Utility and Street Right-of-Way Planning – 2050 & Beyond

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Assistant City Engineer

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Outline

- Classical utilities – what we have & what we're doing with them
- Drivers for change – public expectations, our energy future, climate change…
- (So many) Opportunities
- Consequences – space and access, emerging relationships between public & private systems
- The case for integrated design

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Utilities – Not just boring old pipes

- Utilities are the City's "lifelines":
  - Water mains = arteries
  - Sewers = veins
  - Data systems (telecoms, security) = nerves
  - Energy systems (electrical, gas, heat) = lungs
  - Lighting, traffic control, cameras = eyes

  Together they are a manmade organism that quietly keeps the City alive. Like our bodies, most of us take them for granted (when they work)

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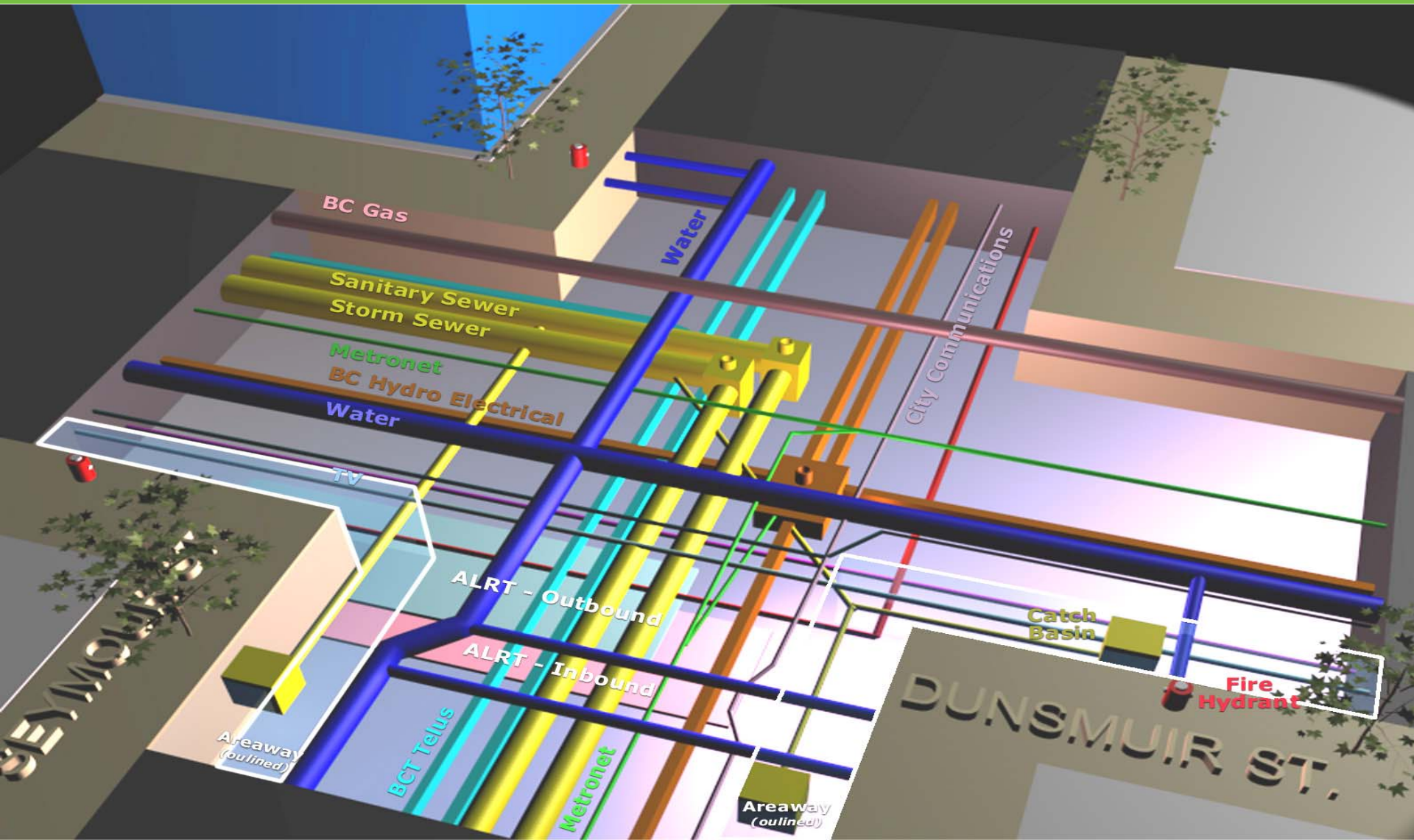
The hidden arteries of our City



Who Planned This?

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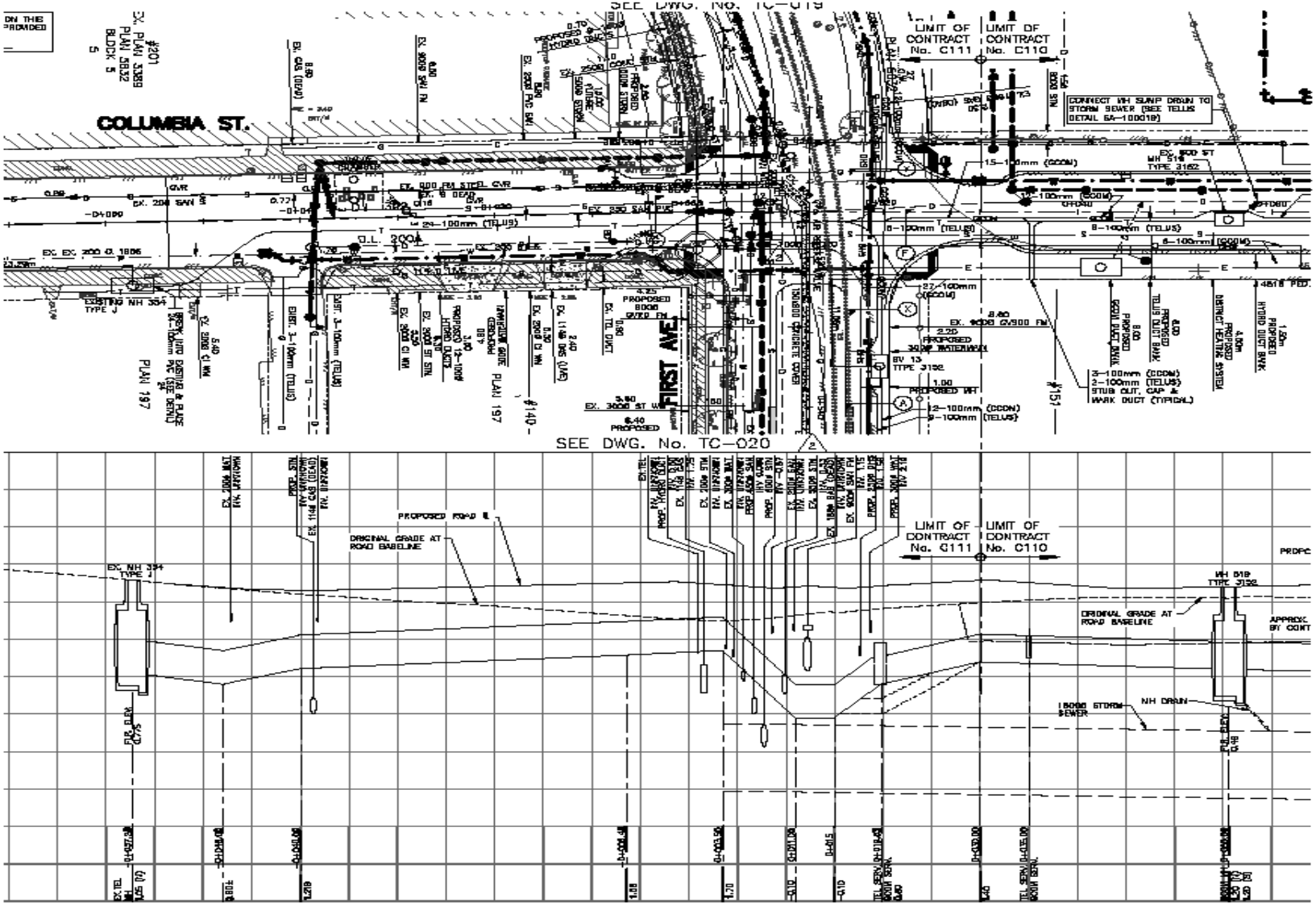
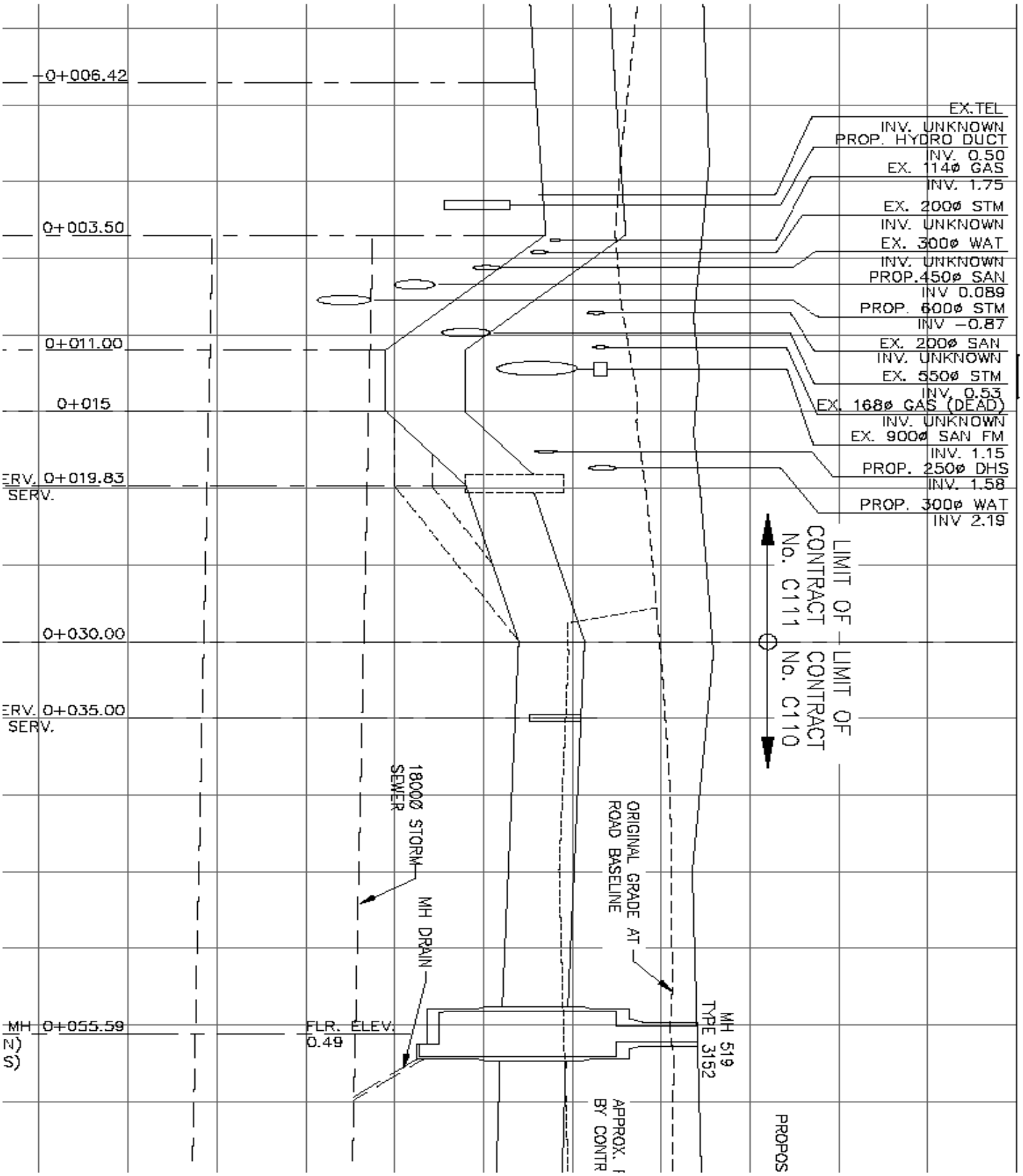
Gridlock – 2010 Underground!




0+006.42
0+003.50
0+011.00
0+015
ERV. 0+019.83
SERV.
0+030.00
ERV. 0+035.00
SERV.
MH 0+055.59
N)
S)
EX.TEL
INV. UNKNOWN
PROP. HYDRO DUCT
INV. 0.50
EX. 114ø GAS
INV. 1.75
EX. 200ø STM
INV. UNKNOWN
EX. 300ø WAT
INV. UNKNOWN
PROP.450ø SAN
INV 0.089
PROP. 600ø STM
INV -0.87
EX. 200ø SAN
INV. UNKNOWN
EX. 550ø STM
INV. 0.53
EX. 168ø GAS (DEAD)
INV. UNKNOWN
EX. 900ø SAN FM
INV. 1.15
PROP. 250ø DHS
INV. 1.58
PROP. 300ø WAT
INV 2.19
LIMIT OF CONTRACT No. C111
LIMIT OF CONTRACT No. C110
1800ø STORM SEWER
MH DRAIN
ORIGINAL GRADE AT ROAD BASELINE
FLR. ELEV. 0.49
MH 519 TYPE 3152
APPROX. BY CONTR
PROPOS

It’s not all underground:

- Street lighting
- Traffic signals & controllers
- Trolley wiring
- Above-ground electrical, tel, cable, etc
- Traffic signage, wayfinding
- Parking metering/paystations
- Cell and radio repeaters
- Street furniture
- Trees & street landscaping
- Etc. etc. etc.

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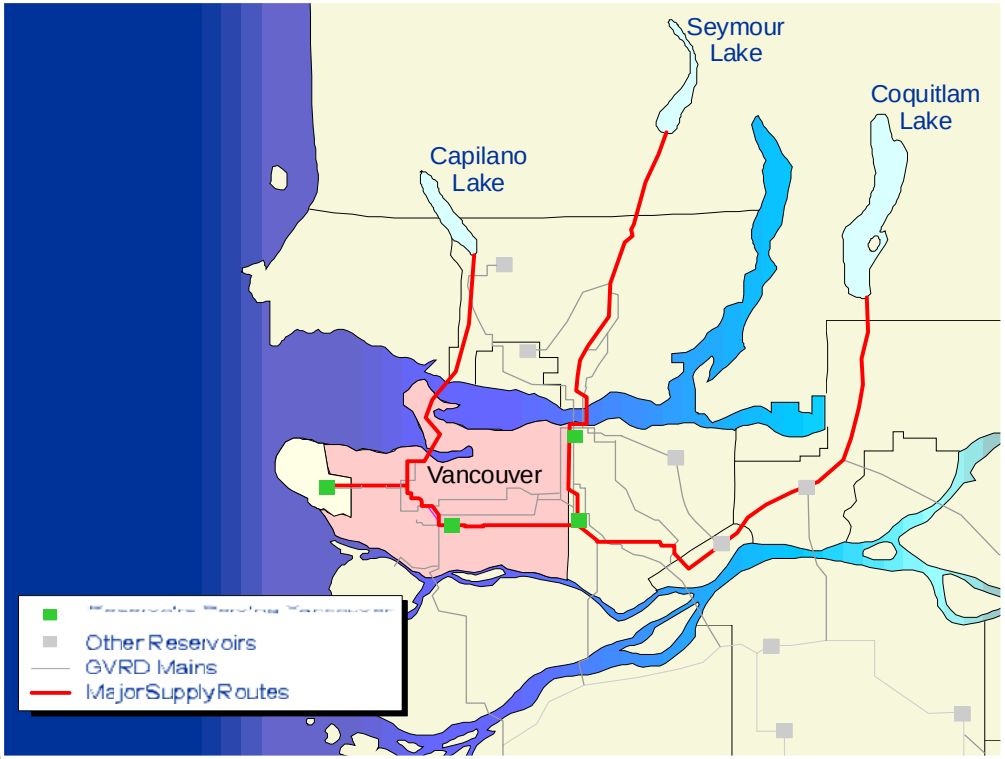
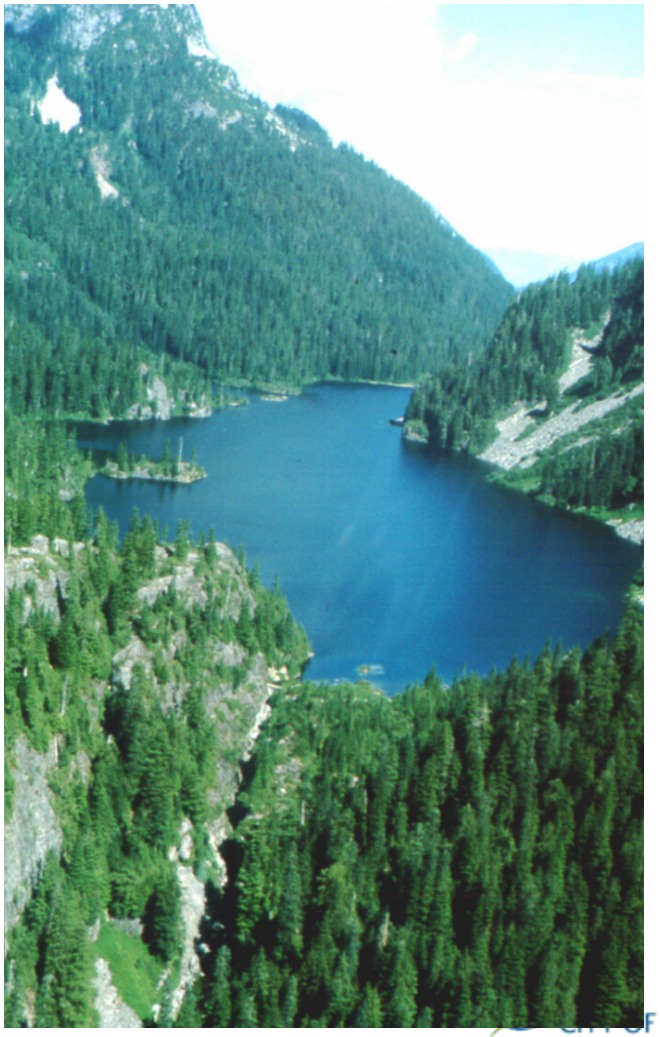
The Region's Water System





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Waterworks Utility Objectives – Sustainable Infrastructure

- Maintain the City's Waterworks infrastructure using sound life cycle replacement strategies
- Reduce the need to upsize the water system through conservation, demand management and water loss management

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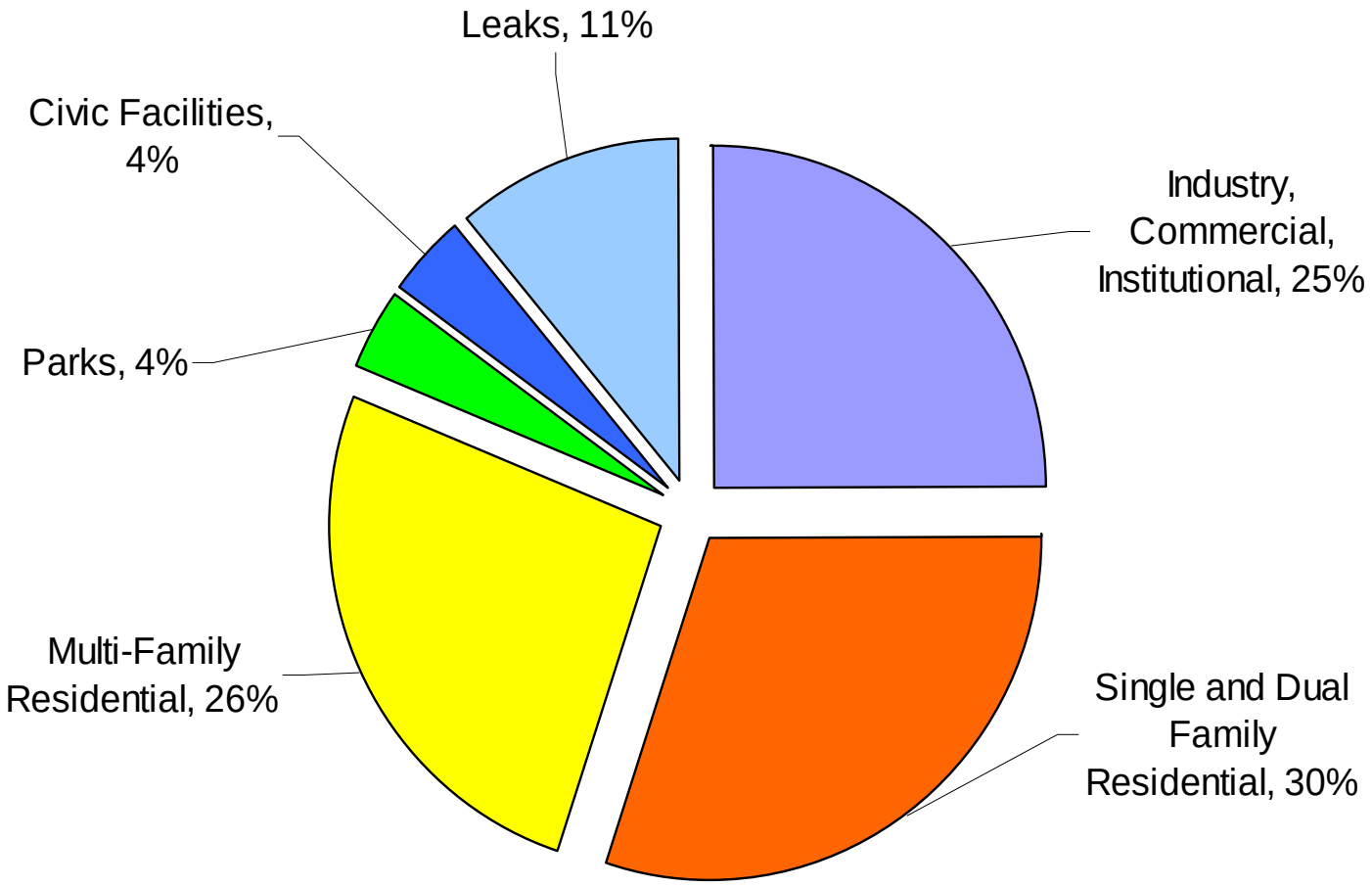
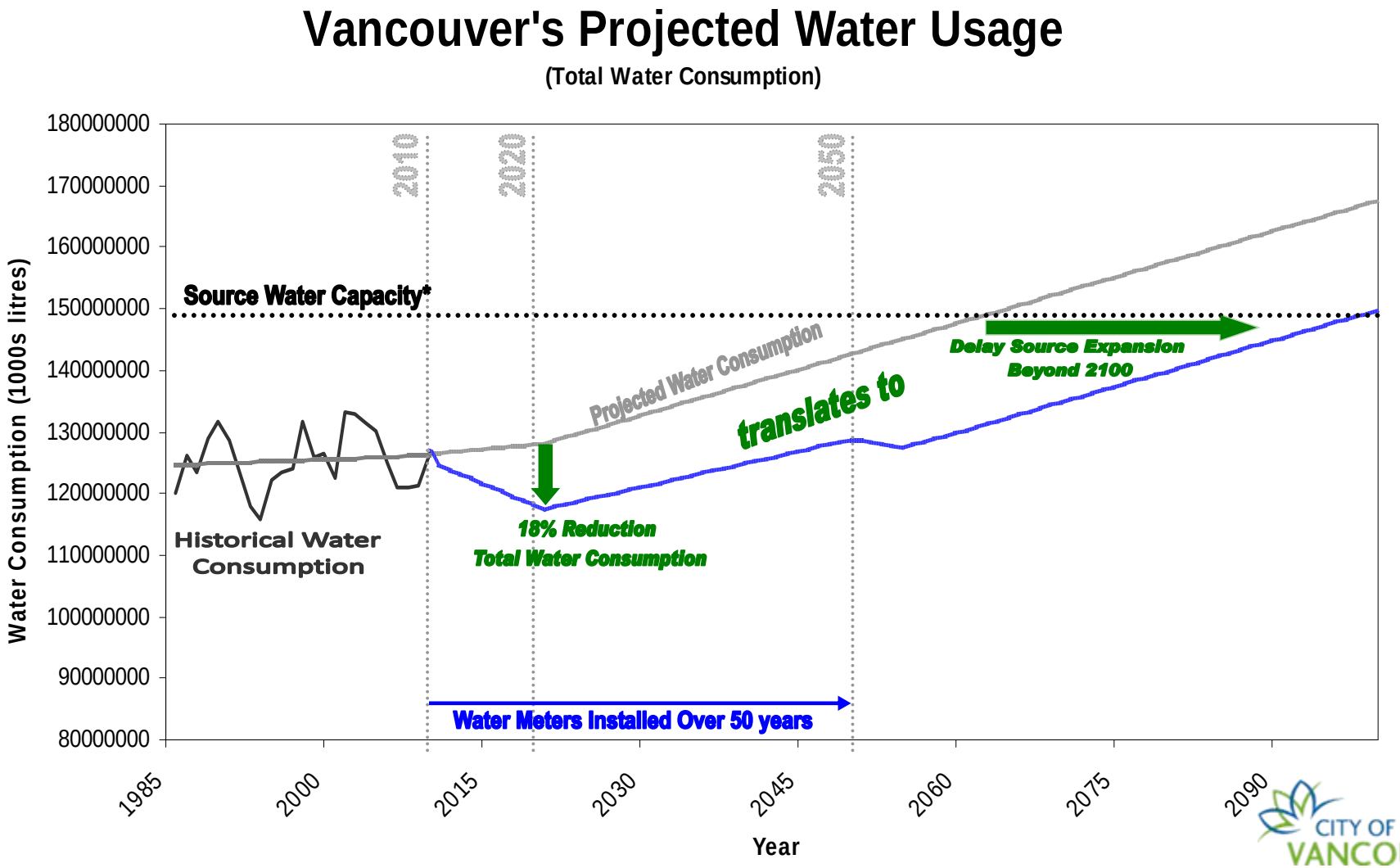
Vancouver's Water Consumption by Sector



Goal - Preserve Our Sources in Perpetuity (offset population growth, etc.)



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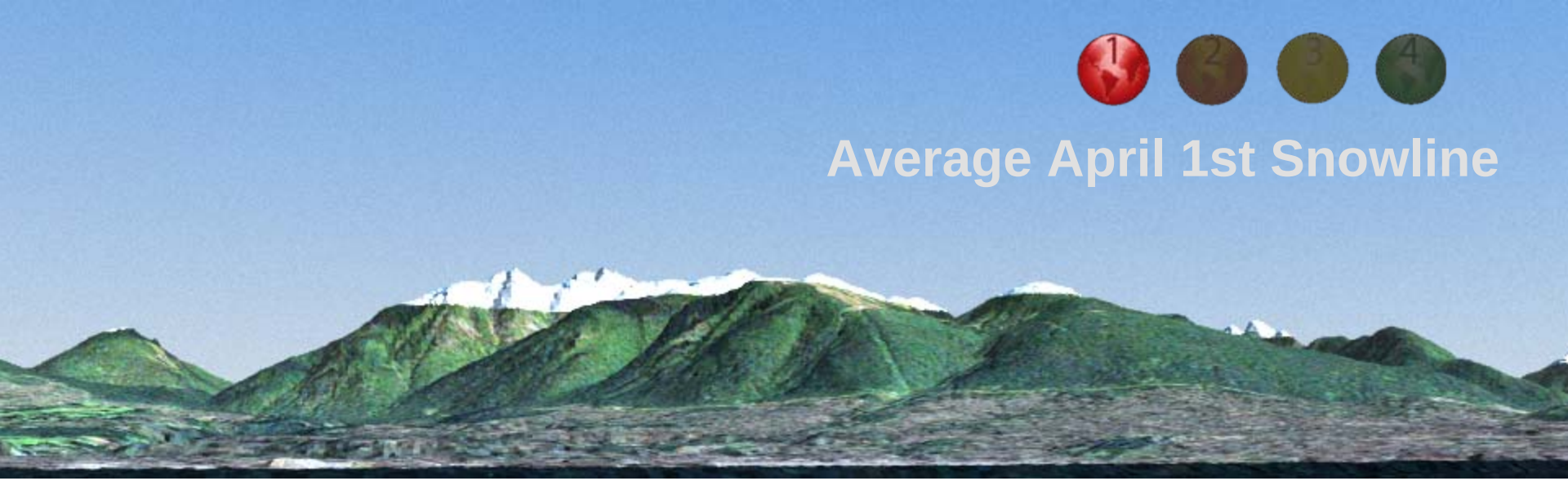

Canadian General Circulation Model 2: A2 scenario

April 1st snowline elevation (m)

1200

800

400

0

1960

2000

2020

2050

2100

Year

Comprehensive Water Conservation Program

- Demand Management by sector:
  - Water metering & pricing incentives
  - Building code changes
  - Retrofits in existing buildings
  - Point-of-sale regulations: appliances/fixtures
  - Rainwater harvesting
  - Greywater/blackwater/saltwater alternate sources integrated into utility & building designs
  - Drought tolerant public & private landscapes
  - Leakage control through ongoing infrastructure repair & replacement (1%/year in perpetuity)

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False Creek, c. 1912

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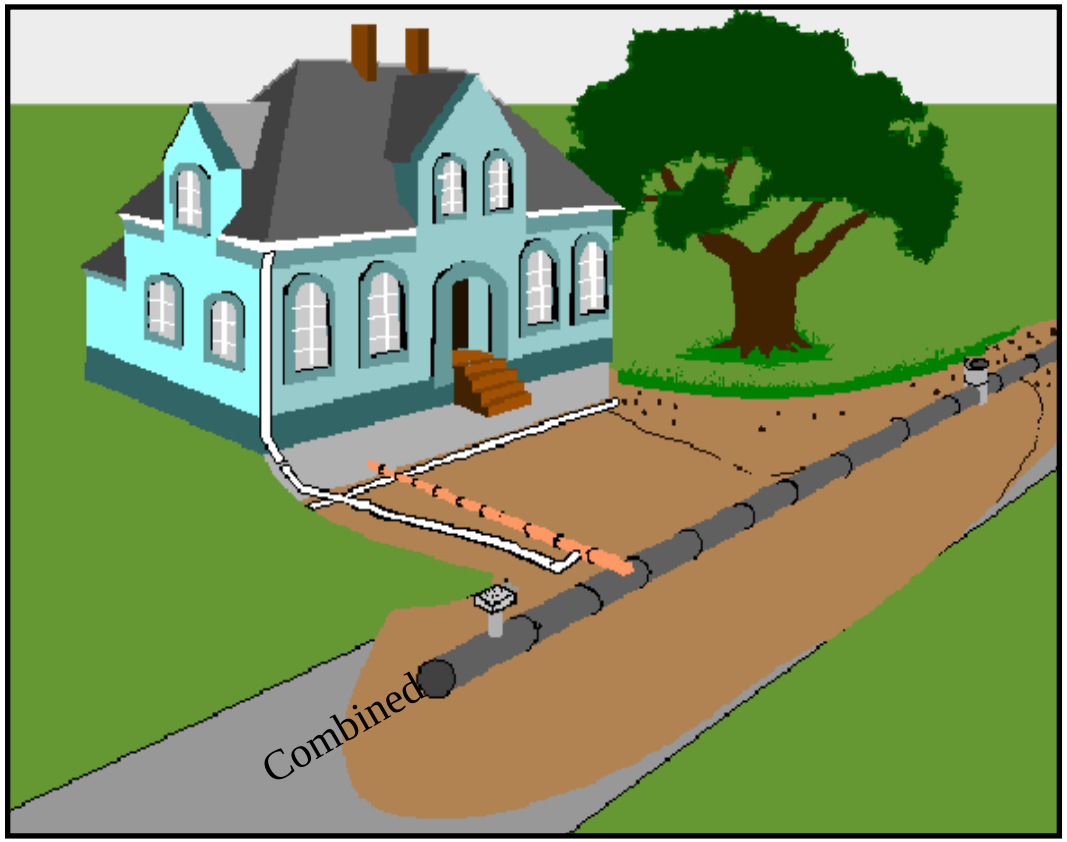
Combined Sewage System



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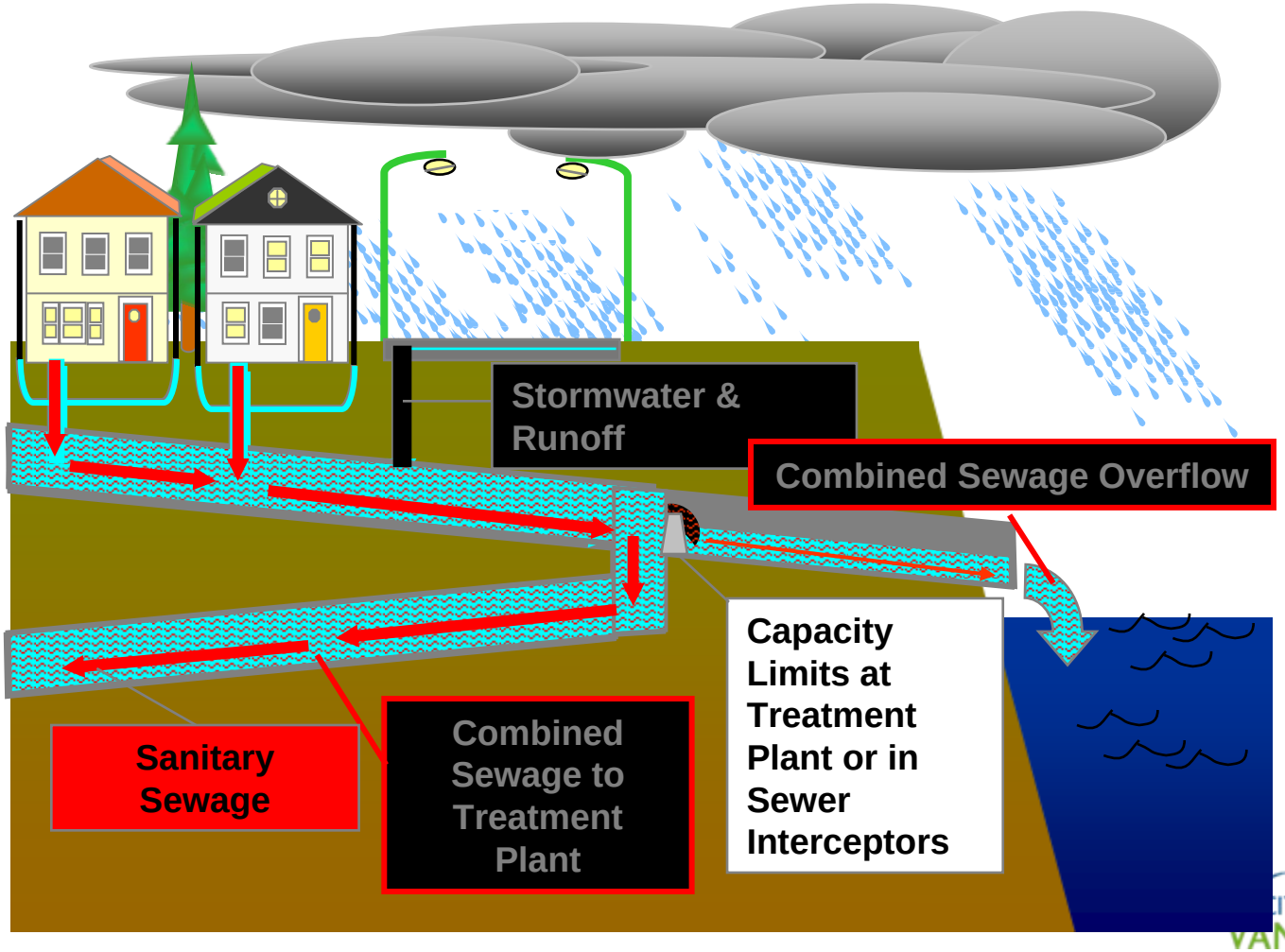
Combined Sewer Operation



False Creek - 2001

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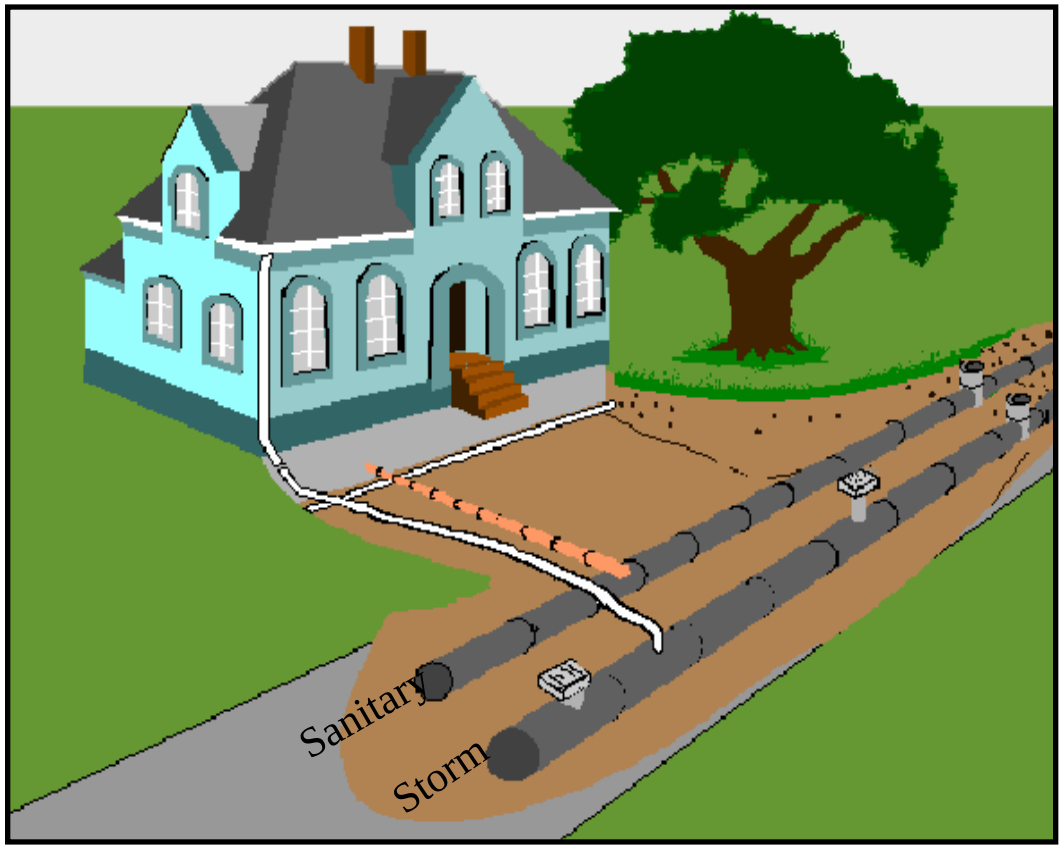
Separated Sewage System



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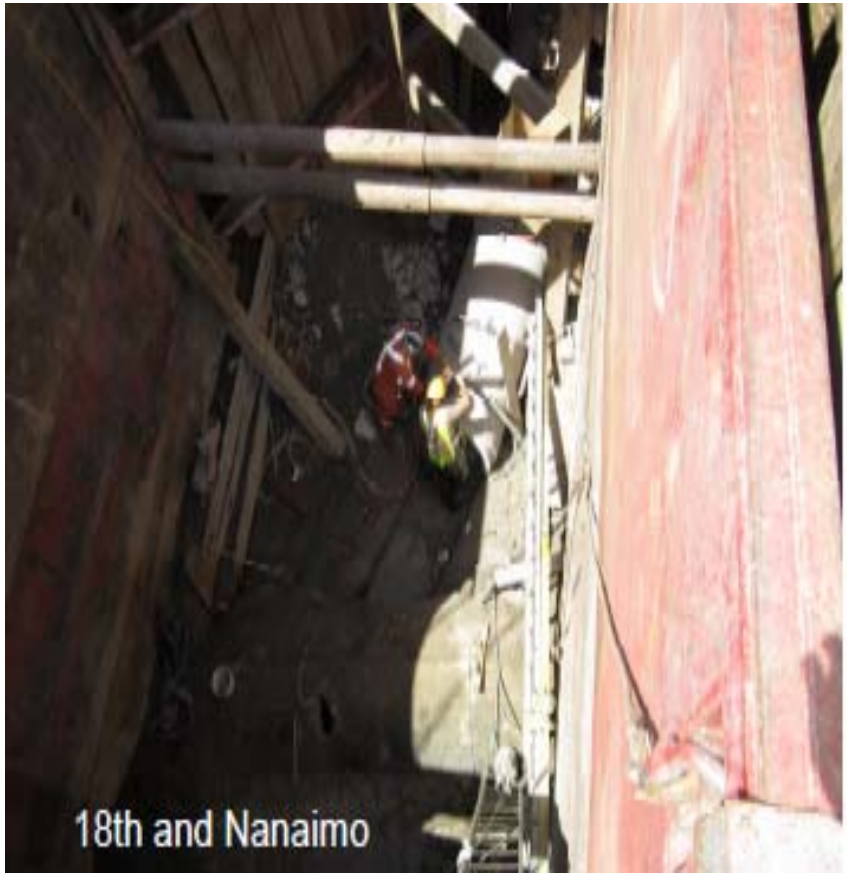
Sewer Separation – $25M+/year until >2050

[Nanaimo Street 2010 (8m depth)]



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CSO's Must Go! (By 2050)

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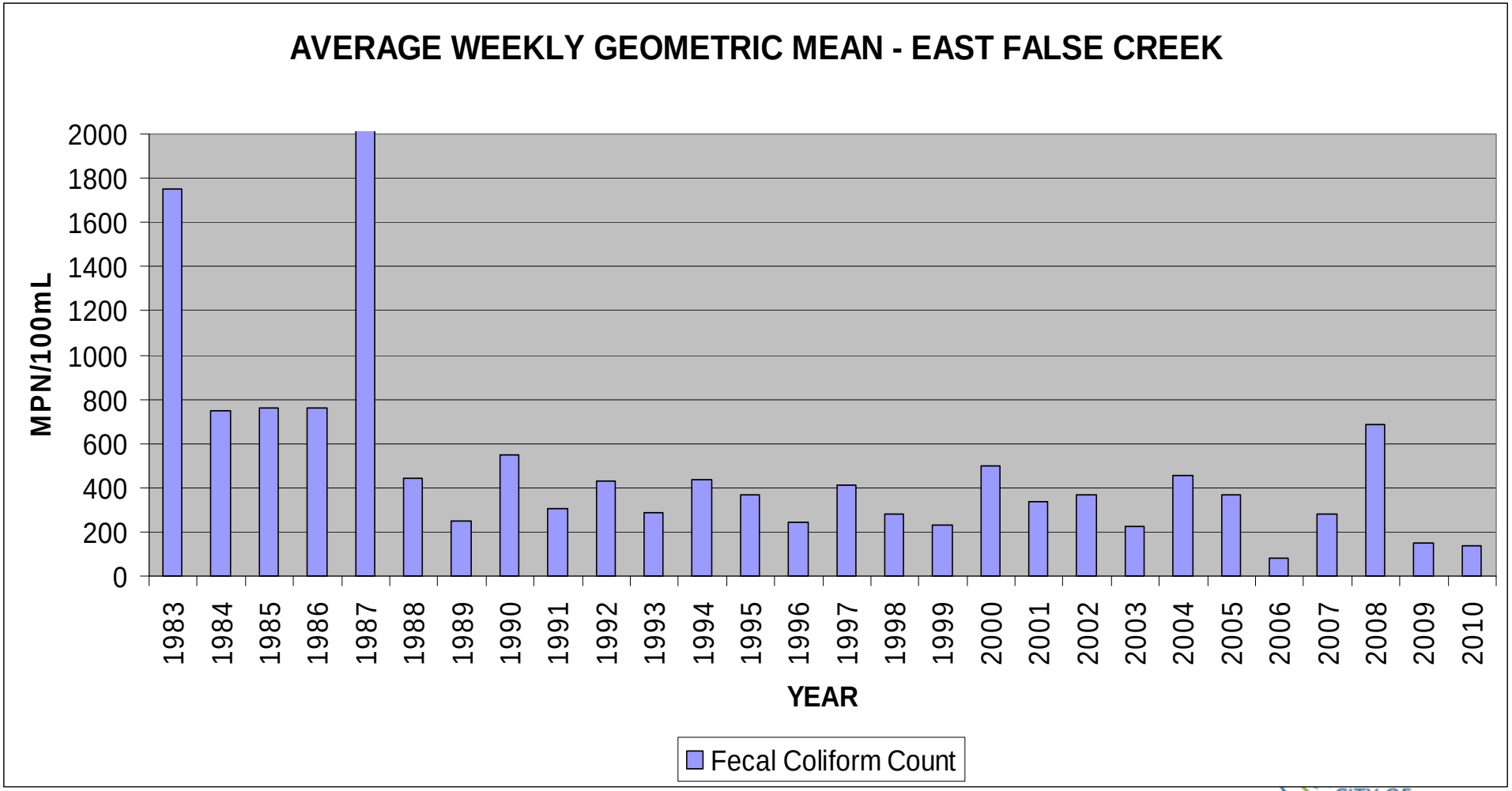
Progress eliminating Combined Sewer Overflows



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Some of the benefits…

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One downside…

Climate Change – storm surge (Boundary Bay 2006)

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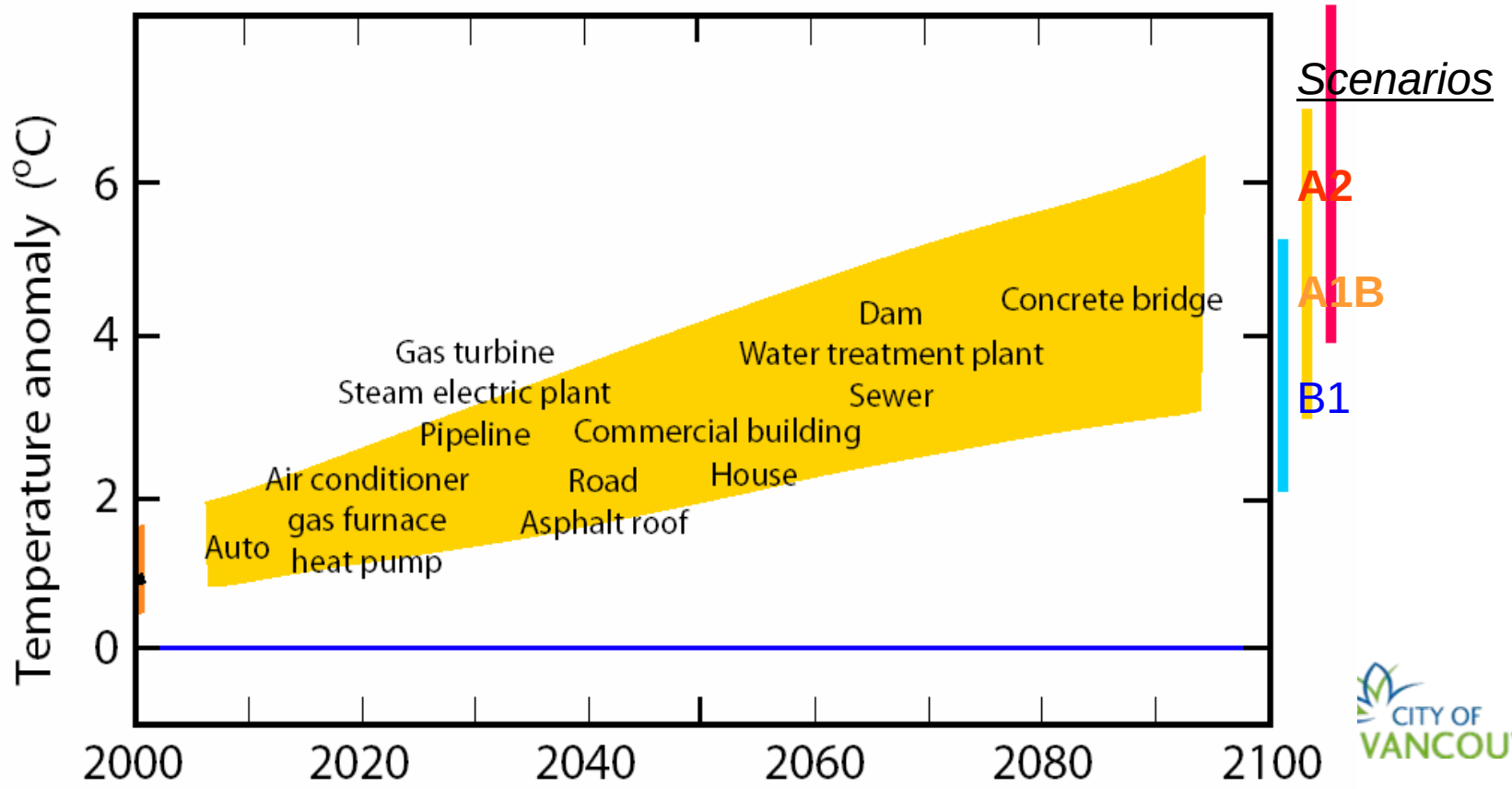
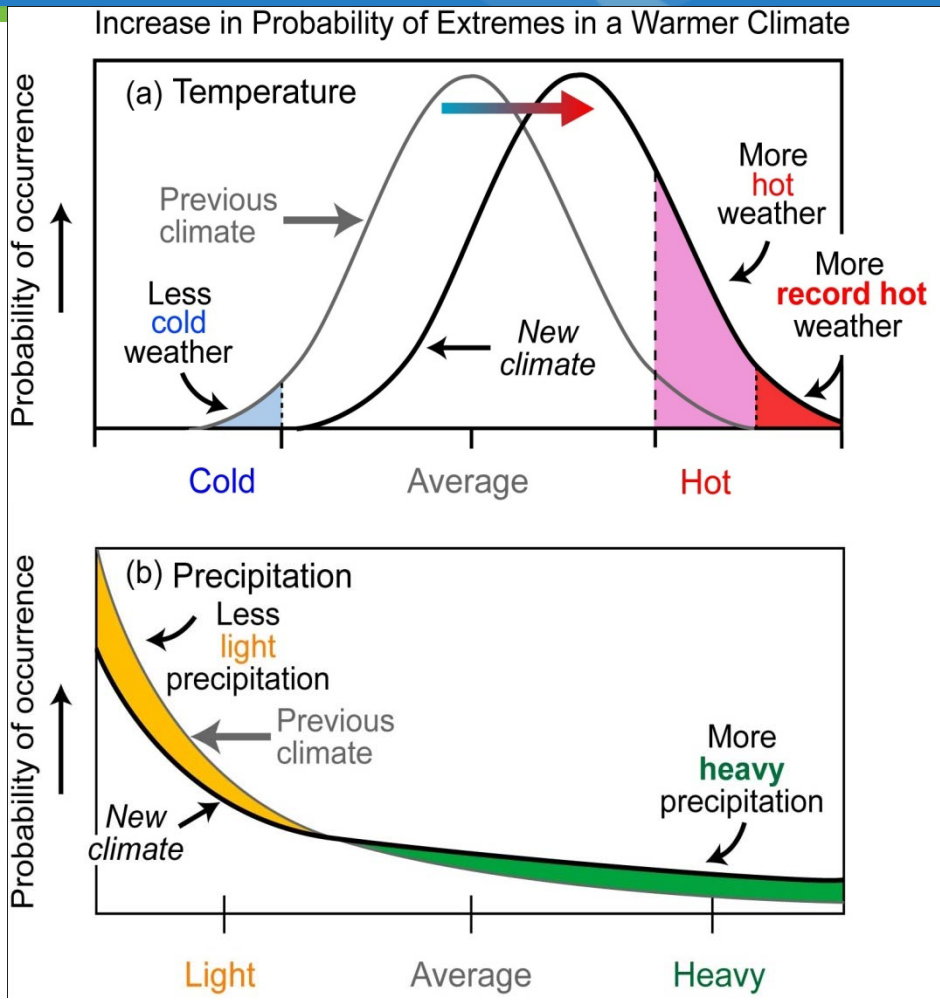
Infrastructure design needs to incorporate climate change *(from IPCC 2007, WG2-Chapter 15—slide from L. Mortsch)*

- How to avoid costly retrofits or underperformance of infrastructure?
- Long life & high value of North American capital stock



CC Impacts—Changes in Statistics

- Small changes in mean or extremes can yield large changes in risk
- Damages likely to increase exponentially
- Infrastructure sensitive to
  - Rate of climate change
  - Changes in mean climate (weathering)
  - Changes in extremes (thresholds/failure)
  - Adaptive capacity (ability to plan, respond, design, maintain)
- Balance between safety, reliability and cost of design



(Graphics from by T. Peterson)

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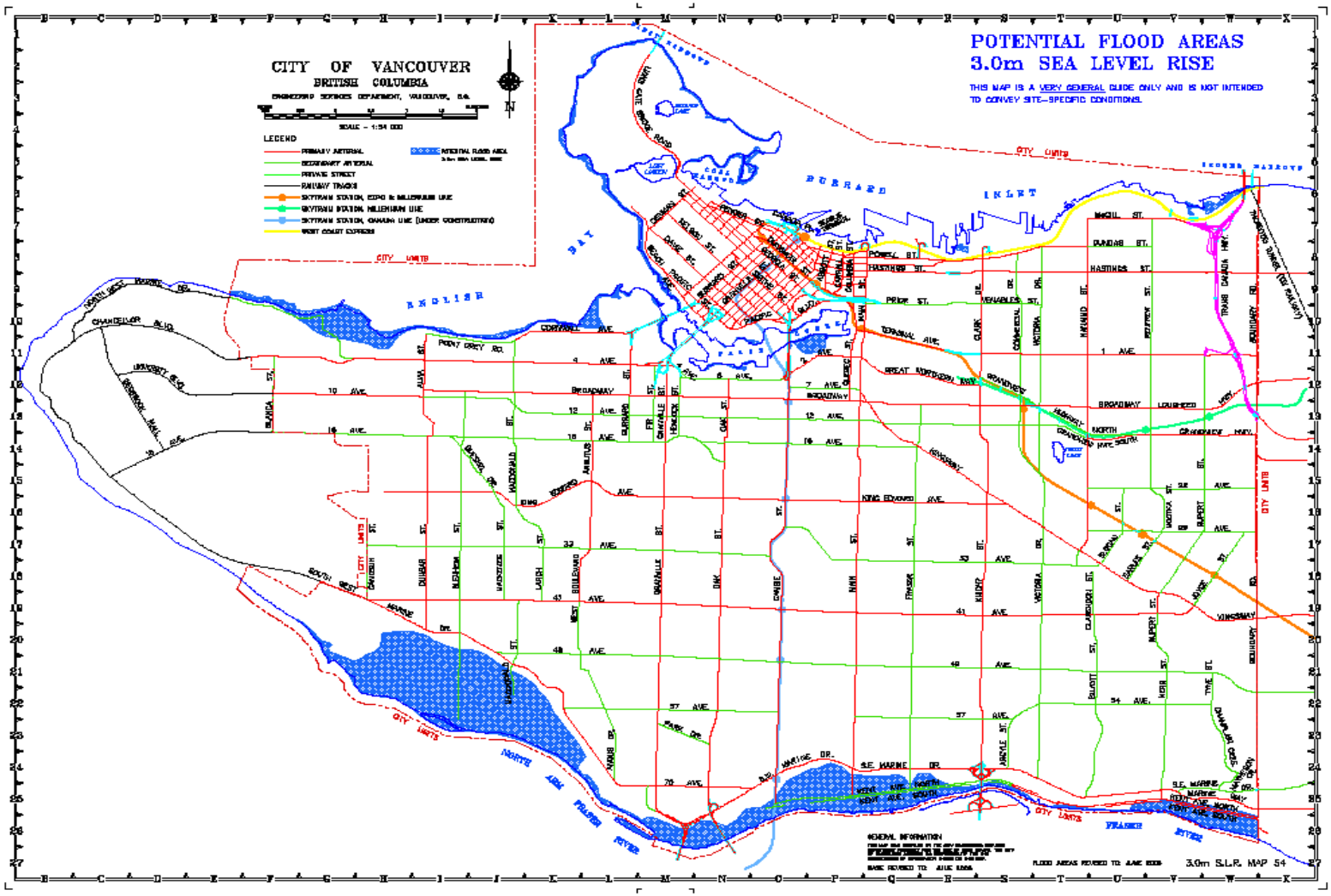
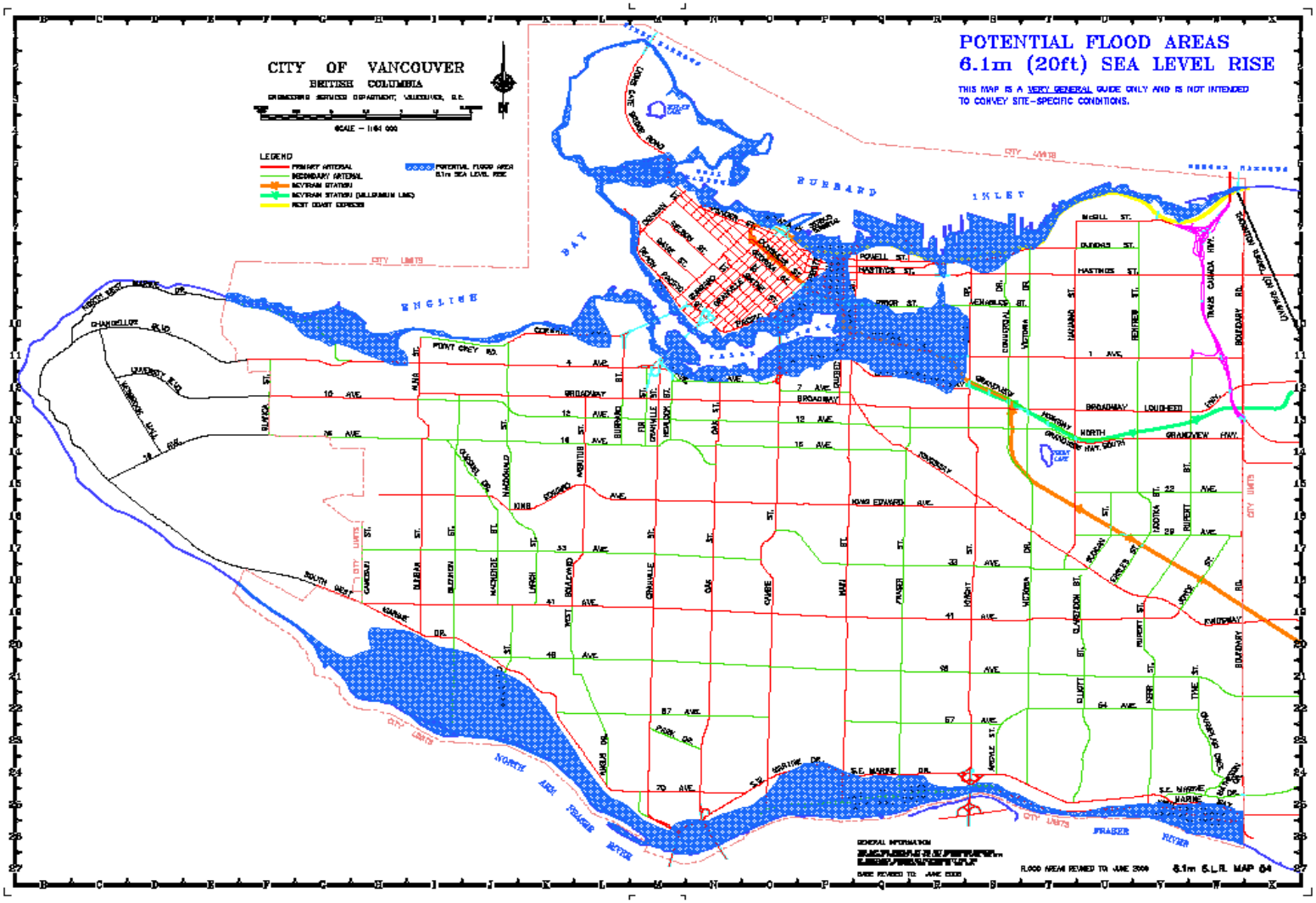
Climate Change – 3m sea level rise (2100)



Climate Change – 6m sea level rise (extreme est.)



Lowland flooding – rainfall + storm surge

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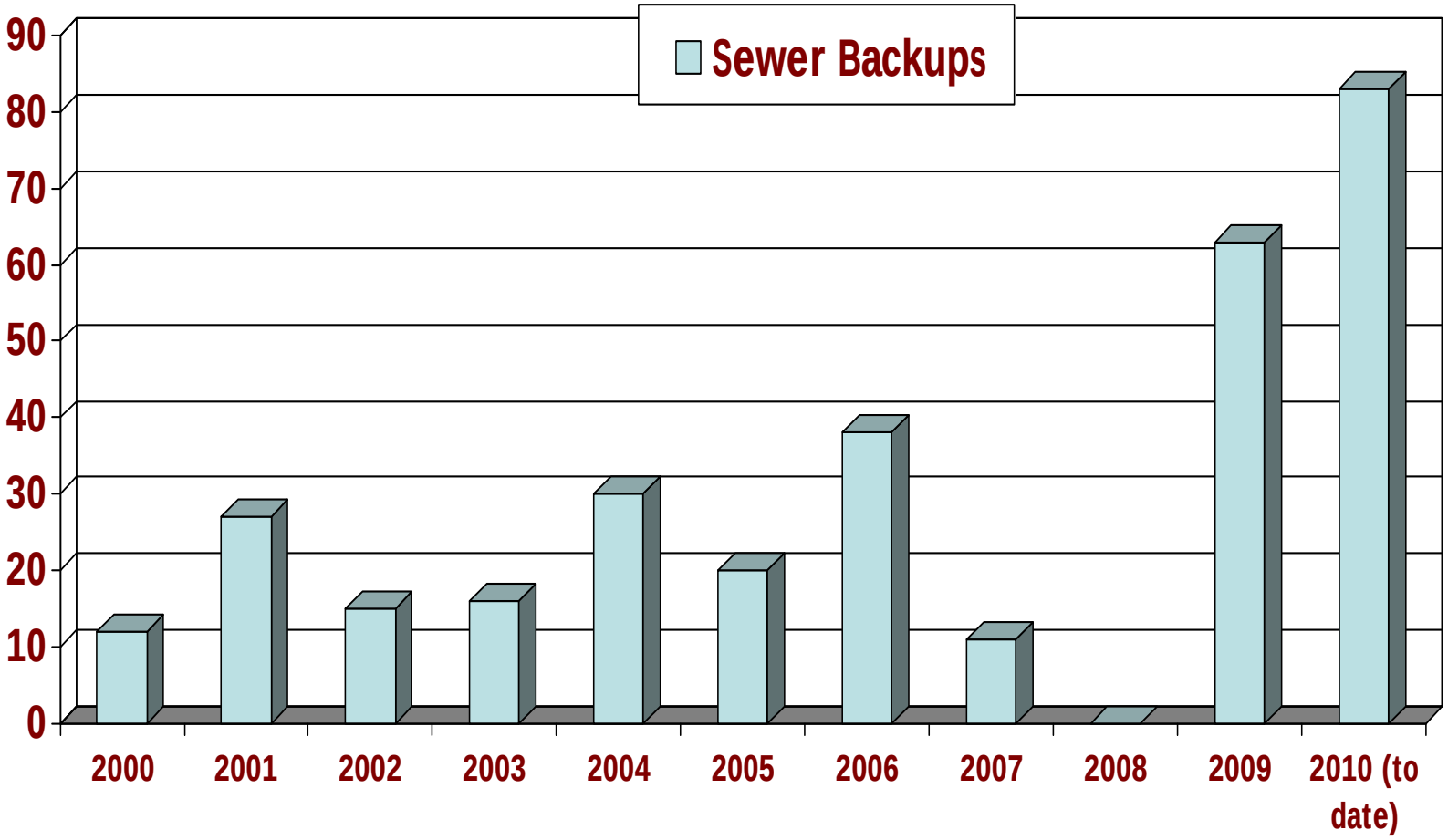
Overland flooding – storm sewer failure (Intense Rain - 2009)

Claims for storm-induced sewage flooding



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English Bay
Vanier Park
Jericho Beach Park
David Lam Park
Granville Island
Pacific Spirit Park
VanDusen Gardens
Queen Elizabeth Park
Point Grey Golf Course
McCleery Golf Course
Langara Golf Course

The impermeable landscape

No place to go

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Storm water detention, treatment & habitat (Hastings Park & Still Creek)

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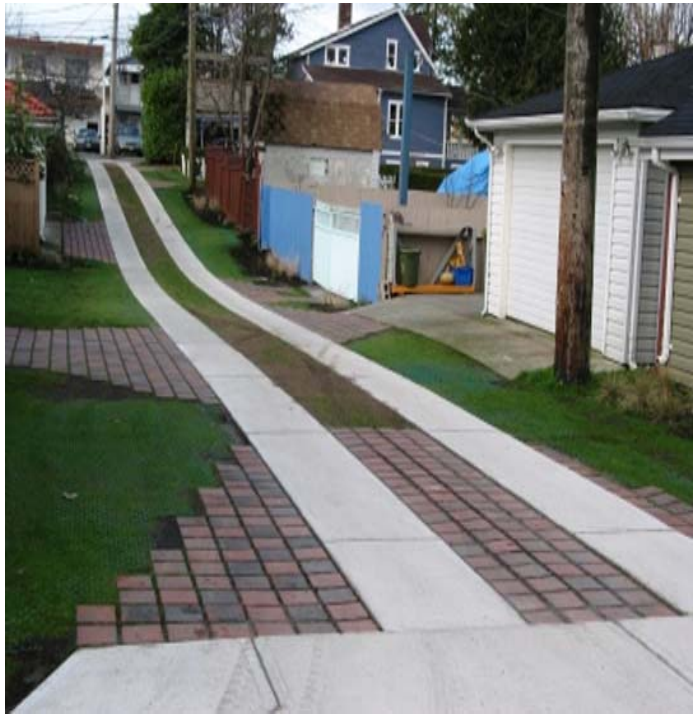
Country Lane – roadway or stormwater system?

Lane or public open space?



New “utilities” – stormwater retention cells

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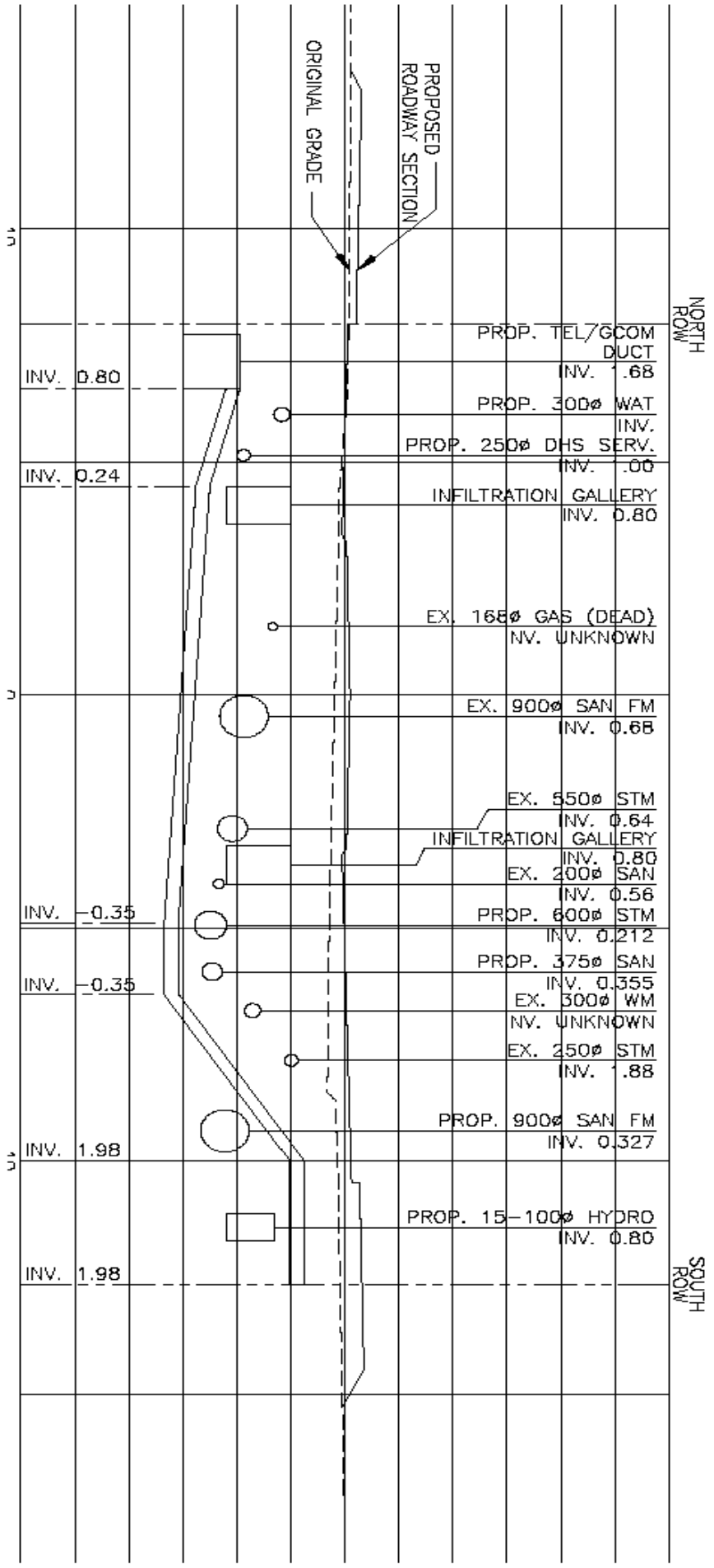

ORIGINAL GRADE
PROPOSED ROADWAY SECTION
NORTH ROW
SOUTH ROW
PROP. TEL/GCOM DUCT
INV. 1.68
INV. 0.80
PROP. 300ø WAT
INV.
PROP. 250ø DHS SERV.
INV. .00
INV. 0.24
INFILTRATION GALLERY
INV. 0.80
EX. 168ø GAS (DEAD)
NV. UNKNOWN
EX. 900ø SAN FM
INV. 0.68
EX. 550ø STM
INV. 0.64
INFILTRATION GALLERY
INV. 0.80
EX. 200ø SAN
INV. 0.56
INV. -0.35
PROP. 600ø STM
INV. 0.212
PROP. 375ø SAN
INV. -0.35
INV. 0.355
EX. 300ø WM
NV. UNKNOWN
EX. 250ø STM
INV. 1.88
PROP. 900ø SAN FM
INV. 0.327
INV. 1.98
PROP. 15-100ø HYDRO
INV. 0.80
INV. 1.98

Vancouver's Greenhouse Gas Targets

2010
Municipal operations emissions — reduce 20% (achieved)

2012
Carbon neutral municipal operations

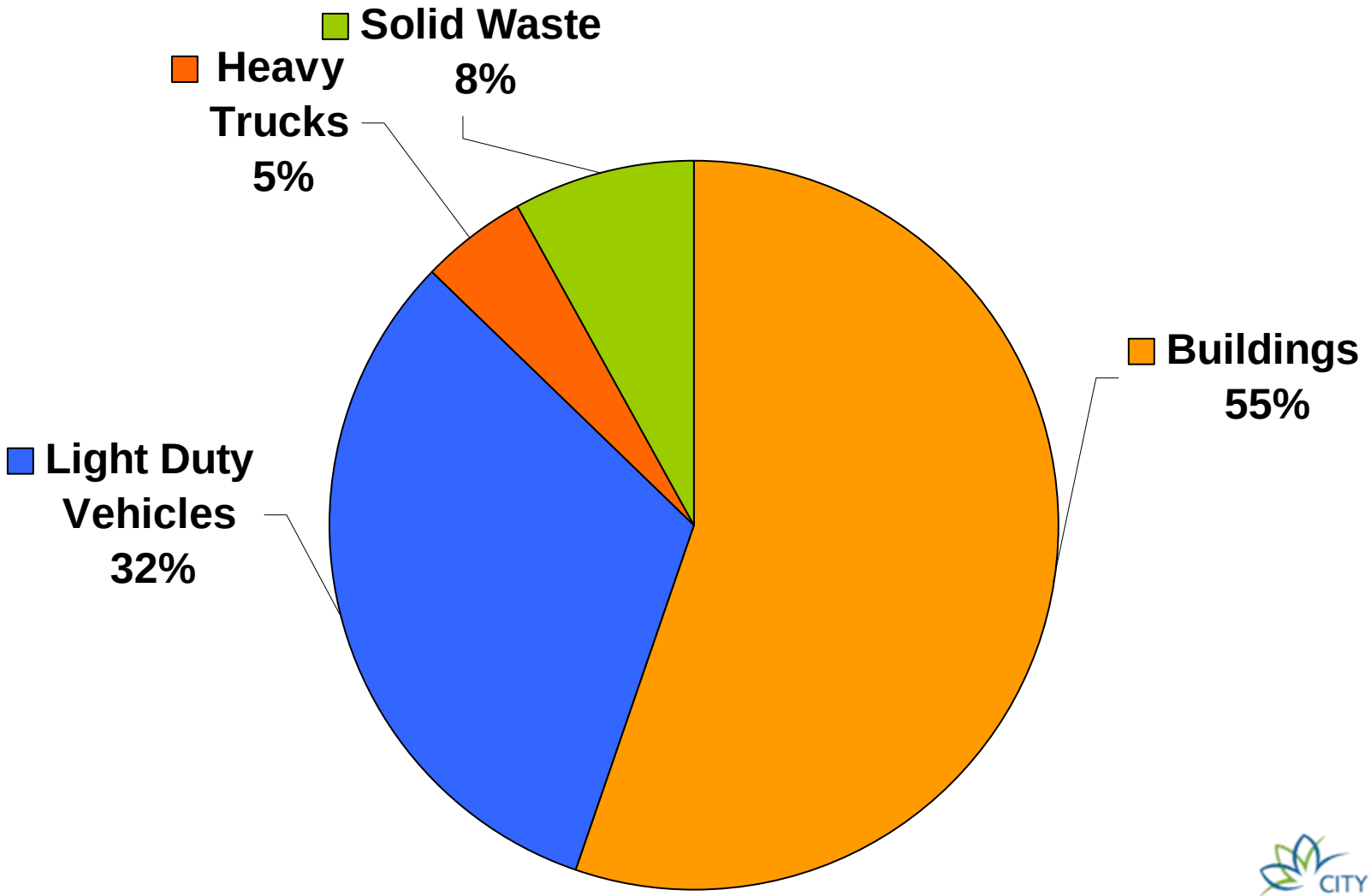
Reduce community emissions by 6% (on track to achieving)

2020
Reduce community emissions by 33% to 2007 levels

All new buildings are carbon neutral

2050
Reduce community emissions by 80%

Vancouver's 2008 GHG Emissions



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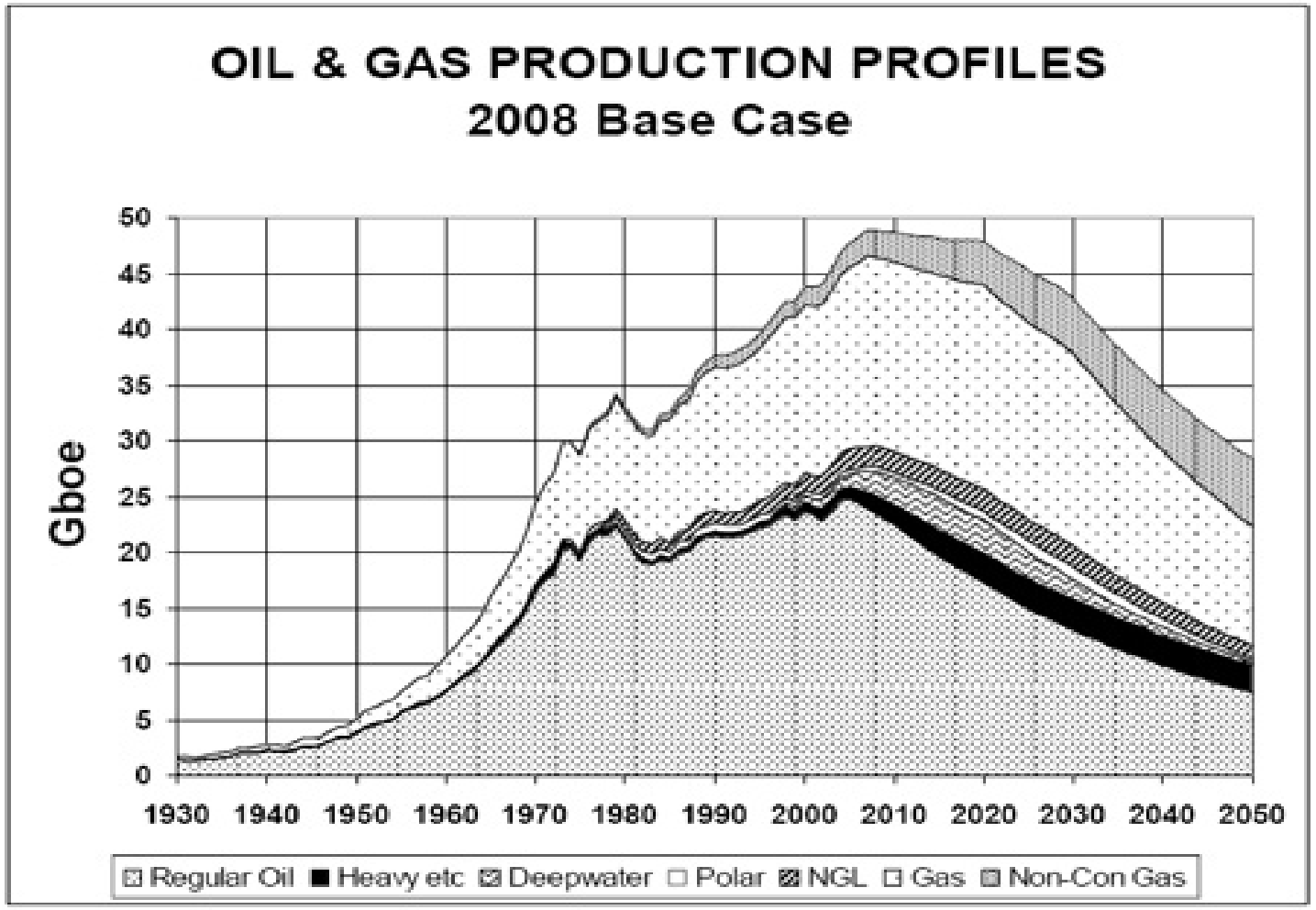
Pressures – Peak Oil/Changing Energy Supply



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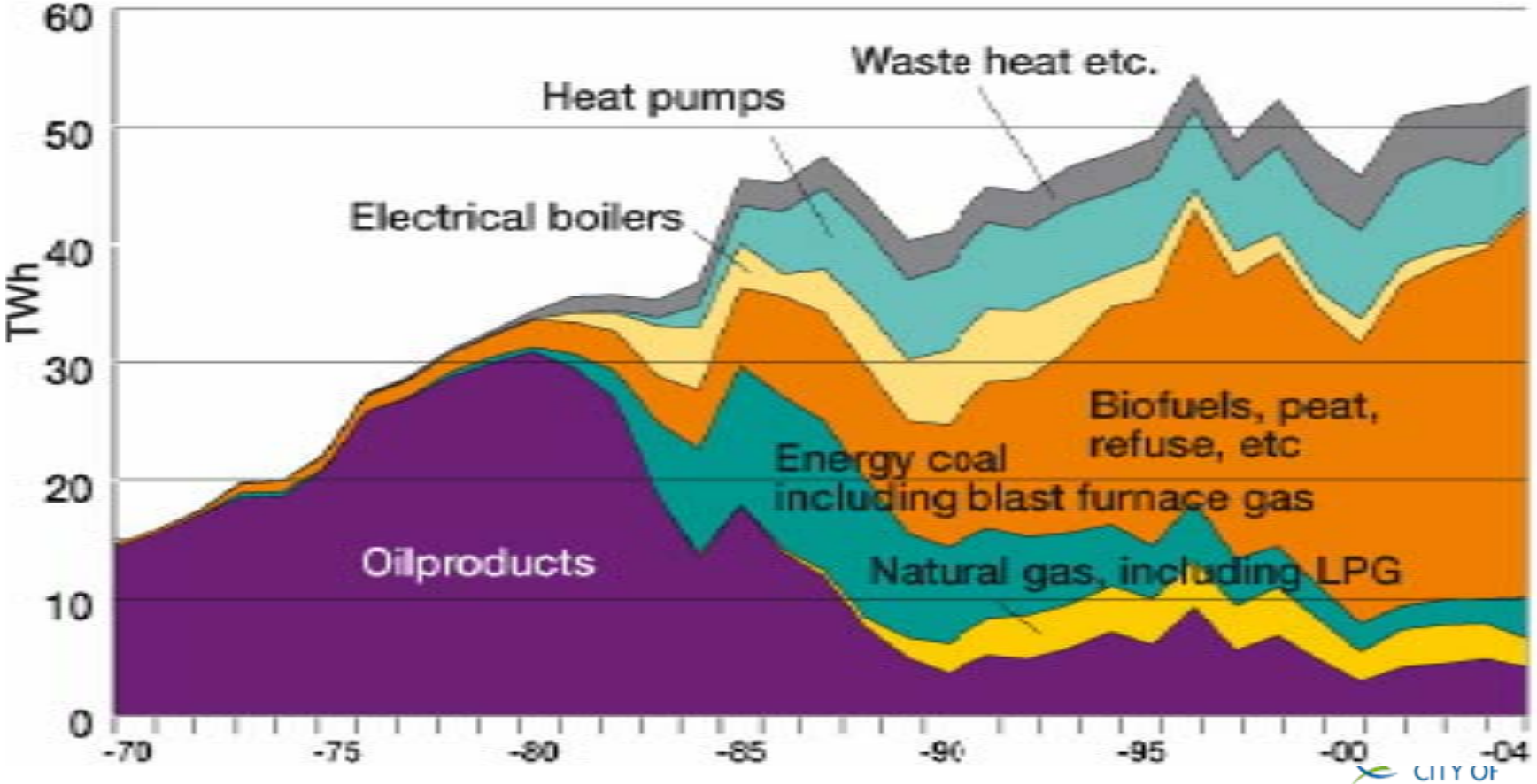
Enabling an Adaptable Low Carbon Future

Swedish District Energy Growth and Energy Mix 1970 - 2004



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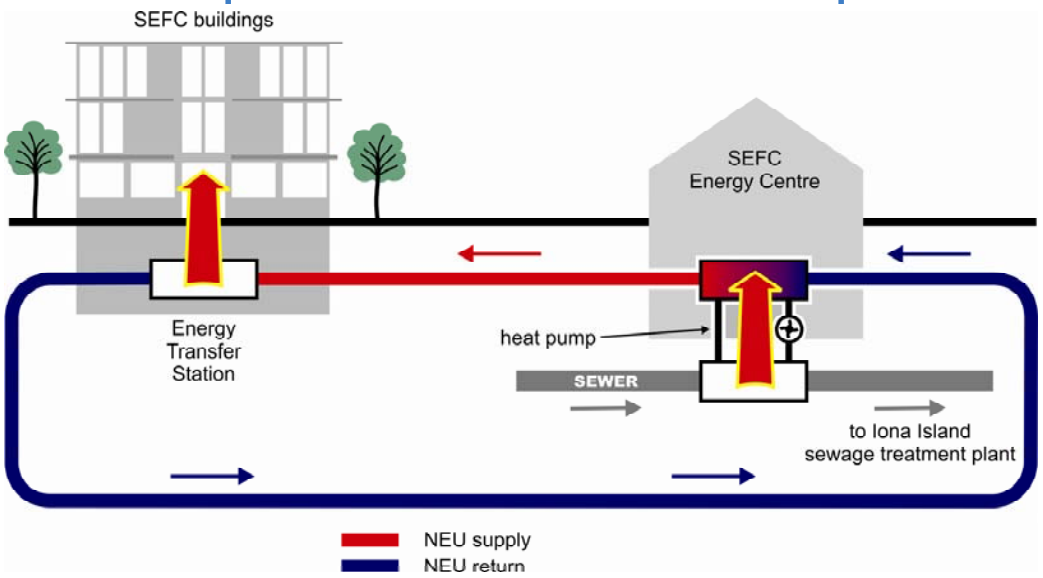
Neighbourhood Energy Utility

South East False Creek NEU

- Build-out = 6 million square feet, 16,000 residents
- Sewer heat recovery supplemented by solar hot water
- Renewable sources = 70% of heating (gas boilers for peaking and back-up); reduce GHG emissions >50%
- Financially sound, fuel price resilient, and adaptable to new technologies



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False Creek Energy Centre
(sewage pump station & heat recovery plant)

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Lessons from SEFC NEU Development

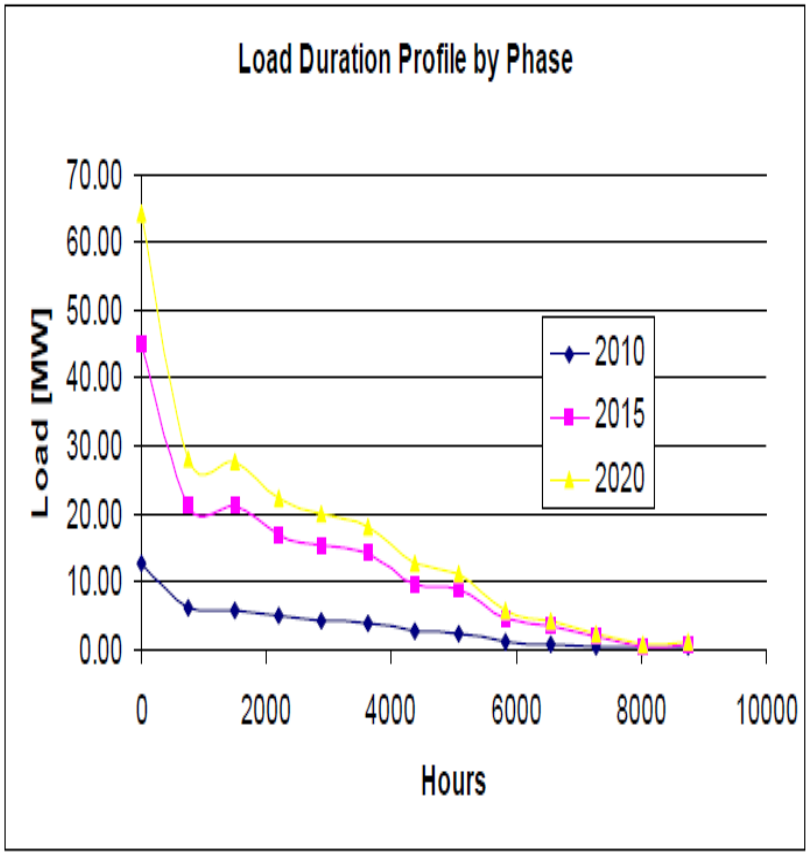
Economic viability of systems strongly dependant on:

- heat load density
- matching size of green source to base load;
- installing green technology when there is sufficient demand

Long-term success will depend on:

- Competitive rates
- Self-funding utility model
- Reliable, high quality service

Figure 1 – Space Heat Load Duration Profile by Stage



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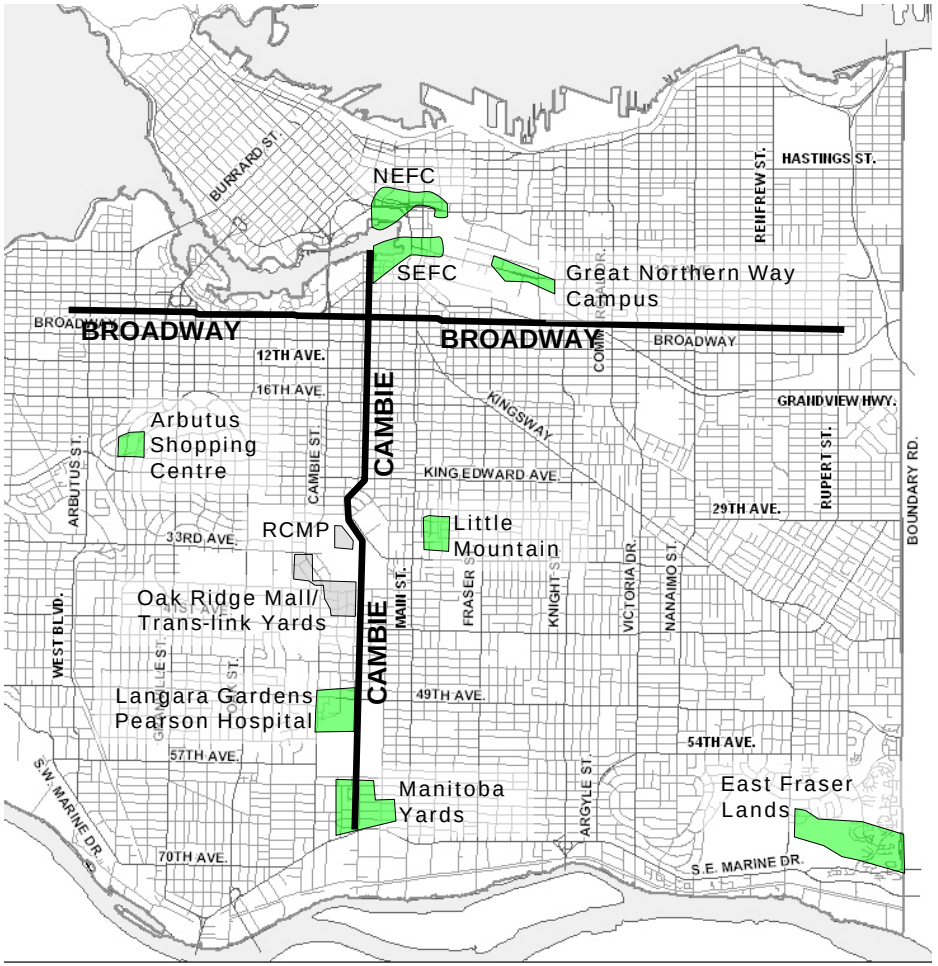
District Energy Expansion in Vancouver

Imagine a Vancouver where …

New large site developments catalyze development of renewable district energy systems.



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Current Opportunities

Expand SEFC NEU

- System sized to serve SEFC at build-out
- Seeking immediate opportunities to serve properties just outside SEFC; ; flats service planned but will require 2nd energy centre
- SEFC system cannot serve NEFC

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Current Opportunities

Establish a District System for EFL

- System is financially viable
- Small initial loads = initial system heat from energy centre with conventional boilers
- Connection to renewable source will be financially viable in 2022 (without grants)
- Most promising option for sustainable energy is waste heat from Metro's Burnaby WTE facility
- Parklane has approached City and are in partnership discussions

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Current Opportunities

Establish a District System for NEFC

- Screening level assessment = system likely viable
- Central Heat steam system = peak and back-up heat for NEFC neighbourhood
- More detailed feasibility and preliminary system design is underway with Central Heat
- Initial re-zonings require connection to a system; building design to enable connection to hot water distribution system; and agreements requiring connection to renewable system when available

Current Opportunities

PCI/South Cambie District

- Initial study looked only at building scale energy opportunities
- City to lead a district study for the entire district (with funding from developers) – *aiming to have results in time to inform rezoning conditions*
- PCI will develop best sustainable energy plan for their site on a stand alone basis in case sustainable district system not viable

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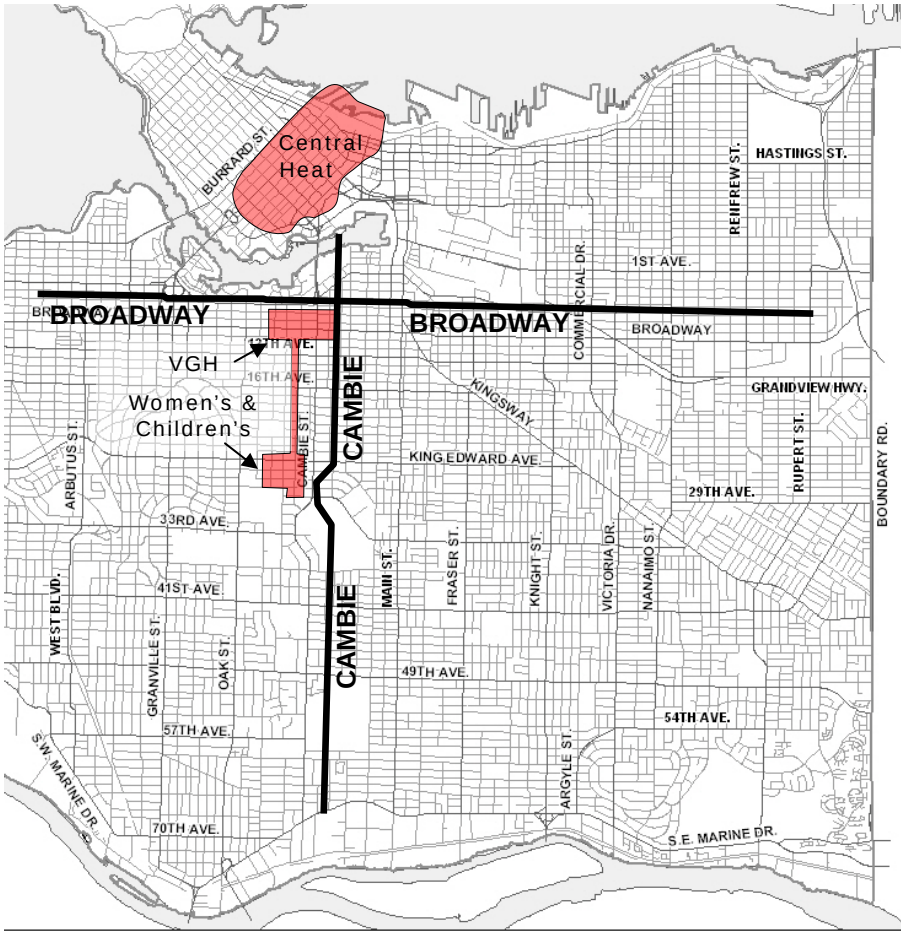
District Energy Expansion in Vancouver

Where …

Existing "legacy steam" systems transition from carbon intensive to renewable fuel supplies.



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Current Opportunities

Central Heat

- Replacing natural gas requires technology that can generate high pressure steam to serve their existing system
- Screening level assessment = new, large scale biomass plant may be very cost competitive way to reduce 80,000t GHG per year using well proven technologies
- Central Heat service area includes or is adjacent to highest existing and future new heat loads; converting to low carbon system is largest GHG opportunity for Vancouver
- Issues to resolve include biomass supply study (system would require approximately 210,000+ tonnes of waste wood per year); air quality impacts; public perception

Current Opportunities

Hospitals

- Children and Women's and VGH's heating systems are connected by existing steam heat line
- Children and Women's boiler replacement delayed to explore renewable heat energy and utility opportunities
- 2010 Provincial funding for public agency energy projects adjusted to target/catalyze this opportunity
- Children and Women's proximity to additional large development sites (RCMP, Bus Barns, etc) could catalyze low carbon zone
- VGH proximity to Central Broadway existing and future loads creates significant opportunity

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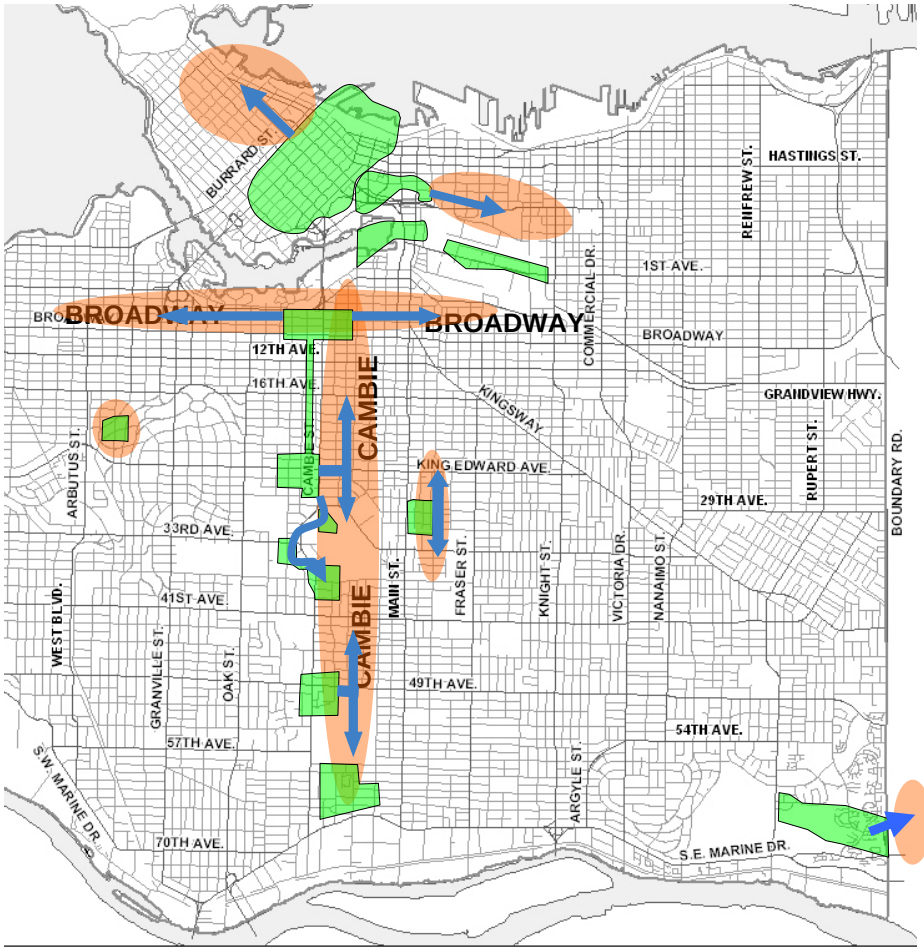
District Energy Expansion in Vancouver

And where …

Development in high growth neighbourhoods and corridors achieve carbon neutrality by connecting to these local renewable energy systems.



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Current Opportunities

"South Bridge"

- Molson's Brewery is large heat energy user; City initiating joint exploration of renewable energy opportunities
- New Bental development east of Molson's may create opportunities to use Molson's waste heat or help anchor a new district scale system
- Neighbourhood has surprisingly high existing heat loads that might be connectable
- Initiating discussion with Squamish development west of Molson's regarding district energy viability

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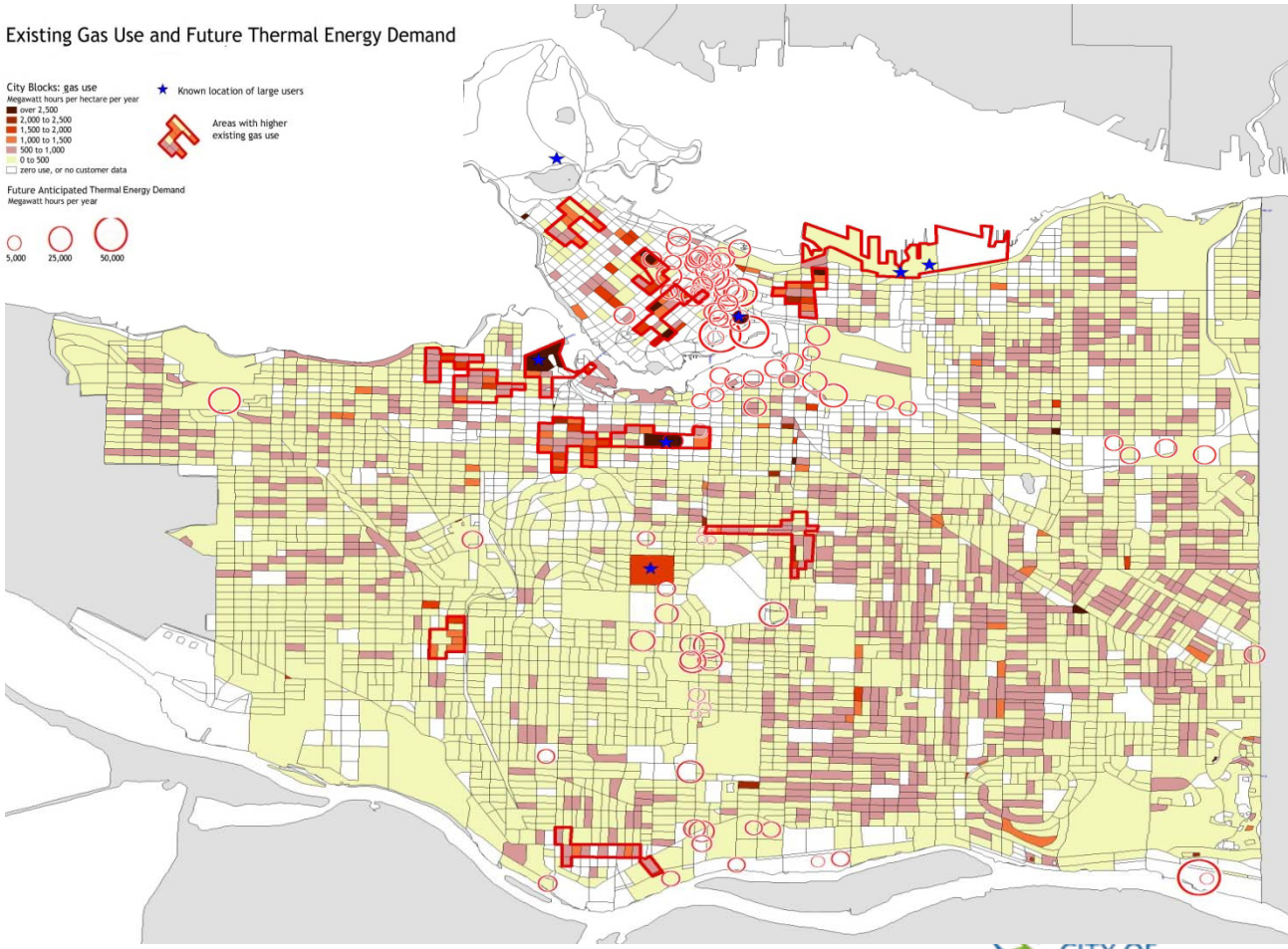
Current Opportunities

Other "2-acre" site studies

- Little Mountain
- Arbutus Centre
- Crofton Manor (West 41st)
- Broadway Tech Centre

Other Projects

- BC Housing – DE Feasibility for downtown properties



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District Energy – System Integration

- http://www.youtube.com/watch?v=AXq4e3RNg_Y

- David Ramslie speaks at Greenest City about Green Buildings and District Energy integration.

- (50 sec. mark)

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The BIG idea – Integrated Resource Management

- The built systems of the City must operate like a man-made ecosystem, with cross-functionality and the ability to constantly evolve.
- If we can do it, this will radically change the relationship between utilities, public spaces, and buildings. For example, buildings become producers of energy, collectors of water, and waste treatment systems, for the community.

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IRM leaders – Hammarby, Sweden

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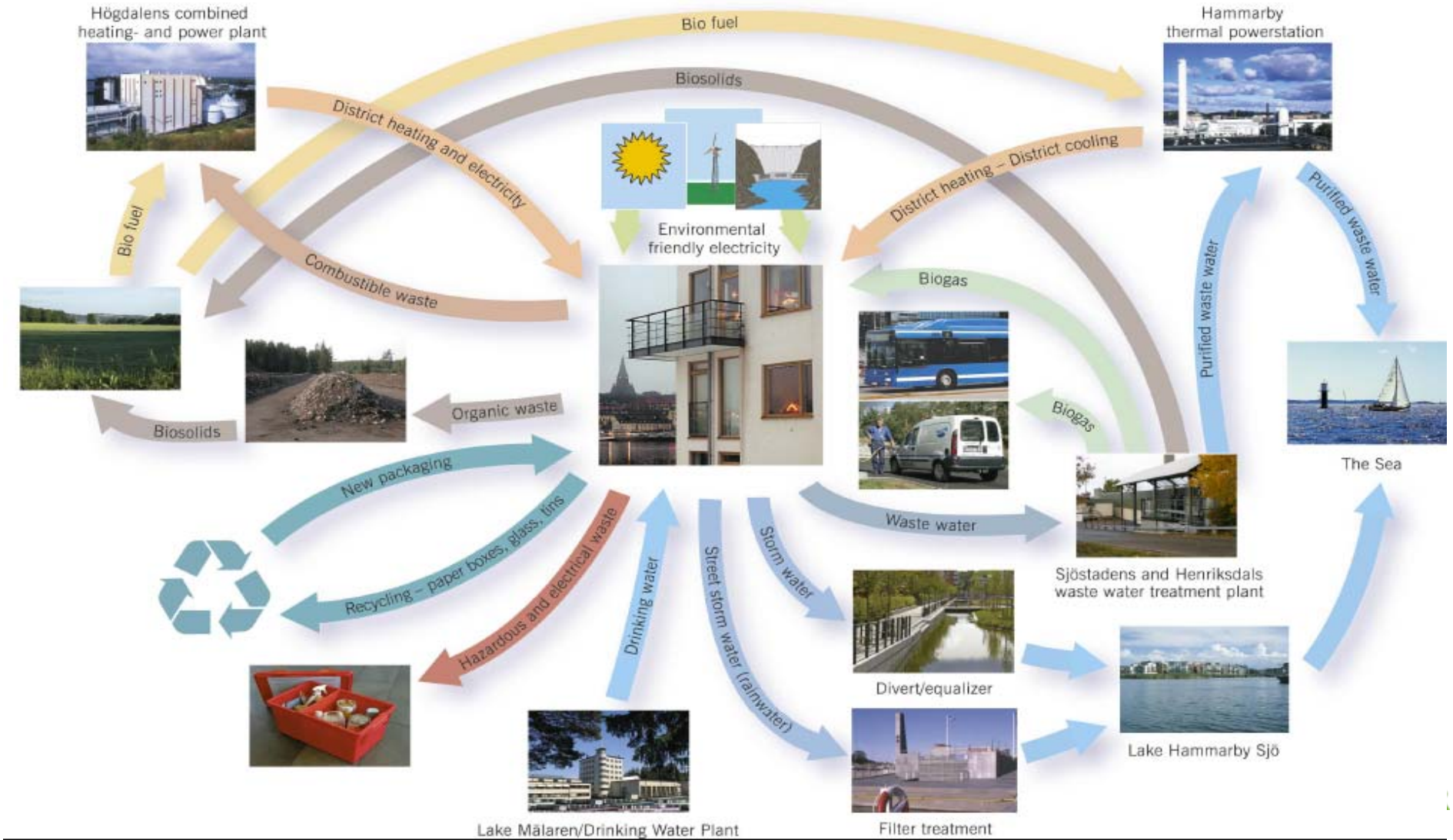
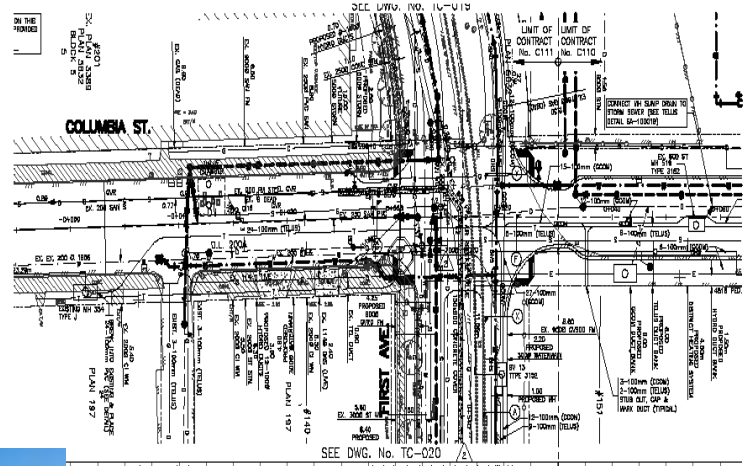
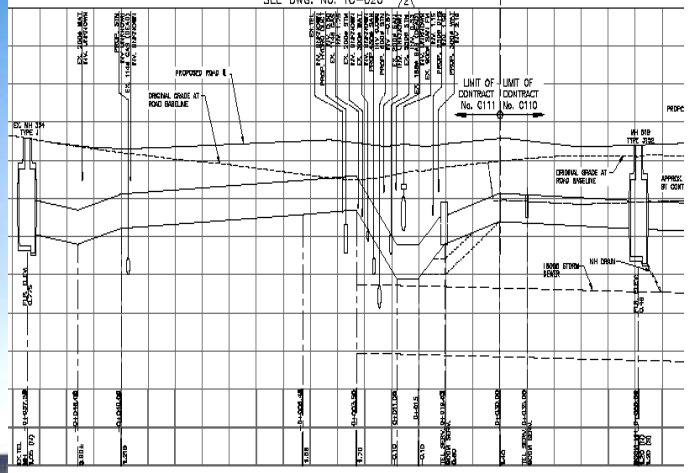
IRM in Sweden, 2007



New Utilities – Where will they go!





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The Case for Space

- Utilities need space
- Generally, they are placed within the public right-of-way (streets)
- They are beginning to integrate into Parks and other public open spaces, as well as dedicated spaces within private buildings
- They are only “one” component of the many functions that must share very limited public spaces

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Competing uses of sidewalk space

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Narrow RoW challenge

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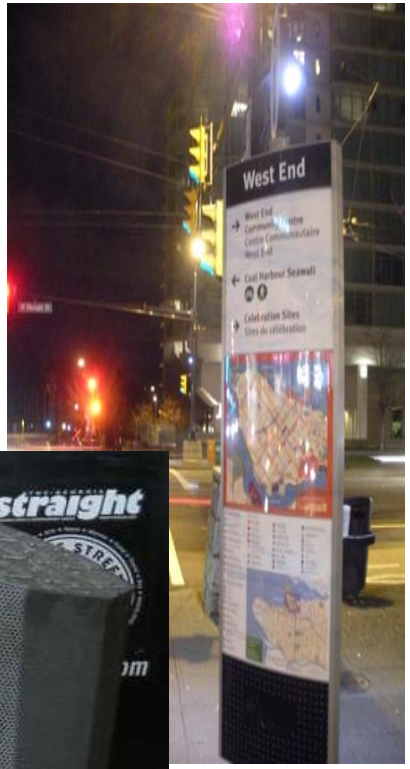
New “utilities”



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Wide RoW – great potential!

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CONCLUSION

- Utilities are…
- The City's lifelines
- Must be thought of as a system, preferably organic, evolutionary, and adaptable
- No longer consist of only pipes & conduits – include gardens, ponds, storage cells, soil systems, special pavements, etc.
- Are critical components of public open spaces – streets, parks, courtyards, etc
- Require space (below and above ground) and regular access to them, thus they compete and sometimes conflict with other desirable uses.
- As the City densifies, Integrated Design is essential to balance those competing needs & interests.

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Habitat as the next “utility”?

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