHAPTER V

The unplanned consequences of covering the reservoirs

Having determined that the reservoirs were covered as a means to control water quality and to reduce losses or waste, this chapter considers the unplanned consequences this would have for the related landscape. It is not our objective to determine whether covering the reservoirs solved the water supply problems it was intended to, nor to diminish the importance of public health concerns and the problems that arose because of limited public resources, but instead to consider how such developments may have had other unintended but no less problematic implications. If, as suggested in Chapter I, the development of the Montreal waterworks reveals a marriage of planned intentions and an unplanned context, the result includes both planned and unplanned consequences.

Although the question of what usage the reservoir covers might acquire arose in the analysis of reasons for covering the reservoirs, it was clearly never with the purpose of providing a place for a new function that the reservoirs acquired their new form. The resulting landscape is at best a neutral ground that could suit many functions, and at worse, not really adapted to any. The landscape of the reservoirs was never in itself a leading factor, but it does embody the issues that were considered important. Following our objectives of relating these developments to environmental, technical and social ideas, three perspectives are developed: the impact of the loss of water in the landscape, the impact of less visible water elements for the waterworks, and finally the impact of these changed landscapes for the mountain.

5.1 The loss of water in the urban landscape

What is the impact of losing visible water in the urban landscape? The loss of water represented by the covering of the reservoirs illustrates the end of a longer trend that was even more marked in the earlier phases of the development of water supply and sewage, as creeks and other natural bodies of water were drained and covered over in conduits and underground canals.

Figure 5.1 High-Level Reservoir, 1885

(Source: View 1547.1, Notman Photographic Archives, McCord Museum)

The covering of the reservoirs belongs to the later phase of the disappearance of water. Already man-made, their disappearance is less about the loss of "natural" water than water in general.

As seen in Chapter I, Hough, Spirn, Thayer and others have suggested that the result of such loss of water in the urban landscape is that the potential perception of the water in the system as part of nature is lost. The understanding of the relationship between urban water supply and the natural cycle is reduced, and the sense that drinking water is an element of nature thereby also diminished. This loss can then be associated with a diminished ability to perceive our own functions within nature as functions of necessity, or to realise the interdependence between our needs and those of the environment.

But the sense that the water transformed by industrial processes is superior for our needs to that found in nature is limited to this urban context of polluted waters. People retain a sense that the water as found in pure nature should ultimately be better, explaining the increasing preference for bottled spring waters transported from areas far from the city and its contaminating impact. Ironically, considering the diminished value of the water on Mount Royal, the water from mountain springs are particularly valued. **(Figure A.25)** Is this not paradoxical in a city like Montreal, for whom the river was so long considered to be an unusually abundant and clean source, and the mountain a site protected and removed from urban development? Although the river has regained favour for swimming and fishing, activities that depend upon a renewed faith in the quality of water, our dependence on the scientific control of drinking quality water is so great that people often demonstrate repugnance at the idea that they are drinking from the St-Lawrence. And the mountain has long been "invaded" by polluting cars and surrounded by the not-so-clean physical plants of the major institutions that surround it. Surprisingly such repugnance never arose in the texts examined concerning why the reservoirs were initially covered. Considering that the arguments given were more likely to concern wastage and losses than public health concerns, the open reservoirs were clearly not considered a major public health risk. One might even wonder if they had been built as impervious but open concrete basins from the beginning whether would they have been covered at all?

Nevertheless, the impact of covering the reservoirs can be related to the development of water quality standards that lead to a controlled scientific process of drinking-quality water production. One implication of such standards has been to separate water into different classes. In the polluted urban context, the treated or finished water produced by the waterworks became superior to the water in the natural environment, i.e. rain, snow or groundwater. Covering the reservoirs, particularly in their completely reconstructed form as impermeable concrete cells, represents the complete isolation of "finished" water from the water otherwise present in the urban eco-system.

As water became a product of a controlled industrial process, it then became just one of many utilities (gas, electricity, telephone and eventually cable) so that its distinct relatively natural relationship with the urban landscape was transformed and its technical character expanded in importance.[228] While this may have been a necessary and

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[228] How water became just one of many public services is reflected in the fact that the service in charge was renamed the Water Commission then the Waterworks then Public Works.

acceptable development of urban infrastructure, it contributed to concealing of the natural cycle of water still at work within water supply, sewage and storm drainage.

The meaning of the loss of water of the open reservoirs can also be examined more in detail as a particular kind of lost water landscape. What was it like to have these large lakes of relatively still waters (or part of the year, ice and snow) in the middle of the city? A still body of water has a particular value in a landscape, reflecting the sky and the surrounding landscape, focussing the space, suggesting peaceful meditative activities, in contrast with the urban bustle.

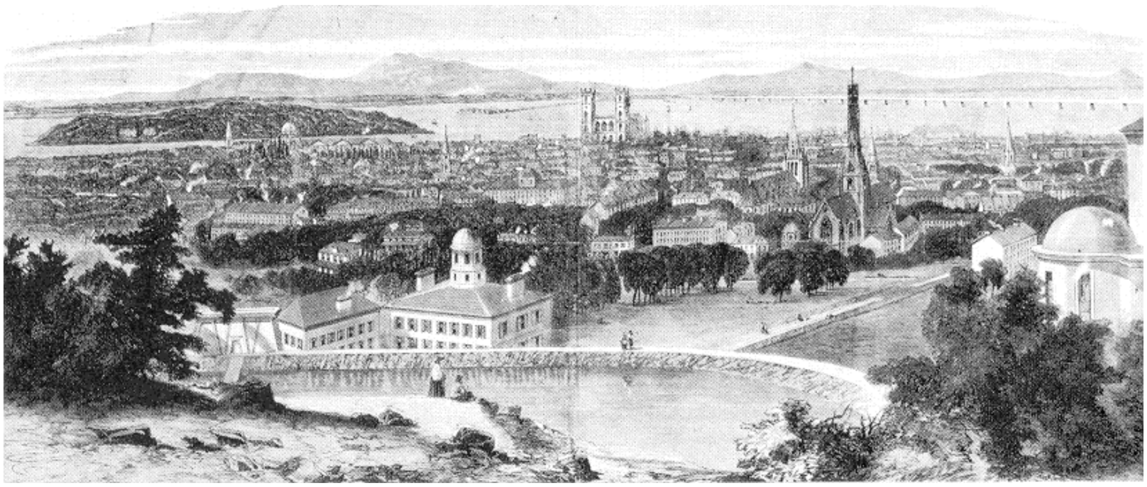

Figure 5. 2 "View of the City from the Royal Mount," 1860
An artist's impression of the McTavish reservoir as a reflecting pool.

(Source: G.H. Andrews, engraved by R.P.Leitch, *The Illustrated London News*, August 25, 1860, reproduced in David Bellman, editor, *Mount Royal Montreal,* (Montreal: McCord Museum, 1978), S25.)

Since the original basins were at least partly in stone, the water would not have appeared to be as much a product of science and control as it was. The stone basins maintained a natural aura, to be replaced by the clearly man-made character of the grass-covered roofs. Thayer suggests that such materials transform our perception of a technological element in the landscape. Sites dominated by the original materials are less explicitly technological. At the same time, he suggests that amongst the types of industrial sites that have the worst image in relation to the environment are those that extracted materials below the ground.[229] As excavated sites, in their earlier forms the reservoirs could be

[229] Thayer, *Gray World, Green Heart,…*(1994), 112-115. This has been explored in depth in Rosalind Williams, *Notes on the Underground, An Essay on Technology and the Imagination*, (Cambridge (MA): MIT, 1990)..

closely associated with quarries. This is still evoked by the stone cliffs that frame each site on the mountain site, cliffs which in the earlier form of the reservoirs would have continued below the surface of the water. **(Figures 5. 3-4-5)** Unfortunately no images have been found showing the reflection of the stone in the water. **(Figure 5.1)**

Surprisingly few examples of texts that refer to the positive qualities of the open reservoirs were found. A rare lyrical reference is found, quite ironically, within the same article where DesBaillets described the plans to cover the reservoirs, when he spoke of the reservoirs reflecting surface offering something restful to the neighbourhood.[230] **(Figure 2.36)** Another article, also about the covering of the McTavish, refers to Montreal's "water bowl" as a special feature or attraction, but without explaining why.[231]

Figure 5.3 McTavish reservoir site with cliff face on northwest side, 1999

Figure 5.4 Vincent d'Indy reservoir site with cliff face on south side, 2000

[230] Des Baillets, "Le reservoir McTavish," *Métropole*, 1947.

[231] "Capped Reservoir to Become Site of New Botanical Garden," *The Montreal Star*, July 13, 1946

Figure 5.5 Côte-des-Neiges reservoir site with cliff face on west side, 2001

It has been suggested that open reservoirs in other cities sometime acquired ornamental value as lakes, to the point where the moment of covering them was considered a loss.[232] In some cases they have been maintained a part of a park, or a site of heritage waterworks facilities.[233] In the case of Montreal, one can only gather the popular value of the reservoirs through engravings, photos or postcards since no historical records have been located of any opposition to their being covered. Is it possible that the quarries adjacent to each of the site lent them a technical even a negative character? **(Figure 2.22, p.58, Figure 2.33, p.72)**

5.2 Less visibility for the waterworks themselves

What was the impact of the changed landscape of the reservoirs for the waterworks themselves? Could one say that by making the water of the waterworks less visible, the function itself became less visible? Unplanned as they might have been as ornamental landscapes, the open reservoirs contributed to a greater visibility of the waterworks. One could see how many and how large the reservoirs were and have a direct sense of the quantity and quality of the water in the system. As Melosi has suggested, in the earlier stages of water supply development, the public as individuals were more directly involved in the constant evaluation of water quality.

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[232] The covering of the Rosehill Reservoir in Toronto was considered a major loss for the landscape by local residents, with the result that an ornamental water fountain was incorporated in the design for the cover. See Toronto Archives, "Water and the Public Domain…," **(Figure A.23)**

[233] USEPA, *Uncovered Finished Water Reservoirs….* (1999), 1-4.. The case of the Highland Park Reservoir in Pittsburgh illustrates a current campaign to maintain an open reservoir, see Amy Ferchack, "New Highland Park watercourse to improve Lake Carnegie," *Pittsburgh Parks Conservancy Newsletter*, Fall 2001/ Winter 2002.

> The earliest standards of water purity had been physical –color, turbidity, temperature, odor, and taste- and could be observed by the layperson. Complaints were common….[234]

As laboratory tests were introduced that tested the water for organic or chemical contaminants that were invisible to the eye, the potential for individuals to feel capable of judging the water diminished. In earlier articles or texts about the reservoirs there were indeed occasional references to the colour and smell of the water and the presence of algae. The covering up of the water in the reservoirs continued this disassociation of the public from the system and reduced their capacity to understand and participate in how it works. Thayer has suggested that "it has been to the advantage of utility companies and public works departments not to bring these utilitarian land uses into public focus; the less the public is informed, the easier it is to make profitable uncomplicated decisions."[235]

The EPA study on uncovered finished water reservoirs suggests that public awareness of the fact that the reservoir contains drinking quality treated water, raised through public education programmes, can reduce help protect open reservoirs from dangers related to adjacent uses and development.[236] But of course in cases where it was decided to cover the reservoirs, this possibility was never explored.

At a more symbolic level, when the reservoirs were covered, a rare public place of water, a place to represent the value of the collective form of the system, was lost. A last visible public counterpart to a mostly hidden world disappeared. Is it possible that this had an impact on the actual effectiveness of the system? Is it possible that the reduced visibility of the waterworks has lead to their greater neglect, i.e. lack of adequate maintenance or repair? The decisions that the authorities would now have greater freedom in making could also involve decisions to do nothing, not to maintain or not to invest.

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[234] Melosi, *The Sanitary City,…* (2000), 135.

[235] Thayer, *Gray World, Green Heart,…*(1994), 79.

[236] USEPA, Uncovered Finished Water Reservoirs, …(1999), 3-10.

Figure 5.6 Côte-des-Neiges reservoir sign forbidding the public to enter the site. (Detail of figure 2.11)

It is difficult however to directly link the visibility of water and the neglect of the waterworks. Although it makes sense, neglect of the reservoir sites was a problem even before they were covered. Throughout the story of the reservoirs, there would appear to have been a shortage of resources, a chronic condition that eventually leads to major works being required. Neglect has many origins, including factors external to the form of the waterworks such as a lack of financial and human resources and distraction by other priorities. Anderson and others that have studied the history of public works investments in Canada have suggested that there is a pattern of major investment in response to crisis and then as the public forgets the crisis, the priorities shift elsewhere.[237] The decisions to invest in public works, even at the basic level required for maintenance, are also ultimately tied to the cycles of municipal power, and the evolving economic context.

There are also real functional problems related to maintaining subterranean services: access and observation are clearly more difficult for underground services. This is part of the reasoning behind the concept of service galleries that consolidate public utilities within an accessible space, that have been proposed in innovative infrastructure design and management.[238] Neglect has thus been linked to reduced visibility of the services, but not specifically to the reduced visibility of water.

[237] Anderson, “Water Supply,” (1988), 217.

[238] Dominique Drouet, “Systèmes d’acteur et d’iinnovation: questions posées sur les infrastructures urbaines industrialisables,” in *Les opérateurs de réseaux urbains,* vol.1, Coord. Dominique Lorrain, (Paris: CNRS, 1990), 68-80. (Information from Dany Fougères).

The condition of the landscapes of two of the reservoirs this study considers is nonetheless exemplary of major neglect. Brick fences and stonewalls that are part of the Vincent d'Indy and Côte-des-Neiges reservoirs sites are falling down **(Figures 5.7-8).** But there were stories of the walls of the reservoirs crumbling even when they were open to the sky. What has perhaps changed is that the public was probably more conscious of the danger to be associated with these crumbling walls, whereas today, they may not have any idea that there is water behind the walls falling down.

Figure 5.7-8 Côte-des-Neiges reservoir stone wall falling down, 2001

Personal discussions since 1999 with the person at the City of Montreal Public Works responsible for managing the sites have revealed that requests for funds to repair the brick walls and iron grilles around the Vincent d'Indy reservoir were constantly refused.[239] Thus, over the course of the last two years, the walls have deteriorated or collapsed in at least three different locations. In one area, a plywood wall has been built, apparently intended to replace the brick wall for some time still.

Does the fact that people don't know what the reservoir sites contain affect what happens to them? Does the public's understanding of and appreciation of the functional or other values of the reservoirs have a role in how they work? Would the public be more concerned about the state of the water supply system if they realised that these crumbling landscapes are only the most visible signs of the inner dilapidation one hears about?

[239] Michel Gagné, telephone conversations & meetings

Would it not be helpful to have certain visible elements of the system serve as markers for just how well we are investing in the continued value of the system?

Tangled responsibilities

Another indirect result of covering the reservoirs was a change in responsibility for the landscape, as the landscapes were removed from the realm of the water supply department and more generally public works, and attributed to the parks services. In the case of the two sites that were leased to universities as playing fields, the parks department itself conceded its authority. Is it possible that somewhere along the line, these sites became the victim of this transfer of responsibilities? Neither the municipal administration nor the universities have ever invested in the types of landscaping or even basic upkeep work that was originally said to be part of the new programme of the covered reservoir.[240]

Figure 5.9 Vincent d'Indy reservoir and Université de Montréal borderline, 2000

At the time that they were being covered there were plans for each of the reservoirs to have a function on its surface: a public park, a botanical garden and a track and playing field.[241] Each of these functions presented certain ideas about the use of green space in the city, and could have established a particular relationship with existing green spaces on

[240] A third element to consider would be the position of the sites in relation to municipal borders. The Côte-des-Neiges and Vincent d'Indy sites are fringe territories. How does this affect their upkeep?

[241] The only plans that have been located are for the basic integration of the Bellingham (Vincent d'Indy) Reservoir into the site planning for the Université de Montréal campus by Jean-Claude Lahaye in 1968. Detailed plans for any of the sites have not been located.

the mountain, whether the park or the open spaces around the institutions. These functions could for instance have contributed to the idea of reinforcing the greenbelt around the park. The surface and surrounding area of the basins had been of limited access, so that the function of the open reservoirs was strictly linked to the waterworks, whereas the cover created the opportunity for other more accessible functions.

The exploration of potential uses for the surfaces of the former Montreal Water & Power reservoirs can also be seen in relation to the transformation of these sites to places of an acquired public value. The eventual rental of the surfaces by adjacent universities for their exclusive use implies a certain appropriation of public space for quasi-private uses.

While the reservoir roof fulfilled the needs of public health concerns, the proposed use of the roof for playing fields corresponds to a period in the history of Montreal's green spaces when open space was increasingly dedicated to sports and other health or hygiene related functions.[242] The reservoirs were easily appropriated by this trend that was more connected to the institutions than the park. Although the types of sport functions that were developed did not reflect the water-related function below, they reflected the emphasis on health, hygiene and efficiency that lead to their being covered. Abandoned projects for public parks on the reservoirs may be understandable given other priorities of public works or universities, but why haven't the parks services ever seen the opportunity of these sites? Even more puzzling, is that no evidence has been found of any plans to incorporate in the proposed functions any form of water element, such as a fountain or basin that might evoke the now hidden use.[243] Even the most utilitarian drinking fountain is absent from all three reservoir sites, although there are records that the McTavish and High-Level reservoirs once had drinking fountains.[244]

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[242] Jean De LaPlante, *Les parcs de Montréal,* (Montréal, Méridien, 1990), 111-130. Even more extremely in the 1910's several neighbourhoods in Montreal were given a public bath instead of a park.

[243] Compare to the Rosehill Reservoir in Toronto, where a commemorative space-age fountain was built on the site of the covered reservoir. http://www.city.toronto.on.ca/archives/pipedreams/cover.htm.

[244] J.O.A. Laforest, *Rapport Annuel du Surintendant de L'Aqueduc de Montréal pour l'Année finissante le 31 décembre 1899,* (Montréal: The Montreal Printing and Publishing Company, 1900), 38-40.

Although in theory both the McTavish and Vincent d'Indy did become playing fields, it was for university purposes, an even more restricted usage, and in any case, this usage has not involved adequate investment in the maintenance of the sites, especially in the Vincent d'Indy case.[245] The sites remained zoned parks, but the city's parks services have also not contributed enough to their maintenance.[246] The ultimate managers of the sites are public works, that is the department that manages all the water works sites, for whom the landscapes of the water works have clearly not been as much of a concern as other aspects of the dilapidated system. The most recent priorities have been to respond to yet new drinking water quality regulations that were introduced by the Quebec Ministry of the Environment in 2000, following the public consultation process (BAPE) and commissioned evaluations of the state of different systems of the province. The deterioration witnessed on the Vincent d'Indy and Côte-des-Neiges sites indicates that clearly even the most basic resources required to maintain the sites are not allocated.

Beyond neglect there is a tendency to let the reservoir sites be appropriated for functions that do not reflect their zoning as parks, their history as public works investments, or the various intended plans to make use of their grass surfaces for park functions. The Côte-des-Neiges site, zoned park was originally more park-like. But over the last thirty years it has become a busy public works site, for functions that have nothing to do with the waterworks or the parks services. **(Figures 5.10-11-12)** Although the parks services maintain a small section for storing rubbish bins, benches and other parks equipment needing to be repaired or out of season, the greatest part of the site is used by what is ironically called "propreté" that is the roads maintenance services, including garages for maintaining trucks, a diesel station, sheds for salt & gravel, and open stockpiles of various materials. In this context it is not surprising that the city of Westmount chose to

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[245] Universities because they receive public funding and have a partly public character appear to have access to public works sites at a low cost. That this can easily shift into a more private usage is reflected in the fact that McGill is now negotiating with the Montreal Athletics Association, a private club, to have them invest in the repair and maintenance of the McTavish reservoir playing field, in exchange for shared used with MAA members. Where does the general public fit into this? Why has a group like Les Amis de la montagne, or one of its predecessors (e.g. the Park Protective Society or the Montreal Parks & Playgrounds Association) never sought to ensure that the reservoir sites, in either their open or covered form, maintain a clearly collective usage?

[246] Bearing in mind that the Vincent d'Indy was not zoned park, but considered a park…

use the adjacent abandoned quarry as a snow dumping ground, a function of questionable compatibility with a pure water reservoir, even if it is sealed hermetically below the earth. **(Figures 5.10, 5.13)**

Figure 5.10 Aerial photograph of Côte-des-Neiges reservoir site, 1971
Before construction of public works sheds on the northern half of the site.

(Source: Université de Québec à Montréal, Cartothèque, Q71509)

Figure 5.11 Aerial photograph of Côte-des-Neiges reservoir site, 1996

(Source: Photo Multi+Pro, Les Amis de la montagne/ City of Montreal, 1996)

Figure 5.12 Côte-des-Neiges public works yard on north half of site, 2001

Figure 5.13 Westmount public works yard & (former) snow dump, 2001

5.3 The unresolved presence of the waterworks in the mountain landscape

What was the impact of the changed landscape of the reservoirs on the mountain? There are at least two aspects to consider: the impact of the loss of the open basins of water within this landscape, and the impact of the grass-covered mounds that replaced them. How did the loss of water elements or the development of grass mounds relate to other developments on the mountain? If the disappearance of water and the reduced visibility of the waterworks were a direct consequence, what did this signify for the mountain's continued conservation?

As has been suggested above, there is little recorded evidence that the covering of the basins was regretted as lost ornamental opportunities. When one considers how popular a basin like Beaver Lake is,[247] and generally how well-valued water features are in any

[247] GIUM, *La montagne en question*, Vol.2, (1988), 86, 89; Oswald Foisy and Peter Jacobs, *Les quatre saisons du Mont-Royal*, (Montréal : Méridien, 2000), 31.

park or landscape, this seems difficult to understand. But although the reservoirs were similar in appearance to some extent, they were not as accessible, surrounded as they were by first one then two fences, and perhaps more critically, they were isolated from any adjacent green space. Open reservoirs in other cities whose perimeters developed into a popular circuit for promenades or running tracks, were more integrated into a larger green space.[248] **(Figures A.23-24)** Although near to Mount Royal Park, the three reservoirs in this study were cut off by major roads or adjacent institutions. Even in the most recent plans to integrate Rutherford Park or the Côte-des-Neiges reservoir into the Three-Summit plan for the mountain, the links appear strained because of the limited adjacent green areas. **(Figures A.10-11)** Part of the challenge of the sites of the reservoirs in relation to the rest of the mountain is also part of their distinct character: they are all set on terraces below high cliffs that expose the natural geology of Mount Royal but create a clear limit or barrier to the sites on the upper side. **(Figures 5.2-3-4)**

In contrast, the small/ high-level/Peel reservoir mentioned in chapter II was situated in a much more accessible position alongside the Olmsted designed path on the southern perimeter of the park. **(Figure 5.14)** Although it was also surrounded by fences, and at the bottom of a cliff-face, the path connected it with the rest of the park, and nearby stairs and higher levels commanded a direct view over its surface and out toward the city. It is therefore more surprising that this reservoir did not have defenders of its value as an ornamental feature. Since it was put out of use altogether and not just covered over, it might in fact have been retained as a purely ornamental basin. But then, as with the McTavish and the other reservoirs, it was built directly in excavated stone, and leakage was a problem that only worsened over the years. Perhaps there was a factor of security that made a location like Beaver Lake, in a valley well away from the city, more appropriate for a popular basin of water. Did the years of concern about leakage and even potential floods make the surrounding users and occupants of the reservoir areas quite happy to see them disappear?

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[248] As Jervis had proposed beside the McTavish in 1853… See note 129.

Figure 5.14 High-Level reservoir, 1878

(Source: Notman & Sandham, Notman Photographic Archives, McCord Museum- View 951.1)

Figure 5.15 Site of High-Level reservoir from Peel Staircase, 2001

It is surely worth remarking that it was decided to add Beaver Lake to Mount Royal Park, in the same period that the reservoirs began to be covered. The High-Level Reservoir had served as an unplanned but nonetheless ornamental water feature from 1875 to sometime in the 1930's. As the principal new body of water in the park, Beaver Lake became its principal replacement from 1938. But whereas the earlier reservoir had combined its technical function and ornamental value, the technical counterpart to Beaver Lake, the Côte-des-Neiges reservoir, was now covered over and hidden. Beaver Lake was planned from the beginning as a picturesque and accessible water surface, for recreation and enhancement of the landscape. This separation of water functions made explicit a separation between technology and the planned landscape of the park and mountain.

The fact that Beaver Lake would be filled by water from the waterworks was not made an explicit part of its design. In the springtime, when it takes five days or so to fill it up, this action is not highlighted by any fountain or other element celebrating the source of the water, so that it is unclear to park visitors whether the Lake consists completely of accumulated rain water or water from a natural hidden source. In fact, the process involves a temporary pipe awkwardly lying between a manhole and the side of the lake **(Figure 5.18).** Although it appears that a certain ambiguity was and is desired, nothing is really concealed. Even the relationship between the waterworks supplied adjacent cascade and the lake is unclear. Was there once an idea of the cascade appearing to represent the source filling the lake? If so, the cover for the pump was not very discreet, and no real link between cascade and lake survives. Thus, although the covering of the reservoirs can be related to a new form of water display in the park, it was a form that resolved a changing sense of the place of water in the city by keeping it ambiguous.

Figure 5.16 Beaver Lake water supply, Spring 2001

With regards to the resulting forms, the grass mounds or tumulus that took the place of the open basins, there are both the actual situation and many abandoned plans to consider. The form of the cover is at once both unremarkable and conspicuous. Despite the description of the sites in chapter II that evoked similarities, the sites are dominated by different features: although both McTavish and Côte-des-Neiges are dominated by both the pumping station and the grass covered reservoir, the pumping station of the smaller reservoir is relatively more important. The sweeping shape of the road circumventing the south side of the McTavish draws the eyes to the curves of the grass hill, and the opposing curved cliff-face above. In contrast, the Vincent-d'Indy reservoir is dominated by the brick fence that surrounds the site, all the more striking because such fences are relatively unusual around any kind of site in Montreal.

The integration of the reconstructed reservoirs into the landscape of the mountain should also be seen in relation to the reservoirs built within the park in the same period. The Mountain and Summit Reservoirs, built in Mont Royal Park in 1931 and 1957, were both built underground. Although they each had a related stone clad concrete aedicule, there was no apparent intention of calling attention to the reservoir itself or its function. There was clearly no desire to give any presence to water itself, and there was no effective resistance by the managers of the park to the excavation or more radical transformation of the existing topography due to placing the reservoirs underground. The smallest of these two was really quite small, and could easily have been built as a tank concealed within an ornamental tower, in the same way that the water tank on St-Helen's Island from the same period was built as a visible ornamental feature that also provided a viewing platform from its roof. Although a tank would have been more visible, it would have had the value of leaving a less permanent mark on the landscape.

Is there something fundamentally contradictory between the reservoirs and their form and function, and the remaining mountain landscape, or any park landscape? Acknowledging the presence and value of the reservoirs in the landscape means recognising that this landscape has, along with its natural, social, cultural and historical values, acquired technological value. But technical functions have never been that well accepted in this landscape: from the funicular at the beginning of the twentieth century to the communication antennas at the end, technical intrusions have been highly contested.[249] And yet these same intrusions have stood for access and security, and other more subtle technical elements have taken their place with little protest. From the huge parking lots and motorways of the 1960's to the planned artificial skating rink to be built beside Beaver Lake, technology has been allowed to dominate the landscape in many forms.

Why then would it seem necessary or desirable to conceal the waterworks? Does it have to do with our particular idea of what water is and should mean? Illich, Bachelard and Thayer have all suggested in different ways that our discomfort regarding the contrasting meanings and forms of water as an element of nature and technology lead us to ignore and hide it. The apparent contradictions within the complex nature of treated water when exposed to the environment make us uneasy. It is difficult to embrace technology within the natural environment if we suspect that it is working against that environment. How does one make a place for technology in a cherished natural landscapes? Can one get around the desire to hide the water supply system in which we continue to need to invest so much of our collective resources?

Thayer has suggested that landscape or environmental guilt if recognised can be helpful, generating the critical development of solutions to an otherwise unlimited technical development of the landscape. Concealment and camouflage can be revealed, denial and avoidance confronted.[250]

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[249] Bureau de consultation de Montréal, comité consultatif. *L'avenir de la montagne : plan préliminaire de mise en valeur du mont Royal, Rapport de consultation publique*. Montréal : Ville de Montréal, 1990.

[250] Thayer, *Gray World, Green Heart,…*(1994), 159-161.

Figure 5.17 Côte-des-Neiges reservoir ventilation outlet/ mushroom
Even a discreet signal of the hidden function of the reservoir is camouflaged.

5.4 The potential of the reservoir sites in plans for the mountain's conservation: making technology a more transparent, congruent part of the landscape.

The idea of looking at the reservoir sites of the water supply system within the context of Mount Royal is based on an approach to conservation that builds links between different types of heritage present in the same landscape. This approach recognises the greater potential acceptance of industrial heritage when the elements of this heritage are reintegrated in a larger context, often a context of natural resources. At the same time it is a realistic approach in terms of resources, since as the types of heritage values society is interested in recognising multiply and diversify, resources to conserve and interpret these sites become proportionally less. Mount Royal represents one of the two principal defining elements of the Montreal landscape and has both in itself and as the site of a major collection of architectural and historical monuments achieved great recognition, only surpassed by the old city and harbour.[251]

Thayer has suggested that the dilemma represented by the landscapes of technology, and our ability to accept and act on the effects of their presence in the landscape is at the heart of the potential resolution of so-called environmental problems.[252] He suggests a range of types of landscape, in which technology is more or less visible, and more or less the defining functional characteristic of the landscape. Landscapes that hide their function are

[251] Although the status and protection of the mountain remain fragile, as a site it has nevertheless achieved relatively much greater recognition than the sites of the waterworks, and in the least, has its defenders.

[252] He prefers to call these people problems…

opaque; those whose surface usage denies the hidden underground usage are incongruent. He proposes that we should accept our dependence on technology, and come to terms with how it impacts the landscape not by concealing it, but by critically re-designing it; the denial of technology could be transformed into a more acceptable relationship between technology and natural process.

The problem of the reservoirs of Mount Royal is not strictly speaking a design problem: they could continue to function and appear as they do. Part of the reason why this is so is that they continue to function, to have meaning beyond their surface appearance. The question is whether their surface appearance engages our understanding of the place of water in the urban eco-system, as embodied in the water supply system, and whether this form and surface usage is the most pertinent in the context of the surrounding landscape.

While an ecological approach to water management is being developed within Mount Royal Park, the fact that the reservoirs, and their previous form as open basins, is never discussed in relation to the natural forms of water on the mountain reveals that water has been divided into two separate elements: the water we can drink, and the water we can see in the landscape. Ultimately this has negative repercussions for both. Beaver Lake, supplied by both the waterworks and the natural rain or snow accumulation throughout the seasons, becomes symbolic of the whole dilemma. The fact that it is soon planned to rebuild the lake, and add an artificial skating rink, makes the recognition of this awkward relationship between the mountain's conservation and the presence of technology in this landscape all the more pressing.[253]

The reservoirs in their current form represent a hybrid of functions that could be examined for their compatibility not just in practical but also in symbolic terms. How does the field of grass relate to the hidden basin of water? The flatness and general uniformity of the lawn, covered half the year by snow and another quarter of the year by puddles, make it possible to imagine the flat plane of water below. On the other hand, as the puddles suggest, the roof must be drained, and this lawn is both a consumer and

[253] What source of water will be used to resurface the rink? Where will the surface snow and scraped ice be collected and cleaned? Will any of this be visible?

waster of water. If the lawn is to function well as a surface for a playing field it becomes dependent on the whole industrial process now associated with playing field production, including irrigation to produce grass and drainage of excess accumulated water. In other words, a system of water consumption and wastage, that surely is at odds with the image the waterworks should seek to associate with its reservoirs.

CONCLUSION

After considering the story of the Mount Royal reservoirs, their evolving function and form, and in particular, the reasons why they were covered and the consequences this would have on the surrounding landscape, further questions arise: Was covering the reservoirs really necessary? If not, is it worth reconsidering the advantages that leaving the reservoirs open to the sky might have represented? Or are there other more realistic or more appropriate scenarios to consider?

The evidence discovered concerning why the reservoirs were covered is in fact not as conclusive as one might have expected with regards to public health protection; the fact that it took so long to cover the reservoirs only confirms this. Furthermore there are examples today of cities seeking to maintain open reservoirs in order to preserve the ornamental character of these artificial lakes. Nevertheless, it is debatable that this would have been likely in Montreal, where the extremes of climate presented a particular type of stress on the open form of construction and, perhaps more critically, where there is little evidence of popular interest at any time in keeping the reservoirs open. This discovery that the value of the reservoirs as ornamental lakes did not really exist in the case of Montreal leads to a whole series of questions in themselves. The photographs, engravings and post cards of the McTavish and High-Level reservoirs from before they were covered suggest that these sites were indeed valued; both by those who recorded their impressions, and those who thought others would want to acquire such an image. While it is not in the objectives of this study to analyse these images, this would surely merit further study.

In any case, now that they are covered, uncovering the reservoirs, whose roofs are attached to and supported on a rigid framework of columns and beams, would involve major demolition and reconstruction, something that would be very hard to defend at a time when funds for public works are limited. It would only be possible to justify such a major revision, if one could find reasons integral to how the reservoirs work, that is environmental, technical or economic advantages that were not previously understood.

The reservoirs as they exist today are the result of another era, of a time when the focus was shifting from abundant to pure water. Despite an increasing emphasis on water quality, demand continued to grow, and the reservoirs themselves were subject to pressures that had more to with productivity and constrained financial resources. Are we any better positioned today to shift the emphasis to quality not only of the water in the reservoirs but in the resulting environment? Are there solutions for these landscapes that use a bit less concrete and sod, and a bit more of the natural process at work in the landscape, that could help transform these sites into models for the mountain's relationship to the city? The trend of letting the reservoir sites be appropriated is continuing, and will only be prevented if the public takes interest in their potential.[254]

If the idea of the reservoir roofs serving as playing fields now seems like something one can better associate with the great push to develop organised recreational space of fifty years ago, or that the mountain's destiny as a conservation area is now more assured, it may only be that the forms of these types of pressure have changed. The universities now depend more than ever on the excellence of their sports facilities to draw students and funding. Right beside the Vincent d'Indy reservoir, the Université de Montréal just transformed their CEPSUM playing field into a brightly coloured artificial lawn next to which new rows of benches stand on an area that was nevertheless zoned for conservation in the university's development plans. On another major site adjacent to the mountain, one in fact that was repeatedly explored as a likely place for a reservoir, Jeanne-Mance Park remains a battleground between soccer teams who occupy a similar artificial turf and local residents that are calling for appropriate landscaping.

The interest of considering new approaches to the existing conditions is that this could help reinforce the value of the reservoir sites, as a part of both the water supply system and the mountain. The lost water basins contributed a particular kind of water element to the urban landscape, and gave more immediate visibility to the site's function. What could still be regained is a form of water presence, an element that would contribute to

[254] See note 245.

raising the visibility of the waterworks, and thereby the public awareness of how the waterworks are integrated in the landscape.

At the same time, by recalling the public function of these sites, an opportunity arises to explore how to reinforce the mountain's dedicated conservation area. The undeclared potential of the reservoir sites as they once were, as lakes in the mountain's landscape, could at least now be recuperated as part of the green core, albeit less natural, at least every bit as essential as the park, for the city's health. Despite the recognition that Mount Royal is the city's water tower, there remains an awkward relationship between conservation ideals and what are seen as technical intrusions, due perhaps to a lack of information, and situations that lead to the disassociation of the waterworks from the eco-system. Consolidating the mountain as both the lungs and the circulation system of the city, and accepting the level of technical intervention this embodies, could only help to confirm the already established natural, social, historical and cultural value attributed to the landscape.

Three scenarios

In order to test how the new information about the reservoirs that we have uncovered could be used, three scenarios will be briefly explored:

A-The required capacity of the reservoirs is reduced.

The fact that the function of the reservoirs has changed, and the volumes of water stored in the reservoirs may not have been defined by absolute standards, but instead represent the result of their site's capacity, makes it possible to imagine that there could be justification for reducing if not eliminating the reservoir function. This would be easier with a divided reservoir like the McTavish, which can already be reduced in part by closing one or more of the sections.[255] For the other two, it is only possible to close half at present, and according to the logic of always keeping at least two parts, this half would have to be subdivided again. But could one justify this, unless for reasons integral to the waterworks, such as reducing the amount of area to be cleaned, or for reasons to do with

[255] Although the number of cells, which increase the reservoir's flexibility, is now probably of as much importance as the actual quantity of water stored.

improving the usage of the site? Apart from the unverified technical questions, a main problem is that, as has been suggested above, the expense and material wastage involved in removing the cover structure would be hard to justify. Demolition of tons of concrete is now considered to be a waste of both the original energy and materials invested, not to mention, the questions raised by the disposal of wasted construction materials.

But if it were possible to empty even part of a reservoir what would the options be? Would it not then be possible to consider using part of the reservoir for storing something else, such as untreated accumulated rain or snow, to serve as an emergency supply or for street cleaning and flushing sewers? This kind of water, called grey water, is becoming a recognised component of sustainable water supply systems. But perhaps this scenario is too radical in that the reservoirs still do have a function, that has not yet been radically re-examined by those who are in charge of them.

B-A surface function is developed that recognises the hidden function of the reservoirs. As in the scenario described above, a function could be explored that makes use of water collected from rain or snow, but in this case using the surface as a retaining and possibly a treatment basin. Unfortunately the superposition would be the reverse of the ideal situation, which would have the treated water above the untreated, as a precaution in case of leakages. This is not so unlikely as it seems. As we saw in chapter II, major reservoirs of the Paris system were built this way from the beginning. Would it in fact be conceivable to use the reservoirs below for grey water, and build new basins above for the treated clean water, basins that in some manner would give visibility to the water? As seen in chapter III, present water quality standards and regulations do not encourage the construction of new open reservoirs, but only permit the maintenance of existing open reservoirs under certain conditions.[256] Might it still be possible to build a new type of open reservoir, for instance with a roof but glazed sides, as long as it could be proven that water quality standards would be maintained?

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[256] USEPA, *Uncovered Finished Water Reservoirs…*(1999), 1-5-7.

Figure 6.1 Mahatma Gandhi Park on top of Châteaufort Reservoir, 2001
With community vegetable gardens in the centre

Or perhaps there are other functions that one could consider for the top that would both call attention to the water underneath and better exploit the site in a collective usage that promotes a clearer interaction with the urban eco-system. One of the challenges would be to find a way to use the site that deals with the seasons. Two uses come to mind: community vegetable gardens in the summer and skating rinks in the winter. The challenge would be to find uses that consume water in a way that could be exemplary for an integrated approach to technology in the urban landscape. The community gardens that already exist in Montreal on top of the Châteaufort reservoir could be analysed for the potential such a use offers. Currently their irrigation system makes no reference to the water function of the reservoir below or the adjacent pumping station, nor does it explicitly make use of rainwater. **(Figure 6.1)** In fact, although a very positive contribution to the neighbourhood, these gardens renamed Mahatma Gandhi Park have contributed to concealing the presence of the waterworks.

At the same time, before doing anything too quickly, the experience of the last couple of years of exploring these sites has opened our eyes to their accidental vernacular value. This too should be considered. Was it so accidental that a snow dump or a diesel reservoir ended up next to a big storage tank? A city needs all kinds of storage spaces, including less beautiful ones. Where should these go? When their function is directly related to the mountain (like the snow piles collected from the mountain's roads), shouldn't there be a way to integrate them in this landscape?

Figure 6.2 Summit reservoir, pumping station and picnic shelter, 2001

C- Public appropriation of the reservoirs and integration in the mountain landscape.

Although this is in a way the most obvious of the scenarios, since it almost what one would most have expected, it is almost that which makes it appear least likely. Time has shown that there was little will to integrate the reservoirs into the mountain landscape, although it was said to be the intention of the grass covers, that the reservoir sites become parks, botanical gardens or playing fields. But the changing definition of the mountain's role over the last fifteen or so years, which has sought to enlarge its social and environmental functions and consecrate a larger territory of natural and cultural heritage values, suggest that the time has come when the reservoir sites could be integrated in this larger collective project. The essentially collective nature of the waterworks, and the fact that these are by all rights large public properties, suggest that there is an opportunity that shouldn't be missed again, particularly as the pressure for privatization of the system continues. Part of the problem is to see who should and would take charge.

In chapter V it was suggested that the responsibilities for the reservoirs are tangled between public works, parks and the universities. This type of problem is not exclusive to the reservoirs: throughout Mount Royal Park there are sites that lack a concerted management plan because of the number of municipal services involved. When too many players are involved, one of the results may be that no one takes responsibility, and that nothing gets done. If it was intended that the reservoir sites be used as parks, then surely the parks services should have taken the leadership, or at least ensured that the universities took care of the sites in exchange for their use.

On the other hand, why couldn't public works take greater responsibility for the maintenance of its own properties, and an attitude be developed within the waterworks that its properties are not simply industrial, but also have a landscape element to them?[257] The problem goes far beyond the city's public works department, since many of even the largest property owners often neglect the landscape component of their sites. Perhaps however, it is worth recalling, that the parks service developed out of the public works and especially the roads department. Is it possible that as the services and departments specialized, the minimum amount of landscape care within a department was abandoned? At one time only half a century ago the engineers of public works were much more involved in planning the city's parks and playgrounds, something reflected in the character of parks from this era, now considered too utilitarian. Have we since created a situation that assumes and allows the public works engineer to be helpless or powerless in relation to green spaces? Managing a waterworks site as a heritage site involves as much understanding of landscape as architectural and engineering preservation. In the same way, might one not question whether the parks service can function to the best of its purposes without mastering the infrastructure within the boundaries of the sites it manages? Should not the elements of the waterworks found within Mount Royal Park be integrated within park conservation and improvement plans?

This last scenario challenges all those currently responsible for either public works, parks or university grounds, to participate in redefining new objectives for these sites.

For the good of the waterworks, the mountain, and the city

An opportunity to reconsider the place of the reservoirs are presented by both a crisis about the state of the waterworks and plans to enlarge and strengthen the mountain's territory and status. As we have seen, the walls of the reservoirs are literally falling down as this study is being written. But the lack of appreciation of their function today is possibly no greater than it ever was, or one might have recorded tales of the kinds of battles that occurred in other cities where citizens fought to keep the reservoir-lakes in the

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[257] The greenhouses originally integrated in plans for the DesBaillet pumping and treatment plant imply that this idea has occurred before.

landscape.[258] The chance to make a more informed decision about the most appropriate use and form of these sites is one that the city and its citizens will hopefully finally grasp. The reservoirs in their present form embody a series of decisions, an investment in material and human resources in a particular interpretation of the landscape's potential. This study has attempted to evaluate the decisions in terms of objectives and consequences. Understanding the decisions embedded in the resulting forms of waterworks development is in fact an underlying preoccupation of most contemporary studies on the history of water supply: understanding past decisions is expected to inform current decisions. Whether it is to understand how the value of a public system established itself in comparison with initially private services (Fougères), or to disentangle political from technological and social objectives at work within the public system (Gagnon), the studies on the Montreal waterworks have shown the interest of analysing a development as the expression of a choice by individuals or interest groups in a specific context.

In Chapter I, it was suggested that part of the interest in such a study is that historic decisions continue in fact to have an impact in the permanent built forms that were the result.[259] Earlier pre-occupations with durability have sometimes proven to be a problem, in that other factors than durability eventually became more important, such as flexibility. The reservoirs as they were first built and then rebuilt represent just such investment in durability, or at least a durable situation, and then durable materials. The location of the reservoirs on the mountain, their excavation in the rock and the dedication of large areas of land to collective use, all together represent a permanent transformation of the mountain. Then, as they were rebuilt in reinforced concrete, not simply as a shell, but as a veritable honeycomb of columns and beams or arches, their actual construction became a solid and unlikely to be modified construction.[260]

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[258] See notes 232-233.

[259] Melosi, *Sanitary City …*, (2000), 10-12.

[260] Reservoirs being built today use membranes as liners and covers to achieve the waterproof seal. See USEPA, *Uncovered finished Water Reservoirs* …, (1999), 4-13-15.

The positioning of the reservoirs on the mountain profited from the natural topography but was also a response to the challenges this topography presented. Their location can be seen not only in relation to the areas of the city they made it possible to serve, but where it had been decided to settle, in absence of planned water provision. While they profited from the purer environment of a landscape partly protected from development, their expansion ultimately reflects the development of the city, and their transformation reflects the encroachment of the city up the mountain rather than an expanded definition of the mountain as urban reserve. Nevertheless, covering the reservoirs appears in some ways to have had less to do with protecting the water than ensuring that the reservoirs functioned at full capacity. Although perhaps avoidable, in the context of Montreal, covering the reservoirs became inevitable, only waiting for sufficient funds as this was part of a major renovation that was long overdue.

Our consideration of this story had as objective to elucidate the reasons why water has disappeared from the urban landscape. The reasons are complex, and evolved as the city grew and its systems for controlling the flow of water through the city developed. If the results today are that water is much less present than one might wish, it is unthinkable to imagine returning to some kind of previous natural state. Instead, the renewed desire for greater presence of water can be fulfilled in forms that respond to existing resources, and the lost intentions or meanings be sublimated within a more symbolic ordering of ideas.

Although one might almost regret not having discovered a lost idyllic time when the open basins of the Mount Royal reservoirs were expressly considered a part of the mountain landscape, this absence provides an opening to develop new meaning and functions in its stead. In the history of the Montreal waterworks, the covering of the reservoirs represents a late and minor event, more symbolic in the telling than in the actual occurrence. In contrast, many other drastic changes were to occur in the surrounding mountain landscape over the same period, changes whose symbolic value (such as giving access) is sometimes exaggerated to counterbalance the real physical impact (combustion generated pollution, highway like driving and huge parking lots).

Part of the questioning arises out of a sense that the decision to cover the reservoirs was not clear, even though the impact of the decision appears permanent. The interest of understanding historical decisions is partly that it helps us to make decisions today, by helping us see that there are bound to be unplanned consequences to our decisions, including permanent repercussions. Decisions of a technical nature are perhaps less absolute than one might expect, especially when no regulations develop that embody the related standards. When the related actions take a long time there is also a sense that real causality is lost, that other issues must be hidden in the events. A shift from water quantity to water quality can be associated with the reservoirs, but ultimately it is the results of the decision and not the reasons that are left with us.

The development of waterworks combined planned processes and an unplanned context. The consecration of the mountain to conservation in the broadest sense (including its development as an urban park) represents one of the more singular examples of commitment to a certain idea of urban development in Montreal. By locating the reservoirs on the mountain, the waterworks connected to this project. Yet while seeking to profit from the green core, the Mount Royal reservoirs were never taken up by defenders of the mountain as an ecological function.

Hopefully this study will contribute to understanding the value and interest of the reservoir sites not only for the mountain but the whole city. There is still great potential to explore in considering how to integrate the mountain's role as water tower into the landscape. Ultimately this should serve to consolidate the value of both the mountain and the waterworks for the city.

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    Map, periodical, city report collections
Archives Nationale du Québec Viger building (ANQ)
    Map collection
    Photo collection (Fonds Conrad Poirier)

Private

Sylvia Dowd- Private papers of Francis V. Dowd (Dowd collection)
McCord Museum- Notman Photographic archive
Centre de la montagne-documentation centre
Dinu Bumbaru- Private book, map and postcard collection
Daniel Chartier- collection of writings by F.L. Olmsted

Libraries with important collections of journals related to waterworks

École Polytechnique de Montréal (EP)
McGill University, Physical Sciences & Engineering (MU-PSE)
Concordia University, Webster (CW)

Other libraries

Université de Montréal, Aménagement (UM-AM)
Université de Montréal, Lettres et Sciences Humaines (UM-LSH)
McGill University, McLennan Redpath (MU-MR)

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APPENDIX 1

Illustrations

This section includes both illustrations that are of general value throughout the text and illustrations of secondary importance but worth including for the historical record.

Figure A.1 Plan of proposed Montreal Waterworks, detail, 1853

(Source: Detail from "A Topographical Map of the City of Montreal & Vicinity Shewing (sic) the Line of the new City Water Works 1854," included as one of two folded sheets in Comité de l'eau, *Rapport du Comité de l'eau, soumettant les rapports des ingénieurs sur les nouveaux aqueducs de Montréal*, (Montréal: John Lovell, 1854), BNQ-SS)

Circled in red :
McTavish reservoir

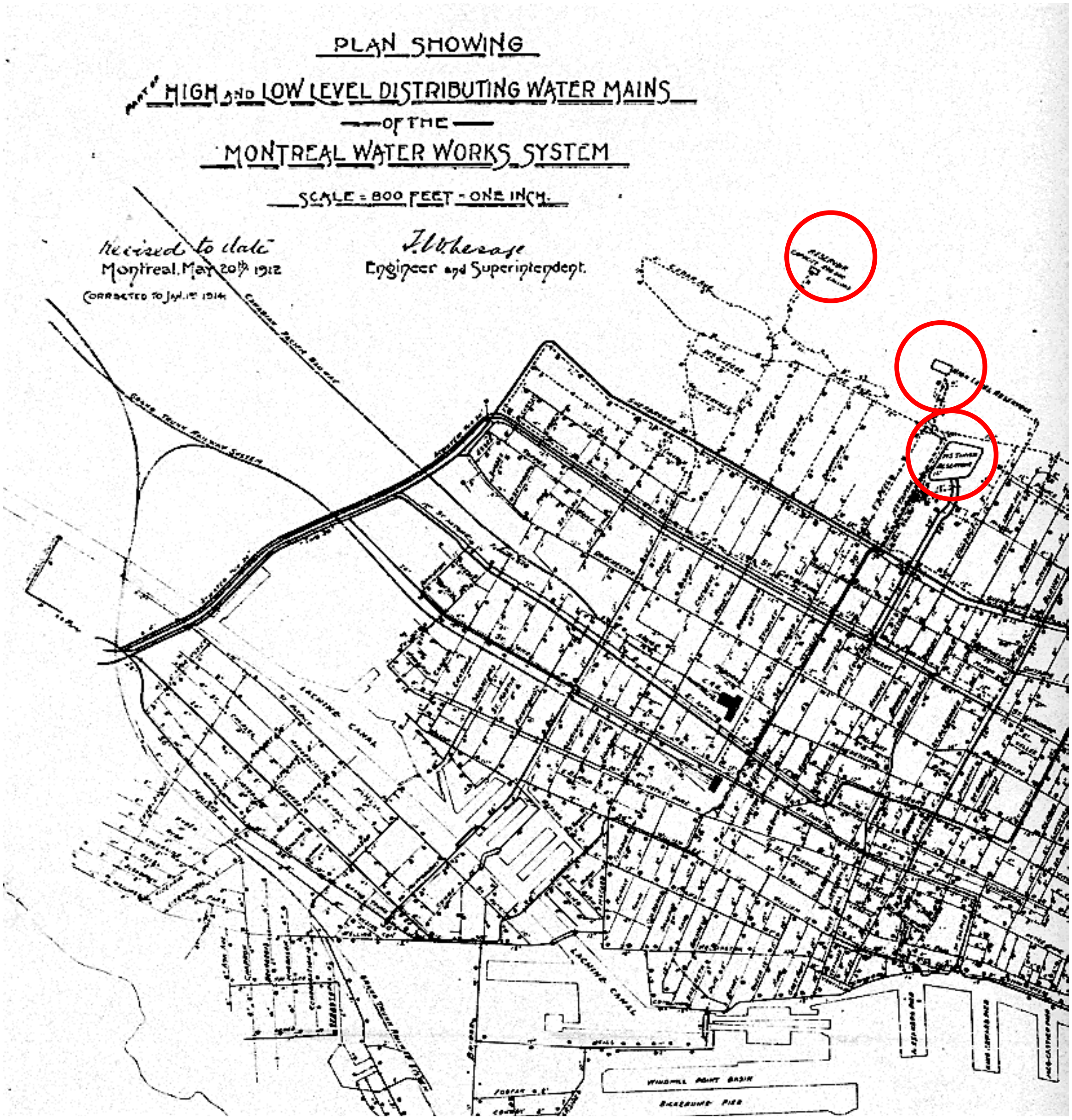

Figure A.2 Montreal Waterworks systems, detail, 1912

Circled in red from left to right:
Cedar reservoir (built ca.1911)
High-level reservoir (1875)
McTavish reservoir (1853-56 with later enlargements)

(Source: VM-GDA, 1912-3 (microfilm))

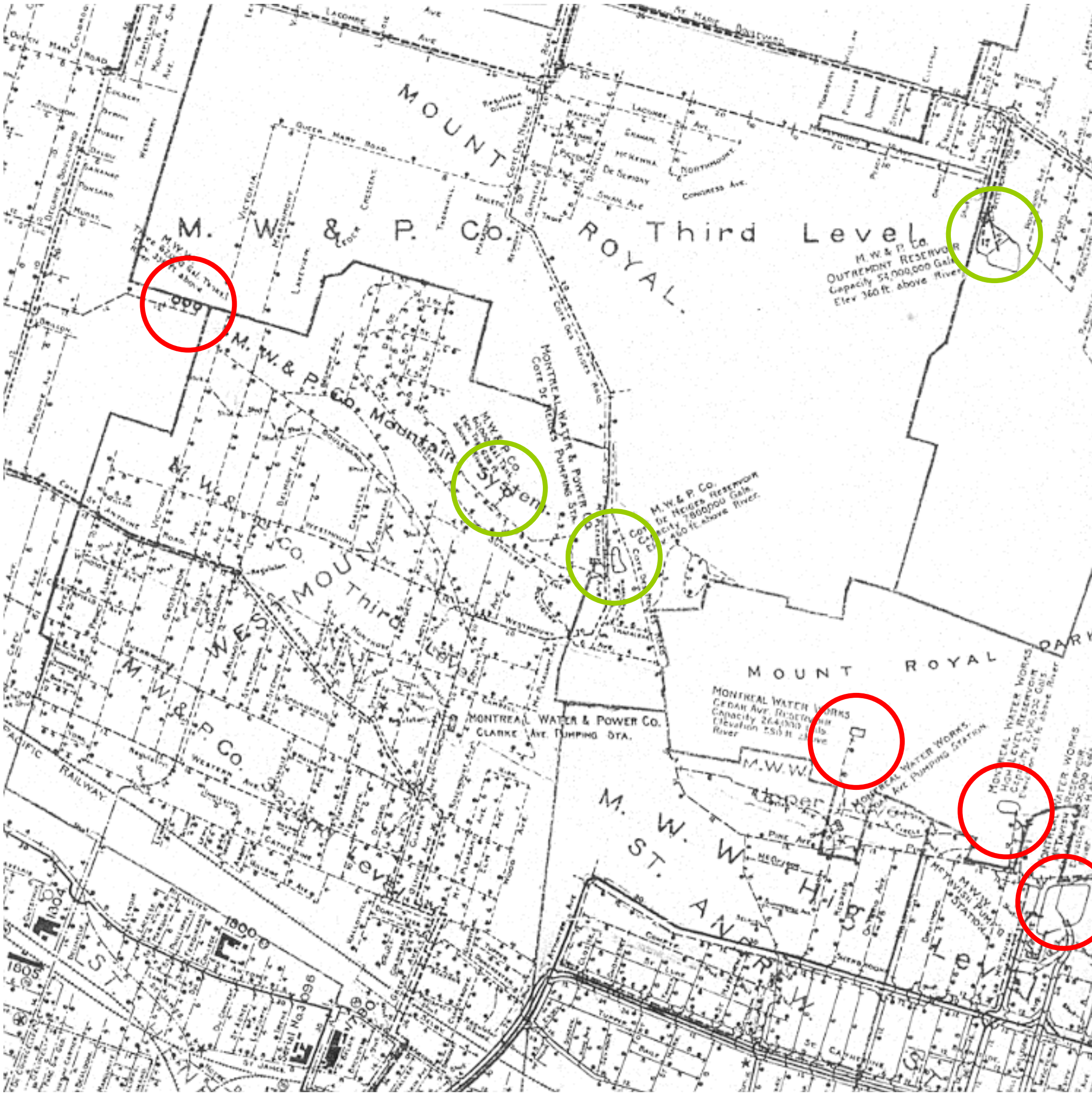

Figure A.3 Montreal Water Supply systems, detail, 1915

Circled in red from left to right:
Notre-Dame-de-Grâce tanks (n.d.)
Cedar reservoir (built ca.1911)
High-level reservoir (1875)
McTavish reservoir (1853-56 with later enlargements)

Circled in green from left to right:
Westmount summit tank (n.d.)
Côte-des-Neiges reservoir (built ca. 1893)
Outremont reservoir (built ca.1910-15)

(Source: VM-GDA, 1915-5 (microfilm))

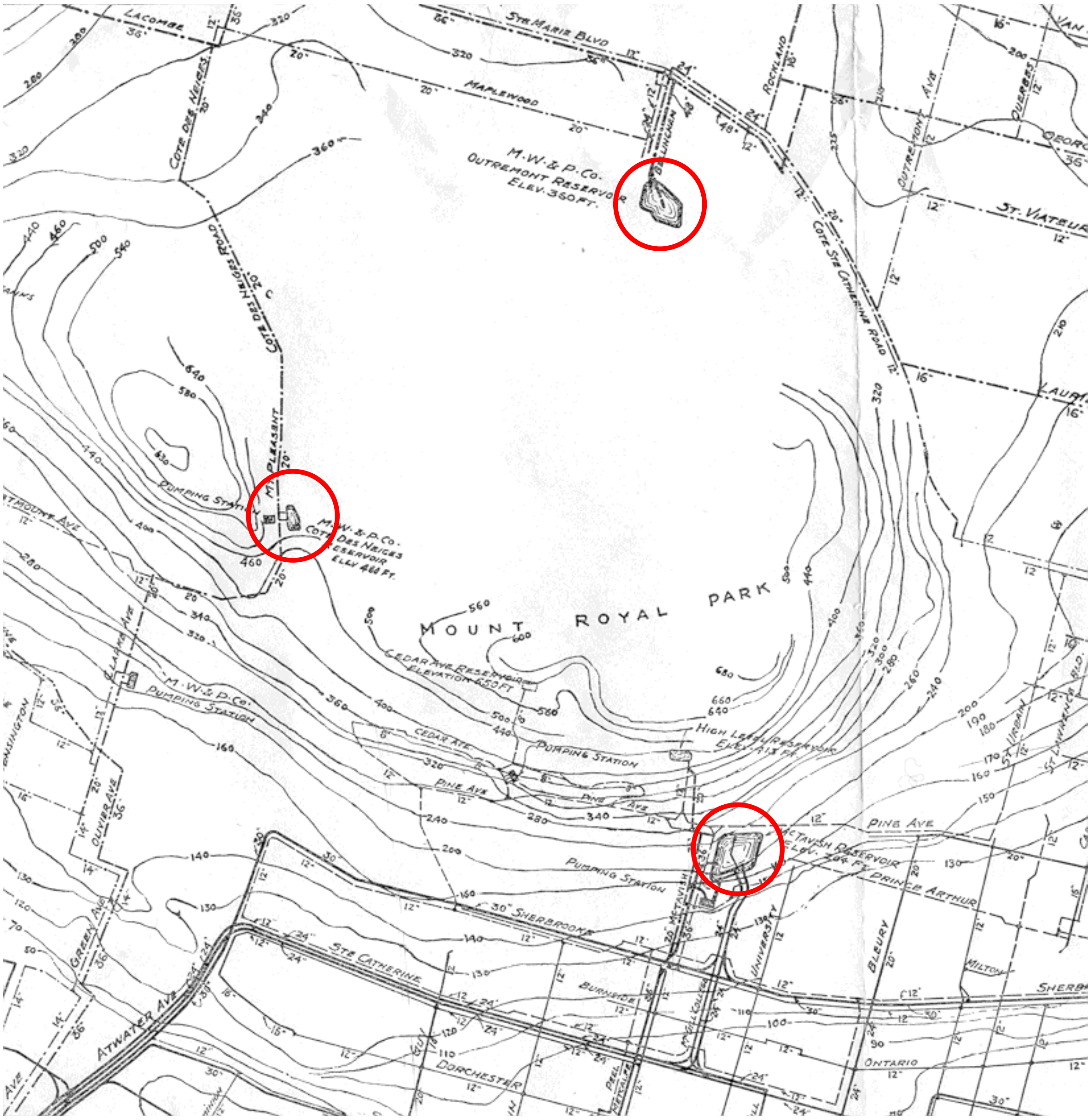

Figure A.4 Montreal water supply systems, detail, 1920

Circled in red from left to right:
Côte-des-Neiges reservoir (built ca. 1893)
McTavish reservoir (1853-56 with later enlargements)
Outremont reservoir (built ca.1910-15)

(Source: Dowd collection)

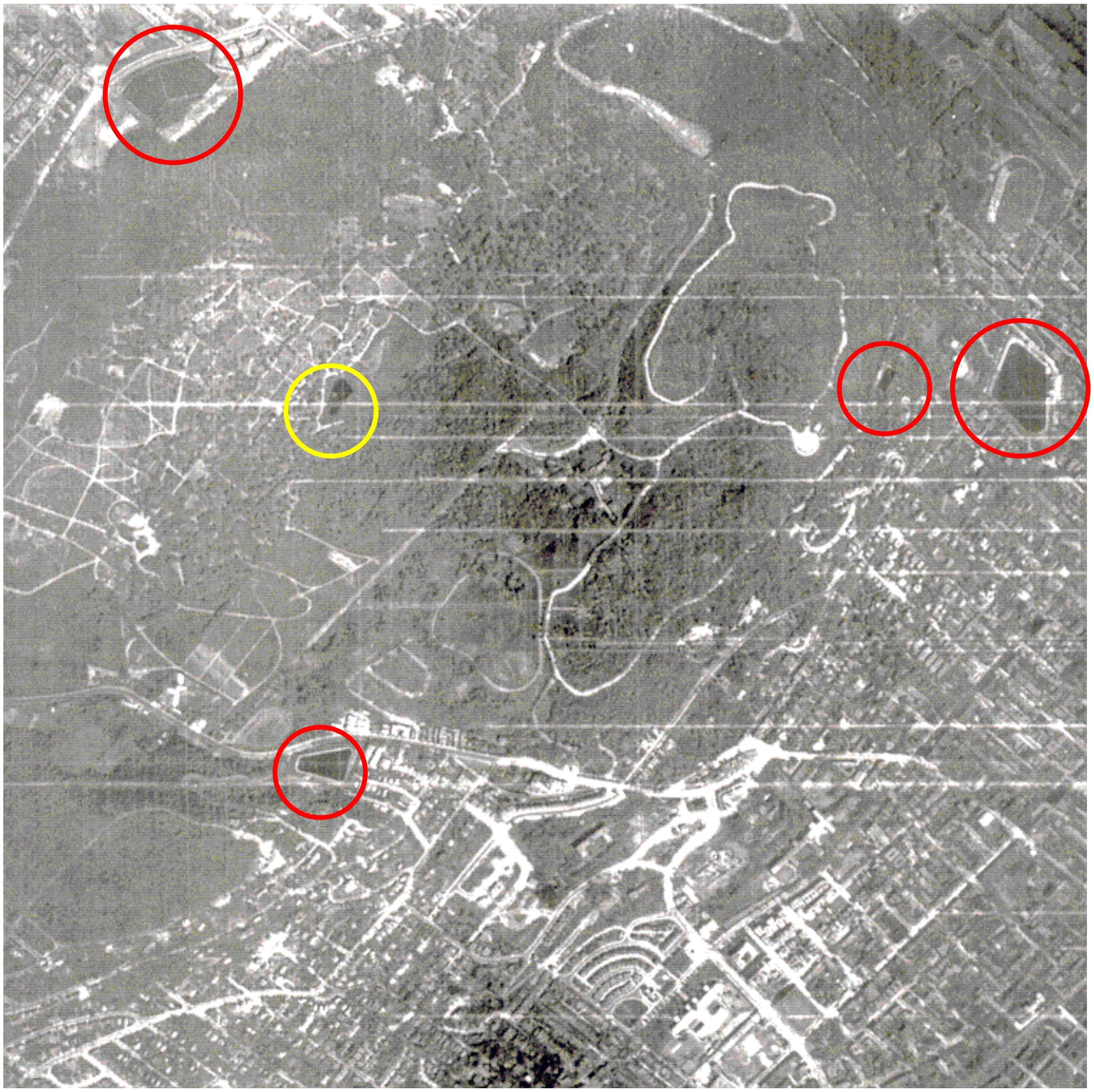

Figure A.5 Aerial photograph of Montreal above Mount Royal, 1930

Circled in red from left to right:
Outremont reservoir (built ca.1910-15)
Côte-des-Neiges reservoir (built ca. 1893)
High-level reservoir (1875)
McTavish reservoir (1853-56 with later enlargements)

Circled in yellow:
Basin in Notre-Dame-des-Neiges Cemetery

(Source: Université de Québec à Montréal, Cartothèque, A-2257-30)

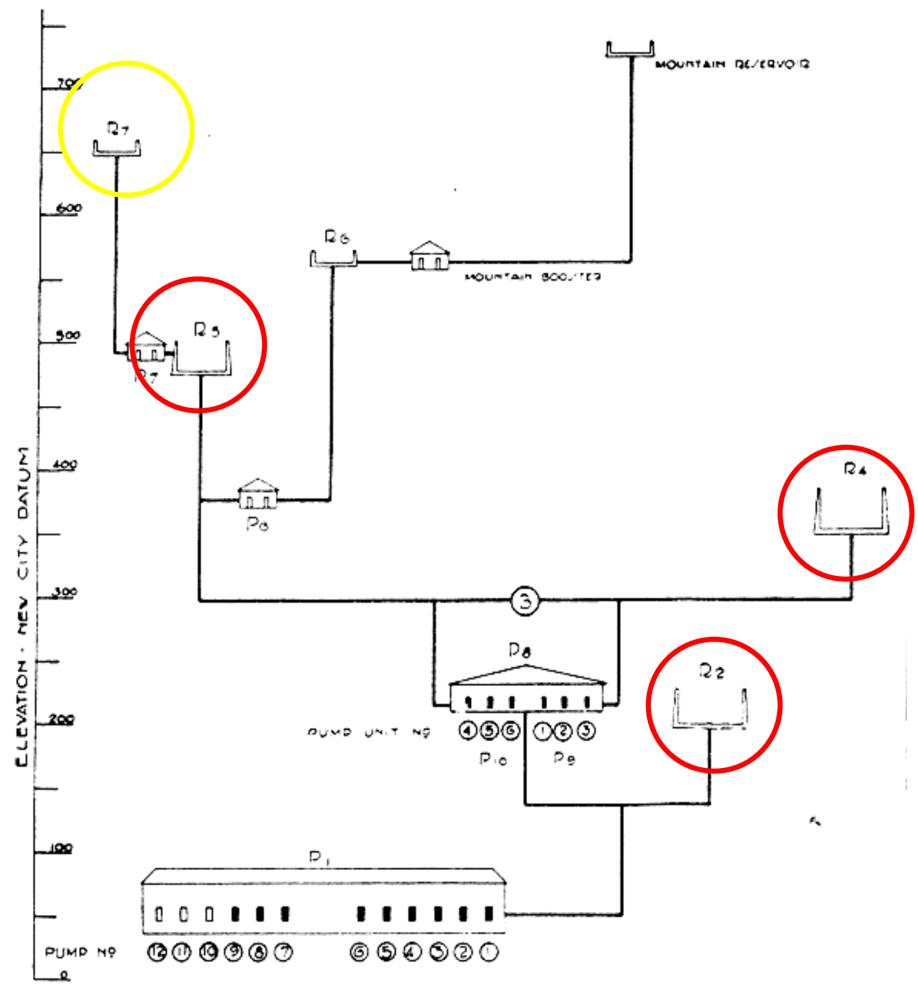

Figure A.6 Key diagram of pumping stations and reservoirs of the Montreal Waterworks, 1937

Circled in red from left to right:
R3 Côte-des-Neiges reservoir
R2 McTavish reservoir
R4 Outremont reservoir

Circled in yellow
R7 Westmount reservoir

(Source: Charles-J. DesBaillets, "Historical Background and Important Features of the Montreal Waterworks, Described for the Benefit of Those Attending the Convention of the Canadian Section, A.W.W.A," *Engineering and Contract Record*, (April 14, 1937), 19)

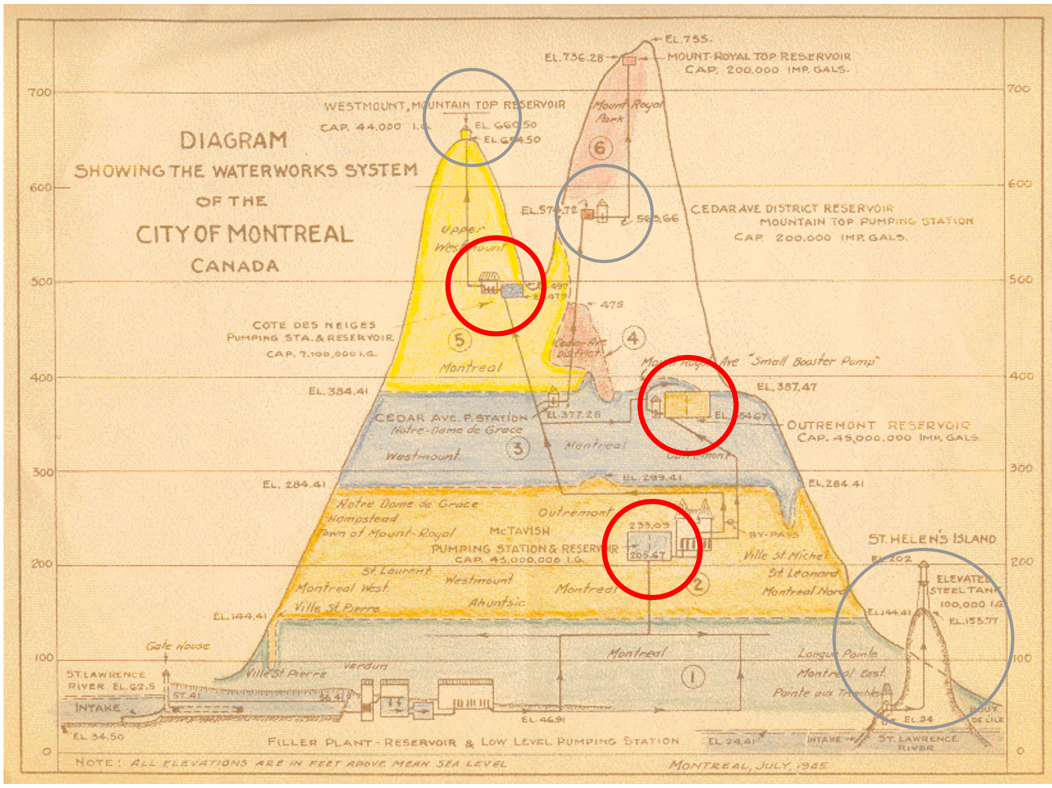

Figure A.7 Diagram showing the Waterworks System of the City of Montreal, 1945

This is possibly the earliest section of the system showing the division into colour-coded vertical levels.

Circled in red from left to right:
Côte-des-Neiges reservoir
Outremont reservoir
McTavish reservoir

Circled in grey:
Westmount mountain top reservoir (actually an elevated tank), date unknown
Cedar reservoir (built ca. 1911), now defunct, replaced by Summit reservoir
The Montreal East and St-Helen's Island system and elevated tank that are no longer shown on city plans

(Source: Dowd collection)

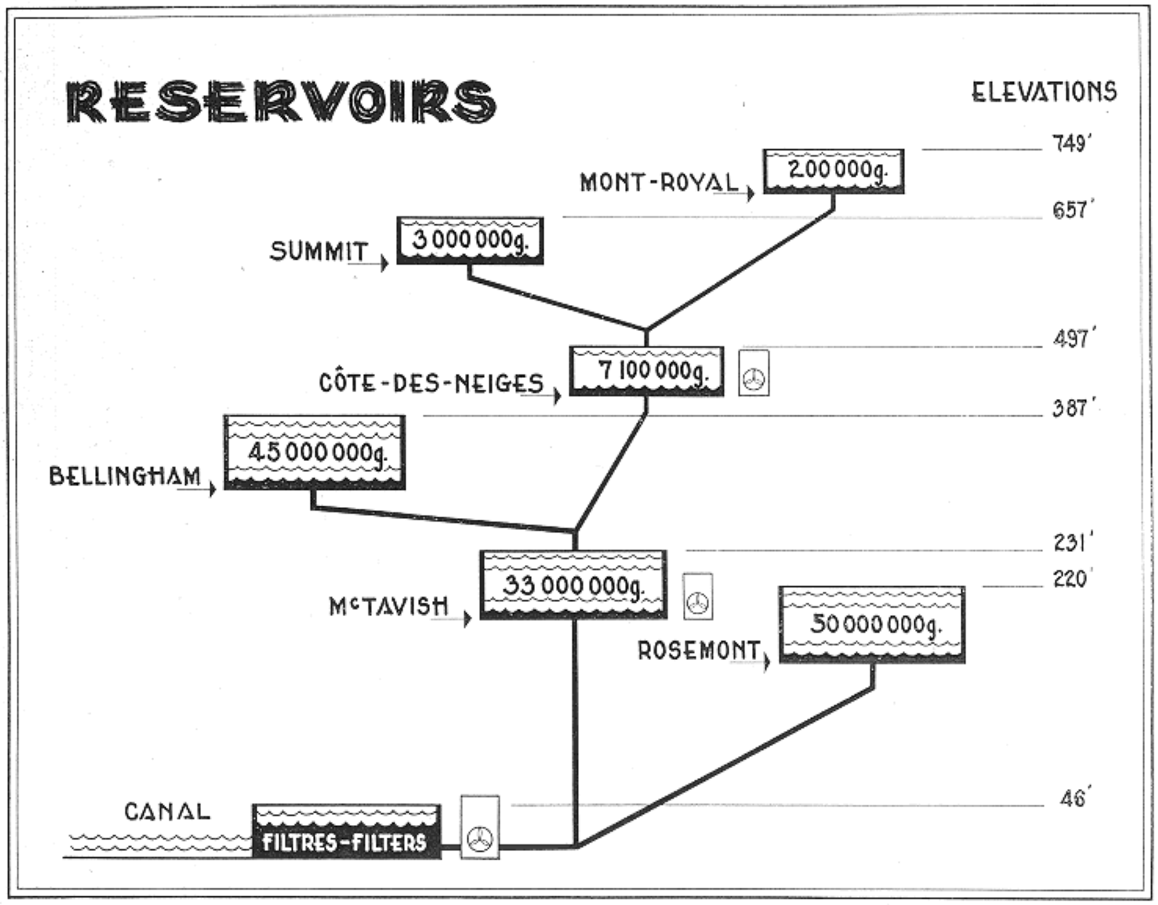

Figure A.8 The reservoirs of the Montreal Waterworks, 1959

In contrast with Figures 2.2 (p.39) and A.7 the mountain is only represented by elevations. This type of diagram also gives the impression that the system is still only branched and not looped (Compare with Figure 1.4).

(Source: Public Works Department, *Montreal Waterworks*, (Montreal: City of Montreal, 1959), 22. Dowd collection)

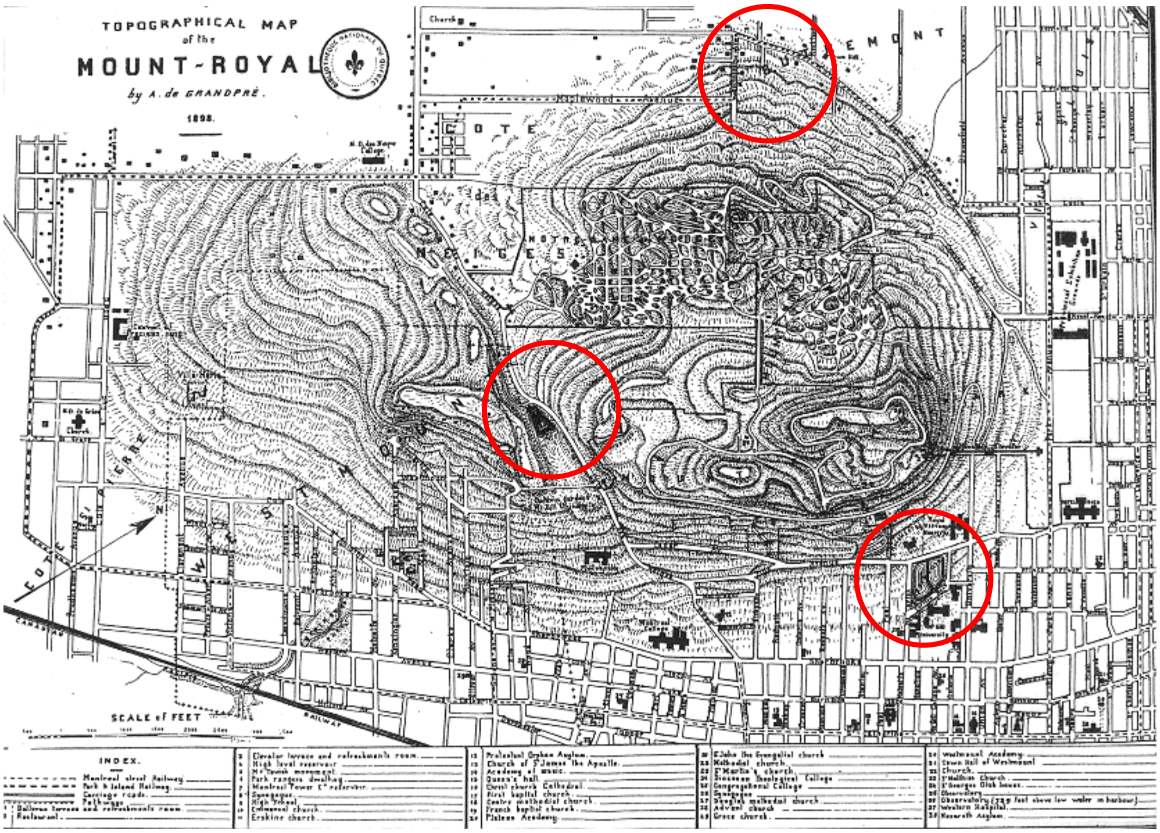

Figure A.9 Topographical Map of Mount Royal, 1898 (A. De Grandpré)

Circled in red from left to right:
Outremont reservoir (built ca.1910-15)
Côte-des-Neiges reservoir (built ca. 1893)
High-level reservoir (1875) and McTavish reservoir (1853-56 with later enlargements)

(Source: VM-GDA, 1898-2 (microfilm))

Figure A.10 Mount Royal Three Summit Concept, detail, 1990

Circled in red from left to right:
Côte-des-Neiges reservoir/ Ville de Montréal public works yard
Vincent d'Indy reservoir/ Université de Montréal playing field
McTavish reservoir /Rutherford Park/ McGill University playing field

(Source: VM-SHDU, *Plan de mise en valeur préliminaire du Mont-Royal,* (Montréal: Ville de Montréal, 1990), annexe)

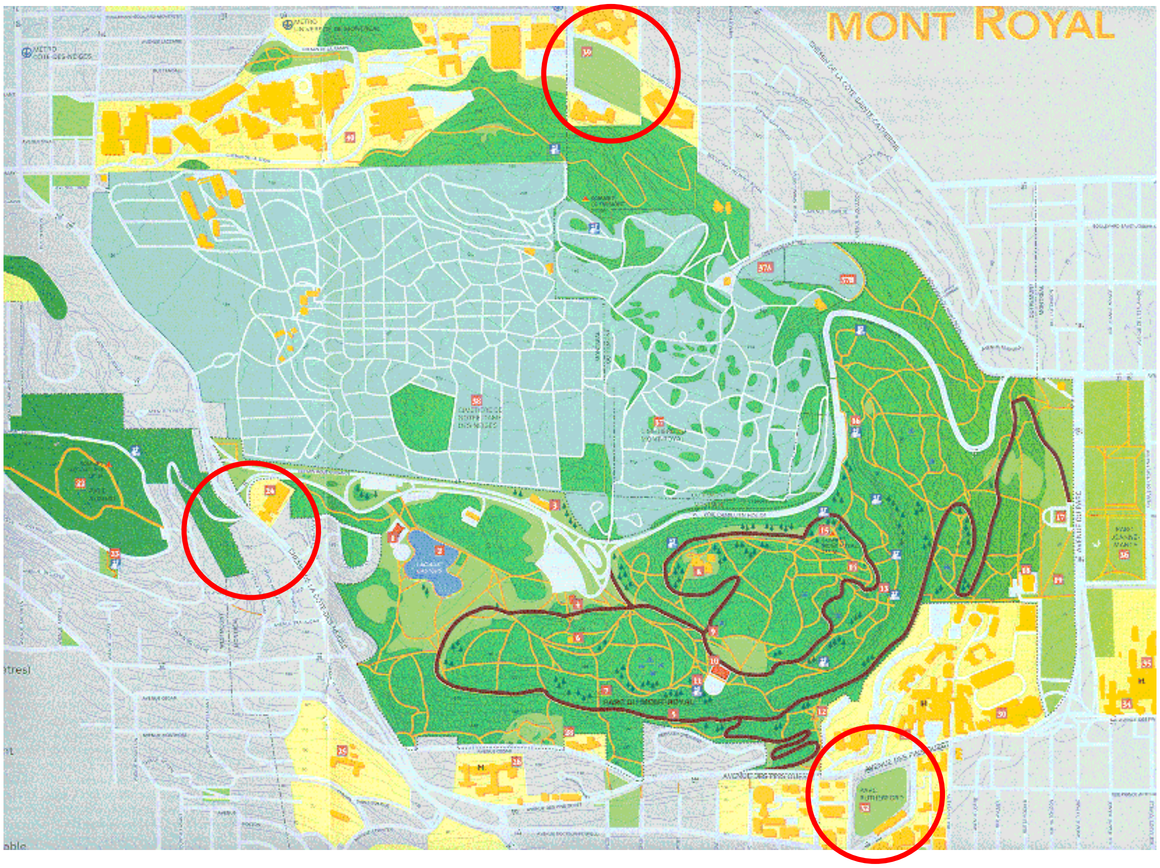

Figure A.11 Map of Mount Royal, 1997

Circled in red from left to right:
Côte-des-Neiges reservoir/ Ville de Montréal public works yard –unidentified in map
Vincent d'Indy reservoir/ Université de Montréal playing field
McTavish reservoir /Rutherford Park/ McGill University playing field

(Source: Centre de la montagne)

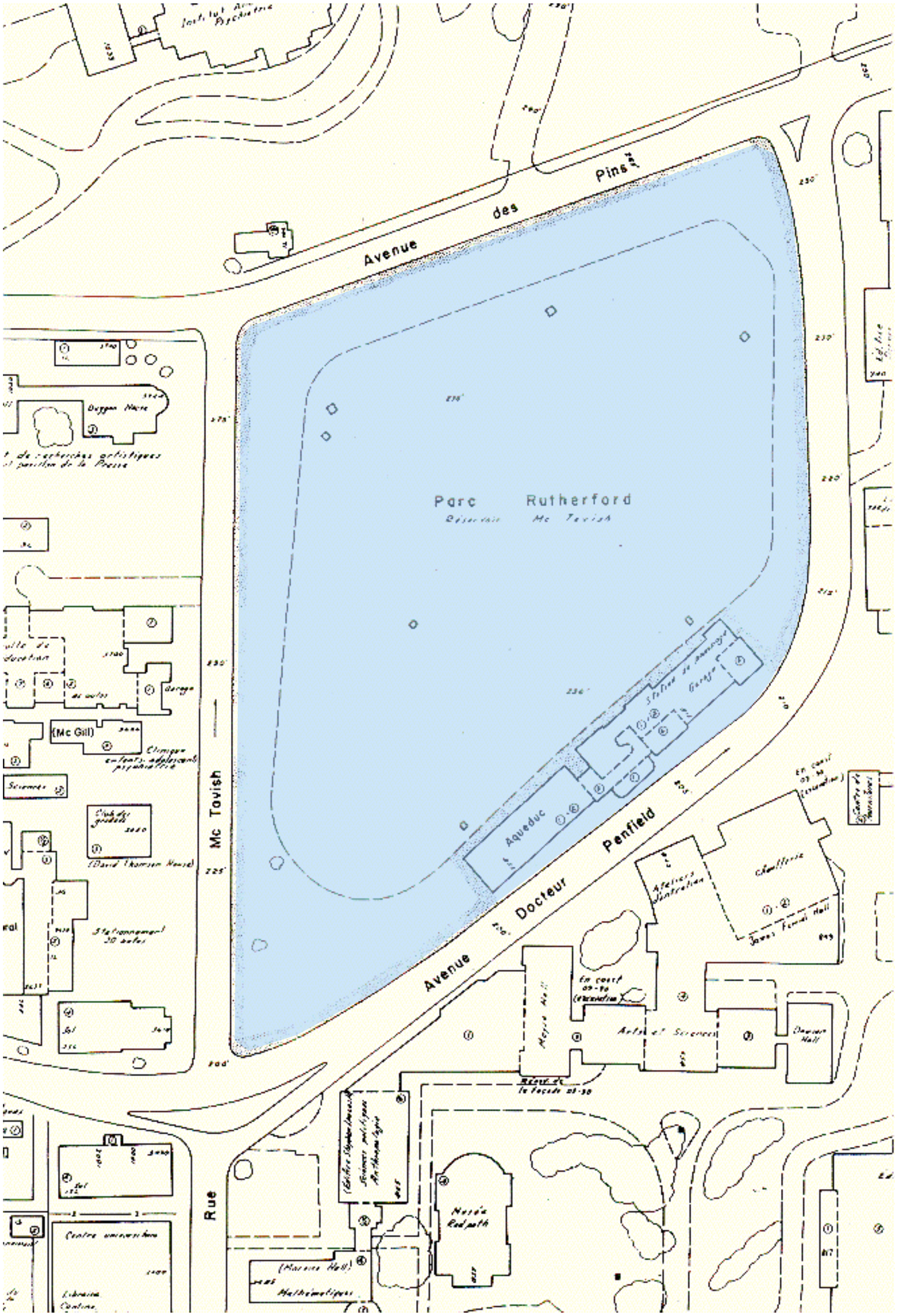

Figure A.12 Plan of McTavish reservoir site (Rutherford Park), 1990

(Source: VM-SHDUM, *Plan d'utilisation du sol* 228-27, rev. 09-90)

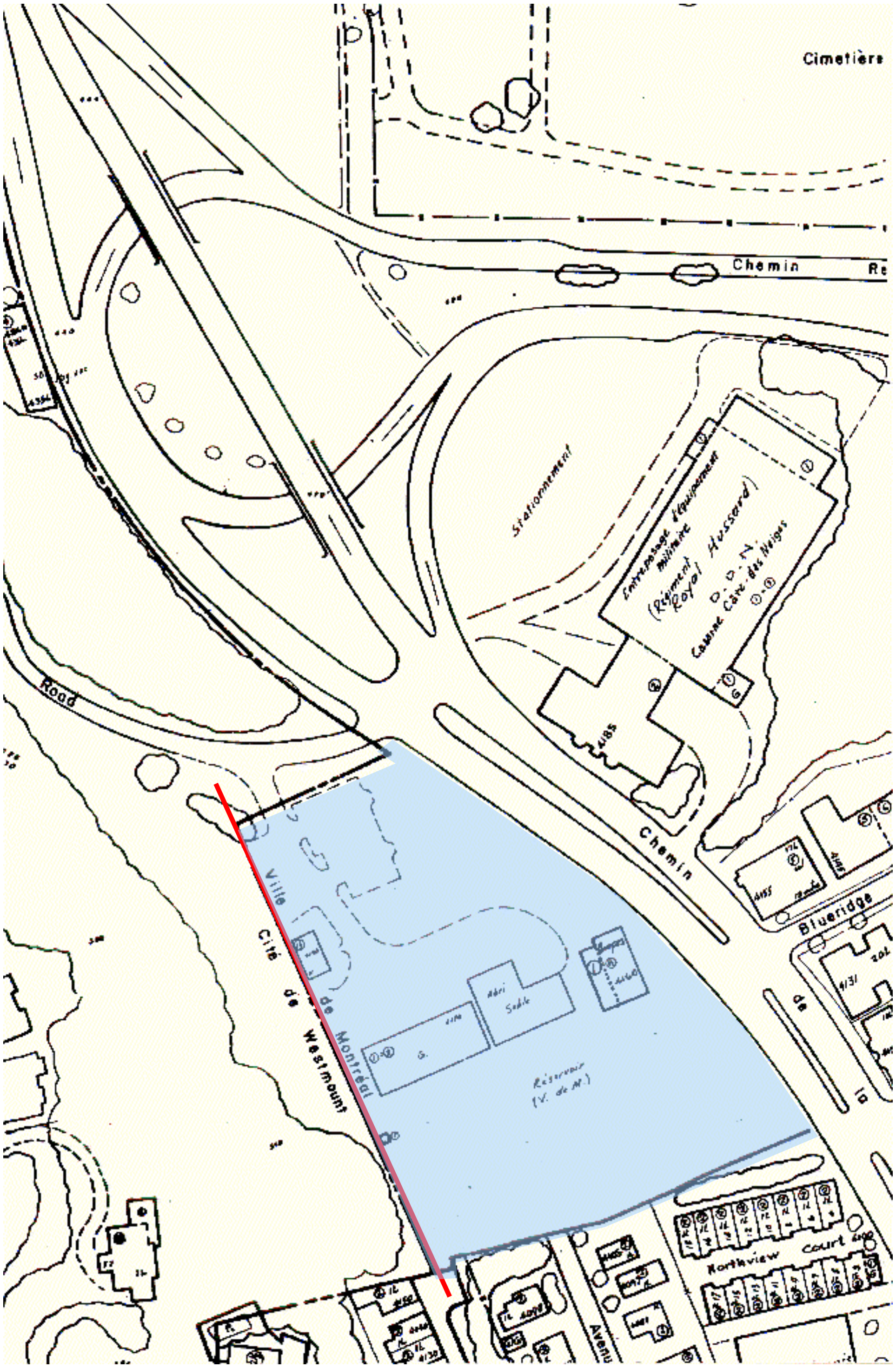

Figure A.13 Plan of Côte-des-Neiges reservoir site, 1990

The red line corresponds to border between Montreal and Westmount.

(Source: VM-SHDUM, *Plan d'utilisation du sol* 226-28, rev. 07-90)

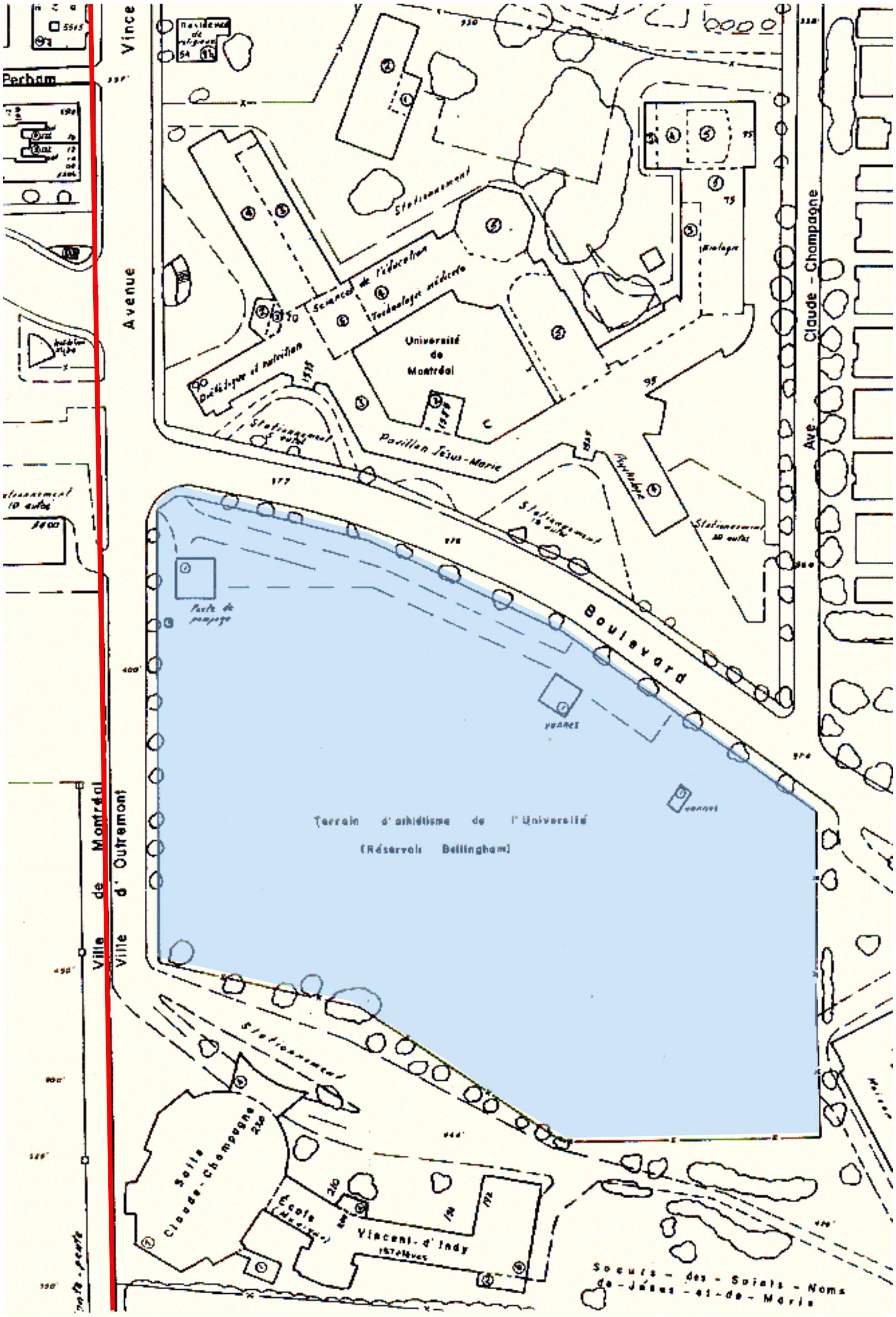

Figure A.14 Plan of Vincent d'Indy reservoir site
(Terrain d'athlétisme de l'Université / Réservoir Bellingham), 1990

The red line corresponds to border between Montreal and Outremont.

(Source: VM-SHDUM, *Plan d'utilisation du sol* 227-30, rev. 08-90)

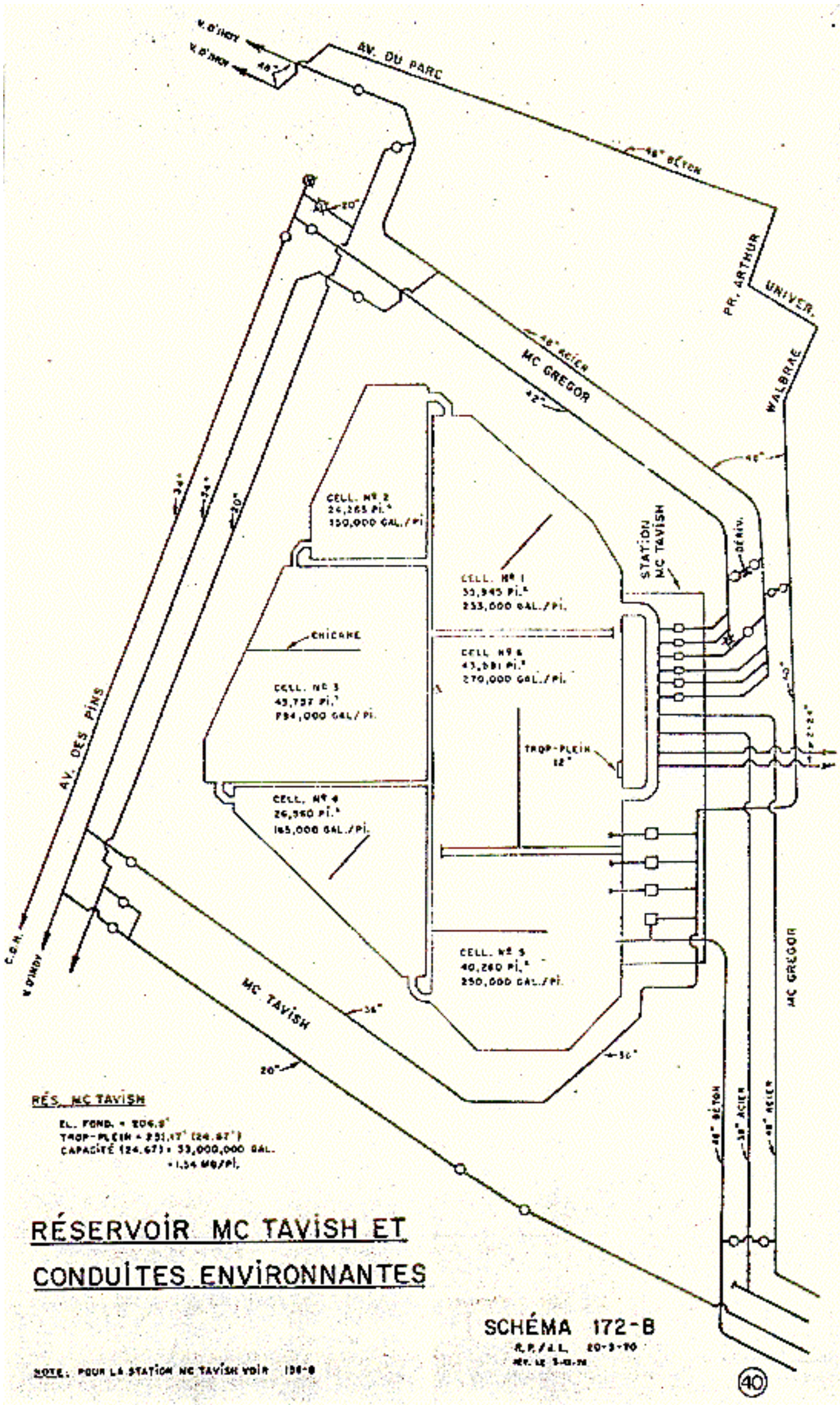

Figure A.15 Plan of McTavish reservoir and conduits, 1970

(Source: VM-GDA, Press-cuttings series R3390.2, 815-855 (microfilm))

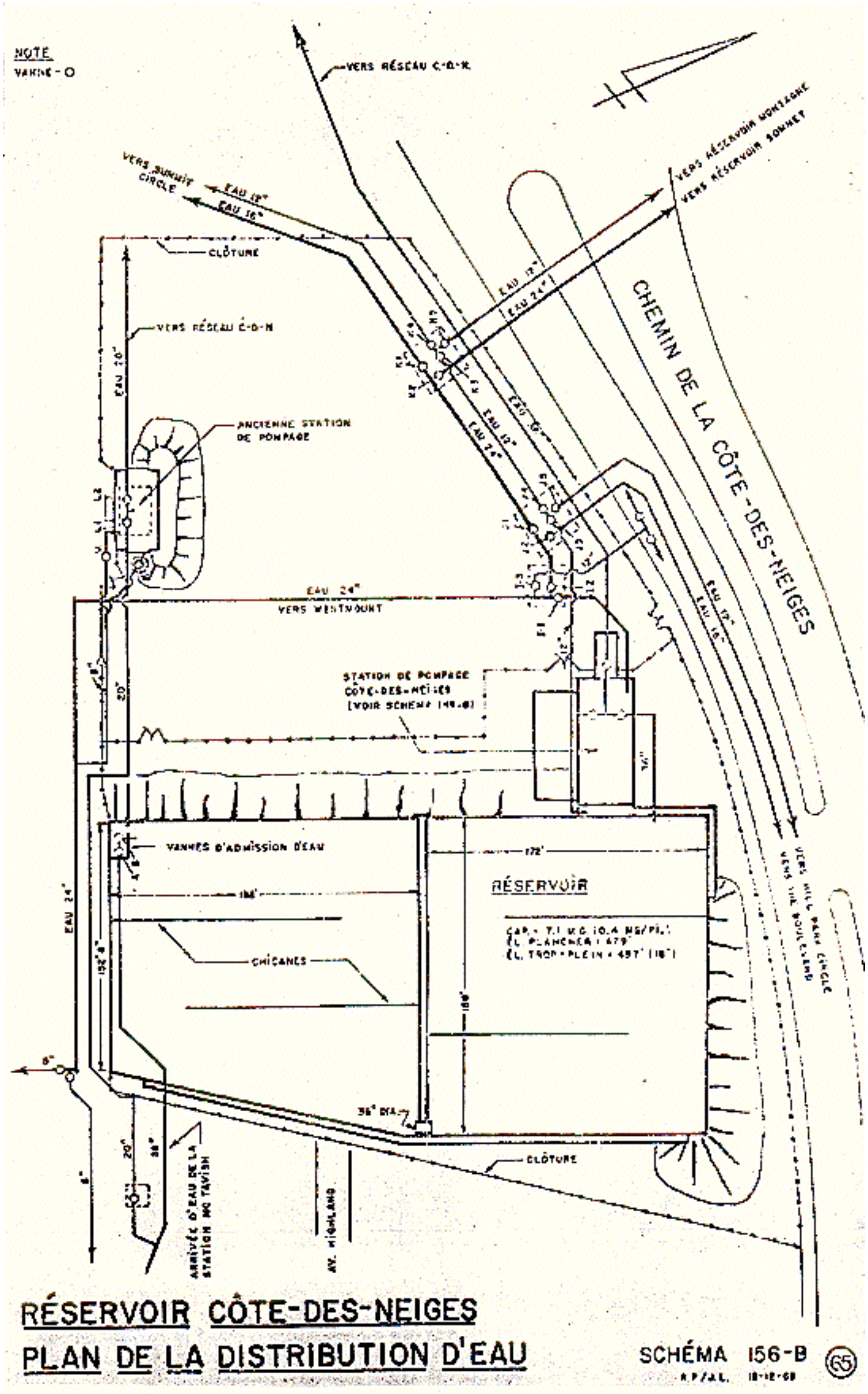

Figure A.16 Plan of Côte-des-Neiges reservoir water distribution, 1969

(Source: VM-GDA, Press-cuttings series R3390.2, 815-855 (microfilm) *N.B. this drawing is located with McTavish series*)

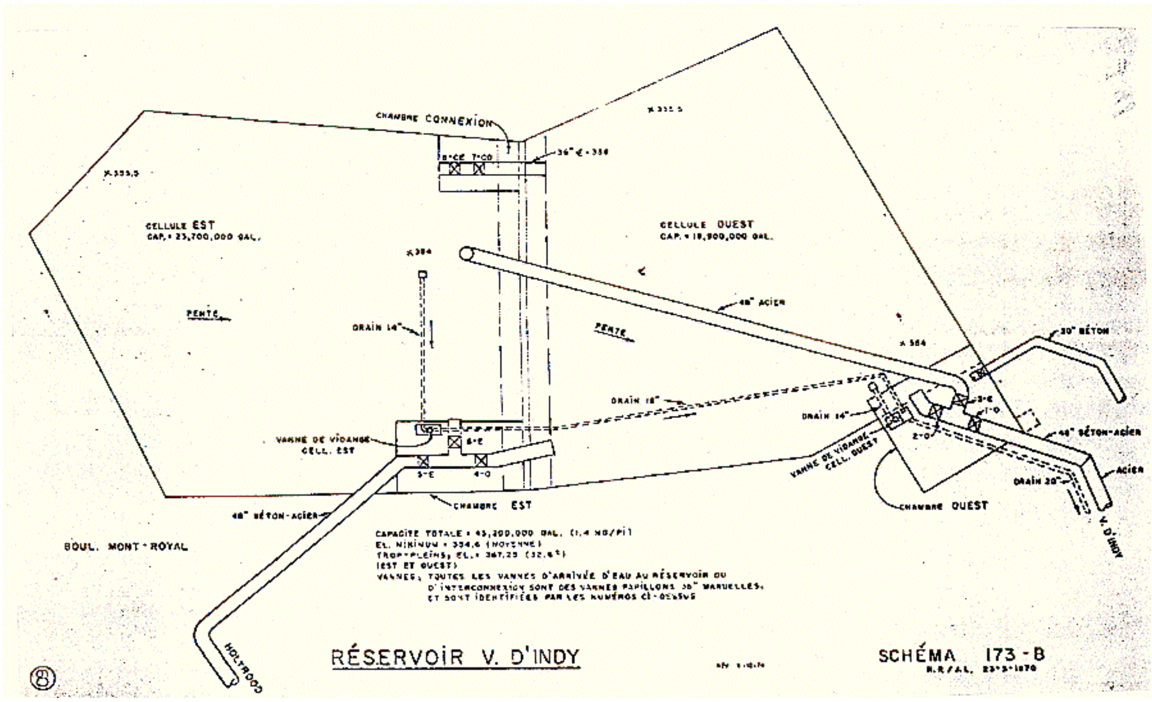

Figure A.17 Vincent d'Indy reservoir and conduits, 1970

(Source: VM-GDA, Press-cuttings series R3390.2, 100 (microfilm))

Figures A.18-19-20 Post card views of the High-Level reservoir, ca. 1900-1930

(Source: Dinu Bumbaru, private post card collection)

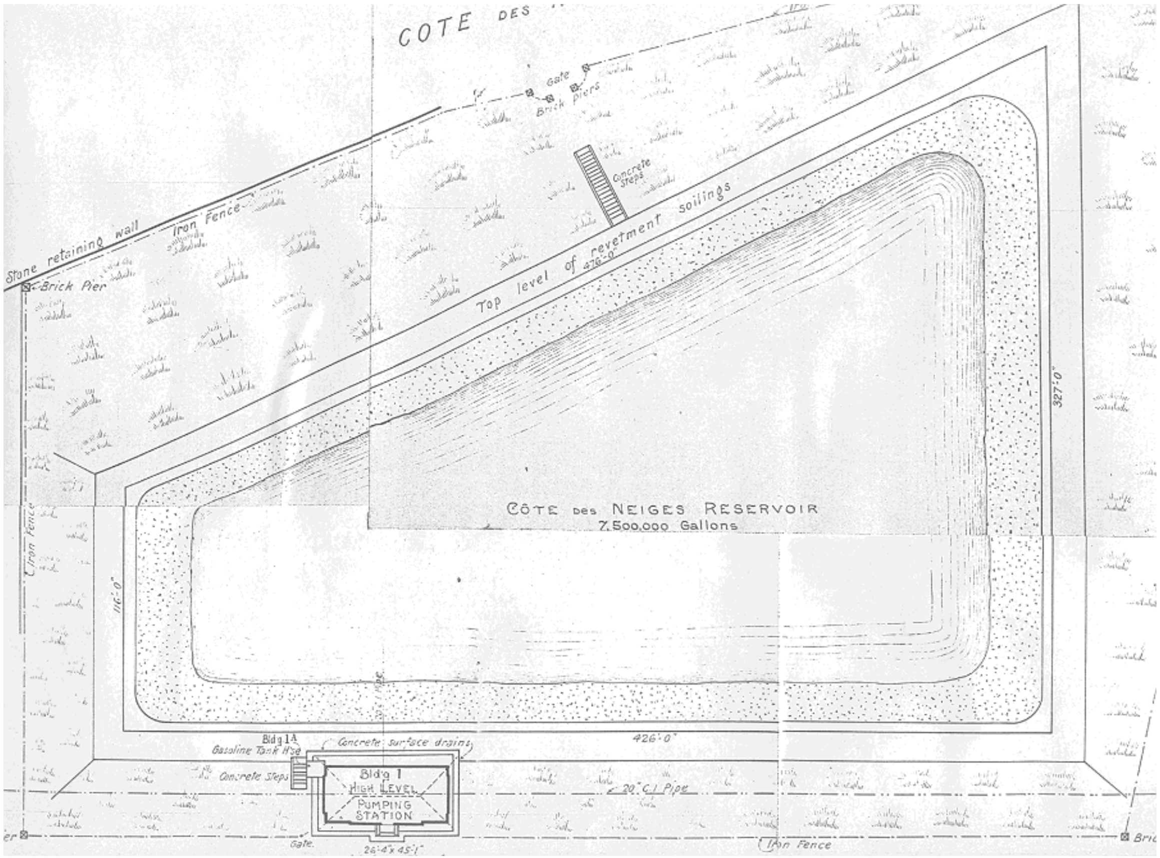

Figure A.21 Côte-des-Neiges Reservoir, 1915

(Source: "Drawings of M.W. & P. Coy's pumping stations and Buildings forming part of Am. Appraisal Coy's report," VM-GDA, Fonds Montreal Water and Power Company P46 /C3,7 A:54-02-02-03)

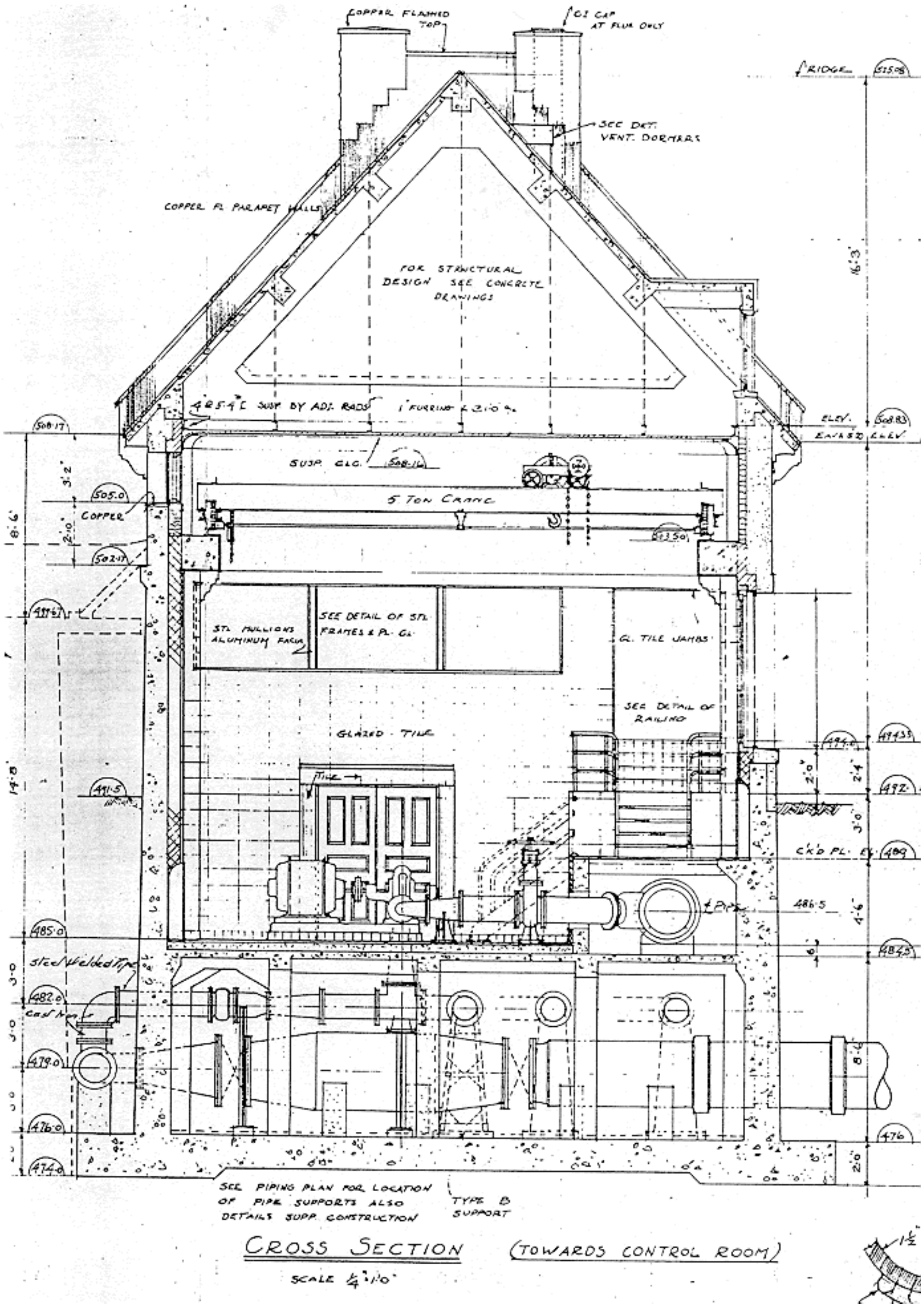

Figure A.22 Côte-des-Neiges pumping station, Cross section, 1937

(Source: Plans de construction, Côte-des-Neiges, VM-SI)

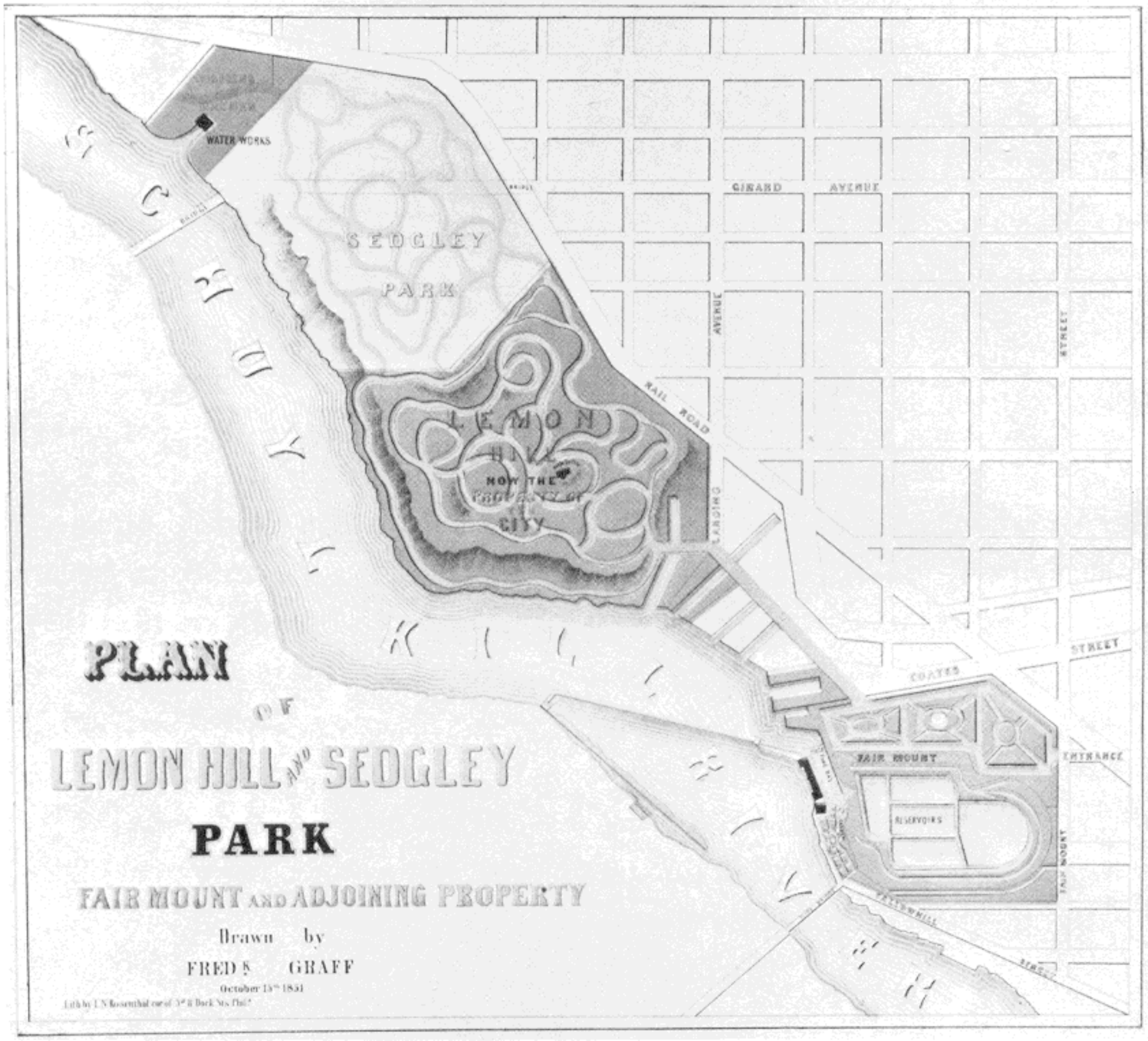

Figure A.23 Plan of Fairmount, Lemon Hill and Sedgley Park, Philadelphia, 1851.

(Source: Frederic Graff, The Franklin Institute Science Museum, Philadelphia, Gr.V:21, reproduced in Jane Mork Gibson, *Bulletin*, *Philadelphia Museum of Art*, (*The Fairmount Waterworks*), 84:360-361 (Summer 1988): 33.)

Figure A.24 Rosehill reservoir, 1955
Note the stair leading to a promenade around the reservoir, and no fence.

(Source: Toronto Archives, Series 4, sub-series 1, Item 311, "Water and the Public Domain." *Pipe Dreams, A Metro Archives Exhibit.* <http://www.city.toronto.on.ca/archives/pipedreams/uncover.htm>. (19.11.2001))

Figure A.25 Chlorine dispensing boat and apparatus, 1955
Note the overgrown rock basin surface.

(Source: Toronto Archives, 92.068 binder 37, "Water and the Public Domain." *Pipe Dreams, A Metro Archives Exhibit.* <http://www.city.toronto.on.ca/archives/pipedreams/rosehill.htm>. (19.11.2001))

Figure A.26 "From the Pure Mountain Stream" 1938 chlorine advertisement

(Source: Canadian Industries Limited "From the Pure Mountain Stream," *Engineering and Contract Record,* (March 23,1938), 5)

APPENDIX 2

A selection of quotations concerning the reasons for covering water reservoirs

In addition to the texts quoted within the body of Chapter III, the selection of texts included here record the specific language used as the arguments for covering the reservoirs developed. Reasons from elsewhere are quoted before those from Montreal. To be noted for instance are the consideration of natural factors as a problem as great as man-made pollution, as well as the recurring concern for wastage and efficiency.

Reason why a basin was covered in Toulouse in 1838

> Le premier basin ayant été laissé à ciel ouvert, donc soumis à l'action des rayons solaires, se dégrade en une année: « la végétation y acquit une vigueur extrême; les divers moyens employés pour la détruire furent sans effet : des reptiles s'y joignirent; et ces plantes, ces animaux, en mourant et se putréfiant dans une eau tiède, la rendait (sic) très mauvaise. »
> On se résout à combler la fosse…[1]

Technical manuals & text book references to covering reservoirs

> **Covered Service Reservoirs**.- The covering over of these (service) reservoirs is very advantageous, especially when the water stored in them has been collected from underground waters, or rivers fed by springs, as such waters are very liable to contain vegetable germs, whose growth is checked by the exclusion of light, and also after the water has been filtered, when it specially liable to be contaminated by any impurities to which it ay be exposed. Moreover, the water in reservoirs near towns requires to be guarded from dust, smoke, fumes and other sources of pollution; and the water in a covered reservoir is maintained at a more equitable temperature than in an open reservoir.[2]

> **113. Covering and Protecting Reservoirs.-** Sunlight is necessary for the growth of Algae. Therefore, in the southern part of the United States, it is desirable, and often economical, to provide clear-water wells, small reservoirs, and tanks with tight-fitting covers., in order to exclude sunlight and thus exclude the growth of algae. The number of bacteria is less in covered reservoirs, and the growth of micro-organisms is almost negligible. A cover also prevents blood-worm infestation, which is caused by the hatching of eggs of fly-like insects, called *midges*. These eggs are deposited on material floating on the surface of the water. Birds, animals and human beings are prevented from throwing things into the water. When the reservoir is below the ground level, a cover keeps out contaminating substances that tend to enter from the surrounding ground.
> … Large storage reservoirs do not usually require either a cover or a fence, as the water will be subsequently treated at a purification plant. However, where an uncovered reservoir is built in the ground, it is desirable to place an adequate fence some distance back from the edge. The lower 2 1/1 feet of the fence should be made of mesh with holes about 1/8 or ¼ inch square, in order to prevent frogs, newts, and salamanders from reaching the water.[3]

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[1] D'Aubuisson, "Histoire de l'établissement des fontaines à Toulouse," 1838, quoted in Sabine Barles, *La ville délètere, Médecins et ingénieurs dans l'espace urbain XVIIIe –XIXe siècle (*Paris: Presses Universitaires de France, 1999), 171.

[2] Leveson Francis Vernon-Harcourt, *Sanitary Engineering with Respect to Water-Supply and Sewage Disposal,* (London: Longmans, Green, and Co., 1907), 211-213.

[3] W.A. Hardenbergh, *Water Supply and Purification,* (Scranton, Pa.: International Textbook Company, 1938), 107.

Quality of water supplies (reservoirs)
…Basins poorly located and of poor construction are likely to permit contamination. … the bottoms and walls should be freed from cracks that will permit leakage inward or outward. Brick construction should be avoided, as it frequently permits leakage. Table 19 shows that 10 epidemics occurred from leaky basins or reservoirs. The reservoir should also be covered if possible, to exclude dust, insects and malicious pollution….
Ventilators will be needed to allow entrance of air as water level fluctuates, but these should permit a minimum of dust to enter and no insects.

Table 19: Classification Of Causes For Water-Borne Typhoid Fever And Number Of Outbreaks For The United States And Canada During The Decade Of 1920-1936 Inclusive.

Reservoirs or cistern storage:	
Seepage from sewer or surface into cracked cistern or reservoir	10
Reservoir polluted by flood waters	1

NB. The greatest number of cases (out of a total of 479) due to the use of polluted river water, or irrigation ditch water untreated (46) and the surface pollution of shallow wells (55).[4]

Storage Facilities and Consumption
…Covered reservoirs are favored where algae may interfere with the use of water, although many large open reservoirs are used because of the high cost of covering. In these, algae control in the summer serves as a substitute for covering. The new 30 m.g. covered reservoir in the Toronto system is a good example of modern practice in this field.[5]

The reasons why the Rosehill Reservoir in Toronto was covered

The water in the Rosehill Reservoir remained open to the air for almost a century before it was covered in the early 1960s. The decision to give the reservoir a roof was justified by the economic savings that followed: water that had already been chlorinated at the filtration plan did not have to be rechlorinated before use. Furthermore, fears of nuclear fallout, growing pollution from auto emissions, and pollution from plants, humans, and other animal species, provided added rationales for the covering of the reservoir. Some of these fears need to be seen in context, particularly in the wake of the Cuban missile crisis of 1961. … Toronto's location on a migratory flight paths was a particular concern: "Probably the greatest source of contamination is from water fowl (who) use this reservoir during their migratory flight and having come from northern marshes, lakes and ponds, bring with them on their feathers and feet all manner of undesirable contaminants."[6]

[4] Ernest W. Steel, *Water Supply and Sewerage*, (New York: McGraw hill Book Co., 1947 (1938)), 228, 233.

[5] Dr. Albert E. Berry, "Developments in Canadian Waterworks Practices 1850-1940," *Water and Sewage*, (December 1940): 17.

[6] Toronto Archives "Pipe Dream, the Web Exhibit, A Metro Archives Exhibit," <http://www.city.toronto.on.ca/archives/pipedreams/dom.htm>, (19.11.2001).

Reasons specific to Montreal

COVERS FOR THE EXISITING DISTRIBUTION RESERVOIRS
In connection with the installation of filtration plants, it is the usual custom in Europe and on this side of the Atlantic to provide covers for whatever new reservoirs may be built for holding filtered water. This is partly for the purpose of keeping the filtered water cool in the summer time and free from contamination from dust and leaves; and partly to protect it from growths of algae and other microscopical (sic) organism, which while not injurious to health, are frequently the source of quite objectionable tastes and odors (sic). We consider it much preferable as a general proposition to store filtered water in covered rather than uncovered reservoirs.
With respect to covers for the McTavish and existing high-service reservoirs, we have not considered this matter in detail, owing to uncertainty as to the future of these reservoirs when the time comes for considering the supply of water for the city from what might be considered a single plant. Furthermore, it has been the custom practically without exception in American cities to deliver filtered water from existing reservoirs without providing covers for the same. This has been the case at Lawrence, Mass., Albany, N.Y., Pittsburgh, Pa., Cincinnati, Ohio, etc. In some cases arrangements have been made for changing the inlet and outlet pipes so that no stagnant corners would exist where vegetable growths might be facilitated.
For the present we consider advisable to leave in abeyance the question of covering the reservoirs, although it may be added that the cost of covering the McTavish and the high-service reservoirs is estimated to be approximately $125,000.[7]

Montrealers were given an unwarranted shock when the City undertook to clean the McTavish reservoir. So seldom is the reservoir emptied that timid persons associated the occurrence with a search for infantile paralysis germs. Earlier in the day, a rumour spread to the effect that a dead body had been found. Official quarters and newspaper offices were besieged with enquiries. The emptying of the reservoir afforded an explanation for the musty taste in the water that the residents have been noticing lately. Algae, a green moss-like growth, was discovered in the bottom. It contains bacteria. Although it gives the water an unnatural taste it is not dangerous and there is no cause for alarm. Because this algae usually grows near the surface and not near the bottom, several samples were preserved for a special analysis. …The reservoir has not been cleaned since 1932, and considering the long period, there was surprisingly little residue in the bottom. The presence of the algae was really the only discovery. It is understood that the city of Montreal has under consideration a plan providing for the coverage of all the municipal

[7] Herring & Fuller Consulting Engineers, *Report on an Improved Water Supply for the City of Montreal,* July 2, 1910, 67-68.

reservoirs. Concrete roofs will be erected. This will assure the ultimate protection and will result in reduced costs.[8]

Le rapport du directeur des travaux publics attire aussi l'attention sur le fait que les réservoirs McTavish et Outremont, d'une capacité respective de 43 et 50 millions de gallons et qui continent de l'eau filtrée et stérilisée, sont à ciel ouvert. L'eau dans ces deux réservoirs, et surtout dans le réservoir McTavish, subit une nouvelle contamination de l'extérieure. Aujourd'hui, elle doit être stérilisée une deuxième fois au réservoir McTavish, en y mettant du chlore, ce qui revient à dire que ces réservoirs devront, dans un avenir rapproché, être recouverts pour empêcher une deuxième chlorination (sic) assez coûteuse.[9]

La reconstruction … du réservoir de la rue McTavish, qui menace actuellement de céder sous la pression de l'eau et de causer des dommages incalculables. Ce réservoir contient 30,000,000 de gallons d'eau, retenue par une digue de béton armé. Cette digue est lézardé à plus d'un endroit et l'on y a même trouvé une cavité d'une verge cube. Le jour où le mur ne sera plus assez fort pour retenir l'eau, la digue sera renversée d'un seul bloc, livrant passage à l'eau, qui se déversera directement sur l'université McGill, puis vers le bas de la ville, où elle occasionnera des dommages matériels considérables et même des pertes de vie. Devant ces explications, données par le Comité exécutif et par les ingénieurs de la ville, les membres du conseil ont approuvé avec une imposante majorité le projet de réfection.
…Le contrat octroyé à l'Atlas Construction prévoit la construction d'un nouveau réservoir, pourvu cette fois d'une couverture qu'empêchera l'eau de se polluer. Actuellement les employés de l'aqueduc purifient l'eau avec du chlore avant son entrée dans le réservoir et ils sont obligés de recommencer l'opération avant de le livrer à la consommation. La dépense est doublée…
Le Conseil a voté le projet avec une grande majorité, mais ce n'est qu'après le plus long des débats qu'on est arrivé à ce résultat. …On a d'abord voulu savoir si la reconstruction était vraiment urgente…(Conseiller Asselin) Les ingénieurs de la ville ont répondu : Oui. Ils ont même ajouté que si les travaux ne sont pas immédiatement entrepris, ils dégagent leur responsabilité de ce qui pourrait résulter de l'incurie de la ville….
Que l'on songe, dit-il, (Conseiller Seigler) aux dommages effroyables que pourraient faire 30,000,000 de gallons d'eau dévalant le long de la montagne. Nul dans cette salle, dit-il, ne peut dire avec certitude qu'il n'y aura pas alors de nombreuses pertes de vie. C'est vrai que les travaux ont attendu dix ans. C'est une

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[8] "Reservoir Emptied to Remove From Bottom Moss-Like Growth Giving Water Strange Taste," *The Montreal Standard*, September 11, 1937.

[9] "Montréal aura une eau plus potable," *La Presse,* February 24, 1945.

raison de plus de les entreprendre immédiatement, car le fait d'avoir attendu dix ans ne prouve pas que le mur pourrait tenir pendant deux années encore.[10]

Un rapport du directeur des travaux publics, M. Lucien L'Allier souligne que les murs de ce réservoir ne sont pas en parfait état. Le mur sud, constitué par le roc de la montagne, laisse passer à sa partie supérieure de l'eau d'infiltration. De plus, une certaine quantité d'eau de surface pénètre également dans le réservoir. À cause de la construction récente de nouveaux bâtiments à proximité de ce réservoir, le directeur du service est d'avis qu'il faudra absolument le recouvrir car la qualité de l'eau pourrait être altérée.[11]

Récemment, de nouveaux bâtiments ont été construits à proximité, ce qui pourrait, au dire du directeur des travaux publics de la métropole, M. Lucien L'Allier, ing.p., contribuer éventuellement à altérer la qualité de l'eau d'un réservoir à ciel ouvert. La tuyauterie dans le réservoir et dans la bâtisse de contrôle, à cause de son état de vétusté, est insuffisante, pour assurer son alimentation continue, advenant un bris dans l'unique conduite qui y amène l'eau. M. L'Allier recommande à l'administration la rénovation du réservoir, la construction d'un toit au-dessus, la rénovation de la tuyauterie, des vannes et des appareils de contrôle. Il faudra également installer une conduite en béton armée de 48 pouces de diamètre, pour assurer l'alimentation ininterrompue du réservoir.[12]

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[10] "Concordia fera reconstruire le reservoir de la rue McTavish," *Le Devoir*, November 6, 1945.

[11] "Le reservoir Bellingham rénové et recouvert," *Le Devoir*, January 5, 1961.

[12] "Rénovation du seul réservoir d'eau non couvert à Montréal," *La Presse*, January 5, 1961.

APPENDIX 3

The reconstruction of the McTavish reservoir

This section includes an extended quotation from a text written in 1947 by Charles J. DesBaillets, Chief engineer of the Montreal Waterworks, which describes the history of transformations to the McTavish reservoir. This excerpt describes the work underway at the time the article was written, that is the reconstruction with the cover.

It is presently unusual for anyone to have the opportunity to visit the reservoir, although in fact the McTavish can theoretically be visited because of the way it was built. The text helps provide an image in words of what the eye rarely gets to see.

…Depuis longtemps, l'étanchéité des murs du réservoir McTavish laissait à désirer; de nombreuses infiltrations s'étaient produites, affectant de façon sérieuse leur solidité, et devenant un danger pour les propriétés avoisinantes aussi bien que pour la vie des citoyens. De plus, la glace en hiver aggravait chaque année la situation. Le vent, la neige et la fumée, transporteurs de germes, polluaient à nouveau les eaux stériles qu'il recevait du Bas-niveau, à tel point qu'une nouvelle stérilisation au chlore était nécessaire.

Devant cet état de choses, on décida, le 11 juillet 1945 de demander des soumissions pour recouvrire le réservoir McTavish, le diviser en six cellules communiquant entre elles et pouvant, au moyen de poutrelles d'arrêt, être isolées les unes des autres, et aussi construire un système de drainage pou vider lune ou plusieurs de ces cellules sans interrompre le pompage.
Les travaux commencèrent le 28 novembre 1945, et aujourd'hui environ 50 % sont terminés.

Parmi les principaux ouvrages, il fallait tout d'abord construire une digue d'étayage en grosses pièces de pin de la Colombie de 12 x 12 pouces de section, pour soutenir le mur de maçonnerie qui divisait le réservoir en deux; car d``es les débuts des travaux on avait vidé le côté est du réservoir, laissant toute la pression de l'eau agir sur un seul côté du mur de séparation et créant sur celui-ci des poussées dangereuses. On perça ensuite la dalle de béton du fond pour introduire en dessous du ciment sous pression afin de combler les vides existants.
Le mur de maçonnerie fut démoli et l'îlot de roc miné; on en retira 16,000 verges cubes de roc.

Il reste encore à installer le système de drainage, poser les poutres d'Arrêt réunissant les cellules entre elles, construire des murs de détournement des eaux, ainsi que quatre cellules complètes, car deux seulement sont terminées. Il faut aussi poser des ventilateurs pour aérer l'eau contenue dans les cellules, établir un système d'irrigation sur le toit, composé d'un drain de 3 pouces de diamètre recouvert d'une couche de 6 pouces de sable; enfin recouvrir le tout d'une couche de terre de 3 pieds d,'épaisseur. Enfin faire les raccordements nécessaires avec l'usine de pompage actuelle et l'usine projetée.

Les murs intérieurs et extérieurs des cellules ont 25 pouces d'épaisseur. Ils sont construits en béton armé. Les murs extérieurs sont éloignés des murs du réservoir par un passage couvert, supprimant ainsi toute pression sur ceux-ci. Les dalles du fond assises sur du roc solide ont 7 pouces d'épaisseur; la hauteur des cellules du plancher au plafond est de 25 pieds 9 pouces; la hauteur de l'eau est de 24 pieds. Leur capacité varie de 3.6m.g. à 6.9 m.g. formant un total de 37 millions de gallons pour tout le réservoir.

L'eau communique d'une cellule à une autre par des ouvertures de 6 x 10 pieds, contrôlées par des poutres d'arrêt.

Les cellules sont aérées par des ventilateurs disposés sur le toit du réservoir. Chaque cellule est séparée de la suivante par un espace de 2 pieds 4 pouces, permettant l'inspection et l'entretien des murs.

Le toit, d'une superficie approximative de 217,000 pieds carrés, est du genre à dalles planes, d'une épaisseur de 10 pouces, supporté par une série de 456 colonnes de 22 pouces de diamètre placées à vingt pieds centre à centre. Il sera recouvert d'une couche de 3 pieds de terre afin de le protéger contre la gelée de l'hiver; on y sèmera du gazon, on y plantera des arbustes et on y tracera des allées, en un mot on en fera un parc des plus attrayants, qui jettera une note de gaieté vis-à-vis l'hôpital Victoria et le quartier universitaire de McGill.

Les autorités municipales, soucieuse de la santé et de la sécurité des citoyens aussi bien que de la beauté de la ville, viennent d'ajouter un monument qui fera l'honneur aux habitants du Grand Montréal.[13]

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[13] Charles J. DesBaillets, "Le reservoir McTavish, Un monument qui fera l'honneur aux habitants du Grand Montréal, Transformations successives de ce réservoir.,"*Métropole*, (1947), n.p. (VM-GDA, R3390.2)