Securing Water for Sunderland
Searching for Liquid Gold

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November 14, 2023

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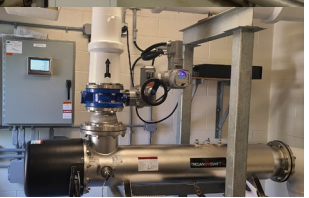
Searching for Liquid Gold - Outline

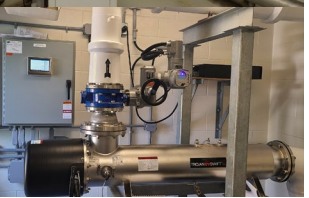


- Background
- Beneath the placid surface…
- When it rains…it pours…
  - Aging Wells & Infrastructure
  - Need for redundancy → searching for New Water Supply
  - Upgrades at existing wells
- Searching for Liquid Gold
  - Searching for immediate solution
    - Well exploration
    - Treatment strategy
  - Searching for long term solution – Class EA
  - Searching to maximize longevity of existing infrastructure
- Lessons Learned
- Acknowledgement

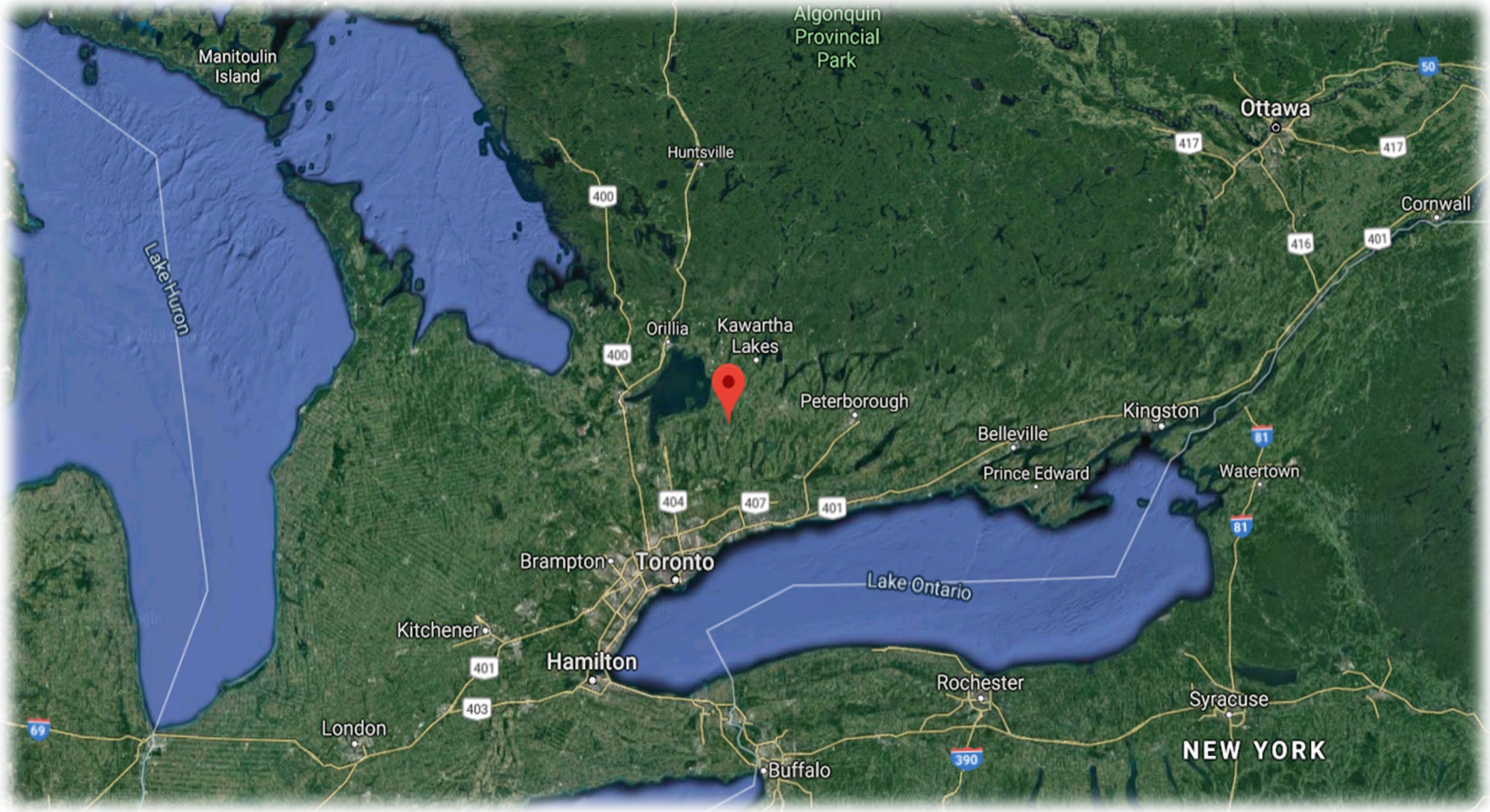
Searching for Liquid Gold - Background







- Where is Sunderland?



Images taken from Google Earth

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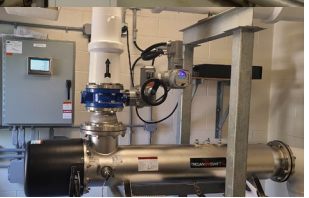

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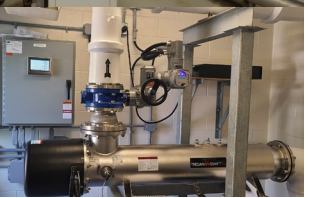

- Population (2021): 1,490 serviced population
- Water Demand (2007-2022)
  - Average day: 3.7 L/s (319 m^3/day)
  - Maximum day: 8.0 L/s (690 m^3/day)
- Water System (prior to 2018)
  - 2 Municipal Wells - MW1, MW2
  - Firm capacity: 8.2 L/s
  - Water source – groundwater, GUDI with in-situ effective filtration (near Beaver River)
  - Shared treatment facility – UV & chlorine disinfection
  - Standpipe 1,773m^3 (with limited useable volume)

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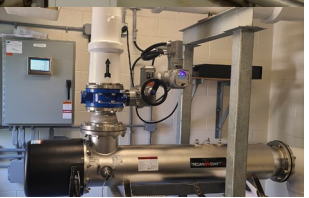

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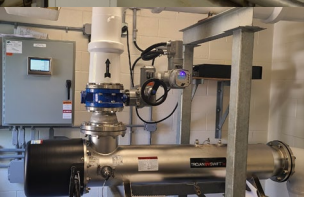

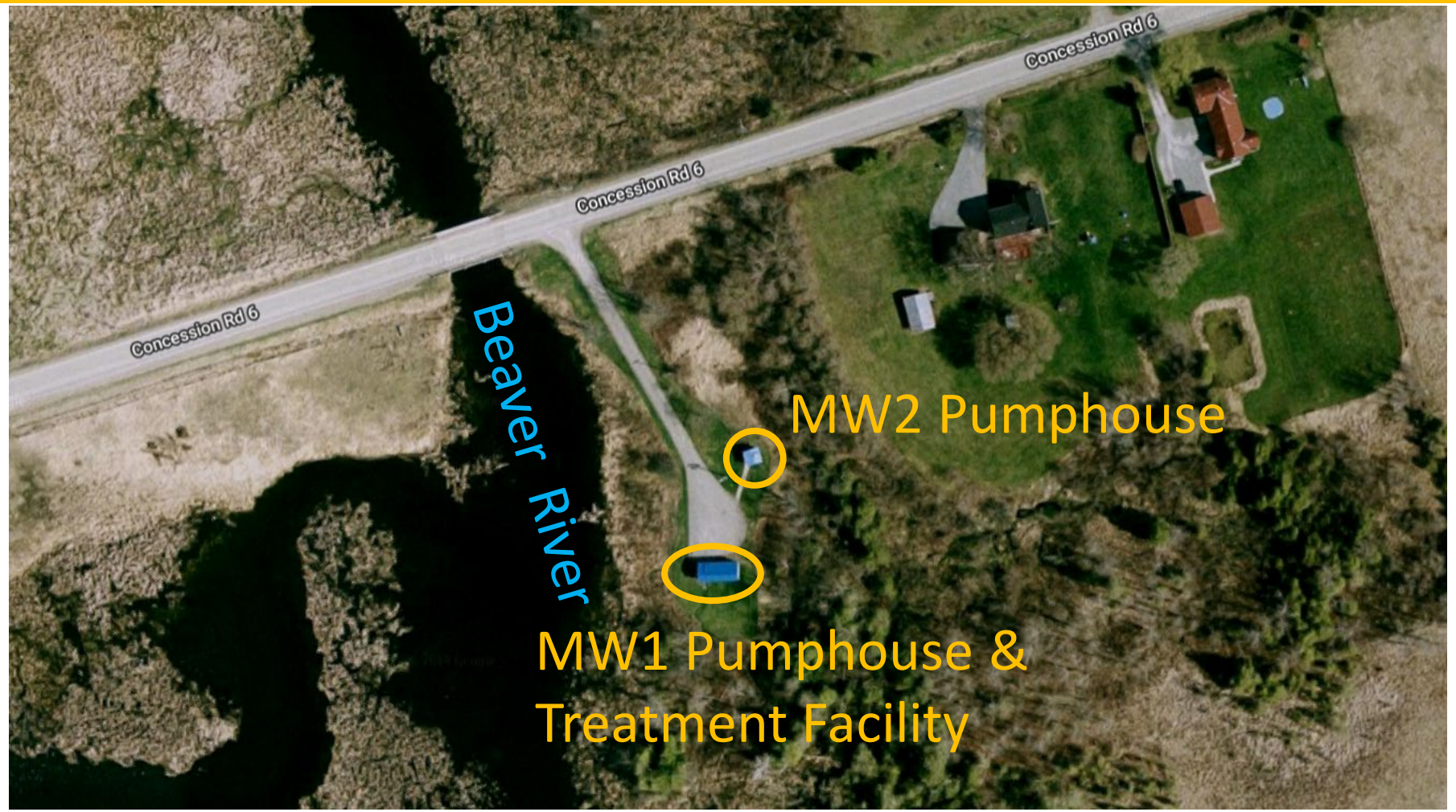

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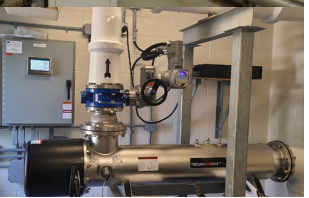

Parameters	Requirements	Municipal Well 1 (MW1)	Municipal Well 2 (MW2)
Age (as of 2023)	---	66	51
Capacity (L/s)	2017 Max day 7.5 L/s	8.2	14.2
PTTW Rate (L/s)	34.10	17.05	17.05
UVT%	UV Design > 75%	~90%	**<75% (2017 onwards)**
DOC (mg/L)	5 From ODWS	Avg 1.15 Range 0.08-4.25	Avg 2.72 Range 0.96-4.49
Manganese (mg/L)	0.05 From ODWS	Avg 0.02 Range MDL – **0.72**	**Avg 0.14** Range MDL – **0.71**
Iron (mg/L)	0.3 From ODWS	0.067 Range 0 – **3.6**	Avg 0.22; Range MDL – **6.19**
Turbidity (NTU)	1 From ODWS	<1	<1
Hardness (mg/L)	500 From ODWS	207 - 358	304 - 382

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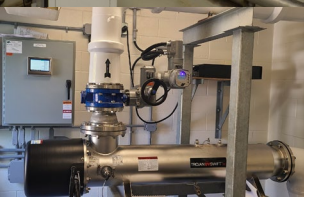
Searching for Liquid Gold– Beneath Placid Surface







- MW1 and MW2 were deemed as GUDI with effective in-situ filtration
- Treatment included UV and chlorine disinfection to achieve the required disinfection credits

Log Inactivation Requirements	UV Disinfection Credit Earned (with min 75% UVT)	Chlorine Disinfection Credit Earned	Disinfection Achieved?
Cryptosporidium: 2 Log	2 Log	--	Yes
Giardia: 3 Log	3 Log	--*	Yes
Virus: 4 Log	2 Log	2 Log	Yes

*Note: Contact pipe with post chlorine injection too short to have significant Giardia inactivation

Searching for Liquid Gold – Beneath Placid Surface

- However MW1 & MW2 were moderately susceptible to contamination from Beaver River
- MW2's UVT% unexpectedly dropped below the minimum 75% requirement for the previous UV system's design criteria (prior to 2023 upgrades)
- Even after rehabilitation of MW2, the UVT did not improve and remained consistently below 75%
- Region proactively took MW2 offline and notified MECP and Township of Brock

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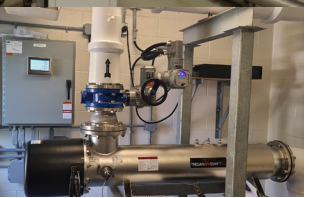
Searching for Liquid Gold – Beneath Placid Surface

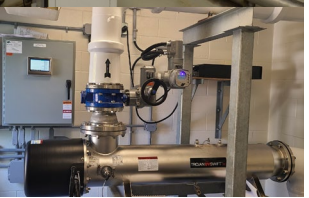


- This meant:
  - Sunderland Water System only had MW1 as the water source (capacity of 8.2 L/s; historical max day demand of 8.0L/s)
  - No contingency in water supply (no firm capacity)
  - Limited useable storage volume in standpipe
- Region had to quickly secure another water source for contingency or find alternate means of providing water to Sunderland in case MW1 also failed

Searching for Liquid Gold – When It Rains, It Pours







Class EA 2020-2023

Summer 2017

MW2 Offline

- MW2 Taken Offline
- MW1 only well remaining operational to provide water supply to Sunderland

Summer 2017- Mid 2018

Groundwater Exploration Program

- Region undertook an emergency well exploration program to urgently find a backup groundwater source
- New source was identified at same property as Existing Jane Street Standpipe
- Declaration Order Issued by MECP to permit installation of emergency well.
- Requires Class EA to Address Long-Term Water Supply Needs

2018 - 2019

Design and Construction of MW3

- Development of an emergency municipal groundwater well (MW3) on the existing Jane Street Standpipe property and associated treatment system

2022 - 2023

Emergency UV Upgrades at MW1

- Lack of spare part replacements of existing UV system resulted in emergency upgrades to get new UV system at MW1

Searching for Liquid Gold – Searching for a Solution

- Immediate Measures in 2017/2018 to deal with MW2 being offline
  - Region brought in temporary portable diesel generator for MW1
  - Region installed temporary exterior potable water tank with pump at MW1 site in case water trucks had to fill the tank, and the water pumped into the system
- Emergency Measures at MW3
  - Region & R.J. Burnside (RJB) undertook quick well exploration program to find alternate water supply
  - Region worked with R.V. Anderson Associates (RVA) and Newterra Ltd. (packaged treatment supplier) for a treatment system for the new well

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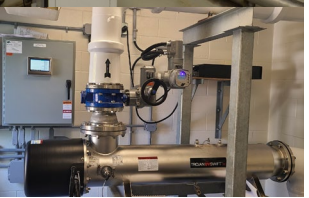
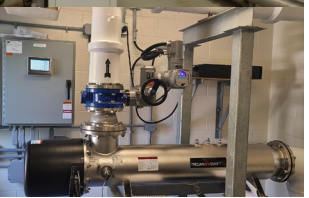
Searching for Liquid Gold – Searching for New Water Supply



- Well Exploration Locations

Figure courtesy of R.J. Burnside, from "Sunderland Emergency Water Supply Exploration Test Well TW17-3 construction & Testing Report"

Searching for Liquid Gold – Searching for New Water Supply



- Well Exploration Results
  - TW17-3 (by Ex. Standpipe Site) had promising results
    - 10L/s capacity (able to supplement MW1)
    - Minimal impact to adjacent monitoring wells and private wells
    - Relatively good water quality
- Advantages of TW17-3 Location:
  - On Region owned land (by Ex. Standpipe Site)
  - Easy connection to nearby water distribution system
  - Sufficient land for well and associated treatment facility

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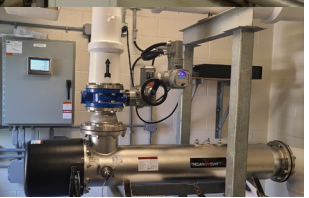
Searching for Liquid Gold – Searching for New Water Supply







- TW17-3 Water Quality

*Note: TW 17-3 Water Quality from pump test

Parameters	Requirements	Municipal Well 1 (MW1)	Municipal Well 2 (MW2)	Emergency Well (TW17-3)*
Capacity (L/s)	--	8.2	14.2	10
PTTW Rate (L/s)	34.10	17.05	17.05	10
UVT%	UV Design > 75%	~90%	**<75% (2017 onwards)**	~89%
DOC (mg/L)	5 Note1	Avg 1.15 Range 0.08-4.25	Avg 2.72 Range 0.96-4.49	Avg 0.65 Range 0.43-0.79
Manganese (mg/L)	0.05 Note1	Avg 0.02 Range MDL – **0.72**	**Avg 0.14** Range MDL – **0.71**	0.02 Range 0.01-0.02
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Turbidity (NTU)	1 Note1	<1	<1	<1
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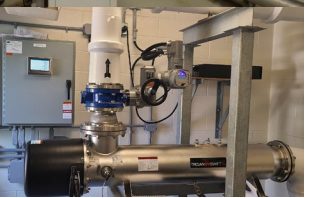
Searching for Liquid Gold – When It Rains, It Pours







Class EA 2020-2023

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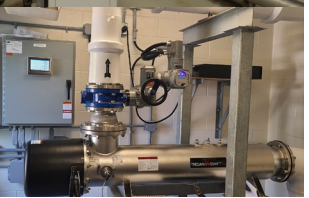
Searching for Liquid Gold – Searching for Appropriate Treatment Strategy



- Designing MW3 treatment system
  - Imminent changes to GUDI Terms of Reference (for Ontario)
  - MECP proposed draft GUDI terms of reference to help reduce risk of negative health impacts from microbes and protozoa as result of past poor GUDI characterization, uncertainty from hydrogeological analysis, or from non-GUDI sources (i.e septic tanks)
  - Region proactively used that as their guideline for the treatment requirement for the new well

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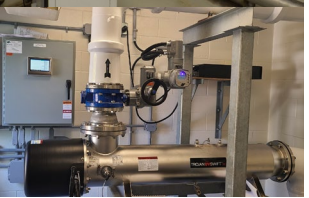
Searching for Liquid Gold – Searching for Appropriate Treatment Strategy



- Using MECP's draft GUDI Terms of Reference to determine disinfection requirements:
  - Well constructed as per O.Reg. 903/90?
    - Yes
  - Is there risk of protozoa (Cryptosporidum and/or Giardia)?
    - No
  - Is there > 4 hits of E.Coli per year + > 2 detections of photosynthetic Pigment-Bearing Algae and Diatoms or demonstration of pathway connecting to the subsurface/above ground/near surface areas?
    - No
  - Does the turbidity exceed 10 NTU in 2 consecutive samples and/or the 95th percentile is above 5 NTU?
    - No
  - Therefore, Well Category 1 → minimum of 4 log virus disinfection

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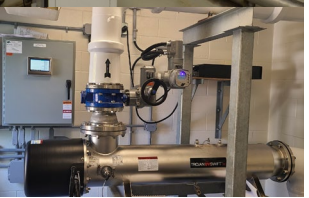
Searching for Liquid Gold – Searching for Appropriate Treatment Strategy

- Various treatment and disinfection strategies considered to achieve 4 log virus inactivation
  - Pre-treatment - cartridge filters for dealing with turbidity and minerals etc., as required
  - Disinfection:
    - Chlorine for primary disinfection (via contact tank/contact pipe)
    - UV system (2 log virus inactivation) + chlorine (2 log virus inactivation + secondary disinfection)
    - UV system (4 log virus inactivation) + chlorine (for secondary disinfection only)

Searching for Liquid Gold – Searching for Appropriate Treatment Strategy



- There were various project limitations that needed to be considered:
  - Needed a quick, implementable solution
    - ➢ Packaged treatment system
    - ➢ Design-Build collaboration with Region, RVA and Suppliers
  - Intermittent operation of TW17-3 (MW1 as duty/primary well)
    - ➢ System needed to be able to start and stop relatively fast
    - ➢ System needed to ‘reset’ quickly
    - ➢ Could not use chlorine contact tank approach for disinfection as there could be long water age in contact tank if TW17-3 was not used frequently enough

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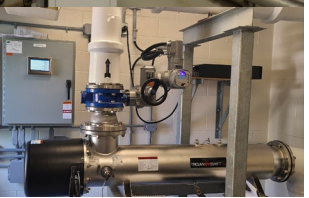
Searching for Liquid Gold – Searching for Appropriate Treatment Strategy



- There were various project limitations that needed to be considered:
  - Space limitations
    - Enough land for small treatment system but not a large unit
      - ➢ Packaged Treatment System needed to fit inside a seacan
      - ➢ Cannot use chlorine contact tank for full 4 log virus inactivation
    - Short distance prior to connecting into the water distribution system
      - ➢ Cannot use chlorine contact pipe for full 4 log virus inactivation

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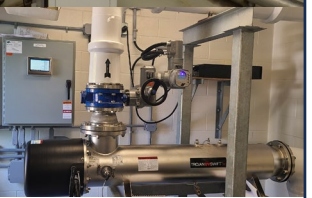
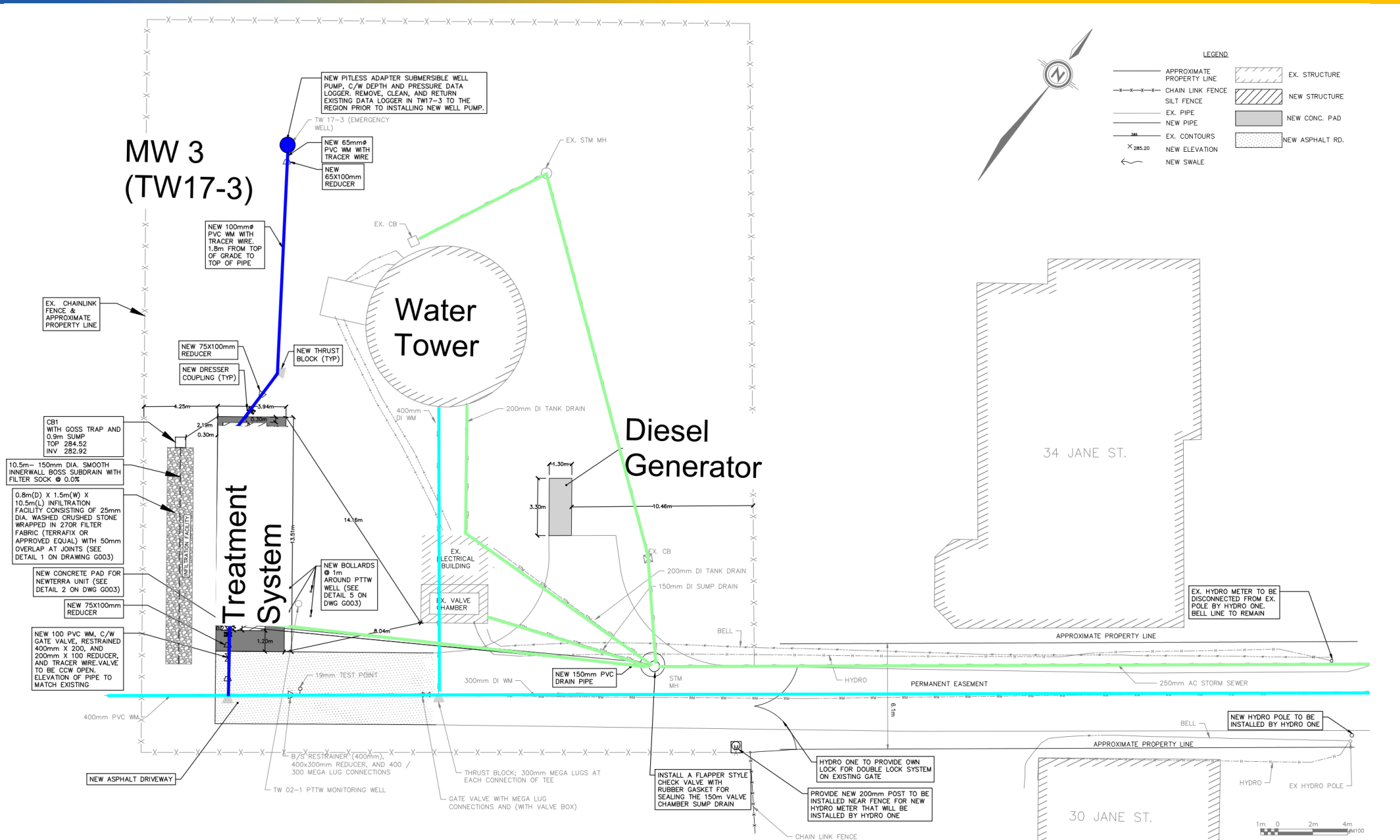
Searching for Liquid Gold – Searching for Appropriate Treatment Strategy





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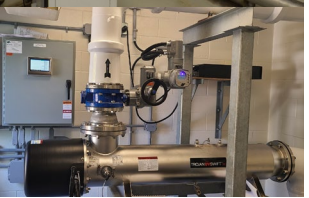

- Final treatment strategy chosen included:
  - Pitless adapter well pump at standpipe site
  - Cartridge filters for occasional turbidity and mineral issues (used as required only)
    - Cartridges are washable and replaceable/disposable
  - UV system to achieve 4 log virus inactivation and disinfection
  - Chlorine for secondary disinfection

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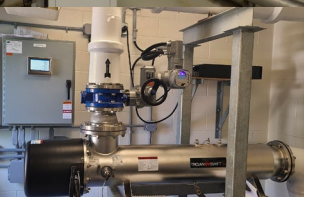

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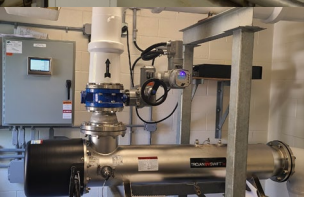
Searching for Liquid Gold – When It Rains, It Pours







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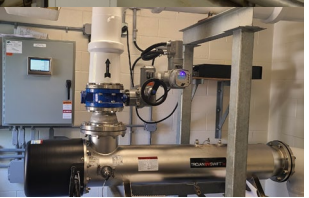
Searching for Liquid Gold – Class EA Process



- Schedule B Class EA undertaken to comply with MECP's Director Order
- Goal of Class EA – long term strategy for Sunderland water supply and storage
- Growth forecasted to triple by full build out
- Firm capacity of well system needed to increase from current 8L/s to 31 L/s
- Additional water supply sources needed to meet future demands
- Public, Indigenous community and agencies were consulted
- Identification and evaluation of alternatives for additional water supply and storage location were undertaken

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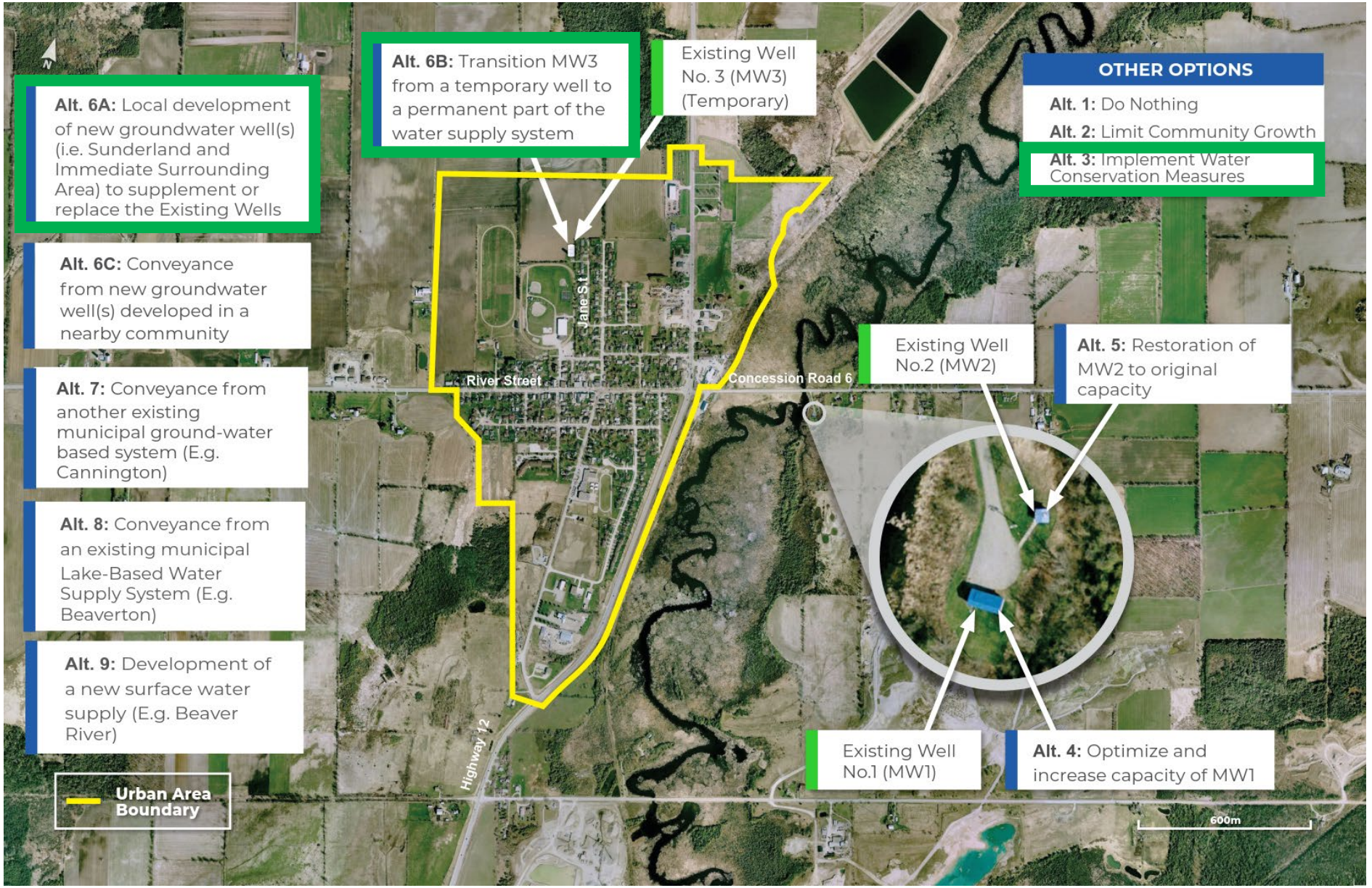
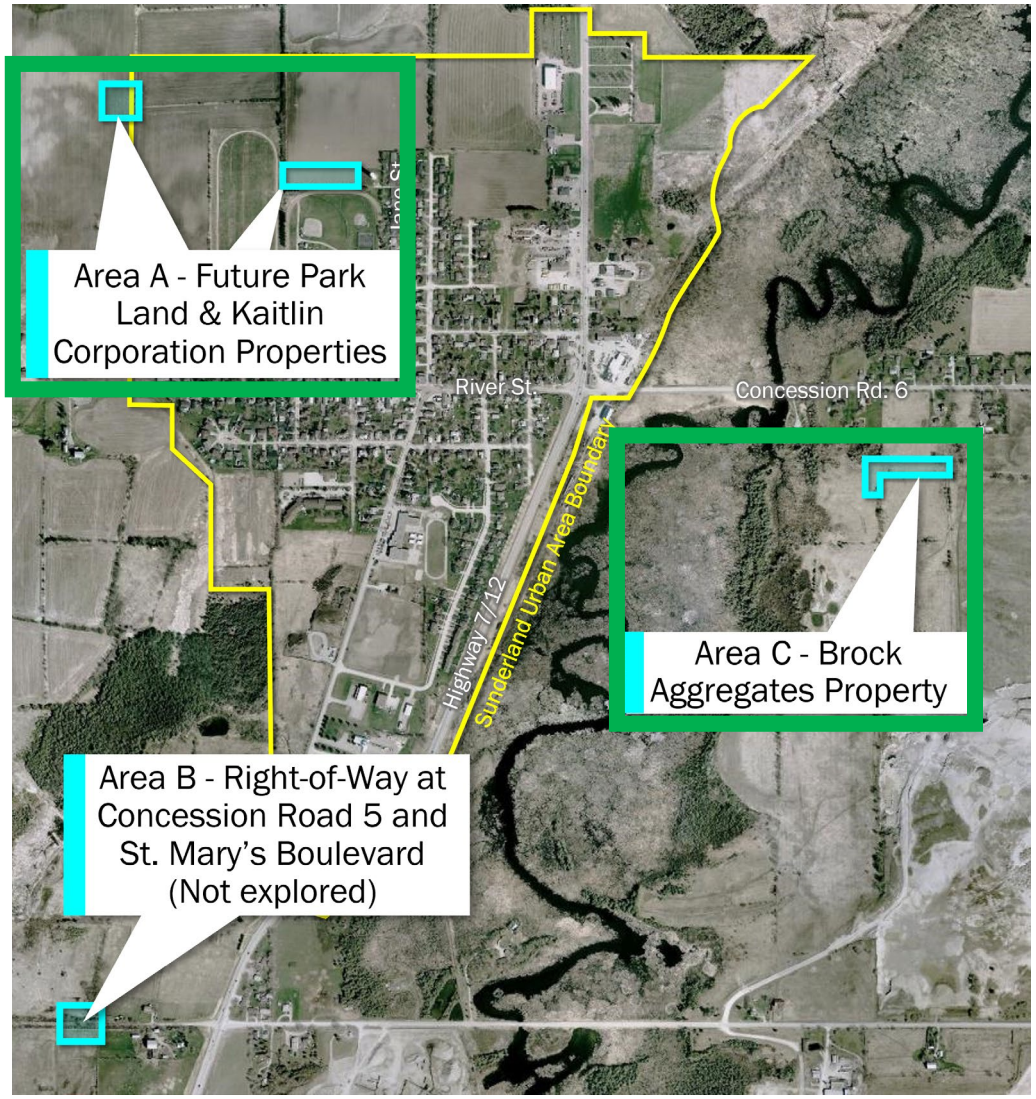


Searching for Liquid Gold – Class EA Process – GW Exploration



Ground Water Exploration Program Findings:

- **Area A**
  - Park Land - decent water quantity and good water quality
  - Kaitlin Property - good quantity of water however quality of water required additional treatment (high nitrates).
- **Area C** - produced good quality of water however limited quantity of water. The aquifer in Area C is separate from Area A.
- **Area B –** was not explored as Area A and Area C results were favourable. Area B is also technically complex and would have higher financial costs.

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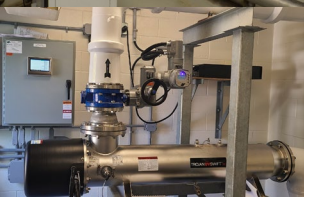
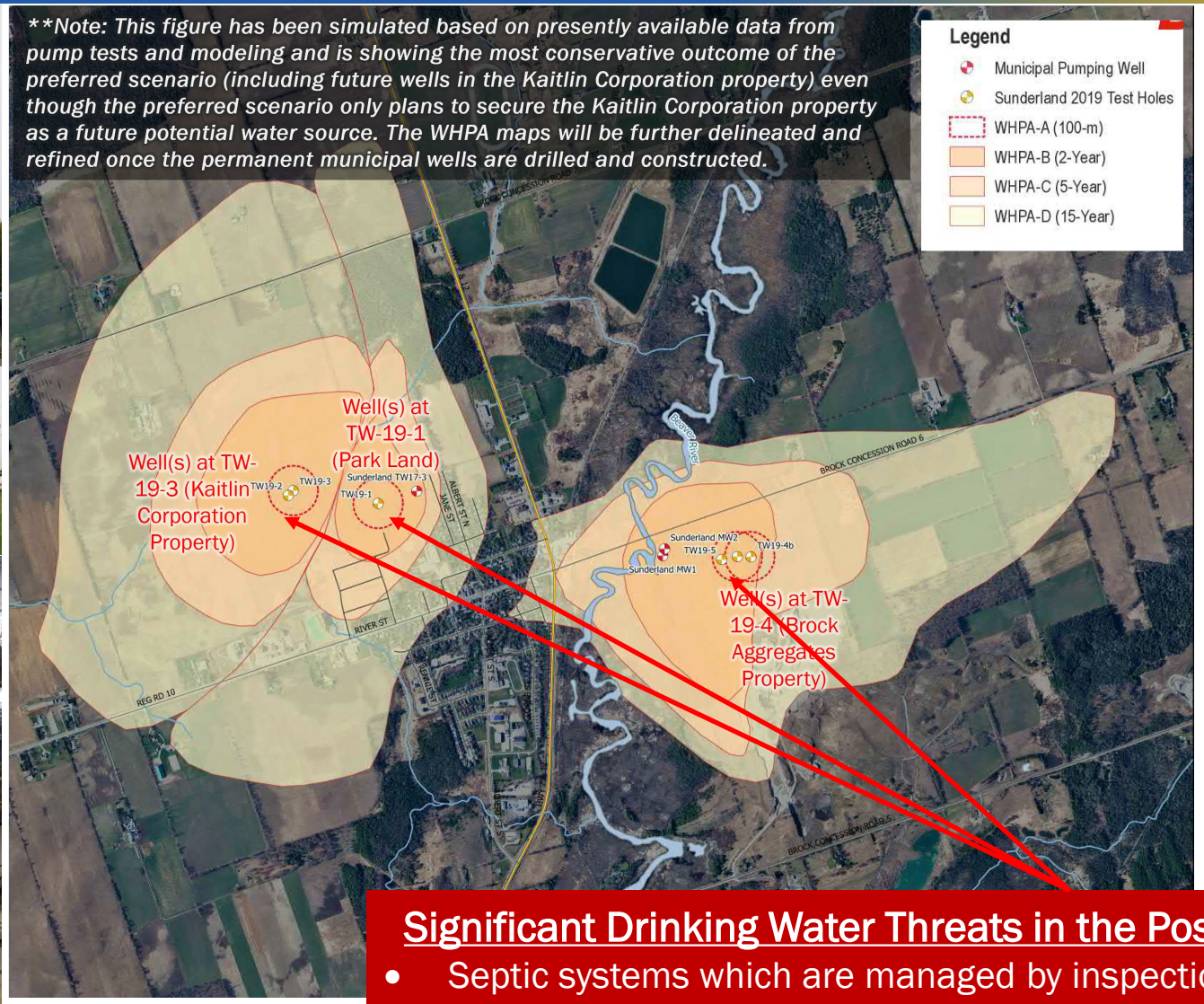
Searching for Liquid Gold – Class EA Process – GW Exploration





- WHPA maps and modeling completed to help with evaluation
- Source water protection – need to identify vulnerability scoring and significant drinking water threats

Significant Drinking Water Threats in the Possible Future WHPA-A include:

- Septic systems which are managed by inspection of the septic system every three (3) years.
- Agricultural activities which can be managed through a Risk Management plan.
- Commercial activities which can be managed through a Risk Management plan.

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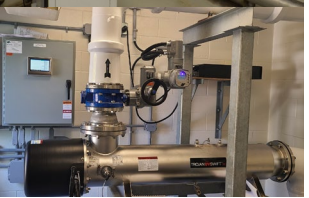
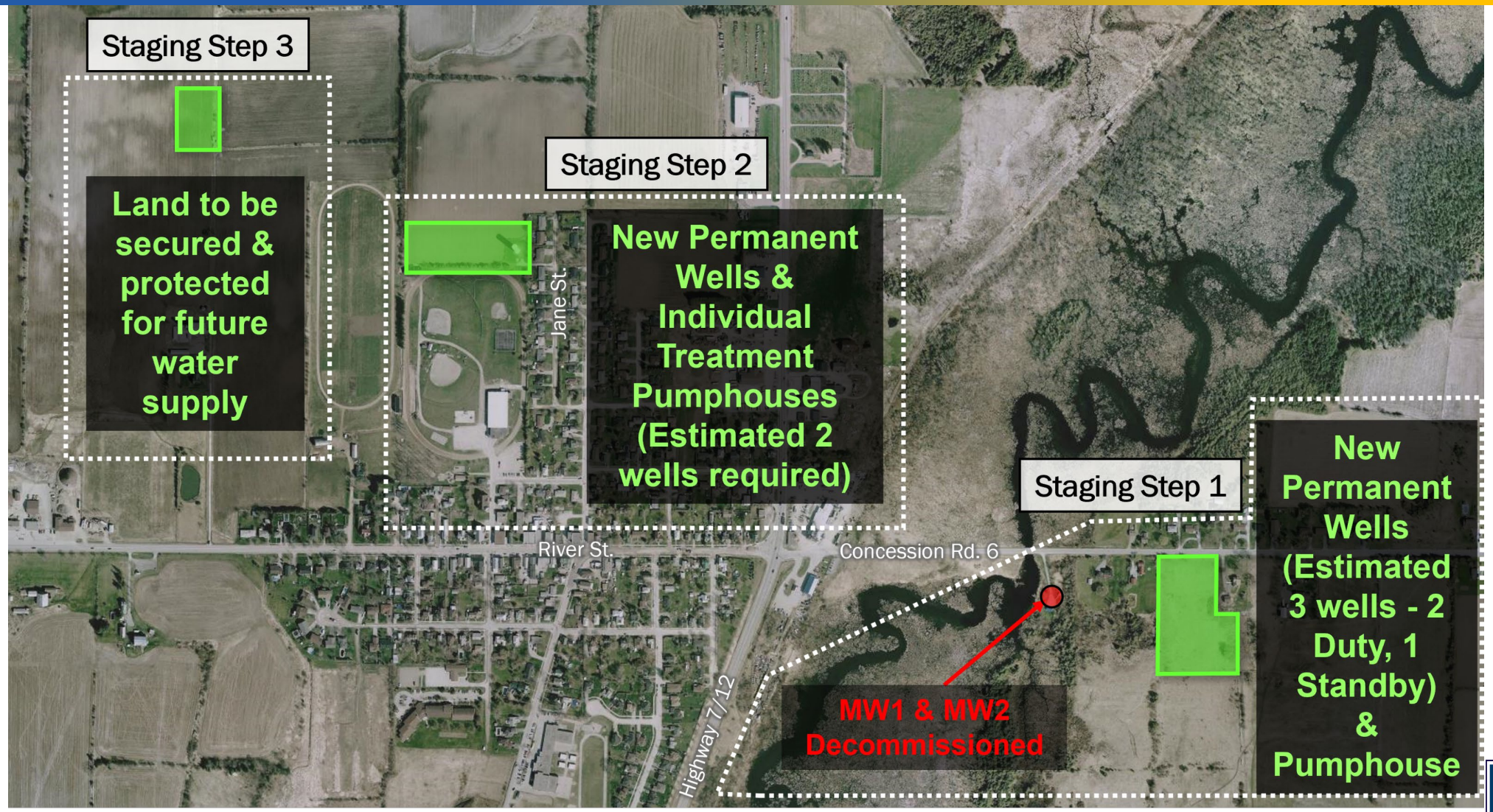
Searching for Liquid Gold – Class EA Preferred Solution





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National Water & Wastewater Conference 2023
Canadian Water and Wastewater Association

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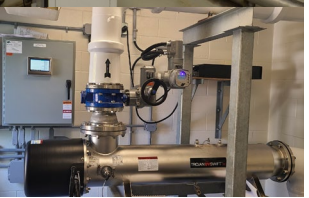
Searching for Liquid Gold – When It Rains, It Pours







Class EA 2020-2023

Summer 2017	Summer 2017- Mid 2018	2018 - 2019	2022 - 2023

MW2 Offline

- MW2 Taken Offline
- MW1 only well remaining operational to provide water supply to Sunderland

Groundwater Exploration Program

- Region undertook an emergency well exploration program to urgently find a backup groundwater source
- New source was identified at same property as Existing Jane Street Standpipe
- Declaration Order Issued by MECP to permit installation of emergency well.
- Requires Class EA to Address Long-Term Water Supply Needs

Design and Construction of MW3

- Development of an emergency municipal groundwater well (MW3) on the existing Jane Street Standpipe property and associated treatment system

Emergency UV Upgrades at MW1

- Lack of spare part replacements of existing UV system resulted in emergency upgrades to get new UV system at MW1

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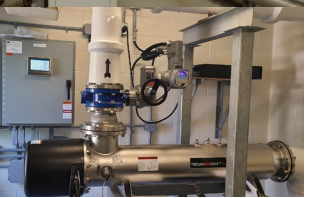
Searching for Liquid Gold – Searching for Spare Parts

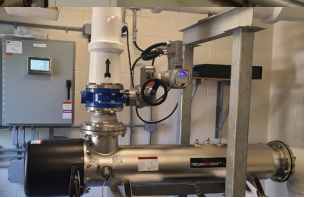


- Region foresaw preferred Class EA solution would take several years to implement due to land acquisition, design and construction
- Meanwhile, MW1's existing UV units were reaching end of life and had limited spare parts available throughout the industry

Searching for Liquid Gold – Searching for New UV Unit

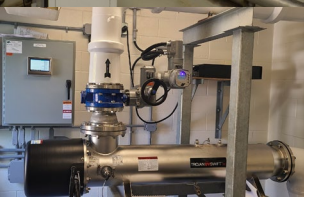






- Region proactively chose to replace the expiring UV units with a newer UV unit
- Meanwhile, unexpected changes water quality at MW1 resulted in selecting UV unit that could handle a wider range of water quality fluctuation

Searching for Liquid Gold – Lessons Learned



- Proactively look at your system and identify weak points/risks
  - Age, signs of deterioration
  - Availability of spare parts
  - Reaching capacity limitations
  - Lack of redundancy
  - Change in conditions/parameters
- Come up with contingency plan/measures
- Plan ahead for upcoming changes in regulations and limits/standards

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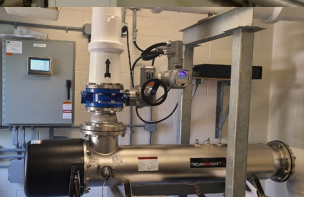
Searching for Liquid Gold – Lessons Learned



- Regular rehabilitation of wells and checking for water quality is essential to maintaining important utilities such as water supply
- Even with regular rehabilitation, a well can end up not recovering fully
- Having firm capacity in well system is very important
- Groundwater exploration and securing new water supply takes time – so plan ahead
- Source water protection is important – consider acquiring land in advance to protect area of future groundwater supply

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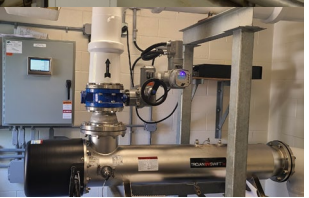
Searching for Liquid Gold – Lessons Learned

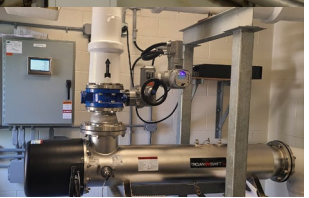






- For Ontario, imminent GUDI Terms of Reference will impact the disinfection and treatment requirements of numerous well systems → need to familiarize oneself with proposed changes and how it will impact you and management of the facilities
- If a well looks promising and water quality tests are going to be done during the hydrogeological pump test, also measure UVT
  - This will allow for choosing UV as a treatment later on
  - Otherwise fresh flowing water samples would need to be taken after the pump tests are done

Searching for Liquid Gold – Lessons Learned



- For Ontario, there may be a lowering of the allowable manganese concentration from 0.05mg/L to 0.02 mg/L
- Choose a treatment system that will allow for some fluctuation in water quality – be it allow for filtration or wider range of operability with UV
- Consider climate change's impact on wells and aquifer and plan for redundancy
  - Well redundancy via firm capacity
  - Aquifer redundancy via having well fields at different aquifers if possible

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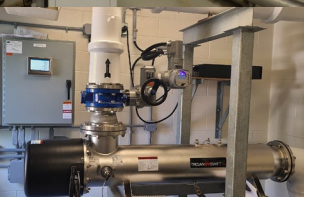
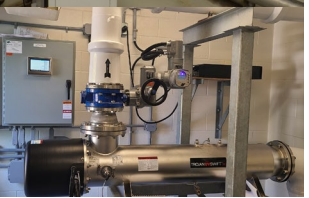
Searching for Liquid Gold – Lessons Learned



- Choose equipment from supplier with knowledgeable technical service team available to troubleshoot
- Check for availability of spare parts
- Where possible, select brand/model of equipment to allow sharing of spare parts between equipment/facilities

Searching for Liquid Gold – Acknowledgements



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  - Regional Municipality of Durham
  - R.J. Burnside & Associates Limited
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  - Ministry of Environment, Conservation and Parks
  - Lake Simcoe Region Conservation Authority
  - Newterra Ltd.
  - International Water Supply
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  - Kenaidan Contracting Ltd, Selectra Inc.

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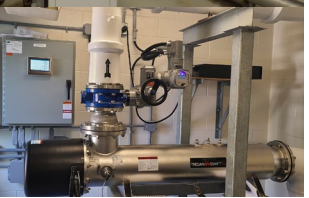
Searching for Liquid Gold - Questions



Thank you

Questions?

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