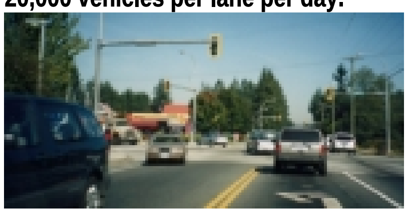
SECTION C - INFRASTRUCTURE
C.1 TRANSPORTATION SYSTEM
C.1.1 **Auto Oriented System**

Plans are in the works to construct a **perimeter road** to connect Highway 1 with Highway 99 in an attempt to divert truck traffic from residential streets.

Projected Expenditures [Surrey, 2001]

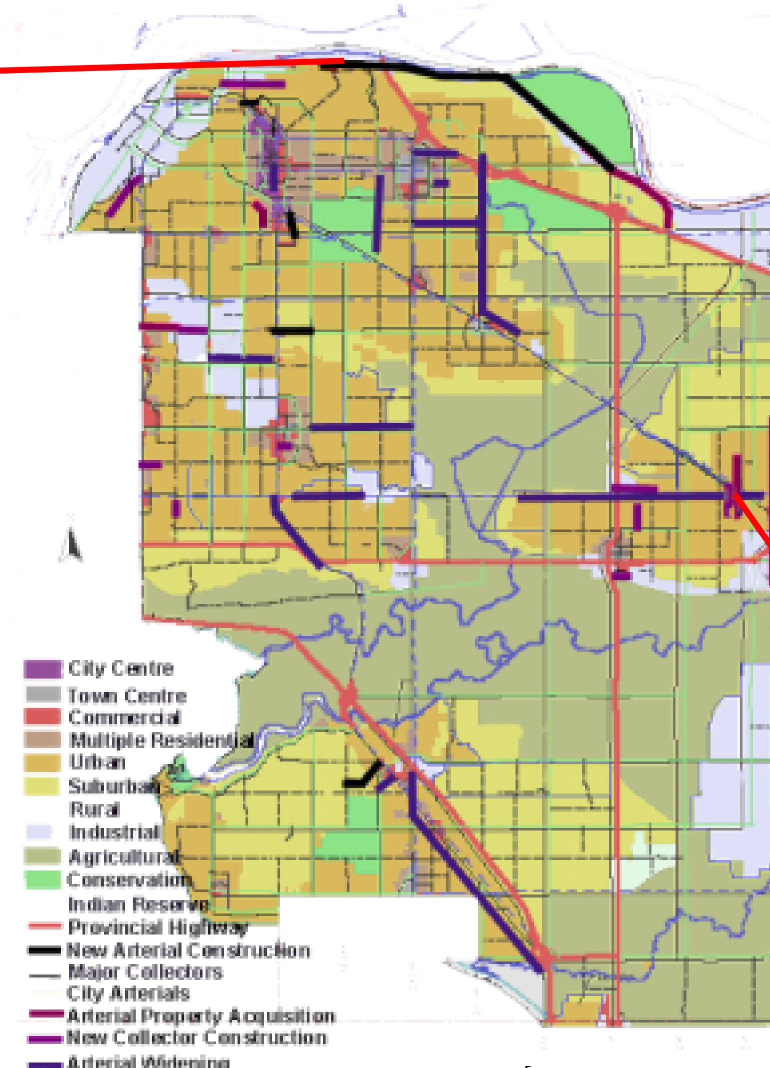
Pedestrian	9.1%	[+0.6%]
Cyclist	2.9%	[+1.3%]
Transit	4.1%	[+2.3%]
Roads	83.9%	[-4.2%]

Surrey is attempting to establish a **grid pattern of arterial and collector roads**. New sections of these roads are to be built plus many km of the existing roads will be widened to provide additional traffic capacity based on projections of **20,000 vehicles per lane per day.**



Centre Line Lengths ~ km

Arterial Roads	373
Major Collector Roads	212
Local Roads	990
Lanes	90
Provincial Highways	81
[Surrey, 2001]	1,746



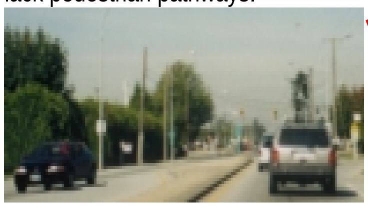
[Surrey, 2001]

Surrey is intent on decreasing the public's need to travel. Plans are underway to ' facilitate pedestrian movement, to establish a bicycle network, and to design self-contained neighbourhoods with mixed land use, increased densities and a modified road network'. Surrey wants to encourage pedestrian activity, decrease travel distances, reduce the need to travel, reduce dependency on cars and to make transit more convenient [Surrey, 2001].

Serviceability of 1665 km road network is seen to be "fundamental to the viability of modern living in the community". projected growth of an additional 105,000 people in next 10 years [Surrey, 2001].

Buses operate primarily on arterial roads. Complaints of the transit system are: lack of cross regional service, lack of cross town service, infrequent service and a decrease in service reliability due to increases in traffic congestion [Surrey, 2001].

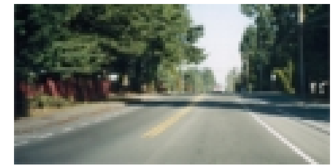
While many amenities and transit links are within the **5-minute walking** radius of most community households, they are often barred by congested arterial roadways that lack pedestrian pathways.



Small programs to **calm traffic** have been implemented such as traffic circles, pavement narrowings, raised intersections and speed bumps

Older roads are being upgraded by ditch enclosures, curbs, pavement widening, sidewalks, and streetlights to meet current servicing standards [Surrey, 2001].

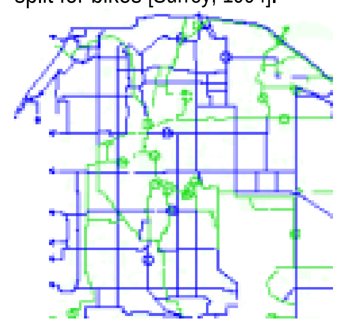
City plans are to have **sidewalks** on both sides of regular transit routes; on safe routes to schools; in commercial areas and on arterial routes and collector roads that pass through single family and high density areas [Surrey, 2001.

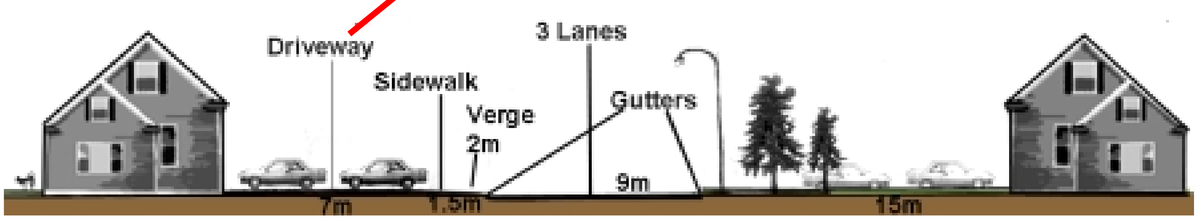


<u>Modal Split</u>, [Statistics, 1997]

Car	88.5%
Transit	8.5%
Walk	1.3%
Other	1.6%
VKT	76.3 km/person/year [Condon, 2002]

The city is developing an extensive system of pathways and over 210km of signed **bicycle friendly routes.** Surrey is intent on achieving an improved modal split for bikes [Surrey, 1994].





C.1.2 **Pedestrian Oriented System**

Vancouver Transportation Plan

- **commits to re-allocating existing road space as opposed to increasing road capacity**
- meet the increase in transportation demand through public transportation, cycling, and walking
- support local retailing, personal, business and community services, to minimize the need to commute
- **promote traffic calming**

DOWNTOWN TRANSPORTATION PLAN

Prioritizing:

- "Pedestrians First Policy"
- Bike Lanes
- Network of Transit Routes
- Sustainable Goods and Traffic

GREENWAYS

Greenways are considered corridors for cycling, rollerblading and walking. The City of Vancouver has committed to increase the amount of Greenways from 40 km to 140 km.

TRAFIC CALMED NEIGHBOURHOODS

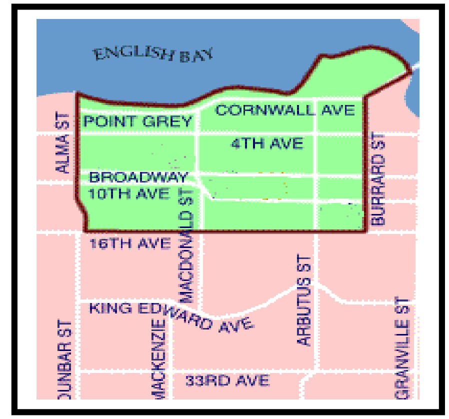
Choosing a Different Path

In the 1960's, when freeway development became the largest public expenditure in the history of the United States, Vancouver chose a different path. "Alternatives to the car are essential, both for a more environmentally sustainable future, and for a solution to congestion on city streets" (City of Vancouver, 2002)

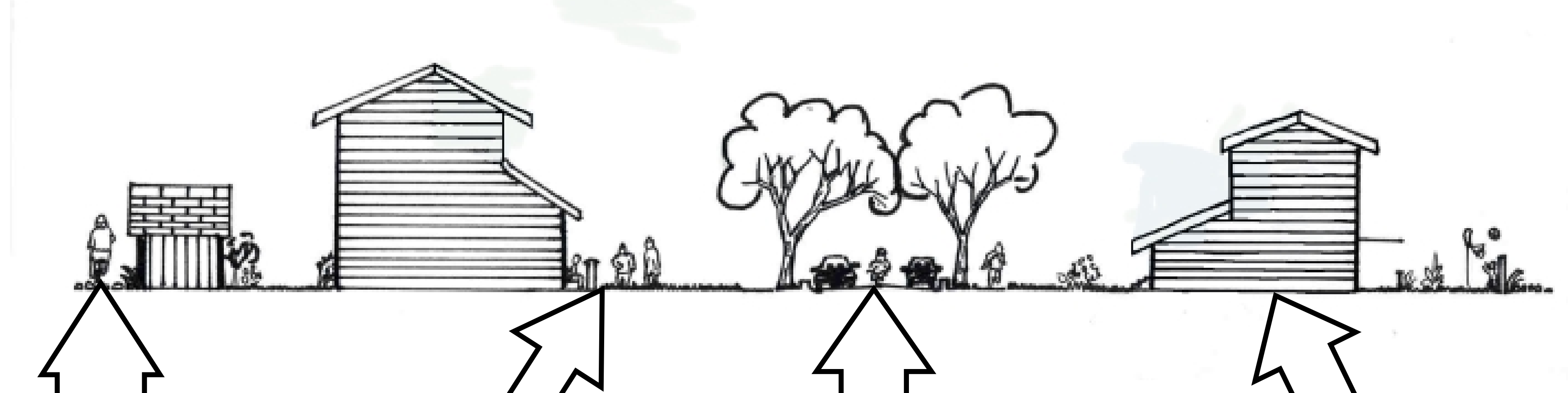
Mode of travel to Work	Kitsilano	Vancouver
Vehicle, as driver	53.8%	55.1%
Vehicle, as passenger	4.4%	6.1%
Public Transit	24.9%	23.6%
Walk	9.2%	10.7%
Cycle	6.7%	3.3%
Other	1.0%	1.2%

Kitsilano, Vancouver

Kitsilano is a small neighbourhood located within the City of Vancouver's west side. The street configuration follows the grid pattern that was established by the use of the electric trolley car in the late 1800's. Kitsilano has a vast array of service in the immediate are that make transit and other alternative modes of transportation a viable option.



KITSILANO: A TRAFFIC CALMED NEIGHBOURHOOD



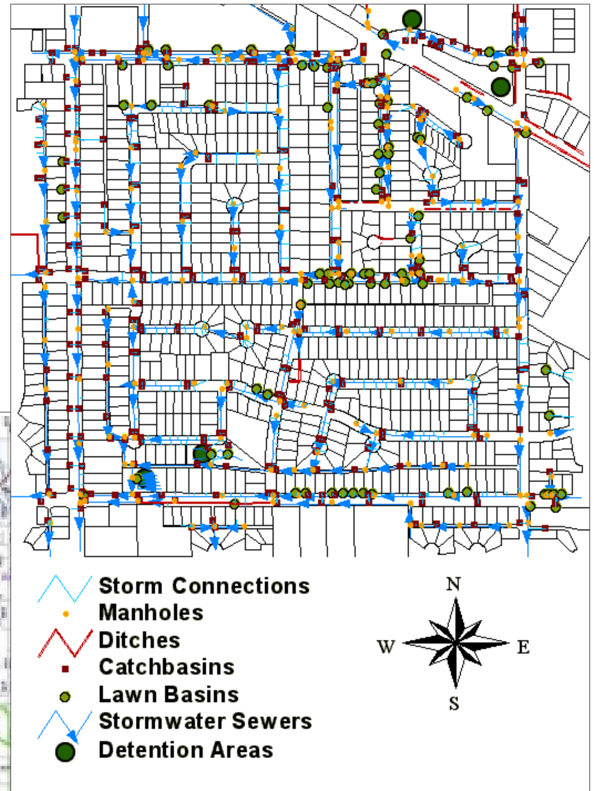
Active Alleys
Having the appealing look of a countryside road, Kitsilano allies are multi-use, social areas.

Community Interaction
Due to the light traffic volumes, community members are more prone to interact with each other. Since traffic is not a threat or disturbance front yards are a social space, not an automobile buffer zone.

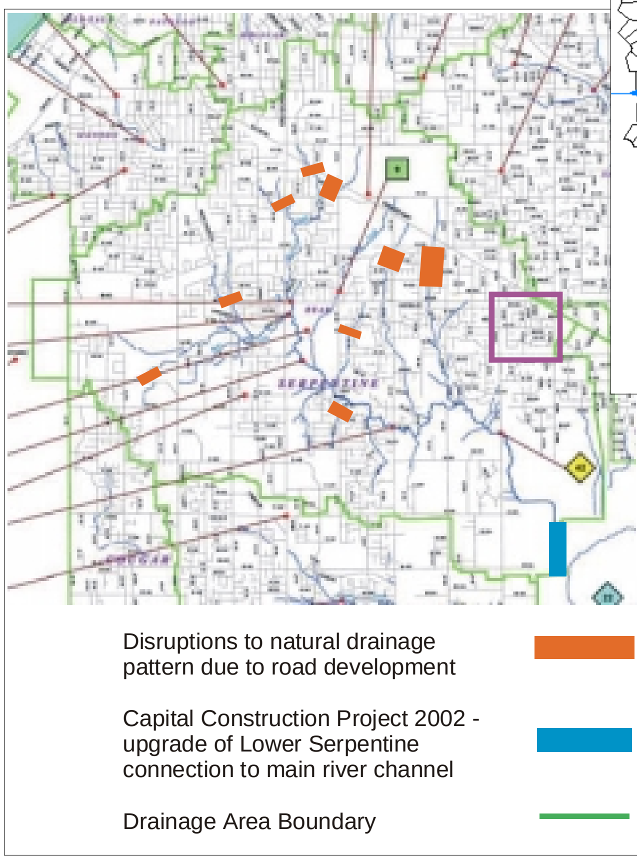
Light Traffic
Kitsilano streets are less than 9 meters in width, or three lanes, two of which are used for parking. This dramatically reduces vehicle speed and use. Cyclists, pedestrians, skateboarders, and children are much more prevalent, in these streets, than moving automobiles.

Strategic Use of Space
This cross section of the 3300 block of West 6th Ave shows the effective use of space. The house is close to the street and garages are at the back of the house, both of which increase the "eyes on the street" making for a safer and therefore more socially used space. (Engwicht, D 1999)

Drainage ditches on site.



The Site: components and location of drainage system. (City of Surrey, Engineering Dept.)



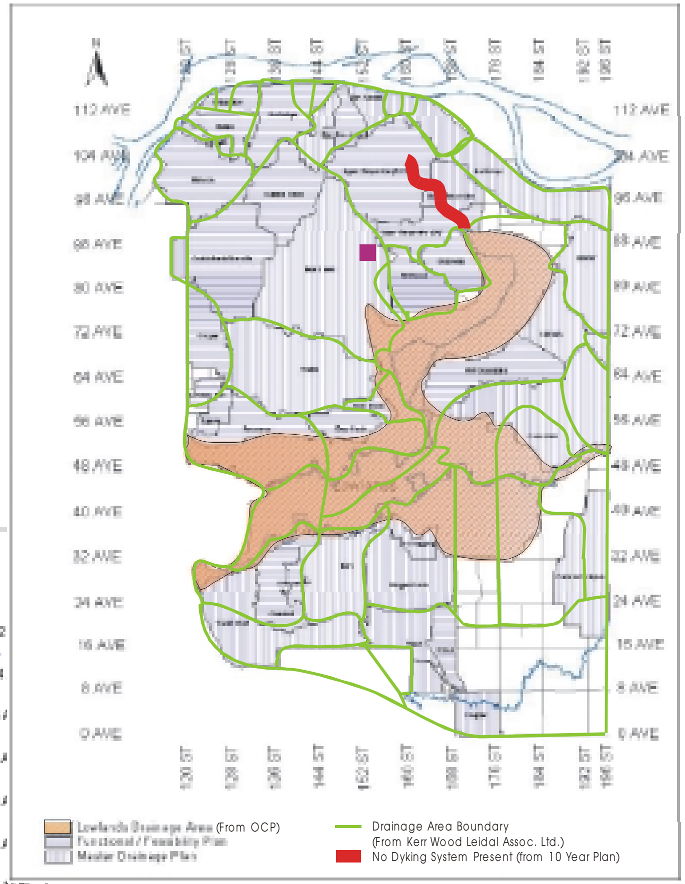
The Watershed: disruption to a natural drainage system. (Base map from Kerr Wood Leidal Assoc. Ltd., 2002)

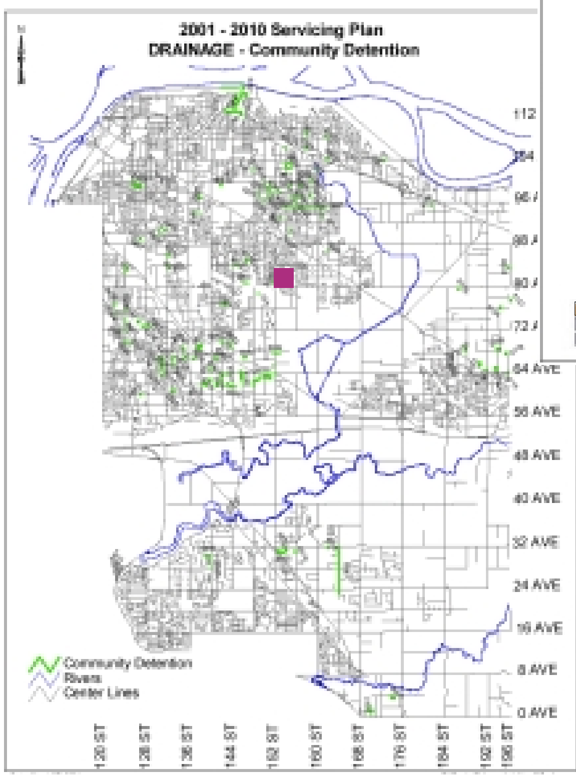
C.2 DRAINAGE SYSTEM

C.2.1 Auto Oriented System

The Site: Located in the Bear Creek Study Area, the site has no history of streams running through it. The original southwest-flowing direction of surface drainage continues to exist in post-development, though in a modified form. Streets running on a north-south and east-west grid system allow for the orthagonal movement of stormwater along street surfaces to catchbasins, where runoff is then channelled underground through the storm sewer system. Pipes continue to move runoff orthagonally through the site, with pipe diameter increasing to the south and west of the site as runoff is collected. Lawn basins and ditches also collect runoff, moving it toward the pipe system.

The Watershed: Comprised of three drainage study areas including the Bear Creek Study Area, the Lower Serpentine Watershed houses the site at to its north-eastern boundary. Development in the watershed has lead to the interruption of the area's river and its tributaries as these watercourses are culverted to accommodate roads. The burying of portions of streams has disrupted ecosystem function with respect to aquatic and riparian habitat, water quality, and groundwater recharge. The urban development of catchment areas has impacted neighbouring lowland areas with increased runoff volumes that lead to flooding (*Ten Year Servicing Plan, 2001*).





Site location

The Region:

Above: Regional map depicting layout of natural drainage Systems, areas under study, and missing infrastructure. (Base map from *Ten Year Servicing Plan*, 2001; OCP 1996; Kerr Wood Leidal Assoc. Ltd., 2002)

Left: Proposals for stormwater detention areas. (*Ten Year Servicing Plan*, 2001)

The Region: Surrey's drainage system is comprised of a combination of engineered storm sewer systems in the urban areas, constructed drainage ditches and canals in the more rural and older urban areas, and natural watercourses, streams and rivers. The current estimate of the inventory of systems maintained by Surrey is summarised as follows:

Ditches 1530 km
Storm Sewers 1630 km
Upland Water Courses 190 km
Lowland Watercourses 50 km
Serpentine River 40 km
Nicomekl River 15 km
Campbell River 14 km
Total 3469 km

Flooding and potential public health concerns have been documented by the City, and studies completed for North Surrey have determined the need to upgrade drainage systems in older areas of the City. Much of Surrey's agricultural lowlands are protected from flooding by dykes, but dykes in the upper end of the Serpentine River were never completed. This area also lacks systems to pump the water into the dykes during storms. Master Drainage Plans and Feasibility Plans are under way to help plan for the future management of drainage areas.

Stormwater detention areas have begun to be built in upland catchment areas in response to downstream flooding concerns. (*Ten Year Servicing Plan*, 2001)

C.2.2 **Pedestrian Oriented System**

The Region: The drainage net system for the city of Vancouver operates mainly as a component of the sewer system. Most stormwater and other runoff fluids enter a combined drainage/ sewage system, eventually routed to the Iona processing plant; however, under heavy rain, the volume of stormwater exceeds system capacity, and a mixture of wastewater, and stormwater/runoff overflow into Vancouver Harbour or the Fraser River.

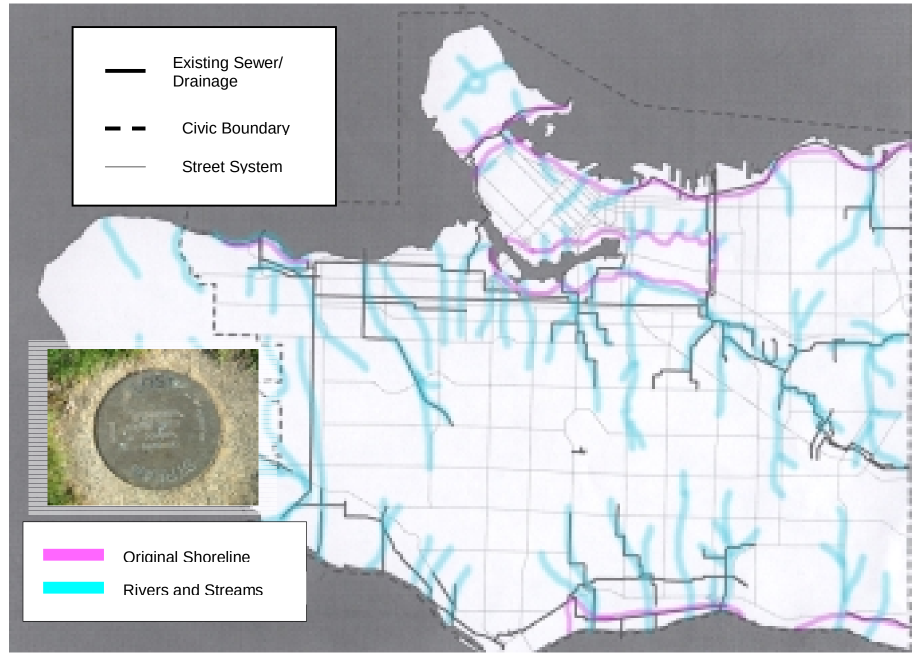
- **70% of Vancouver's sewer system is combined**
- **Combined System Overflow (CSO) incidents occur about 140 times/year into Vancouver Harbour and Fraser River**
- **CSO's occur about 45 times into both English Bay and False Creek**
- **The City hopes to have 95% of the system separated in roughly 50 years.**

  (*Above figures and provided by BC Hydro)

Aside from bacteria, the most damaging pollution is caused by chemicals in CSO's that persist on the urban surface until rainwater washes them into the nearest water body. They include:

- **Chlorophenols** from wood preserving
- **Zinc** from house rooftops
- **Copper** from vehicle brake linings and waterpipe
- **Hydrocarbons** from car exhaust, and **gas** and **oil** from parking lots and roadways

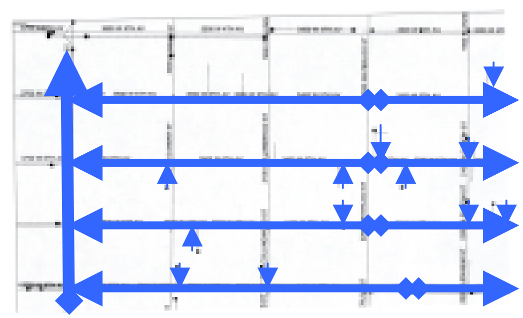
**NOTE: A separated sewer system would still discharge these chemicals into local waters untreated.



and sewage systems illustrates the shortcomings of traditional infrastructure building, as well as missed opportunities for on site stormwater retention. *Source: City of Vancouver, Engineering Department (VanMap) and Sewage Design (natural drainage system).*

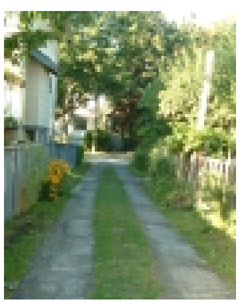
The Site: Kitsilano single family dwelling

- Site drainage patterns in blue
- Line width denotes relative water volume



Source: City of Vancouver, Engineering (VanMap)

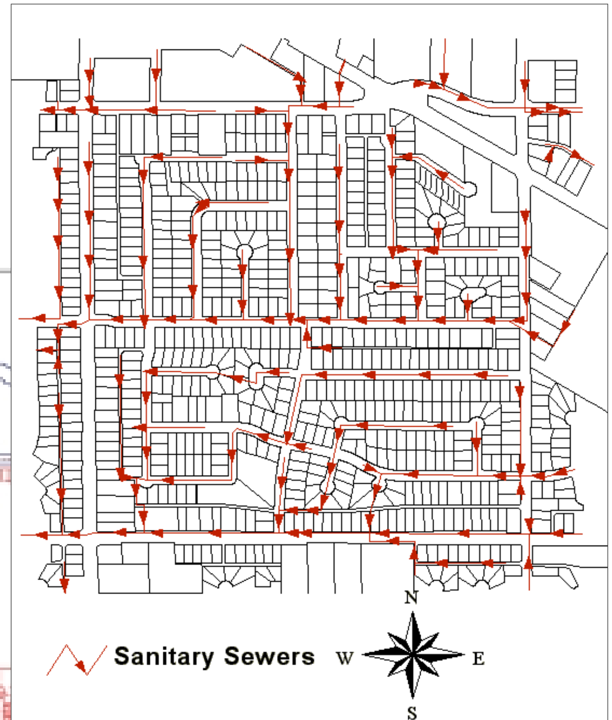
The Site: Kitsilano single family residential: good rainfall absorption and stormwater retention



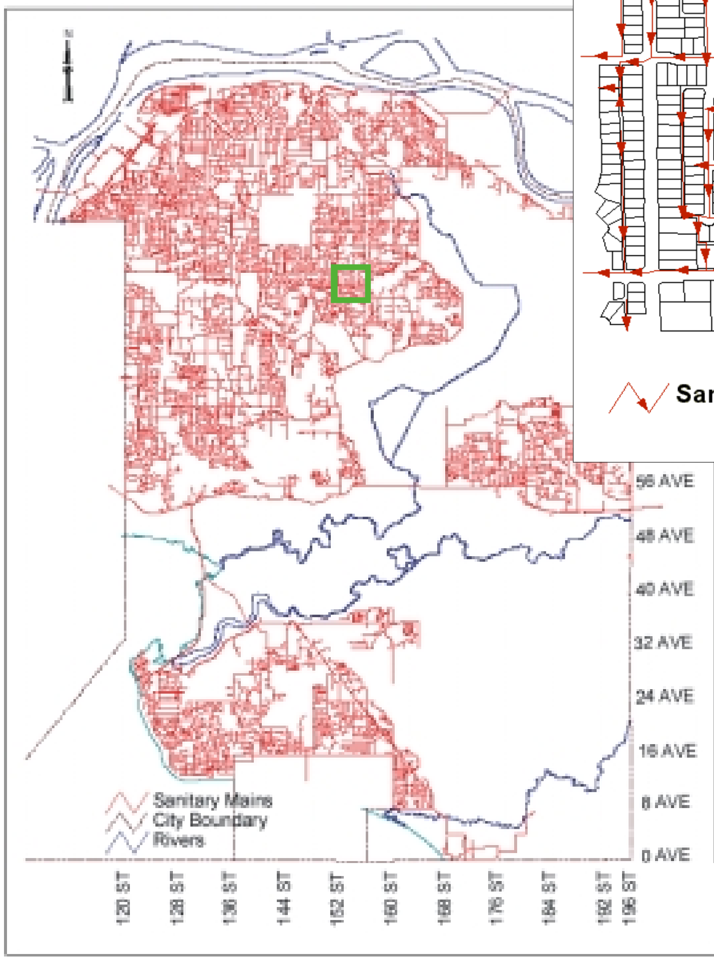
Pervious lane along 6th Ave.

Storm drain and vegetation working together

No curbs and vegetation buffer strips along Blenheim St.: runoff is slowed down and absorbed.



The Site: gravity sewers with directional flow indicated. (City of Surrey, Engineering Dept.)



The City: pipe layout for sanitary system. (*Ten Year Servicing Plan*, 2001)

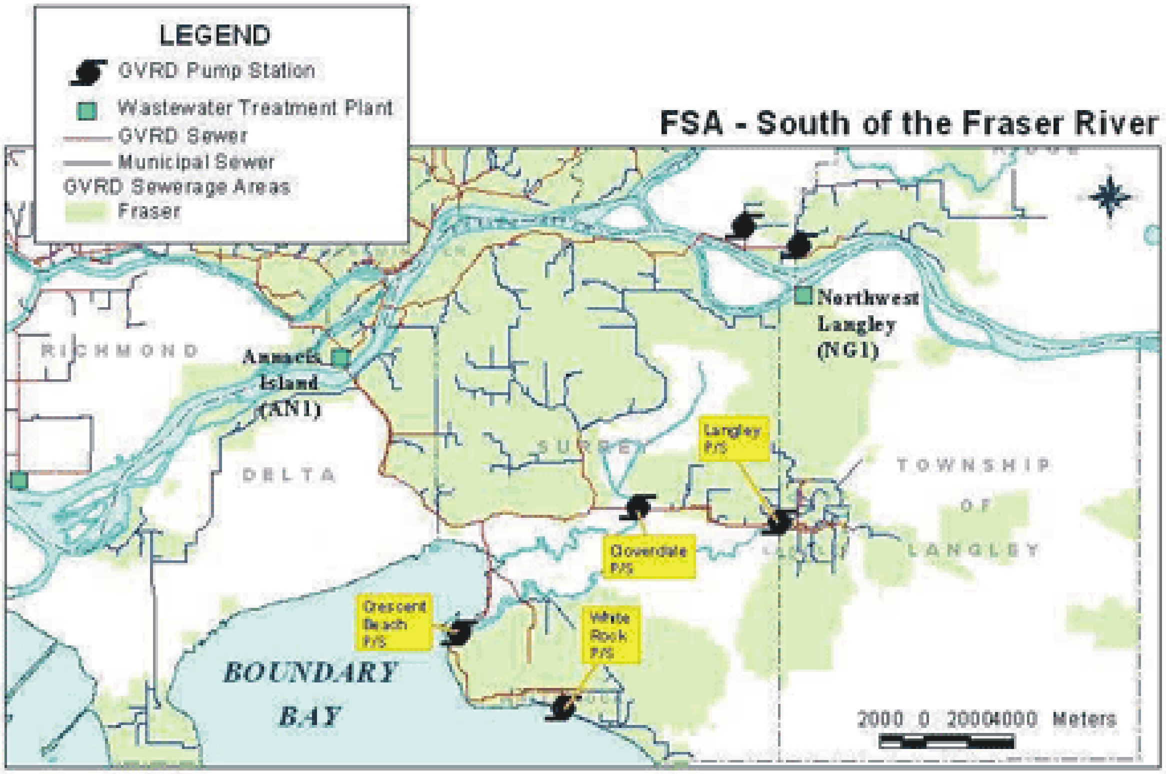
C.3 SANITARY SYSTEM

C.3.1 Auto Oriented System

The Site: Every home and business has its own link with municipal street sewers. Municipal pipes range from approximately 100 to 150 mm in diameter, and are the responsibility of the individual property owner. (*Ten Year Servicing Plan*, 2001)

The City: Surrey has separate sewer systems for sanitary and stormwater. The sanitary system has an inventory of 1430km of gravity mains, most of which are in good condition. However, there are older sections of the gravity system that were constructed of asbestos cement and other outdated materials that are deteriorating. A management program has been established by the City to monitor and rehabilitate the system.

The Bridgeport and South Westminster areas of Surrey are serviced by a vacuum system, which costs more to operate and has insufficient capacity to handle substantial redevelopment. The City intends to remove the system incrementally as redevelopment occurs. (GVRD, 2002)



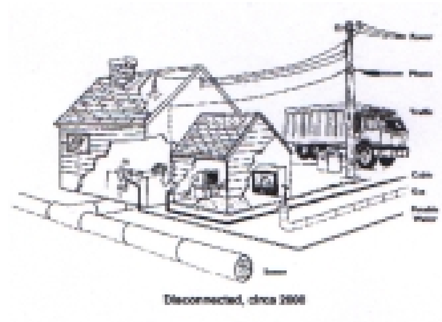
Surrey is part of the Fraser Sewerage Area, with wastewater processed by the Annacis Island Waste Water Treatment Plant. GVRD sewers (in red) collect wastewater from municipal sewers (in blue). (GVRD, 2002)

The Region:
Municipal street sewers flow directly into the largest of all sanitary sewer pipes, GVRD trunk sewers. Trunk sewer pipes can reach diameters of over 3.5 metres. The GVRD piping system makes up less than 5% of the total length of the system. To reach a treatment plant, wastewater must flow through GVRD trunk sewers for up to 35 km. Along the way, pump stations raise the wastewater over high points of land so it can continue to flow downhill by gravity.

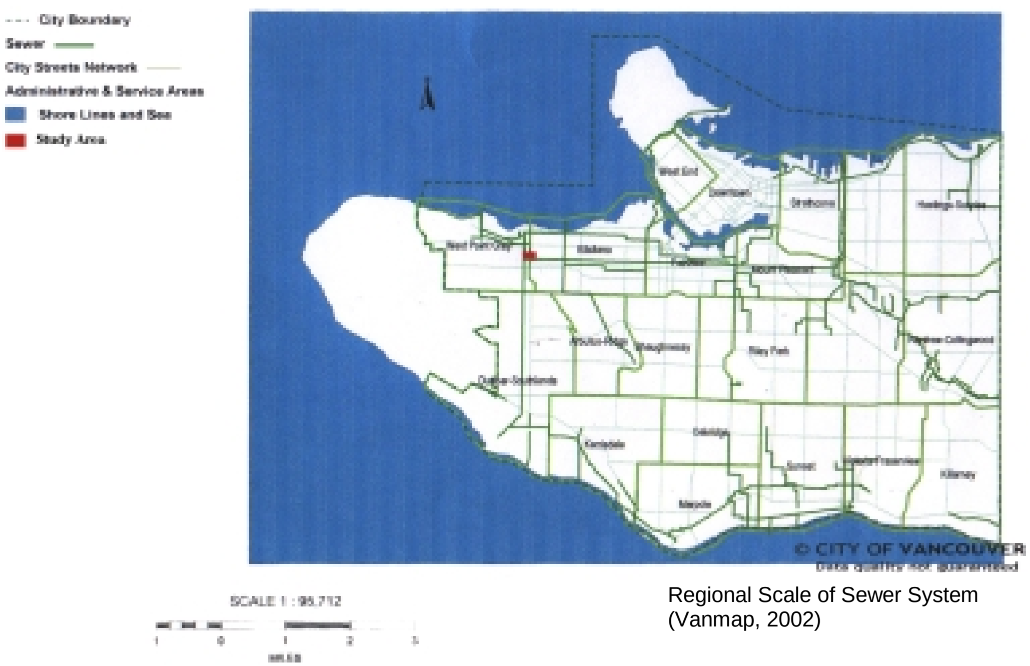
The Annacis Island Waste Water Treatment Plant, opened in 1975, was designed to provide primary wastewater treatment for a population of about 740,000, including most of Burnaby, New Westminster, Port Moody, Port Coquitlam, Coquitlam, Pitt Meadows, Maple Ridge, Surrey, Delta, White Rock, the City of Langley and the Township of Langley. The capacity of the Plant was first increased by 63 per cent in 1984 to serve a population of about 1,000,000. The Annacis Island WWTP was recently upgraded to provide secondary wastewater treatment to meet environmental standards, and to increase the treatment capacity to meet Surrey's future growth needs. (GVRD, 2002)

C.3.2 **Pedestrian Oriented System**

The current system collects “wastewater” (water that has been used in homes, businesses and industry). This water comes from sinks, toilets and bathtubs in homes, as well as various processes in business and industry. The wastewater flows from piping in the home or industry into municipal sewers and, finally, into trunk or large diameter sewers to be routed to a wastewater treatment plant for processing, prior to discharge to the rivers and oceans. (GVRD, 2002)

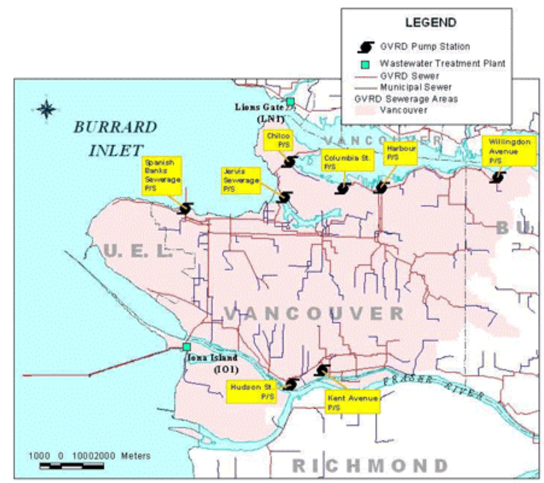


Current infrastructure model. (City Green, 2001)



Regional Scale of Sewer System (Vanmap, 2002)

The types of sewers within the region of Vancouver are the sanitary sewers, the storm sewers and the combined sewers. The sanitary sewers are used to convey liquid waste from houses and industry while storm sewers carry storm water from roadways and roof drains, and combined sewers carry both sanitary and storm water in one pipe. The system in Kitsilano area is still the combined. There is a plan to change them to separate sanitary and storm sewers, but it is still undone.



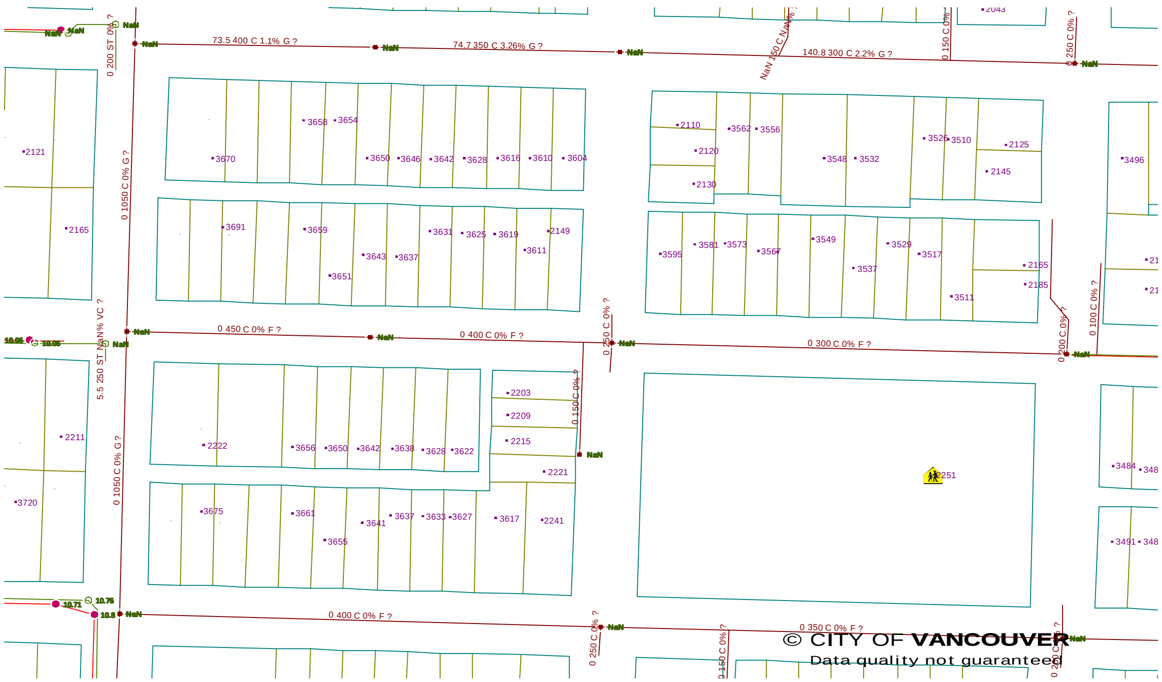
Sewer System for the Vancouver Area (GVRD, 2002)

The sewer system tributary to the Iona Island WWTP is mainly a combined sewer system. During dry weather, all sanitary wastewater is transported to the plant by a network of large interceptors and pumping stations (the system includes 125 km of pipe and 8 pump stations). During wet weather, stormwater runoff can exceed the capacity of the combined sewer system, causing overflows to Burrard Inlet and the North Arm of the Fraser River. (GVRD, 2002)

Every home and business has its private link with the street sewers; those pipes are usually 1.5m in diameter. Once the wastewater gets into the municipal system, it will flow into the trunk sewers. The trunk sewers are 3.5m or more in diameter. All the Kitsilano wastewater is directed to the Iona Island Wastewater Treatment Plant, the flow is induced by pump stations were its necessary. The Storm sewers will carry the stormwater to the Burrard Inlet.

According to the GVRD's 2002 report, because the wastewater collection system is aging, there is a chance that during severe rainstorms flooding could occur.

Collingwood x 7th



Existing Sewer System – Local Scale. (Vanmap, 2002)

Back lane 6th-7th and Alma

C.4 POTABLE WATER SYSTEM
C.4.1 **Auto Oriented System**

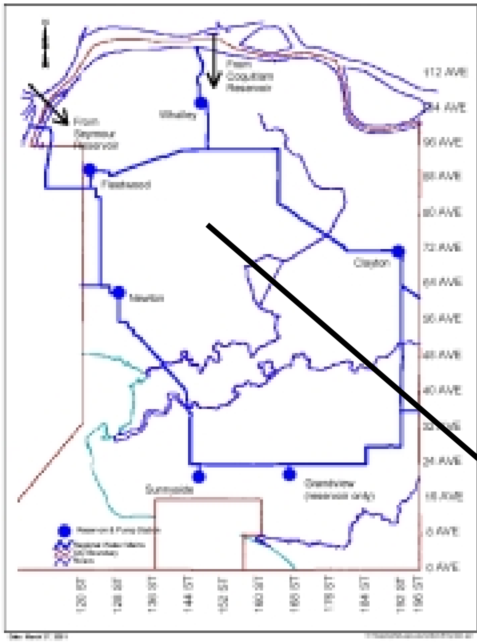


Figure 1. Regional Water System.
Surrey's potable water comes from two main sources: Seymour Reservoir and Coquitlam Reservoir. Surrey's water system takes supply from the major supply points and distributes water to approximately 102,000 premises. Surrey operates a system of pump stations to provide adequate pressure under peak demand conditions (City of Surrey 2001).

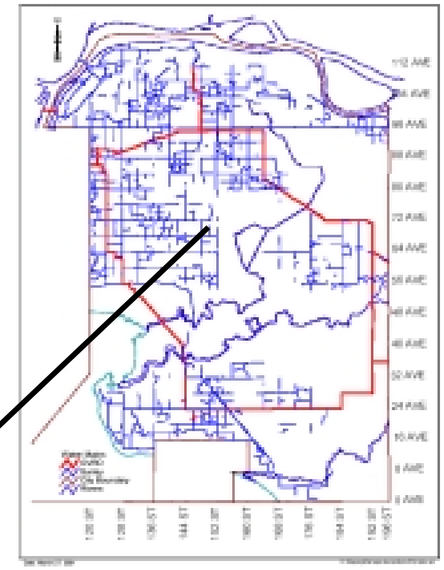
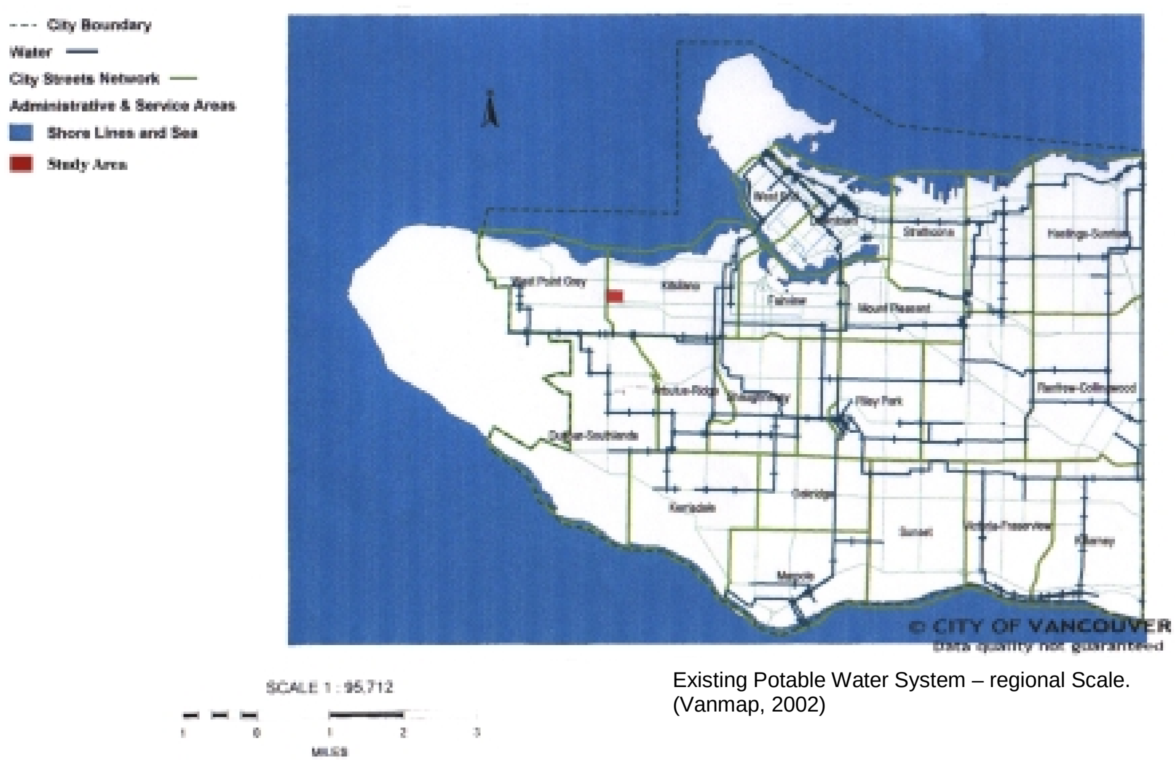


Figure 2. Major Pipe Network.
The study area is shown within all water mains of 250 mm diameter and larger. Surrey's current inventory of water mains is as follows:
150mm and larger: 1533 km
100mm and smaller: 121 km
Total: 1,654 km
(City of Surrey 2001)

Figure 3. Local Water Mains. Lot lines are shown in black outline, and local water mains are represented by blue lines. Around 1960 the minimum pipe design size was increased to 150mm diameter. It was also around this time that a change in materials was made from asbestos cement and cast iron to ductile iron. In the early eighties the PVC pipe-material was also certified as acceptable.(City of Surrey 2001)

C.4.2 **Pedestrian Oriented System**

Three watersheds provide drinking water for the Lower Mainland Region. They are the Capilano, the Seymour and the Coquitlam watersheds.



Existing Potable Water System – regional Scale. (Vanmap, 2002)

According to GVRD's report, the beginning of the GVRD water system dates from the late 1880's when a 16 km long water main was installed to deliver water from the Capilano River to Downtown Vancouver. In 1892 New Westmister completed a pipeline from Coquitlam Lake, and the Seymour River was tapped for Drinking water from 1908. During this period the human activity within the watersheds included forestry, mining, trapping, hunting, and fishing. The Greater Vancouver Water District was formed in 1926, when a 999 lease was granted by the Province for the Watershed Lands, and the Lower Seymour Conservation Reserve, an area set aside for future water supply. (GVRD, 2002)

Greater Vancouver Watersheds. (GVRD, 2002)

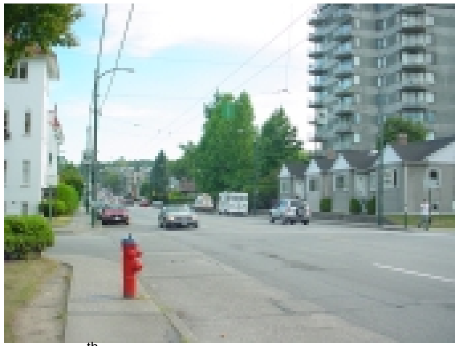
By 1936, mining and logging operations were halted, and a closed watershed policy was adopted. In the 1960's, the Water District began to allow sustainable harvesting. During the years that the GVRD actively managed the watershed forests, 15 per cent of the total forested area has been logged and planted. In 1991, an independent, expert panel reviewed these policies and recommended changes that led to a new proactive, low-level approach to forest management. An Ecological Inventory of watershed lands was conducted through the 1990's. The results of the inventory and the public input have resulted on the following principles of GVRD's Watershed Management:

- The main purpose is to provide clean and safe water.
- The watershed will be managed to reflect and advance the commitment to environmental

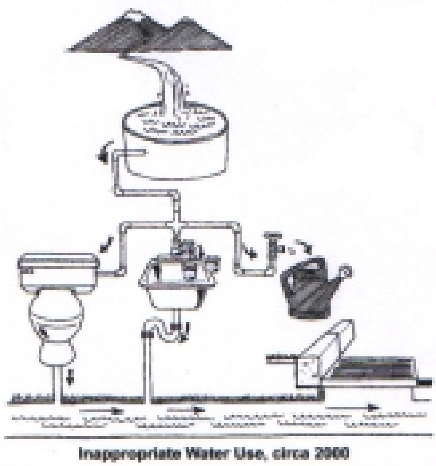
stewardship and protection of those lands and their biological diversity.

- The Region's management plan seeks the minimum intervention necessary to achieve the Board's objectives.
- The management plan will contain policies to return areas disturbed by human activities as close as possible to the pre-disturbance conditions.
- The decision-making process will be transparent and open to the public. (GVRD, 2002)

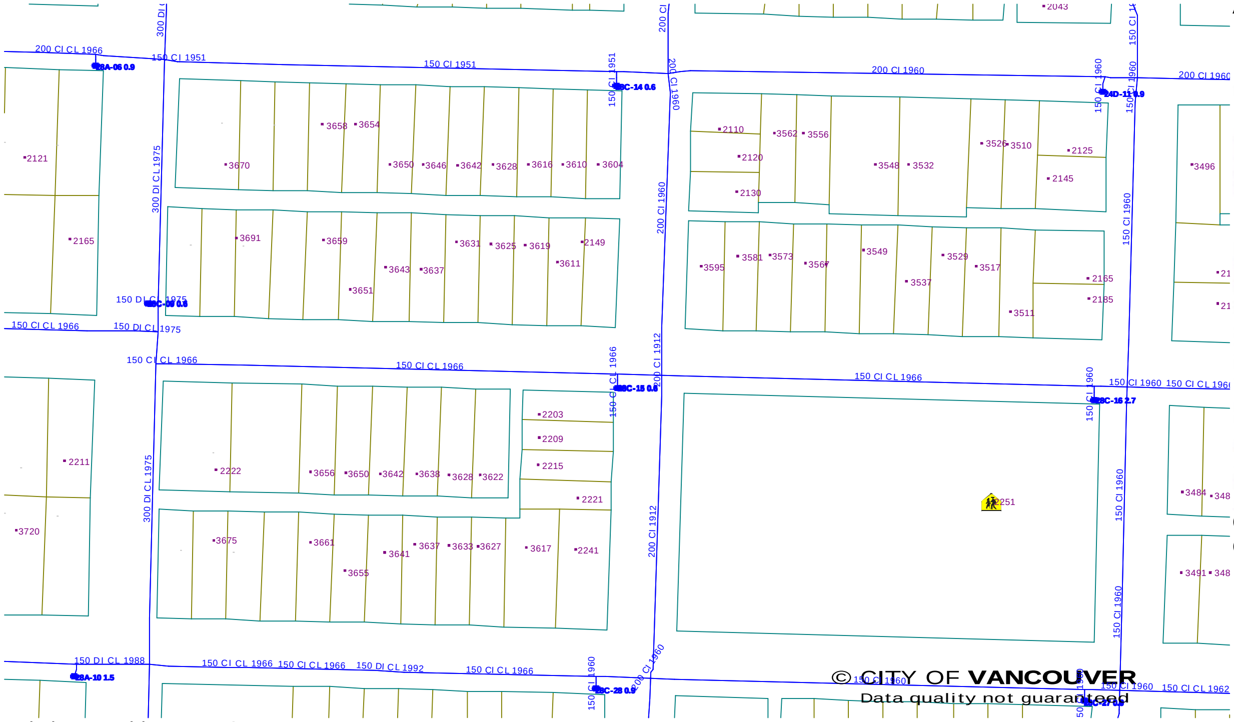
There is a program been done by the City of Vancouver and the Vancouver Coastal Health Authority to monitor the water quality since 1980's. The City of Vancouver in 1996 further introduced a city-wide water main flushing program to remove any sediment in the pipes. The whole water distribution system was thoroughly flushed in 2001.



Alma x 6th



Current Potable Water Distribution System. (City Green, 2001)

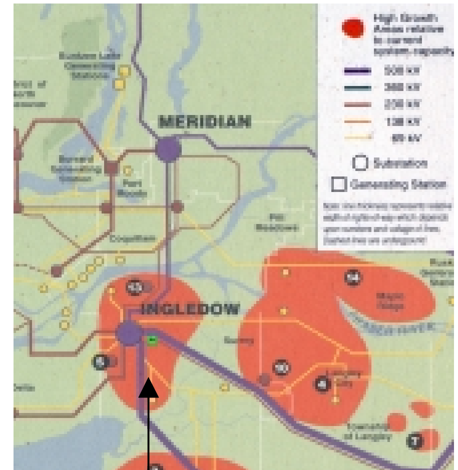


Existing Potable Water System

C.5 ENERGY SYSTEM
C.5.1 **Auto Oriented System**

Figure 1: Regional Context. There are two major transmission corridors into the Lower Mainland – one passes through the Fraser Valley to Ingledow Substation in Surrey (Figure 1). Ingledow is one of the regional power hubs in the Lower Mainland. From this substation, electricity is delivered to individual customers via an extensive system of regional transmission lines, smaller substations, and distribution lines. The study area falls within a high population growth area relative to system capacity; these areas are shown in red (BC Hydro 1994).
The transmission system is also connected to the U.S. System by two 500 kV transmission lines, from Ingledow substation to Custer Substation near Blaine, Washington. This "intertie" permits electricity trade with utilities in the U.S.

1



2

Figure 2: Cable Configuration. As shown in the photograph taken within the study area (Figure 2), many of the electricity cables are above ground. There are also underground cables present in some parts of the study area.

3

Figure 3: Conduit System. The study area is in close proximity to the major transmission corridor running to Ingledow Substation. In Figure 3, the red lines indicate known hydro conduits in the study area.

C.5.2 **Pedestrian Oriented System**

The Region: Extending throughout various regions of the province, BC Hydro has 29 integrated hydroelectric generating stations, 1 conventional thermal station and combustion turbine stations. The region consisting of the lower mainland and Vancouver Island consumes the majority of the provinces electrical energy.

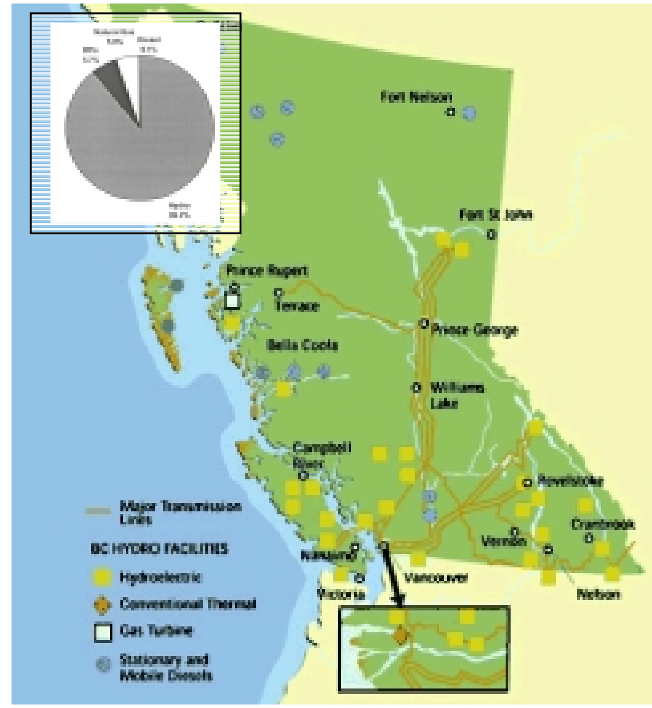
- **90% of BC Hydro's generation is produced by hydroelectric dams.**

As demand increases with increases in population, more pressure is put on the system capacity to produce for this region. Consequently, other means of energy are depended upon, such as the Burrard Generating Station (natural gas-fired station that emits smog-forming pollutants), *particularly during low water years* (ie. lower base flows).

- **In Vancouver and Burnaby combined, 120,000 residential accounts consumed an average of 10,700 kWh last year.**
- **electricity consumption is predicted to grow by 2% per year for the next decade**
- **BC Hydro's existing resources can meet the increased electricity demands to 2007**

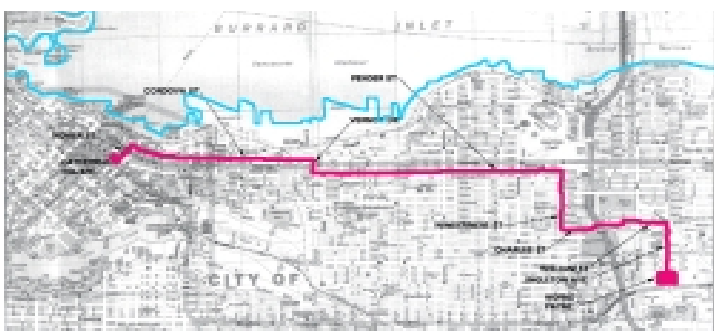
**(Above figures provided by BC Hydro)*

Accordingly, BC Hydro is investigating alternative sources of energy such as hydrogen (ie. Ballard Fuel cells), and biomass (organic sources like wood, compost, waste), wind and wave power.



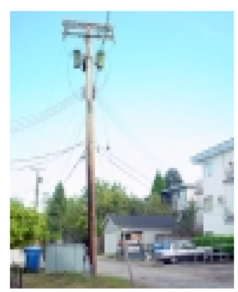
Source: BC Hydro (map), BC Hydro Climate Change Progress Report, 1999 (inset)

The District: A network of substations and underground transmission cables supply electricity to the metropolitan Vancouver area. BC Hydro has also proposed a new underground transmission line from Burnaby to Vancouver (*map below provided by BC Hydro*) to reinforce the existing electrical infrastructure and provide additional capacity for the city to meet future load growth.



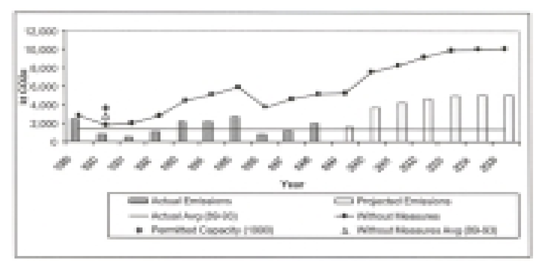
The Site: **Kitsilano**

Single family dwellings receive electricity and gas from underground services via transformers, meters and control devices.



Power Smart at Home

- Home energy profile
- Reduce energy and Greenhouse gases each year
- Home Improvements Programs
- "House as a System" concept



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