The Headwaters Project: A Sustainable Community Development in Surrey, B.C.

PART I: INTRODUCTION

PREFACE

The project documented in this report received a grant under the Affordability and Choice Today (ACT) Program, a regulatory reform initiative sponsored by Canada Mortgage and Housing Corporation (CMHC) and jointly managed with the Canadian Home Builders' Association (CHBA), the Canadian Housing and Renewal Association (CHRA) and the Federation of Canadian Municipalities (FCM). ACT seeks to stimulate changes to planning and building regulations and residential development approval procedures to improve housing affordability, choice and quality. The United Nations Centre for Human Settlements recognized the ACT Program in 1998 as one of the top global best practices for improving the living environment.

Through ACT, grants have been awarded to municipalities, private and non-profit builders and developers, industry associations, educational institutions, planners and architects across Canada to undertake regulatory reform initiatives. ACT grants have been awarded under three categories: Demonstration projects, Approval Process projects and Promotion projects. A wide range of projects across Canada have received assistance.

All completed ACT projects are documented in short project overviews or solution sheets, and a number of longer case studies have been produced as well, to share the benefits of regulatory reform with others. These documents are available to help builders, local building and planning officials, and others recognize and seize opportunities to improve housing affordability, choice and quality through regulatory reform in their communities.

For more information on ACT and ACT projects (both completed and in progress), visit the ACT Web site at www.actprogram.com, or contact:

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DISCLAIMER

This project was partially funded by Canada Mortgage and Housing Corporation, but the views expressed are the personal views of the author(s) and the Corporation accepts no responsibility for them.

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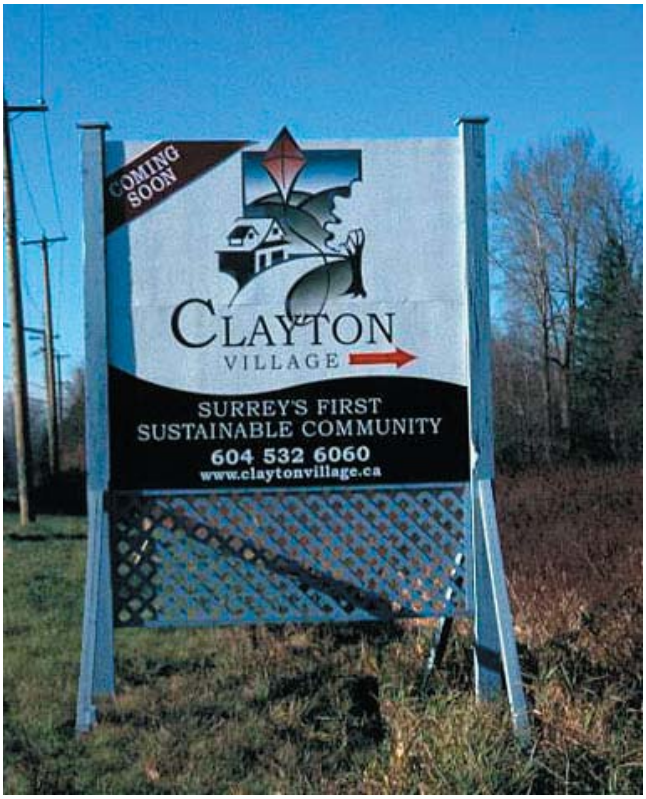
PROJECT SIGNIFICANCE



Low density, highly paved residential communities are not only costly, but increasingly threatening to natural systems. This trend must be addressed in light of projected growth rates and consequent demand for developable land; the population of British Columbia alone is expected to grow from 3.9 million to beyond 4.7 million over the next ten years. The integration of green infrastructure into our built environments is a viable solution to this apparently intractable conflict. The East Clayton Neighbourhood Concept Plan (NCP) incorporates green infrastructure into the design of a 250 hectare site, located in the rapidly-expanding municipality of Surrey, British Columbia, Canada.

The East Clayton Plan's green infrastructure system builds on existing waterways to create an integrated and multi-faceted network of streams, green streets, greenways, self mitigating parcels, and park and riparian areas. This green infrastrucuture system maintains infiltration rates akin to pre-development conditions, and thus maintains stream health. At the same time, greener infrastructure creates more walkable neighbourhoods and is cheaper to build and maintain. Lower infrastructure costs in turn lead to lower housing and long term maintenance costs. For all of these reasons, green infrastructure needs to be recognized as a key component of more sustainable new communities.

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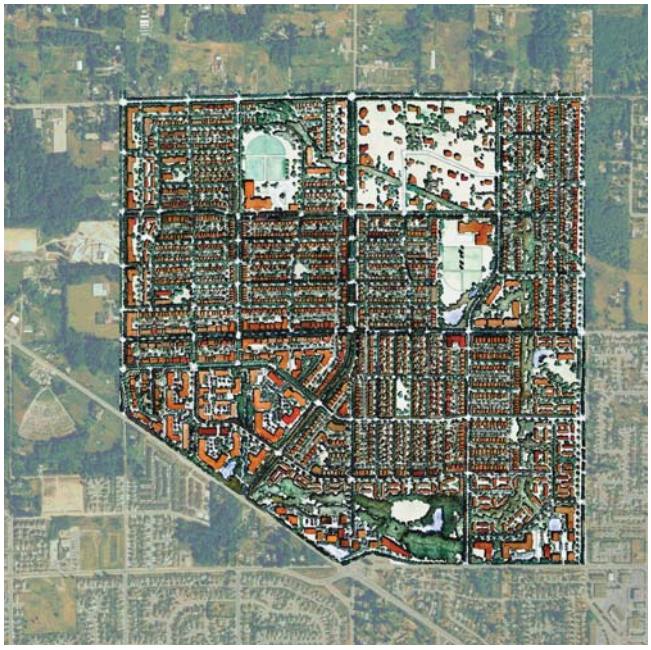
BACKGROUND: THE HEADWATERS PROJECT



In December 1998, the City of Surrey Planning and Development Department entered into a partnership with the James Taylor Chair in Landscape and Liveable Environments (JTC) at the University of British Columbia and the Pacific Resources Centre. The partnership, entitled the "Headwaters Project", represents the first time sustainability principles have been used in British Columbia as the basis for developing a new urban community. The project is a demonstration of sustainable development principles and performance standards on a 250-hectare site in the City of Surrey, British Columbia. Supporting this initiative is an advisory committee and generous support from the Real Estate Foundation of BC, Environment Canada, the Ministry of Community, Aboriginal And Women's Services, Affordability and Choice Today (CMHC), the Greater Vancouver Regional District and Fisheries and Oceans Canada.

The Headwaters partners first produced a Neighbourhood Concept Plan (NCP) for the East Clayton area of Surrey and are implementing the Plan via a demonstration development project intended to apply sustainable principles and alternative development standards "on the ground". The policy, design and implementation framework for this model are contained in the East Clayton Neighbourhood Concept Plan (Stages 1 and 2), various technical documents and City of Surrey corporate reports.

Subsequent stages of the project have been funded by the Ministry of Community, Aboriginal And Women's Services, for the development of an approval process and for the preparation of a Design Manual for Sustainable Communities in conjunction with the Headwaters Project. The major component of this initiative is the design manual, which is being coordinated and produced by the UBC James Taylor Chair in Landscape and Liveable Environments (JTC). A second component of the project is a Background Report, documenting the approval process and various implementation strategies, a large part of which are communicated in this Final Report.

PART II: THE EAST CLAYTON NEIGHBOURHOOD CONCEPT PLAN (NCP)

REGIONAL PLANNING CONTEXT

Virtually all of the growth in the Greater Vancouver Regional District will be urban growth – new residential areas and business areas along with urban infill development. The City of Surrey intends to manage its share of regional growth in an orderly, sustainable and cost efficient manner. The Clayton Area, and specifically East Clayton, is planned to accommodate significant urban growth within the context of the legislation that establishes its authority to plan for urban growth. The Livable Region Strategic Plan, the Greater Vancouver Regional District's (GVRD) vision of land use and transportation, sets out four broad strategies to achieve urban growth in greater Vancouver. These include: protecting the green zone; building complete communities; achieving a compact metropolitan region; and increasing transportation choice. The Green Zone establishes a long-term boundary for urban growth intended to protect the region's natural assets (i.e., parks and watersheds). Building more complete communities requires a balanced distribution of jobs, housing, public services and transportation services. Within this vision for a compact metropolitan region, North Surrey is designated as an area to accommodate residential growth for an estimated population capacity of 472,000 persons or 191,100 households. Under the broad legislative context of the Growth Strategies Statute Amendment Act (pursuant to the Local Government Act), the City of Surrey, in a Memorandum of Agreement with the GVRD, recognized the need to "achieve not only the development of Surrey Centre and an increase in population but more complete communities in other parts of the municipality". More specifically, it recognized that additional growth capacity might be necessary in Cloverdale, of which Clayton is a part. This agreement gave the City some flexibility in accommodating urban growth and established the context for the development of a complete community.

Surrey's Official Community Plan And Complete Communities

Surrey's Official Community Plan (OCP) "promotes planned community development - bringing together residents, business and city resources to guide the location and form of growth toward long term city and regional goals for complete and sustainable communities". As defined in the OCP, complete and sustainable communities are those that offer a wide range of housing choices, services and employment opportunities at high enough densities to support convenient access to services and transit, all within a pedestrian friendly neighbourhood fabric. Complete communities also protect the quality and integrity of ecosystems by incorporating tree preservation, the maintenance of environmentally sensitive areas (i.e., natural flow receiving watercourses) and by managing the quantity and quality of stormwater water runoff through the application of best management practices.

South Newton Charrette

In 1995, an international team of urban designers was assembled to meet the challenge of designing more liveable and sustainable communities within the region. The South Newton area of Surrey was the chosen site for the first Sustainable Urban Landscapes Design Charrette. Emerging from the charrette were principles promoting natural drainage systems, walkable neighbourhoods, interconnected street systems, lighter and greener infrastructure, mixed dwelling types and affordable detached housing.

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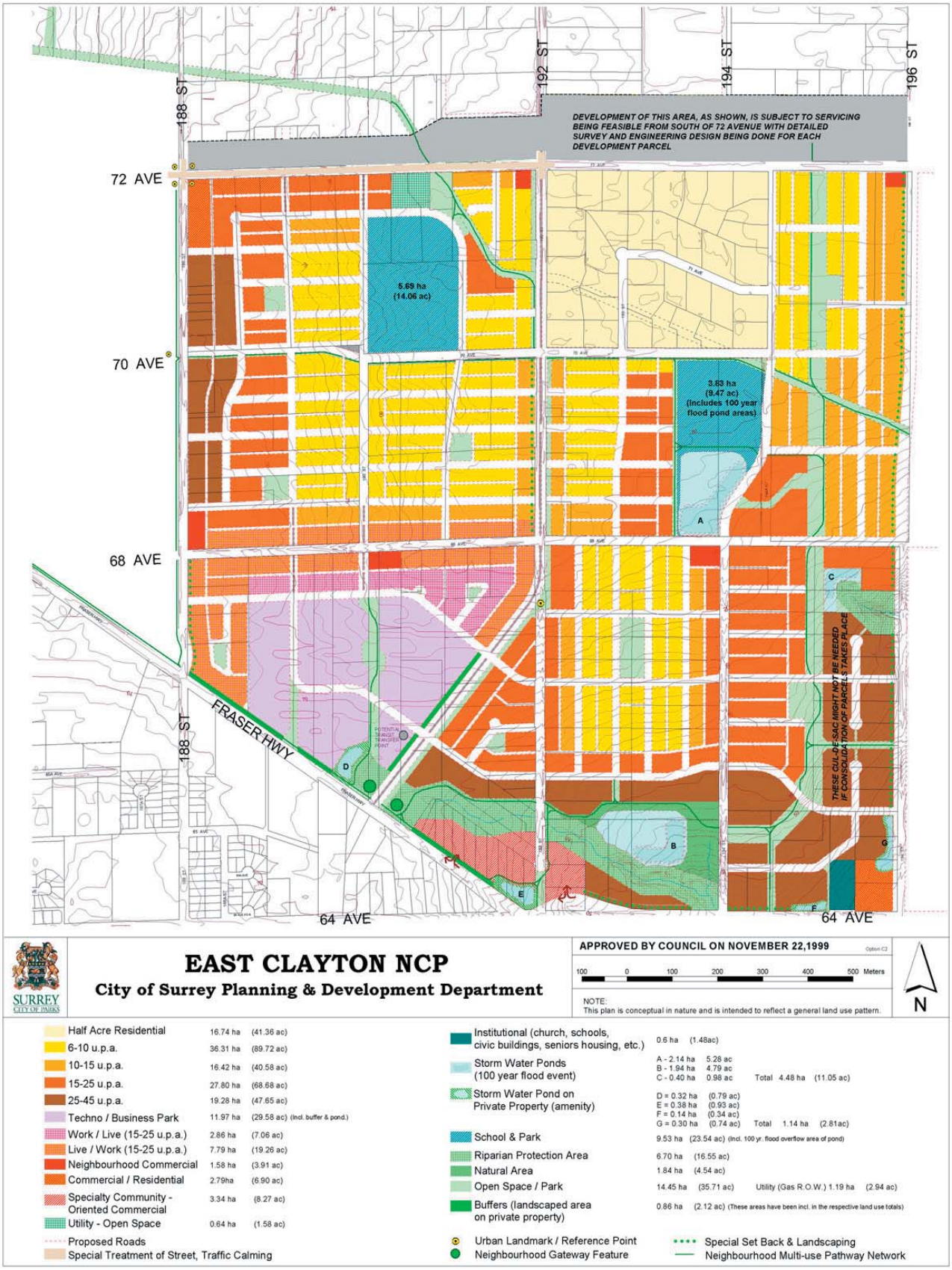
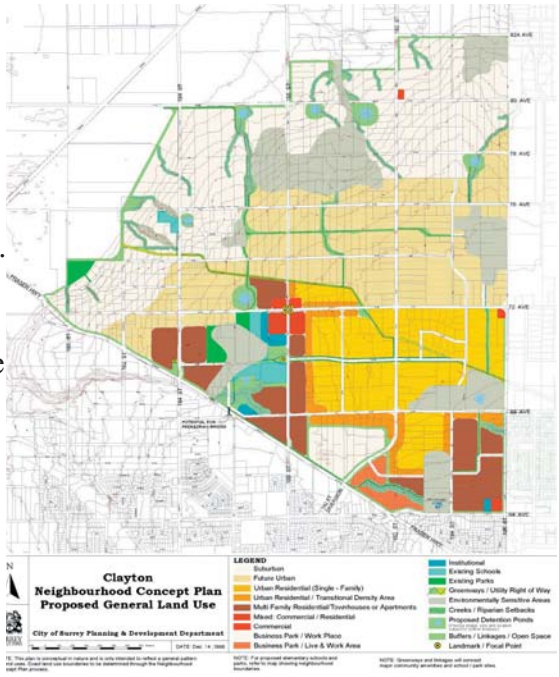


The Clayton General Land Use Plan

The preparation of a General Land Use Plan for the Clayton Area (2,000 acres of which about 550 acres comprise East Clayton) commenced in June, 1996 and involved two stages. The first stage created a "vision" for the entire Clayton community out of which a general land use concept emerged along with a general servicing and phasing strategy, a master drainage plan and sustainability objectives. The second stage involves the preparation of more detailed Neighbourhood Concept Plans for the individual neighbourhoods of Clayton (the first one being East Clayton). The Clayton General Land Use Plan was approved by City Council in January, 1999. At the same time, Council directed City staff to commence the preparation of the Neighbourhood Concept Plan (NCP) for East Clayton. As a result of the financial impediments resulting from the drainage problems in the lowlands and the related costs to manage stormwater, Council directed staff to also explore the application of sustainable development principles, standards and practices during the NCP planning process.



THE PLAN PREPARATION AND APPROVAL PROCESS OVERVIEW

The main components of the NCP preparation process were: the identification of constituencies of interest; a series of workshops; the preparation of a design brief, the formation of a planning design team; charrette events; and public consultation sessions. The development concept (or land use plan) was approved by Surrey City Council in November, 1999. Final approval (Stage 2), which includes the final standards and design of stormwater and utility servicing, is expected to occur in 2002 in conjunction with the demonstration development project. The concluding coordination and design of the demonstration development project will assist in confirming the engineering standards and guidelines in keeping with more "natural" stormwater drainage and utility systems.

The East Clayton Integrated Planning Process

Planning processes demand a high degree of public involvement and when attempting to adopt alternative policies and standards for urban development an engaged public is even more essential. In the case of East Clayton, the process incorporated public consultation at three levels: the Citizen Advisory Committee, direct involvement in the Design Team and general public sessions. Planning for a more sustainable East Clayton community required the integration of resources and an integrated planning approach. It involved a multi-party approach to build policy and develop standards to a level of acceptance and commitment among the diverse participants in the planning process. It also involved raising awareness, providing time for reflection and achieving acceptance of alternative ways to develop the neighbourhood, all within a short six-month period.

Citizen Advisory Committe

In January, 1999 the East Clayton Citizen Advisory Committee (CAC) was established and introduced to the idea of incorporating sustainable development principles and standards into a detailed plan for the East Clayton Area. The Citizen Advisory Committee is made up of twentyfive property owners/residents equally representing the four geographical quadrants of the NCP area. Many of the members were long-time rural residents of East Clayton who knew the land and dynamics of the area intimately. The East Clayton Citizen Advisory Committee was very active in bringing together the community concerns and participating in the planning process. The Committee met at least ten times throughout the NCP planning process and in October, 1999 endorsed development concept component of the East Clayton Neighbourhood Concept Plan. The Citizen Advisory Committee was invaluable to the process. As a core group of local people, they developed an understanding and appreciation for the underlying principles of the NCP, its features and how they were linked to form the integrated and sustainable neighbourhood. The CAC provided an effective two-way communication system to convey information to their neighbours, the design table and City staff as the plan evolved. In their endeavours to represent local landowner interests, they directly participated in the NCP by keeping outstanding issues on the table until resolved or advanced to their satisfaction. Despite major concerns over certain proposals for East Clayton, (i.e., the arterial designations and realignment), the momentum of the plan and its credibility was maintained while seeking options to deal with those outstanding matters. In most cases, self-interest was placed in its appropriate proportion within the context of the community and Citywide interests.

Public Meetings and Consultation

Two public meetings/open houses were held (March and July, 1999), which introduced the ideas of sustainability to the general public and provided a forum for the public to view and make comments on the preferred development concept as well as on the preliminary sustainable development standards for drainage, utilities and transportation infrastructure. Informational material was distributed to every owner in Clayton and public opinion surveys were distributed at the public meetings. A comprehensive display of the planning principles, green infrastructure ideas, land use characteristics and the integrated planning process was set up in City Hall's foyer for four months.

Workshops

In addition to the numerous Committee meetings, a number of workshops were held involving various stakeholders: a) the East Clayton Citizen Advisory Committee, b) environmental agencies, c) transportation and utility agencies, d) various City Departments (including Planning, Engineering and Parks Planning and Parks Operations, Fire, Library, and Police), e) the Surrey School District, f) the development industry, and g) other interested stakeholders such as representatives from Surrey's Environmental and Agriculture Advisory Committees, the Port Kells and Clayton Community Associations, the GVRD and the Township of Langley. Between the winter of 1998 and spring 1999, over 14 groups and more than 150 people participated in the various workshops and charrettes. The workshops brought together members of each of the constituencies to raise awareness of the sustainable development principles and to table the issues each believed essential to applying the principles and the future East Clayton community. The workshops also served as an opportunity to identify a spokesperson to participate directly in the planning process.

The Design Brief
Using objectives, principles, performance criteria and specific standards that were consistent with the Clayton General Land Use Plan and input from workshop participants, a Design Brief was prepared to guide the preparation of the East Clayton development concept.

The Charrette Process
The term "charrette" was originated in the 19th century in Paris. Charrettes began as a way for design students to solve complex design assignments or problems within a compressed time period. Today, charrettes have become an increasingly popular means of resolving contradictory land-use objectives embedded in sustainable development, within a forum that involves various interrelated professions working towards innovative solutions. The charrette process for East Clayton involved a Design Team made up of constituency spokespeople who were to focus on building a physical plan for the East Clayton neighbourhood in a concentrated time period. The East Clayton planning process involved two separate charrettes of two days each: the first aimed at identifying alternatives and systems, and the second aimed at developing specific subdivision patterns and standards. A complete description of the charrette process is contained in the East Clayton NCP document. It is noted that the charrette process was largely designed and implemented by the James Taylor Chair, whose expertise in facilitating charrettes and similar processes has been recognized world wide. A Design Team was established to participate in two main design charrettes held in April and May, 1999, and a series of mini-charrettes focused upon technical matters and design innovations. Discussion and joint resolution of both policy matters and acceptable standards were facilitated by an appointed convener from the Pacific Resources Centre. In addition, constituency "report-back" sessions provided members opportunity to critique and develop negotiable positions for their representatives to take back to the design table. To make the process more manageable, sub-tables evolved out of the charrettes to deal with matters that required action external to the Design Team.

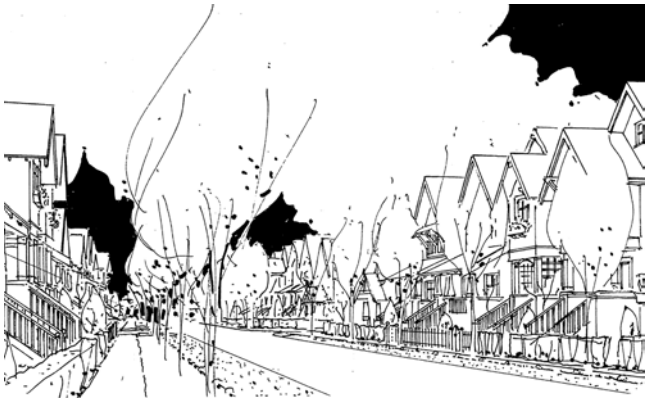
EAST CLAYTON SUSTAINABILITY PRINCIPLES

The East Clayton Neighbourhood Concept Plan (NCP) is based upon the approved General Land Use Plan for Clayton (approved in 1999). The land use and development concept identified in the NCP conforms to seven principles for sustainable development. These principles were formulated as a result of the South Newton Charrette in 1995 and have been endorsed by Surrey City Council numerous times. The principles were to guide the development of East Clayton in ways that support local and regional sustainability objectives. The NCP supports a variety of land uses to maximize affordability, sociability, walkability, and availability of commercial services within easy walking distance for the proposed population of about 13,0001 people. Envisioned as a complete, mixed-use community, East Clayton is designed to promote social cohesion, local economic opportunities, and environmental stewardship while providing equitable access to housing and jobs and reducing dependence on the automobile.

Principle No. 1
Increase density to conserve energy by the design of compact walkable neighbourhoods to encourage pedestrian activities where basic services (e.g. schools, parks, transit, shops, etc.) are within a 5 to 6 minute walking distance from their homes. Achieving a pedestrian-oriented neighbourhood requires that homes are within a walkable distance to shops and services and that streets are interconnected to provide the widest possible choices for reaching nearby destinations. Accordingly, residential neighbourhoods are structured around a fine-grained modified grid of streets and lanes which are considered to be both public corridors and neighbourhood amenities and will accommodate automobile, pedestrian, and bicycle traffic while ensuring easy access to local destinations. Two schools/major parks are located centrally within the community and among residential uses, and each smaller residential area is organized around a central neighbourhood green. The community commercial area, located at 188 Street and 72 Avenue is the most important commercial destination for residents of East Clayton. This commercial area will also serve the additional 17,000 new residents2 expected to reside in the other new neighbourhoods in Clayton as they are planned and developed over time. Each neighbourhood will also have a neighbourhood commercial area that provides a working and shopping place for people within a walkable distance of their residence.

A mixed-use commercial core. A mix of uses (i.e., commercial-residential; live/ work and work/live; ground-oriented town homes), street-oriented buildings, and human-scaled detailing will contribute to the creation of pedestrian-friendly and economically vibrant community nodes.

Principle No. 2
Different dwelling types (a mix of housing types, a broad range of densities from single family homes to apartment buildings) in the same neighbourhood and even on the same street. The Plan accommodates a wide variety of household types and tenures, to provide for a diverse and socially cohesive neighbourhood. The Plan promotes integration between different family types and ages as a way of strengthening the larger community. Creative and economic housing options are encouraged, such as single family homes with a second dwelling unit available to provide a "mortgage-aid" to young families, while also



This perspective sketch shows a diversity of dwelling types and sizes on the same street, a diversity that is masked by the similarity in massing, height, and quality of detail of all the structures. Common touches (such as covered porches, deep overhangs, front-yard fences and hedges, and the amount of window space on the front of buildings), contribute to a powerful sense of unity – a unity that includes a diversity of people within a cohesive community.

serving the needs of individuals and families in need of affordable housing. The types of housing contemplated in East Clayton are: multiple-unit residential in the form of apartments and fee-simple ground-oriented townhouses, single-family homes on small and medium-sized lots, single family homes with second suites or coach houses, live/work areas and mixed use commercial/residential housing. The diversity of housing tenures and types proposed ensures that a proportion of units be affordable rental suites, serving Surrey citizens whose earned income places them in the bottom third of earners region-wide.

Principle No. 3
Communities designed for people; therefore all dwellings present a friendly face to the street to promote social interaction. Blocks are proportioned to create a fine-grained, interconnected network of streets, to reduce congestion, and to allow as many homes as possible to front directly onto public streets. As the dwellings will be situated closer to streets, there will be more "eyes on the street", more usable backyard space, more opportunities for neighbourhood social interaction and overall safer walking environment. Front yards will have buffers that ensure privacy and clearly distinguish between private and public space. Street trees, boulevard infiltration devices and on-street parking are intended to create a pleasant environment for pedestrians and provide a buffer from passing traffic.

Principle No. 4
Car storage and services handled in lanes at the rears of dwellings. The existing site conditions (i.e. slope, vegetation, road network and parcel configuration) has in part determined some of the lot/housing configurations in East Clayton. Blocks with lanes are encouraged. Narrow lots demand lanes to prevent building fronts from being consumed by garages, front yards by concrete, and residents closed off by garages from contact with activities on the street. Lanes allow cars to access units from behind, resulting in a reduction of required front yard setback, and an increase in useable back yard space. The shallower blocks may have wider lots with no lanes; however garages are

Small front setbacks ensure more "eyes on the street" and create a larger backyard area for private outdoor space. Low front-yard fences clearly distinguish between private and public space. Street trees, boulevard infiltration strips and onstreet parking create a pleasant envelope for pedestrians and buffer the effects of passing traffic.

The image at top depicts a residential street dominated by garage doors. The image immediately above shows a streetscape of similar-sized lots but with garages located off rear lanes, thereby allowing homes to directly address the street.

encouraged to be placed beside and behind the principal façade, rather than in front of the dwelling, thereby maintaining direct front door access to the street and reducing the negative effect of garages on streets.

Principle No. 5
Interconnected street network to insure that every trip, whether on foot, bike, or by car, is via the shortest possible route to disperse traffic congestion; and public transit to connect East Clayton with the surrounding region. The organization of roads, blocks, parks, parkways and riparian areas responds to the topography of East Clayton and the location of its subwatersheds. The street network is organized around a hierarchy of streets that includes arterials, collectors, local streets and lanes. This is unlike conventional developments, where traffic is routed along an exclusive and dendritic (i.e., branching like a tree) hierarchy of roads – from an arterial, to a collector, to a local, and finally to a cul de sac. Rather, the Plan's integrated system proposes that traffic be dispersed across the interconnected and modified grid, thereby reducing need for wide paved roadways and large intersections. Major and local through-traffic is accommodated on a system of major and minor arterials, which are designed according to their specific requirements for servicing, utilities, drainage, pedestrian amenities and urban forestry. The street pattern, in concert with sufficient provision of mixed-use services and access to transit, is designed to achieve significant reductions in auto dependence. The NCP sets an overall target of a 25% reduction as the basis for designing the transportation network.

Principle No. 6
Narrow streets shaded by rows of trees to save costs and to provide a greener and friendlier environment. Paved street widths for local and collector streets should range from about 6m to 11.3 m. (37 ft.). Rights-of-ways for these streets should range between about 15m (50 ft.) and 22m (72 ft.) depending on the specific infrastructure and servicing requirements (i.e., drainage, traffic volume and urban forestry).

Narrow, curbless streets save money, cause fewer ecological impacts and are more easily shaded by street trees.

Curbless street profiles and/or alternative drainage systems are intended to allow water to infiltrate directly into infiltration areas and street trees are closely spaced to provide ample shade for pedestrians.

Principle No. 7
Preservation of the natural environment and promote natural drainage systems where stormwater is held on the surface and permitted to seep naturally into the ground.
The backbone of the Plan's ecological infrastructure is its linked system of streets and open spaces, which includes local streets, major and minor parks, schools, riparian protection areas, tree preservation areas, neighbourhood parks and buffers. This system will simultaneously satisfy social, recreational and educational demands while meeting important ecological goals such as stream protection, stormwater management and habitat preservation. As a result of increased permeability of road and yard surfaces, it is anticipated that up to 80% of all rainfall that falls on the area annually will be absorbed. The plan includes two major park/school sites, which function as infiltration basins during unusually heavy rains, and as useable green areas for the surrounding residents and school facilities during normal periods. In addition, a series of shallow ponds serve as detention/infiltration areas for more frequent major rains, holding water until it can seep naturally back into the soil, be transpirated by aquatic plants or be released into the stream clean and at very gradual rates. Designed as natural components of two of the three major parks, the ponds will provide a permanent habitat for avian and aquatic species while also making a positive contribution to the aesthetic quality of the landscape.

Large parks and school grounds are integral components of the site's ecological infrastrucutre. They provide on-site bioremediation and infilatration for large storms, and they become shallow retention basins during 20 to 100 year storm events.

OVERALL GOALS FOR EAST CLAYTON

The sustainable principles provided the general parameters for sustainable planning and design in East Clayton. The NCP is also based upon achieving additional goals related to ecology, economy and social equity as follows:

Ecology

1. To improve air quality by reducing auto use by ensuring that commercial and transit services be located within a 400-metre walkable radius of all residents; and by achieving a 25% reduction in emissions and the corresponding increase in air quality.
2. To maintain stream health and enhance habitat by maintaining or enhancing the ecological performance of native aquatic habitats; by ensuring that 50% of parks, riparian areas and greenways have significant habitat value; and by maintaining existing base flow levels in all on-site and off-site stream channels.

Equity

1. To provide one job per 2.8 residents.
2. To provide a wide variety of unit types appropriate to citizens of all ages and family types.
3. To provide at least 20% of affordable rental housing relative to income distribution and family size of the surrounding communities – with an emphasis on affordable family housing – throughout the neighbourhood.

Economy

1. To give 100% of the dwelling units the opportunity for passive solar orientation.
2. To design all roads and yards so as to infiltrate 80% of runoff and attempting to reduce the costs of road and stormwater infrastructure by 25%.

PART III: SUSTAINABLE DEV'T STANDARDS, DESIGN GUIDELINES AND ZONING

The seven sustainability principles and the above goals resulted in sustainable development standards and design guidelines, which were developed through the NCP process for development projects in East Clayton. These guidelines and standards are mutually supportive, for example, the effectiveness of the drainage system in the demonstration project (and for the entire drainage area) is related to the road pattern and theamount of pervious surface area. In addition, density and street connectivity are related to automobile use and pedestrian access to services, parks, etc. – all main components of a sustainable neighbourhood.

It is noted that the standards and guidelines contained in this report reflect those developed through the various charrette and technical meetings throughout the preparation of the NCP. The precise requirements will be confirmed at the final stage of rezoning associated with the demonstration project.

ACHIEVING DENSITY AND DIVERSITY

Residential development projects in East Clayton will be designed and evaluated in accordance with their ability to meet specific density targets and development standards to ensure that the density and diversity objectives (and thus the sustainable principles) are attained. In addition, the projects will be evaluated on their ability to meet the intent and requirements of Surrey's new series of small lot zones. The standards are intended to be incorporated into the rezoning process associated with the development applications, whether or not a customized zone or a combination of existing small lot zones is used to accommodate the project.

Density and Diversity Targets

The target density for development projects in the NCP is the higher range identified in the NCP, which means that the net residential density should be 27.28 units per hectare or 11 units per acre. This density should be achieved in each development if the overall target density (about 13,000 population) is to be achieved.
To encourage the proponents of development projects to meet the density (and diversity) targets, the City developed a model set of standards which will act as an incentive for proponents to propose higher densities and a range of housing and tenure types. The model incentive standards are illustrated in Table 1. Large development projects should incorporate land use mixes that comprise a wide array of different dwelling types (i.e., low, medium, medium-high and high density housing forms in detached, semidetached, fee simple row and town housing, and apartments) within the project itself and also on the same block. The different dwelling types should be arranged on the blocks in compatible building forms. To achieve a variety of lot sizes and housing types, the City also undertook a review of its Zoning Bylaw with a view to creating a series of new small lot zones to ideally be utilized most predominantly in East Clayton. The new zones and their associated development standards are outlined in Table 2.

Table 1: Achieving Residential Density and Diversity

Density Range as per NCP	Base Density/Zone Permitted [3]	Density Permitted if Both Additional Density and Diversity are Proposed	Zones Permitted if Both Additional Density and Diversity are Proposed [4]
Half-acre Residential (Aloha Estates)	RH	4 upa	one coach house per lot RH, RH-G
6-10 upa Note: minimum density must be achieved in all designations	6 upa/RF	8, 9 & 10 upa permitted if there is a minimum of 20% mix of unit types provided (20% of the unit types on a block or development project must be other than the type allowed in the base zone (i.e., detached single family home in RF Zone); this does not apply to secondary suites (RF-SS); single detached homes regardless of the zone, are considered to be one unit type	Coach houses on every corner lot (zone & regulations impending) RF, RF-G, RF-12, RF-SD, RM-D, RM-10, RF-12C
10-15	10 upa/RF-12	11, 12 upa permitted if minimum 10% mix of unit types provided	Coach houses on every corner RF-12, RF-9, RF-SD, RM-D, RM-10, RF-12C
		13, 14, 15 upa permitted if minimum 20% mix of unit types provided	Coach houses on every corner RF-12, RF-9, RF-SD, RM-D, RM-10, RM-15, RM-19, RF-12C
15-25	15 upa/RM-15	16 - 19 upa	Coach houses encouraged on SF lots RF-12, RF-9, RF-SD, RM-D, RM-10, RM-15, RM-19, RF-12C
		20 - 25 upa	Coach houses encouraged on any SF lots RF-12, RF-9, RF-SD, RM-D, RM-10, RM-15, RM-19, RM-30, RF-12C
25-45	25 upa/RM-30	26 - 30 upa	RF-12, RF-9, RF-SD, RM-D, RM-10, RM-15, RM-19, RM-30, RM-45, RF-12C
		31 - 45 upa	ALL + RM-45

* Net density excludes roads, watercourses and other undevelopable lands.

Table 2: Small Lot Zones

Zone	Lot Size	Max. No. Units Per Acre	Frontage	Dwelling Unit Size	Maximum Lot Coverage	Comments [5]
RF Single Family	6,000 sq.ft.	6	50 ft.	2,800 sq.ft.	40% buildings only	Standard lot
RF-SS Single Family Secondary Suite	6,0000 sq.ft.	n/a	50 ft.	suite max. = 968 sq.ft.	40% buildings only	
RF-G Single		7.5 with	40 ft. - 50% can be	0.55 FAR incl. 300	45%	15% open space

Table 2: Small Lot Zones

Zone	Lot Size	Max. No. Units Per Acre	Frontage	Dwelling Unit Size	Maximum Lot Coverage	Comments [5]
Family Gross Density		15% open space	35 ft.	for garage		required
RF-12 & RF-12C Single Family (12)[6]	4,000	10	40 ft. x 100 ft. wide/shallow lots can be 47 ft. x 82 ft.	2,499 sq.ft.	45%	
RF-9 Single Family (9)	3,000 sq.ft. 30% can be 2,600 sq. ft.	13	30 ft. 30% can be 26 ft.	1,800 sq.ft. Coach house: 700 sq. ft.	45%	
RF-SD Semi-Detached	3,000 sq.ft.	13	30 ft.	1,650 sq.ft.	45%	
RM-D Duplex	10,000 sq.ft.	1 unit per strata lot	80 ft.	0.48 FAR include. 960 for garage	33%	
RM-10 Multiple Residential 10 - Strata or Bareland Strata	3,500 sq.ft.	10	30 ft.	n/a 0.5 FAR for entire lot	40% (strata over 2.5 acres in size)	indoor/outdoor amenity space required; bareland strata
RM-15 Multiple Residential 15 Strata	0.5 ac. (for strata)	15	100 ft. (for strata)	n/a 0.6 FAR for entire lot	45% (strata over 2.5 acres in size)	strata (townhouse); indoor and outdoor amenity space required
RM-19 Multiple Residential 19	1,800 sq.ft.	19	20 ft.	0.90 FAR for interior lot	55% internal unit 45% end unit	fee-simple rowhouses
RM-30 Multiple Residential 30 Strata	0.5 ac. (for strata)	30	100 ft. (for strata)	0.9 FAR for entire lot	45% (strata over 2.5 acres in size)	apartments & townhouses; indoor/ outdoor amenity space required
RM-45 Multiple Residential 45 Strata	0.5 ac. (for strata)	45	100 ft. (for strata)	1.3 FAR for entire lot	45%	medium rise apartments; indoor/ outdoor amenity space required

The design guidelines prepared for development projects in East Clayton are also intended to achieve housing diversity and neighbourhood liveability. They are outlined as follows:

ARCHITECTURAL DIVERSITY

No street block should have more than two consecutive single-family homes with the same house model. Variations in massing (i.e., porches and roof form) and elevations (i.e., window treatments and materials) are encouraged to achieve this. Detailed design guidelines are included in the NCP document.

STREET ORIENTATION

All buildings should be street-oriented and no "gated" projects will be allowed.

PARKING AND GARAGES

For Detached Homes:
Homes should have a maximum of 2 parking spaces per unit, one of which must be on the lot. The second space may be provided elsewhere, such as on the street, subject to the proven ability of the street(s) adjacent to the lot being able to accommodate the projected parking demand generated from all dwelling units on the street or block. A parking evaluation will be required at the rezoning and subdivision stage. All on-site parking should be accessed via a rear lane garage and no more than one garage door per unit should be allowed. Entry drives and curb cuts (where applicable) are to be minimized by combining two driveways for one driveway entry. Permeable materials (i.e., porous pavement, gravel, pavers) are recommended for driveways, parking pads and parking courts.

For Multiple Residential Projects:
There should be a maximum of 2 parking spaces per unit, one of which should be on site. The second space may be provided elsewhere, such as on the street, subject to the proven ability of the street(s) adjacent being able to accommodate the projected parking demand generated from all dwelling units on the street or block. A parking evaluation will be required at the rezoning and subdivision stage. All on-site parking should be accessed via a rear lane garage and no more than one garage door per unit should be allowed. Front entry drives and curb cuts are to be minimized by combining two driveways for one driveway entry. Permeable materials (i.e., porous pavement, gravel, unit pavers) are recommended for driveways, parking pads and parking courts.

For Mixed-Uses:
Street parking for commercial uses should be used where possible depending on the demand for parking generated by the mix of uses in the project. On-street parking should be utilized in mixed-use areas whenever

ACCESS AND STREET CONNECTIVITY WITHIN DEVELOPMENT PROJECTS

General
All streets must be bicycle and pedestrian friendly and there will be a multi-use path along a portion of the 70 Avenue greenway and the north-south dedicated greenway.

Street Connectivity
Street networks within and among development projects must be based on an interconnected street network, in a grid or modified grid pattern, to ensure a variety of itineraries and to disperse traffic congestion, to respect the continuity of green space, drainage requirements, landuse/ topography, and existing property boundaries, to accommodate convenient transit routes, and to generally reduce the environmental impacts of urban development in East Clayton.

Conventional North American suburban development is characterized by low-density housing, culs-de-sacs and curvilinear streets connected to wide arterials. This hierarchical street configuration means that most trips are longer than they need to be and thus favour driving over walking or biking. Building more of these kinds of communities means that more people are forced to drive, trips get longer, and air pollution increases. In contrast, interconnected streets in a grid, or a modified grid pattern, in addition to greenways and bikeways, provide multiple and alternative routes for moving through a community. Research shows that, in combination with higher than average residential densities (i.e., above 25 units per hectare), a high degree of land-use mix (including local employment opportunities) and access to frequent transit service, interconnected street networks can greatly reduce vehicle miles travelled.

The organization of the roads, blocks, parks, parkways and riparian areas in the East Clayton Plan responds to the site's topography and the location of its sub-watersheds. The street network is organized around a four-level hierarchy of streets, which includes arterials, collectors, local streets, and lanes. This is unlike conventional developments, where

traffic is routed along an exclusive and dendritic hierarchy of roads — from an arterial, to a collector, to a local, and finally to a cul de sac. The plan's integrated system disperses traffic across the interconnected and modified grid, thereby reducing the strain on arterials. Major and local through-traffic is accommodated on a system of major and minor arterials, furnished according to specific requirements for servicing, utilities, drainage, pedestrian amenities, and urban forestry.

Improved Walkability of the East Clayton Plan
In addition to the incorporation of greenways, bikeways and improved pedestrian areas, East Clayton will contain a Main Street commercial district and a total of five commercial locations, the latter of which are dispersed throughout the community so as to be within a 4 to 5 minute walk of all residences. A "high-tech" business park, and a live-work area will also ensure local workplaces for the community's residents. Bus transfer points will eventually be located within 800 metres of each residence. The integrated grid of streets and lanes ensures that pedestrians have multiple route choices to nearby destinations.

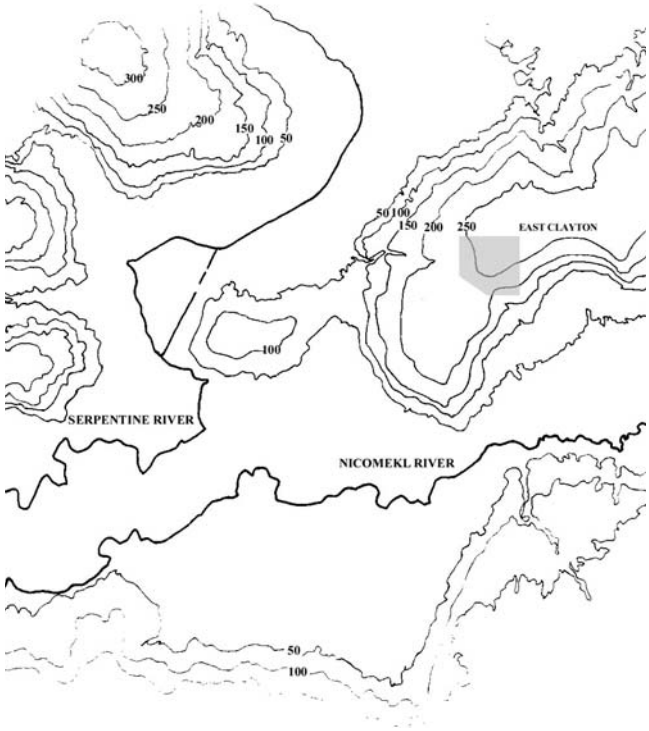
Benefits to Air Quality in the East Clayton Plan
East Clayton's integrated street network, together with higher than average residential densities, mixed land uses and pedestrian friendly green streets, are expected to curb reliance on the automobile. As a result, it is anticipated that both vehicle miles travelled per person per day and per capita production of greenhouse gas attributable to automobile use, will be reduced by over 40% when compared to conventional suburban models. In addition, the number of cars per household will be reduced by 0.6 from the typical number of cars per dwelling in conventional suburban neighbourhoods.

STORM WATER MANAGEMENT GUIDELINES

Infiltration vs. Conveyance

Key among the seven sustainability principles was the preservation and promotion of riparian areas and the drainage regimes that support them. Ultimately this required a change in basic storm water management strategies. Current standards require that rain falling on impermeable surfaces such as roads and parking lots be drained into grates, conveyed by pipes and deposited directly into waterways. This polluted stormwater is deposited at velocities and volumes many times greater than pre-development rates, scouring stream beds and resulting in uneven baseflows. Green infrastructure reverses this trend by encouraging the infiltration of rainwater into the ground, where it is filtered naturally by the soil before it reaches streams. Infiltration also regulates the rate at which water enters the stream system, mimicking predevelopment forest land hydrology.

This alternative approach to stormwater management was particularly crucial on the East Clayton site, which drains into three of the region's most significant rivers: the Serpentine, the Nicolmekle and the Fraser Rivers. Experience in other neighbourhoods allowed City of Surrey engineers to predict that conventional infrastructure would not only lead to stream erosion and baseflow reduction, but it would also increase the duration and frequency of already chronic flooding in agricultural lands (the City was successfully sued by lowland farmers for 60 million dollars for flood damages caused by conventional upstream storm drain systems). Engineers participating the East Clayton design process were therefore faced with how to apply principles of infiltration and pavement reduction to this very sensitive site. Below are listed some general stormwater guidelines:



- Where used, the swale drainage in excess of that lost to infiltration should be conveyed to a deep well system (to a rate specified as the maximum capacity of the well derived through field testing) where possible and economical. Allowable suspended solids in runoff directed to wells must not exceed 10mg/L.

- All developments must ensure a safe conveyance of major flows up to the 100 year return period storm to the creek systems via stormwater detention ponds. The detention ponds are to be designed for a maximum outflow rate as specified in the NCP.
- The stormwater management ponds are to be designed to limit flows to the creeks to existing rates for 2-year and 100-year storms.
- The centre normal water level depth is to be no greater than 1 metre (3.3 feet) with peripheral areas inundated during a five-year return period storm, and remaining marginally wet. Storms exceeding the 5-year return period will flood adjacent sports fields up to a maximum depth of 1 metre (3.3 feet).
- Ponds must be designed with a naturalized edge for habitat and to enhance aesthetic quality.

On-Lot Stormwater Management

Almost 70% of the watershed is comprised of parcels. Each parcel has on-lot drainage areas, making the development of individual parcels another crucial part of the 'green infrastructure' system. Building roofs, driveways and other on-lot impermeable surfaces have to be minimised and their runoff infiltrated into yards instead of into street systems. As listed below, there are several ways to facilitate yard infiltration:

- All permeable surfaces are to infiltrate at a rate not less than 24mm/day during winter (saturated conditions).
- For areas with gross residential densities equal to or less than 20 units per acre, no more than 45% of the site is to be covered with impermeable surfaces (roofs, patios, parking pads etc).
- All impermeable surfaces (e.g., roof areas) are to drain to permeable areas and/or on-site infiltration devices constructed by the developer.
- Native top-soil removed for construction of services, roadways, lanes, etc. is to be replaced on the lots during or following construction.

- Infiltration enhancements can be accomplished via infiltration pits of various designs and configuration.
- In most cases infiltration pits will be located at front, rear or side property lines and as far from the building foundations as is practical so that there is at least one metre of undisturbed parent material between infiltration pits and foundation excavation. Infiltration pits can be filled with ¾ inch crushed rock or prefabricated infiltrators.
- Grass filter strips and elevated yard drain inlets should be used to prevent siltation. Observation pipes should be installed in each.

Streets

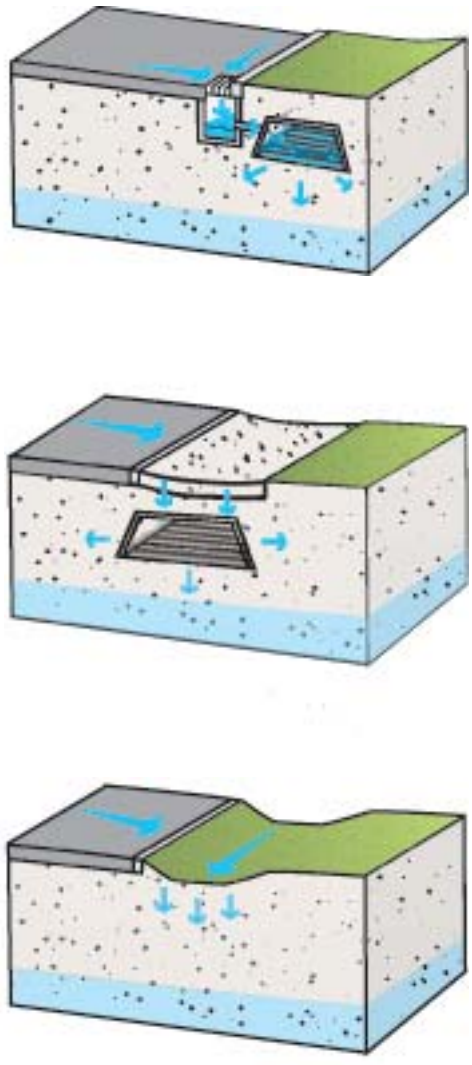
One of the largest generators of excess stormwater in any municipality is the paved street system. The typical "curb and gutter" street section, which has become mandatory for even the most lightly travelled suburban street, prevents rain water from being absorbed into roadside soils.
If one takes this typical curb and gutter detail and multiplies it by the thousands of miles of paved streets typical to most metropolitan areas - the simple curb looks like an environmental disaster in the making. Recently, retention ponds have been required in many jurisdictions as an answer to peak discharges generated by curbed road systems. These ponds may help mitigate peak flows, but they do nothing to protect base flows during dry seasons and are only partially effective in filtering pollutants. They can also operate in unpredictable ways such that flooding can even be exacerbated, rather than relieved (CH2Mhill 2002). A significant emphasis was therefore placed on the design of the streets themselves.

Infiltration is encouraged on the 'green' streets of East Clayton both through the use of permeable surfaces (ei. on laneways and driveways) and by eliminating curbs, thereby allowing water to infiltrate directly into the infiltration zone, or swale. Swales will absorb most street runoff, up to 24mm per day during winter conditions. Only when swales become saturated does water drain into a system of shallow perforated pipes laid into the infiltration zones . This pipe system connects all infiltration devices and moves water to

retention/treatment ponds or artificial wetlands. The system has been sized to convey the two-year event (a downgrade from the traditional five-year event system, made possible by a decrease in overall site run-off due to infiltration measures used elsewhere on the site).

Paved street widths for local and collector streets in the plan range from 6 meters to 11.3 meters. Rights-of-way for these streets range from between 17 meters (56 feet) and 22 meters(72 feet), depending on specific infrastructure, servicing and amenity requirements of each individual corridor. Street trees are planted within these rights of ways such that 60% of the street section will be shaded at maturity (20 years from date of planting). These "urban forest" street trees will be an important element of the streetscape and a significant factor in the maintenance of watershed health, specifically through their ability to moderate hydrologic fluctuations (evaporation, transpiration, retention of water in root zones, increased soil permeability and water retention capacity, etc).

A series of performance standards for the roads in East Clayton were developed through the planning process and should be used as a basis for designing roads within development projects. These performance standards (prepared by Reid Crowther Engineering Consultants) are contained in Appendix A2 of the NCP document. General guidelines for road design are as follows:
- Street right's-of-way should be the same or less wide than the City of Surrey standards.
- The drainage performance is not to be compromised by street standards.
- Maximum infiltration from roadside infiltration devices is 2.0mm/hr (48 mm/day) and 0.5 to 1.0 mm/hr (24mm/day) during saturated and winter conditions.
- Swales should be designed to address surface flow for a 5-year storm event with no road or boulevard flooding; and a 100-year storm event with a maximum of 250mm depth of flooding on the roadway surface.
- Curb and gutter systems for arterials and collectors should be specially designed to ensure that surface water is



Top: Conventional curb and gutter
Middle: Roadside Swale
Bottom: Crushed Stone Infiltration Trench

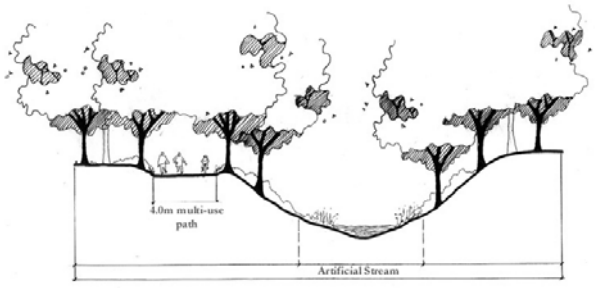
routed to an open channel system for infiltration and water quality.
- Street tree spacing on local streets must accommodate the drainage system (8-10 m) and not be located less than 3m from infiltration devices (infiltration systems overrides the street tree requirement).
- Trees are to be located such that the root system is not within saturated soil zones.
- On-street parking will be prohibited on major 4-lane arterials.
- Driveway entries should be shared and be no wider than 3.5m at the roadway/boulevard interface.
- Driveways crossing infiltration devices must be designed to ensure the continuity of surface water flow during saturated conditions while allowing safe access for residents.
- Local street right-of-ways are to have no more than 50% impervious surface.
- The canopy of street trees should cover at least 60% of the street at full maturity.

School And Park Sites

The Plan's green infrastructure is also comprised of linked open spaces, including major parks, smaller neighbourhood parks and school sites. In addition to offering educational and recreational opportunities, these areas provide ideal locations for naturalised wetland habitat and overflow ponds.

The plan proposes 9.53 hectares of combined park and school sites, which provide forest cover, habitat and on the eastern school site, a naturalised wetland. This wetland will act as a retention and biofiltration area for surface water from other parts of the site and with its native plantings and small islands, extensive bird habitat. The centre depth of the pond is constructed to a maximum depth of one meter, with peripheral areas accepting the 5-year storm. In the event of a 100-year storm, adjacent playing fields would be flooded to a maximum depth of 1 metre. As already mentioned, these wetland/retention facilities are effective for dealing with peak flows, however they cannot substitute infiltration measures elsewhere on site.

Smaller neighbourhood parks also contribute to this system, as they accept drainage from surrounding street surfaces and, in certain locations, provide sites for deep well infiltrators. The infiltrator's main function is to accept stormwater produced by peak flows and discharge this water into regional groundwater aquifers. The capacity of each well will be dependant on its location in the area, ranging from 60 litres/second down to 10 litres/second.



Artificial stream and 4.0m wide pathway through riparian area.

Where a development project incorporates a public park or open space, the following guidelines should be followed in its design:

- The use should be restricted to passive recreation and multi-use pathways should be located outside the prescribed creek set-back areas (if applicable). Where 30 metres of riparian vegetation exists (or the potential for vegetation to be established exists) the streamside protection area (set-back) is 30 metres wide as measured from top-of-bank (and in some cases 15% for single family lots).
- Low-impact walkways outside protected areas or those connecting one side of a stream to another should be no more than 1.2 metres wide. Multi-use pathways outside protected areas should be nomore than 4 metres wide.
- 100 per cent of the area within 40 metres (131 feet) of the top-ofbank of streams is to be covered by tree canopy so that at least 80%of the open space will have habitat value.
- Each riparian area is to accommodate open clearings outside the protected area, as per the Provincial Fish Protection Act Streamside Protection Directive. In some cases, this area will be needed for detaining flood waters for the 100-year storm up to a maximum depth of 1 metre (3.3 feet.).
- At least 40% of the area within neighbourhood parks are to be covered by canopy at tree maturity, thus ensuring that a strong vegetated edge surrounds an open interior space.

URBAN FORESTRY

Residential yards are an important element in the urban forestrystrategy for East Clayton. Locations should be found in the permeable areas of the lot for shade trees such that, when mature, their canopy will cover at least 40% of the lot. Trees will generally be of the "medium sized" variety, capable of achieving approximately 40 feet in height at maturity. Trees should be located at least 3 metres from the outside edge of infiltration devices. Trees should be at least 3" d.b.h. when installed and be thriving one year after planting.

SOIL PRESERVATION

- Site topsoil must be carefully stockpiled for later redistribution on the site. In general, on sites developed for residential use at densities at or lower than 25 units per acre, the area available for respreading this topsoil will be approximately 50% of the area of the site prior to development. Consequently topsoil depths in the finished site will be up to twice what they were originally.
- Topsoil depth in East Clayton is generally thin, often less than .5 metres. Where topsoil depth is greater than .5 meter, at least the first .5 meters of topsoil should be stockpiled for later distribution over the areas of the site intended for permeable surfaces. The intention of this requirement is to insure that the thin soils of the Clayton area have been re-used to their maximum advantage and that topsoil will not be permanently removed from the site. In short, this plan anticipates that yards and boulevards will absorb more water and provide a better medium for tree growth when this project is completed than the site does at present.
- Care must be exercised in grading the site and setting final floor grades in structures to insure that this happens. This site development method will make it difficult and in many cases impossible to retain existing trees. In these cases the need to ensure the adequate hydrological and urban forestry performance of the site after development will take priority.

FOUNDATION DRAINS

- Foundations can be drained in three basic ways: a) electric sump pumps that can be run from municipal water pressure in the event of electric power failure (these pumps should discharge into yards in the same manner as downspouts); b) drain pipes that discharge into street-side infiltration devices, street-side swales, or lanes; and c) in street "storm-drain" systems for foundations which connect into the areas system of infiltration wells or retention ponds.
- Foundation drain strategies can be developed in accordance with cost and site constraints as long as they are approved by the City.