



Trends & Forces in Small Sewage Treatment

**Waterloo Biofilter Designer's Course,
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**Alan Perks
Trish Johnson
R.V. Anderson Associates Limited**

Small Community Trends in Canada

- A reduction in grants available for capital upgrades has taken place, from 67% to 0%.
- New small scale, cost-effective technologies have become available, but more examples, proof of life and precedents are needed.
- Alternative levels of service can reduce the need for costly fully-piped systems in small communities – i.e. on-site treatment, trickle feed water, low pressure sewers, & package plants.



Small Community Trends in Canada (cont'd)

- Regulatory pressures are also increasing, placing more burden on small municipalities for;
 - ✓ reporting
 - ✓ full cost pricing
 - ✓ more stringent effluent limits
- Regulatory changes are often driven by big city needs.
- There is a need for more creative financing to reduce borrowing costs; i.e. package plants.
- There is an increased need for “outside the box” solutions because conventional servicing costs have been increasing rapidly.



Observations on Small Community Services

- Federal/Provincial Infrastructure Grants can lead to high cost solutions.
- High variability in water use, service levels
- Excessive I/I and ICI flows
- Most small communities on lagoons – optimize them
- On-site failures due to lack of pump outs
- Pipes installed in very small, dispersed communities
- Little correlation between system level and population
- Need to consider onsite (POU/POE) and communal technologies via pilot projects
- Important to work within “Guidelines & Objectives”

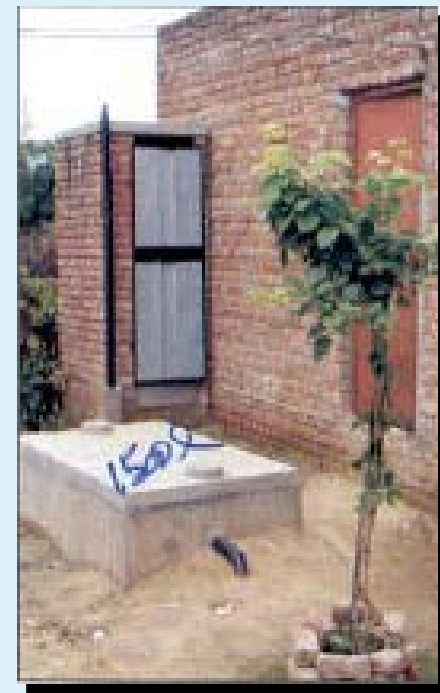
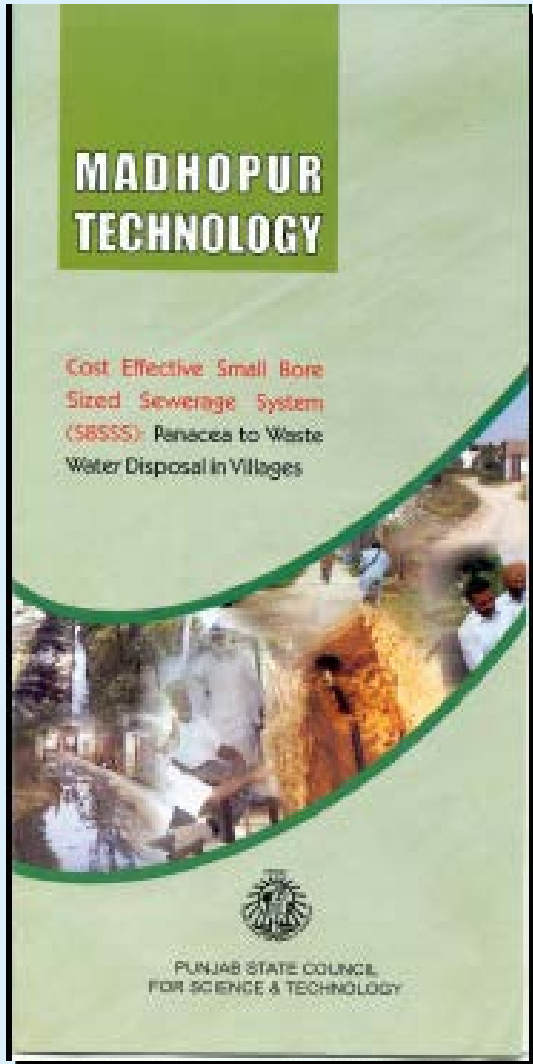


What are the Priorities for Small Communities?

- Consistent approvals/flexible regulations
- Simple, low cost, low maintenance
- Greater awareness of cost effective pilots
- Better training and support
- Reliable systems that work
- Performance guarantees
- Maintenance contracts
- Low cost / on-site facilities +/- \$15-20,000 per house
- Cost per connection the most important performance indicator.



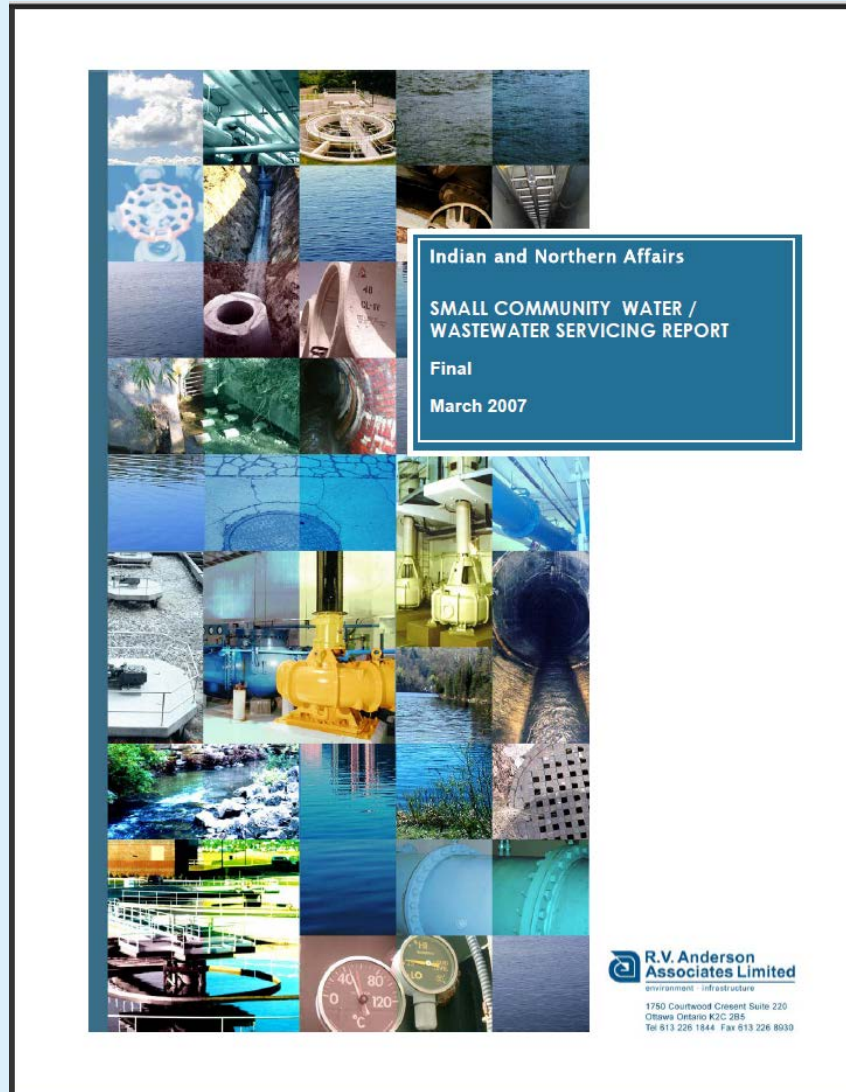
For example – a small bore gravity sewer from India (with a syphon in the most upstream manhole)



Siphon to flush upstream sewers



There is Increased Interest in Small Communal Systems in Canada

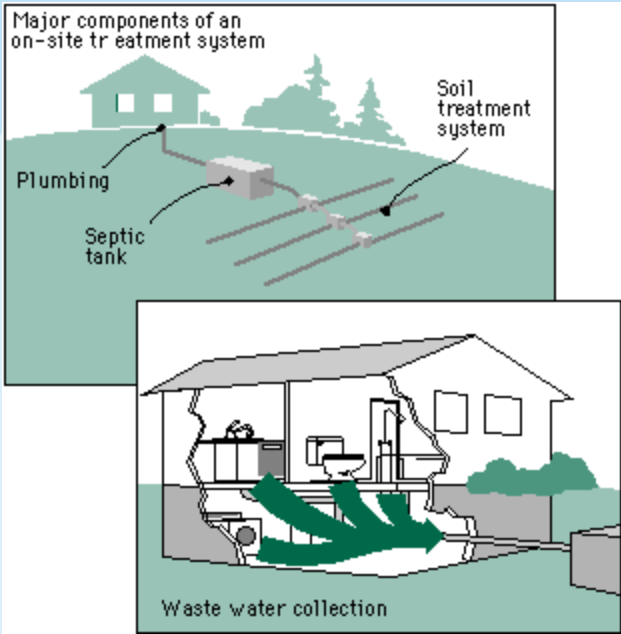


Faced with increasing capital and O&M costs for small First Nations communities, INAC engaged RVA to prepare an assessment of appropriate solutions for communities with less than 1000 population.

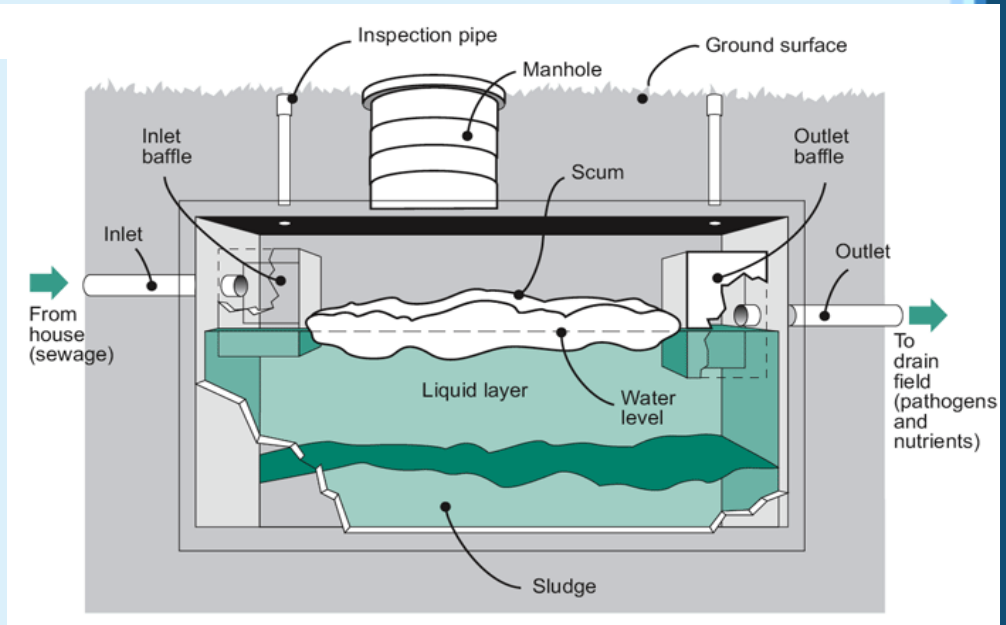
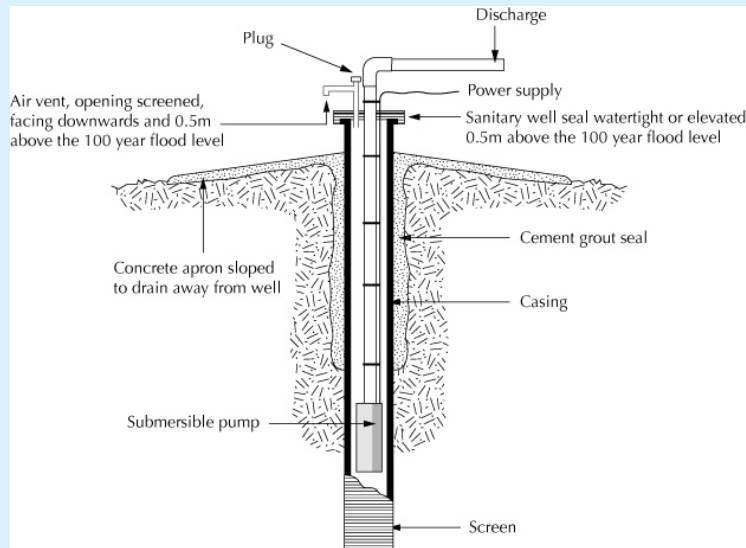
90% of First Nations communities are less than 1,000 population.

Conventional servicing of small, remote communities can be very expensive.





3 million homes in Canada rely on onsite or communal water and wastewater systems to meet their servicing needs



Waterloo Biofilter



Serves 40-80 people
\$7,500 per house

- System is compact, cost-effective, easy to operate, has low maintenance requirements, are primarily passive and suitable for cold weather (-40°C)
- System is fully approved in the Province of Ontario



Peat Based Wastewater Treatment Systems

- Is a passive system – requires less maintenance and eliminates system failure due to mechanical failure.
 - Provides elevated levels of treatment – of particular value in environmentally sensitive areas.
 - Cost effective in many situations, such as impermeable soils, bedrock and failed systems. overall servicing (sewers and treatment) costs by 50 to 70% or more in rocky terrain.
-
- Compact footprint – occupies less footprint than conventional treatment filtration beds.
 - Ability to operate in colder air temperatures without any adverse effects on treatment efficiencies.
 - A number of these systems have been approved by the Nova Scotia Department of Environment (NSDOE) as applications of an innovative technology.

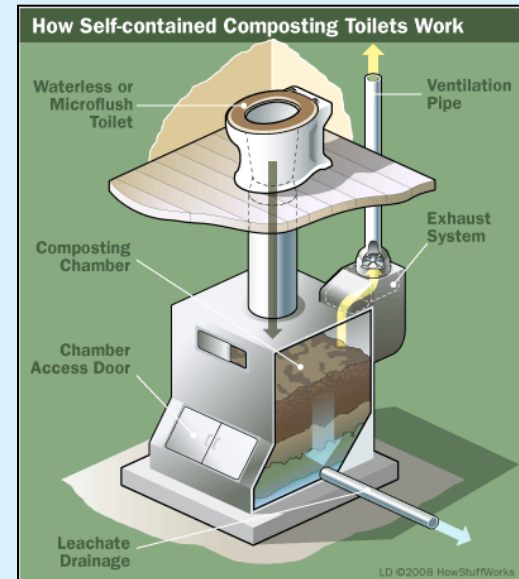


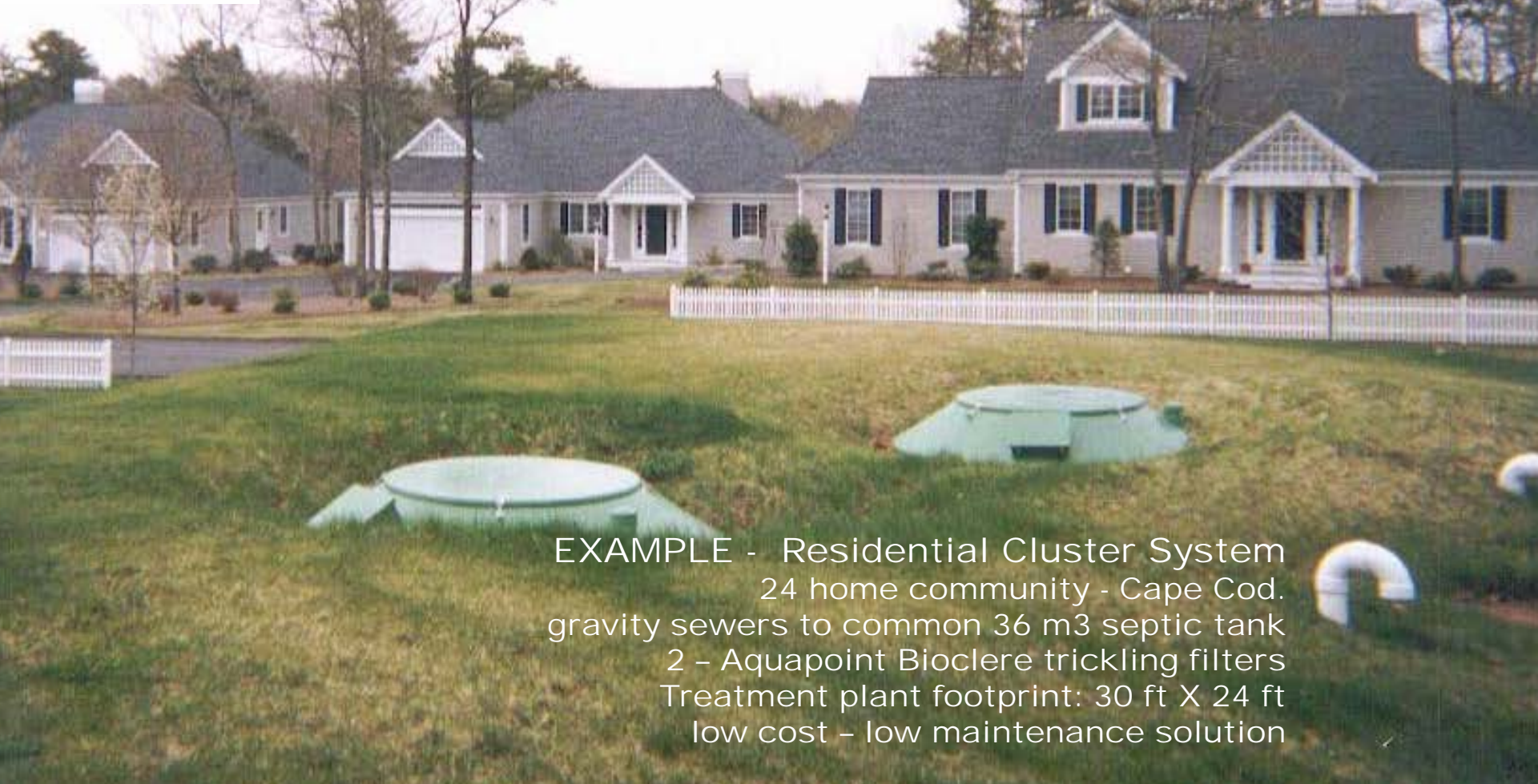
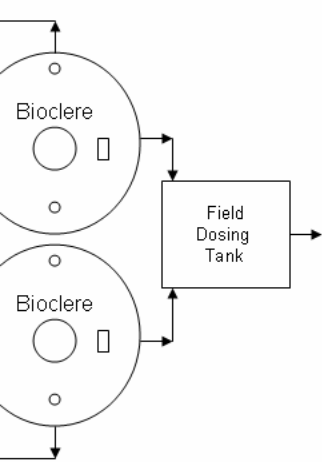
Photo by Kathleen Blanchard



Composting Toilets (Sun Mar)

- Utilize composting and dehydration processes to produce a useable end-product that is a valuable soil additive.
- Use little or no water, has minimal power requirements.
- Suitable for rocky areas
- Canada is known to be as a leader in composting toilet technology.
- The Centre for Indigenous Environmental Resources (CIER) assessed composting toilet technology in northern First Nations Communities. As a result, they determined that this technology was feasible, even in very cold climates.





EXAMPLE - Residential Cluster System
24 home community - Cape Cod.
gravity sewers to common 36 m³ septic tank
2 - Aquapoint Bioclere trickling filters
Treatment plant footprint: 30 ft X 24 ft
low cost - low maintenance solution

Flush and Haul Systems



The Cowater Alaska Flush Tank and Haul System is a 'miniaturized' water and sewage system. It includes the water and sewage haul system as well as the household installations. The system uses small vehicles like ATVs and snow machines to pull small haul tanks mounted on trailers or sleds. The capital cost is about \$50,000 per house and the annual user fee for water and sewage service is approximately \$1,250.



Geotubes for Sludge Dewatering



Successfully used in Eganville ON to handle septage



Packaged Plants

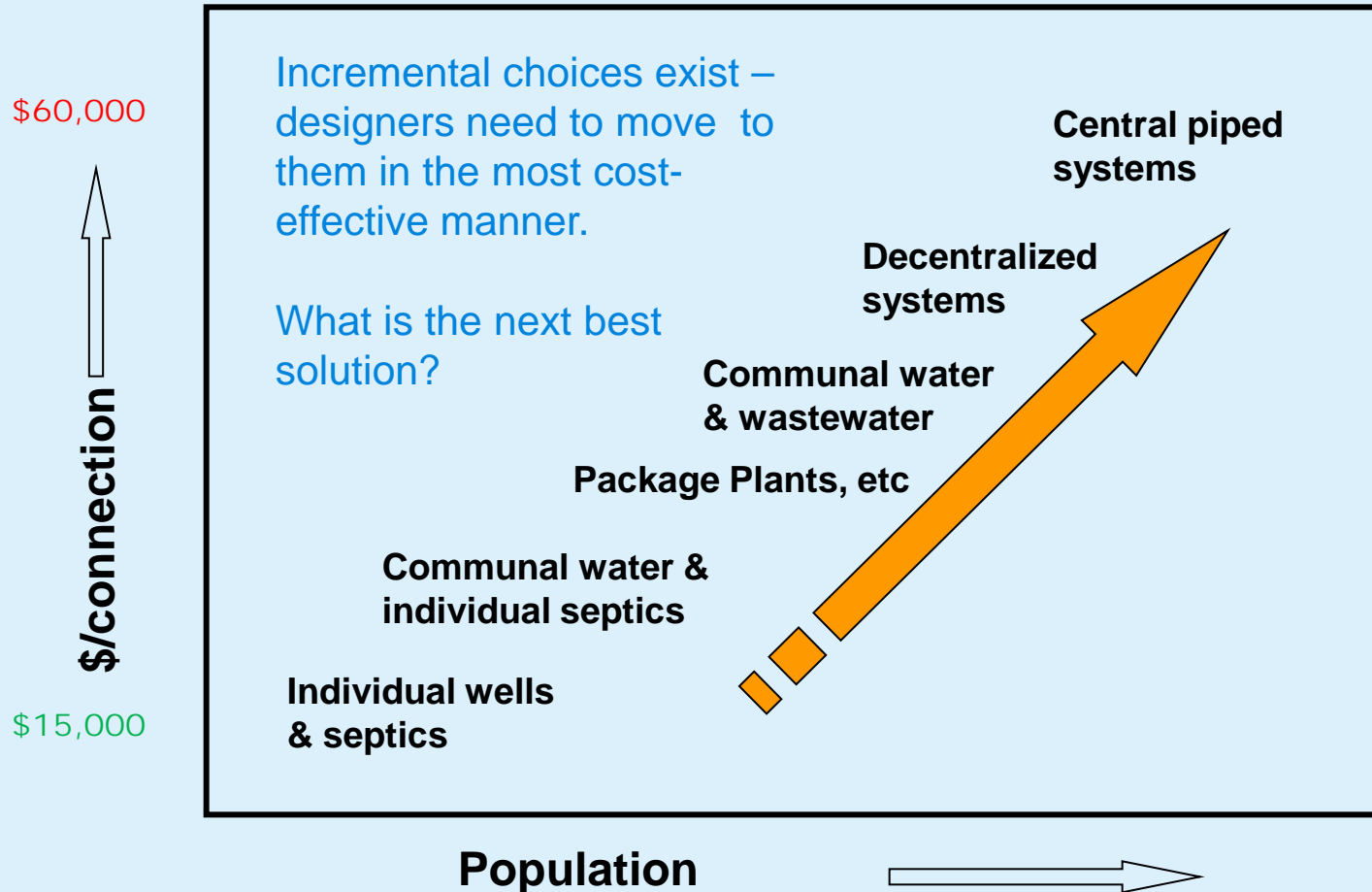
The Reverse Osmosis plant is a fully integrated self-contained system with its own diesel power generator, automatic control system, and a double-pass reverse osmosis water purification system. The system is contained in a palletized enclosure enabling it to be transported via all modes of military transport. The unit can be carried by a HLVW truck equipped with a palletized load system.



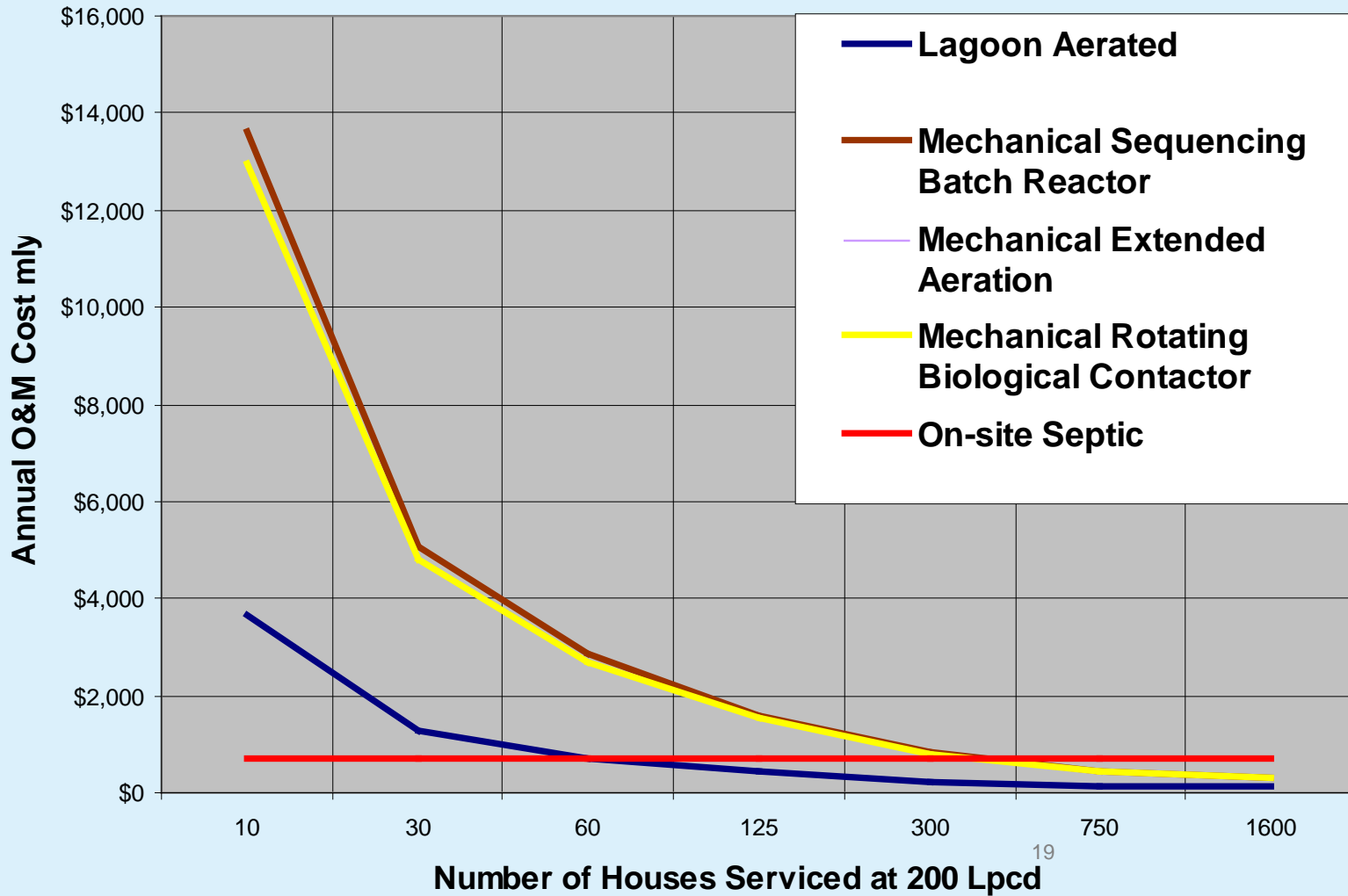
(Cost approx \$5,000 per house, excl transport)



Designers Must Choose the Most Appropriate & Cost-Effective Solution



O&M Costs - Wastewater



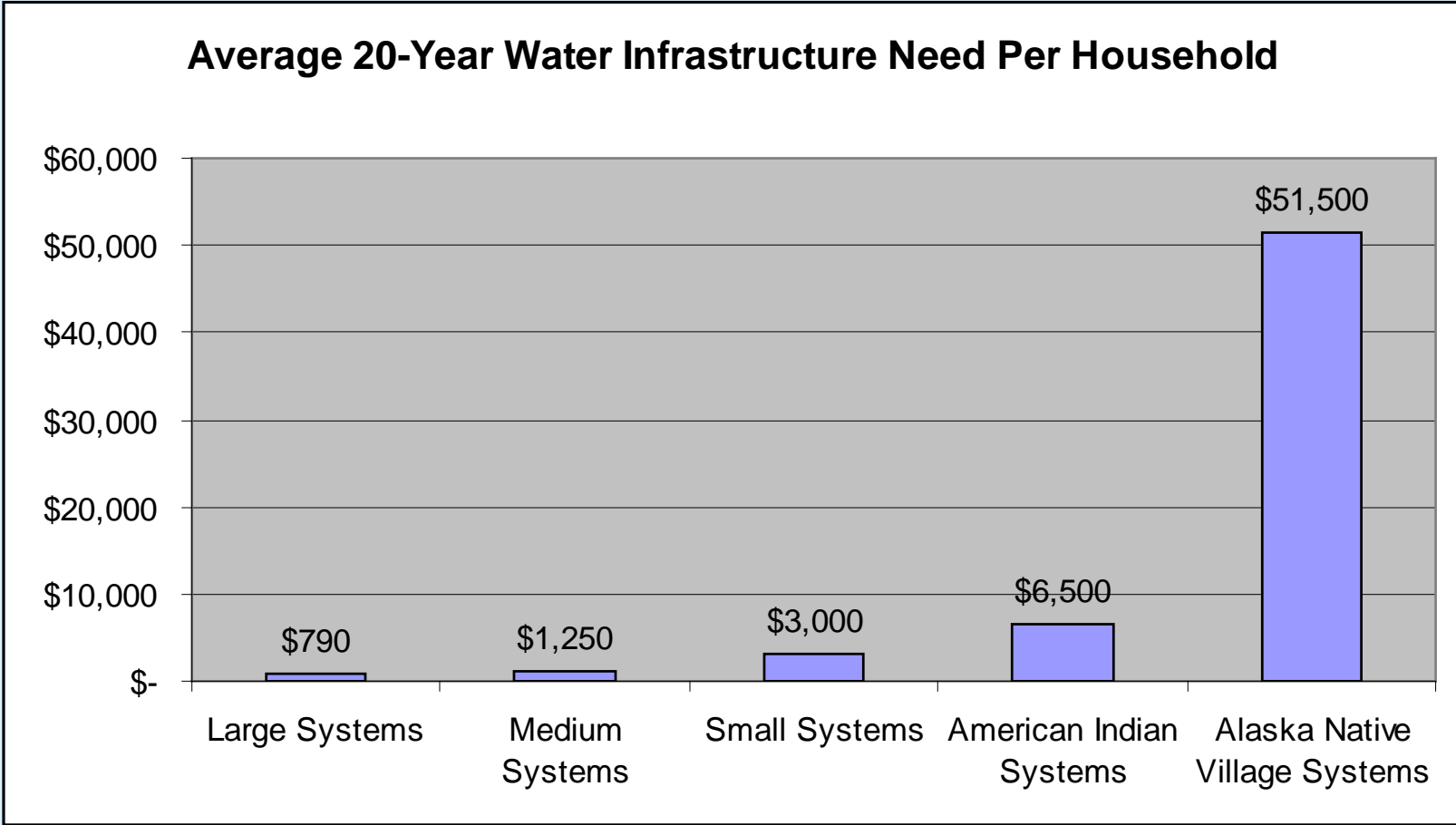
Capital Costs Can Be High

- On-site and communal services , i.e. wells and septics
\$15 - 20K per house
- Conventional subdivision servicing
\$15 - \$20K per house
- Conventional servicing in difficult soils and rock
\$35-\$40K per house
- Conventional services for small and remote communities
\$60k per house *and higher*

As servicing costs increase, the need for small, cost effective, easy to operate alternatives also increases. Small systems and clusters of systems can be very cost effective.



Infrastructure Needs



(source USEPA)



Cost Drivers

- **UNDERGROUND PIPING** is 70%-85% of the cost of conventional sewer/water systems
 - Water but no sewers ?
 - Low density development ?
- **PEAK FLOWS** are very costly to design for
- **FIRE FLOWS** determine watermain size and cost
- **SURFACE EFFLUENT DISCHARGE** is much more expensive than sub-surface disposal
- **SYSTEM LOSSES** can eat up a large part of O&M budget
 - Cost to treat I/I?
 - Leakage/
 - Non-revenue water/
 - Billing errors/



Legacy Systems

- **Underbuilt systems** – short life span & early recapitalization
- **Overbuilt systems** – high O&M costs and inefficient investment
- **Water but no sewers** – overloads existing septics and creates tendency to extend existing high cost services
- **No optimization** – leads to overbuilt situations and inefficient investments
- **Low density development** – very expensive to service with conventional approaches
- **Systems with high I/I** – can result in very expensive upgrades to new electrical & mechanical systems



SWOT Assessment for Small Systems

STRENGTHS

- Cost effectiveness
- Scalability / can be staged
- Rapid installation
- Ease of operation
- Meets performance criteria
- Low water use promoted

WEAKNESSES

- Proof of life – too few examples
- Need more pilot projects for small communities
- Need to “push back” on Regulations & EA’s

OPPORTUNITIES

- First Nations communities
- Create more ‘Mixed’ systems
- Regulatory/financial pressures
- Rapid installation
- Pilot projects & financing
- P Trading

THREATS

- “big pipe” thinking still prevalent
- More stringent regulations
- Need for proper O&M mechanisms
- C of A’s usually force conventional solutions



First Nations need Sustainable Solutions

- 623 communities with 112,566 service connections
- Many Communities still served with truck haul, septics, or watering points
- Mostly small, low density communities where small communal systems could be very cost-effective.



FN Successes

- Low Pressure Water systems – 11 communities in SK
- Reverse Osmosis water plant – Kwicksutaineuk Ah-Kwa-Mish FN in BC
- Peat Moss Wastewater Filters – Labrador Metis Nation in NF
- Wetland treatment system – Six Nations Ohsweken , ON
- Ecoflo Septic system – ON, Que., SK First Nations
- OPTAER wastewater system – Fisher R, Naskapi, Sioux Valley Dakota FN's in MN and QC
- Tundra wetland system – Coral Harbour, in NV



How to get More Cost Effective

- Don't treat clean water – spend to save it!
- Don't produce water to waste it – know where its going!
- Low tech means low cost – and low O&M
- Consider comparative costs on life cycle basis
- Creative partnerships mean creative solutions
- Look for opportunities for staging
- Policy precedents are now being established
 - Pilot New technologies with C of A's
 - Cost-effective solutions like P Trading
- Need to push regulatory agencies for BATEA solutions
- For small municipalities, bigger is NOT necessarily better
- Optimize First!



Strategies for Small Towns

Key tools – key rules

- Officials Plans with 5 year updates
- Master Plans with 5-10 year updates
- EA's now valid for 10 years
- Affordability driving greater need for cost effectiveness & innovation
- Need to re-assess conventional solutions, question authority & push back on regulatory directives

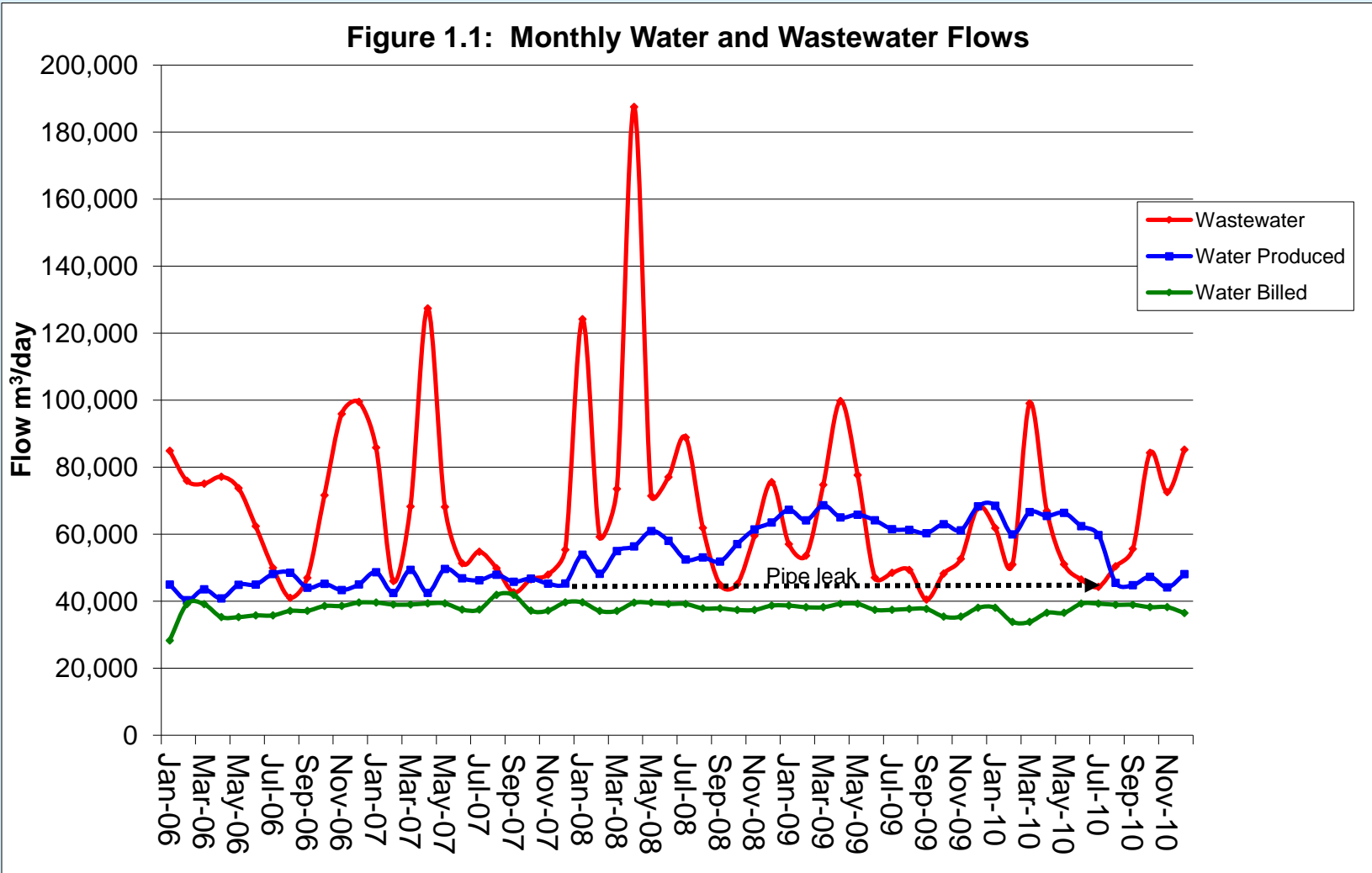


Municipality of North Grenville

- 2005 Master Plan to “Twin the Plant”
- Excessive I/I situation – treating clean water from pipe leaks, sumps, etc.
- Successful I/I reduction work to reduce inflows
- WPCP EA considered alternative servicing strategies - preferred solution included staged expansion with;
 - Equalization facility to manage peak flows more cost effectively
 - Phosphorus trading instead of phosphorus treatment train at plant
- Trading solution could include storm water, agricultural practices and small communal systems as offsets to more expensive WPCP plant treatment train.
- Significant cost savings resulted from these best practices



Monthly Water & Wastewater Flows North Grenville

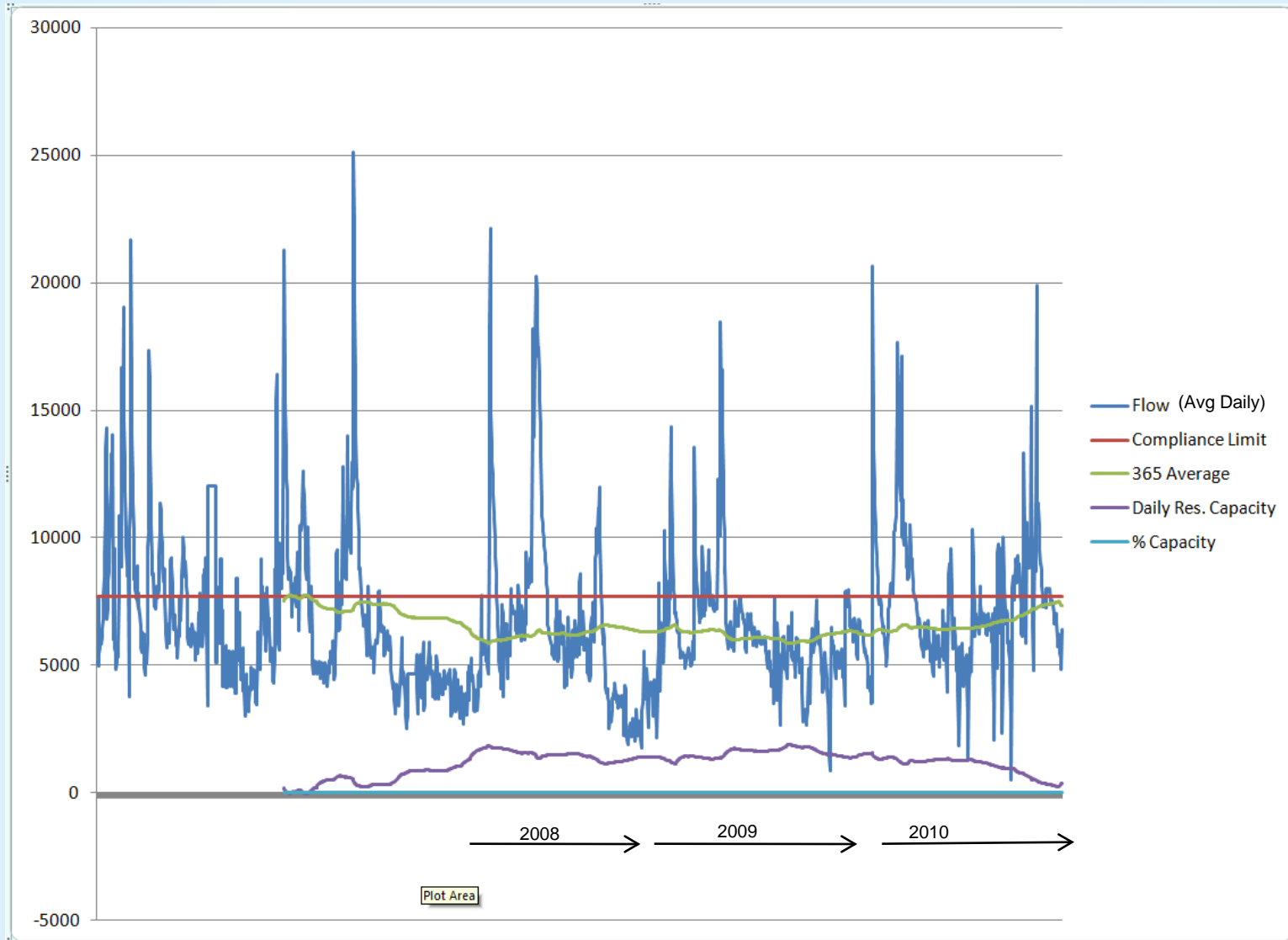


Town of Perth

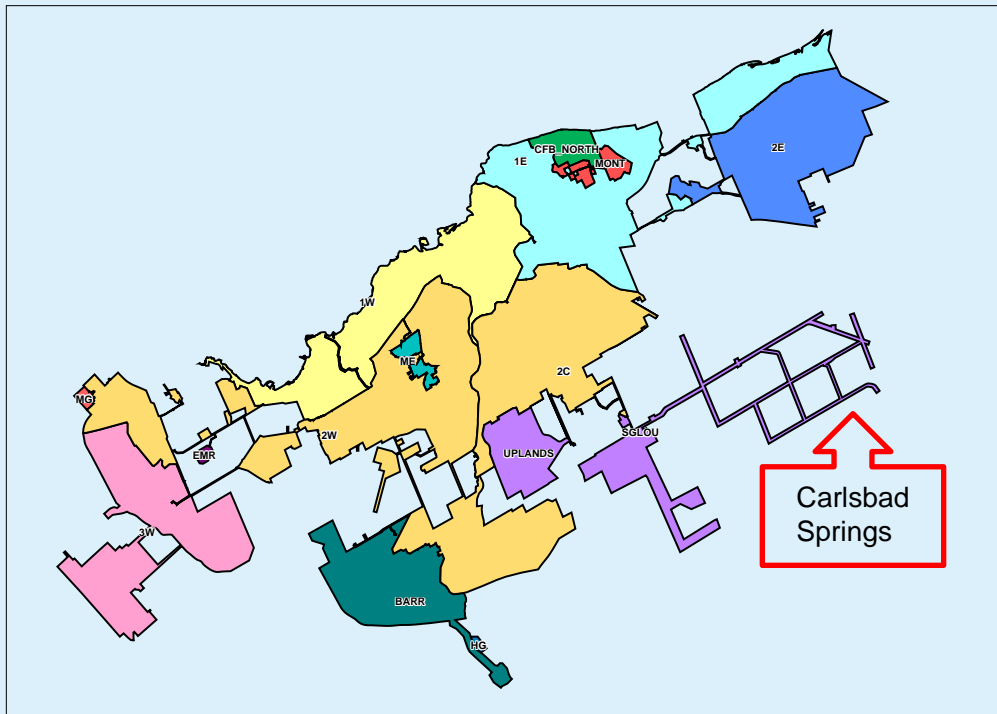
- Lagoon was designed in 1964 for a population of 8,500, but current population is only 6,600.
- However, the lagoon was reaching its C of A capacity due to high I/I and ICI discharges.
- I/I and HVU reduction work reduced lagoon inflows significantly from 94% to 78% through;
 - Sewer sealing and replacement
 - Manhole sealing
 - Redirecting cooling water to storm sewers
- Lagoon inflows creeping back up so polishing and optimization alternatives being considered to extend its useful life.
- P-trading can be a cost effective option in such case.s
- South Nation Conservation has successfully operated a P Trading program for lagoons for 12 years – at a 4:1 offset ratio.



Sewage Flows to Perth Lagoon



Carlsbad Springs Trickle Feed System



Carlsbad Springs was too far to connect to city trunk water main

A small diameter PVC feeder main was plowed into edge of roadway

Every house has 650 litre fibreglass storage tank riding on the small feeder main – and a pneumatic pump to pressurize the house.

Fire protection via pumper tank fire trucks

The system was 33% of the cost of conventional servicing via connection to City trunk water main.

Residents have been quite satisfied with the result – financially and operationally



The Road to Success for small systems designers

- Be heard in basic municipal decision making audiences who:
 - ✓ Are logical but non-technical
 - ✓ Understand responsibilities and budgets
 - ✓ Need sustainable, cost-effective solutions
- Let the data and experience tell the story
- Need confidence and guidance to think “outside the box”
- Need BATEA – Best Available Technology Economically Available



Creative Solutions are Needed

- Less “big pipe” thinking
- Simple to operate + low cost
- Alternative levels of service
- Mixed systems approach
- Water Quality Trading
- Demonstrate the 3 R's in design

