Optimizing WWTP total phosphorus effluent through innovative collaboration and knowledge sharing

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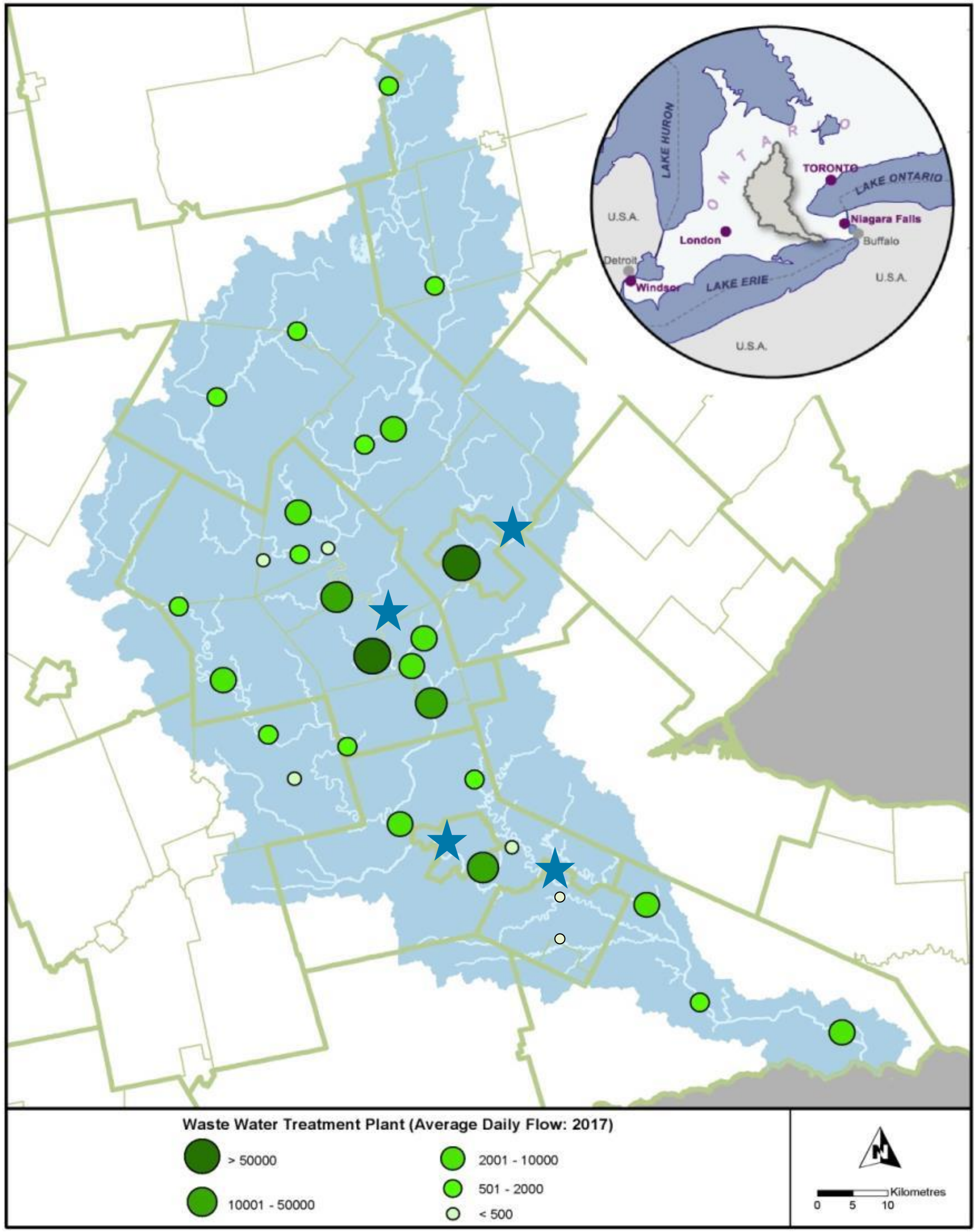
Grand River Watershed

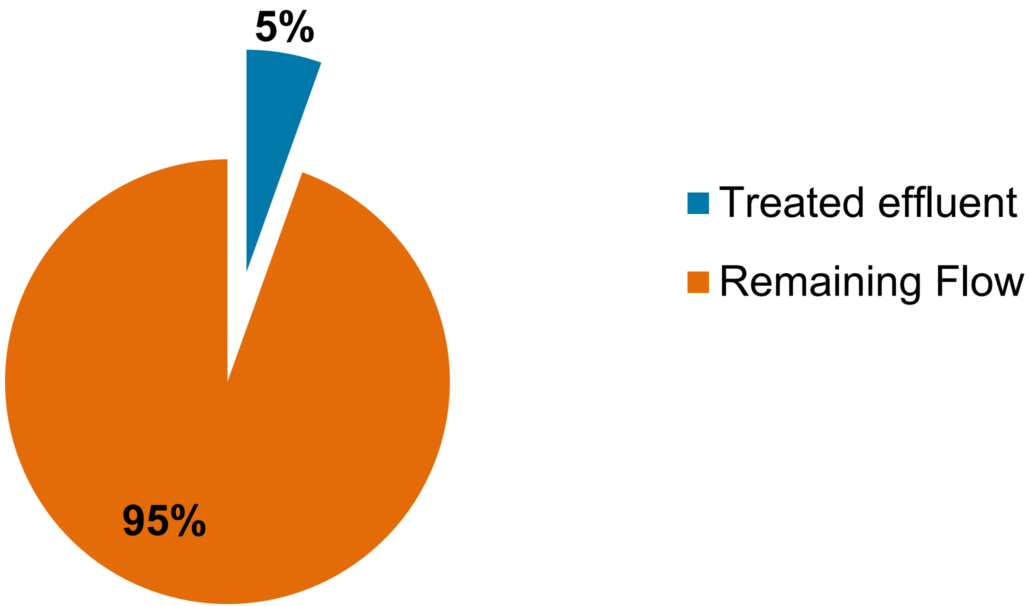
Grand River Watershed

- 30 municipally owned WWTPs
- 4 surface drinking water intakes
- Many other uses
  - Recreation
  - Fishing
  - Agriculture
  - Industrial

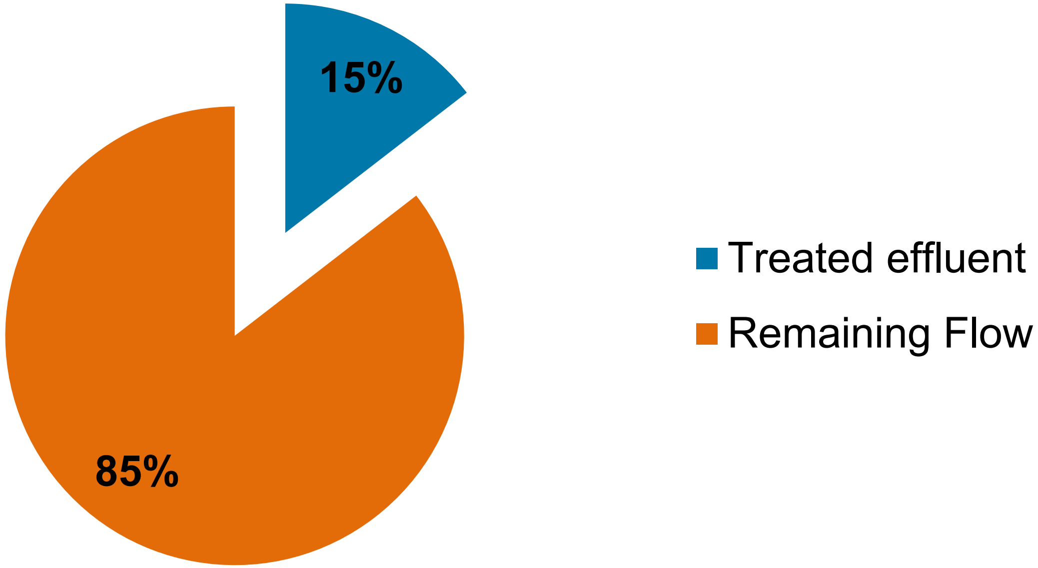


WWTP’s Influence on River

2022

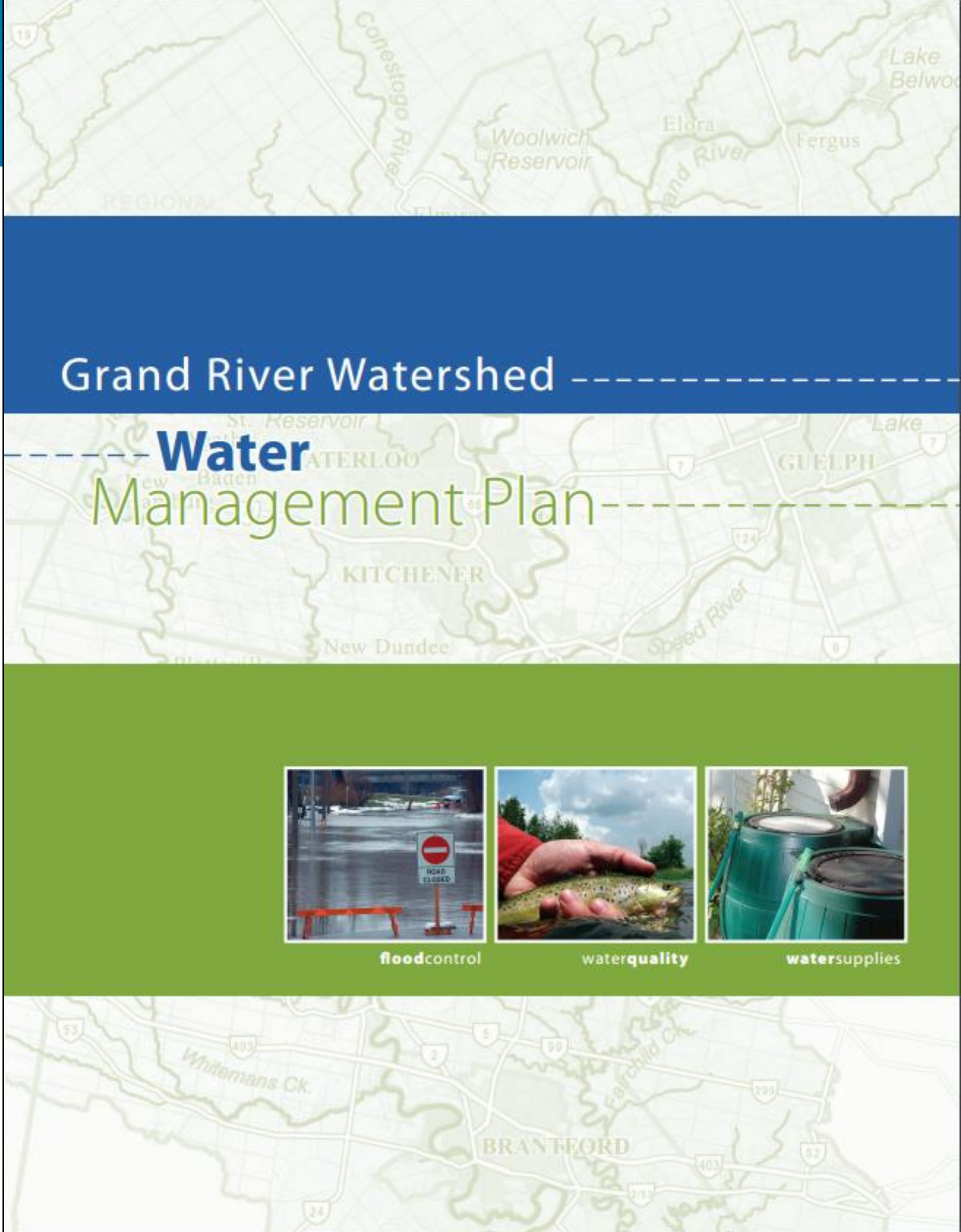


2022 August



Water Management

- Water Management Plan released 2014
- A key goal is to improve water quality to **improve river health**
- **Voluntary targets** adopted for WWTP effluent TP and TAN
- **Optimization** promoted as a tool to achieve targets



GRCA Wastewater Optimization Program

- **Voluntary** program started in 2010
- **Partnership** of municipalities and operating authorities, First Nations, GRCA and MECP
- **Program vision:**
    - **Data-based decision-making** is used at all levels to **fully tap the capacity** of existing infrastructure and people to produce **high-quality effluent, economically** over the long-term to make measurable improvements in water quality of Grand River and Lake Erie

GRCA Wastewater Optimization Program cont'd

- **Evaluating and Communicating Progress**
    - Plants report voluntary loadings, performance and data integrity checks on an annual basis;
    - Results are summarized in a report
    - Plants are recognized for achieving voluntary goals and data integrity checks.
    - The program status is presented and discussed at an annual workshop

GRCA Cambridge - 2019

Optimization Basis – Performance Pyramid

Good, Economical Effluent

Operations
(Process Control)

Capable Plant

Administration

Design

Maintenance

Nutrient Removal in Wastewater Treatment

Total Phosphorous (TP) removal:

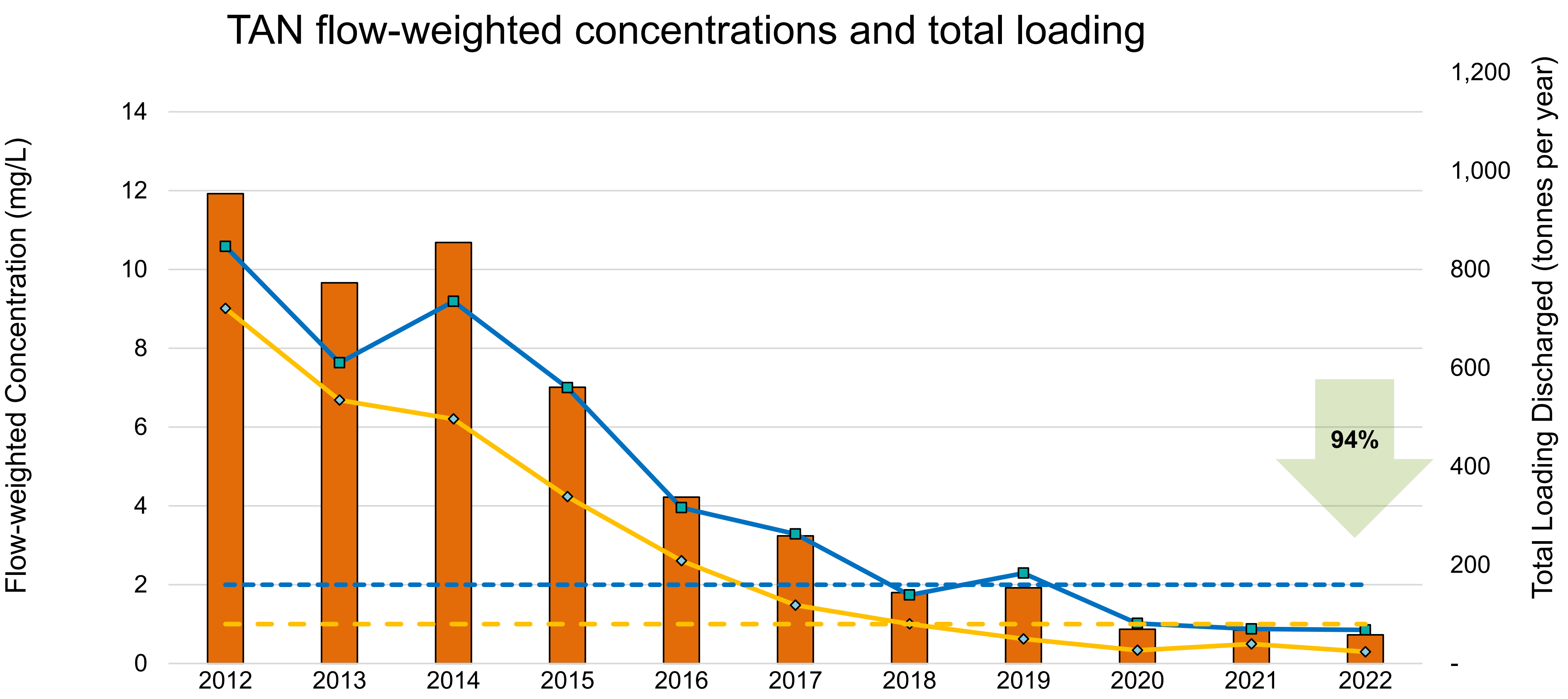
- In Ontario, metal salts are added to precipitate phosphorus
- **Operational requirements**: sampling, testing and chemical adjustment to achieve and sustain the effluent target.

Total Ammonia Nitrogen (TAN) removal:

- Biological process where bacteria convert ammonia to nitrate.
- **Operational requirements**: managing the nitrifying bacteria population and dissolved oxygen throughout the year, especially in cold weather

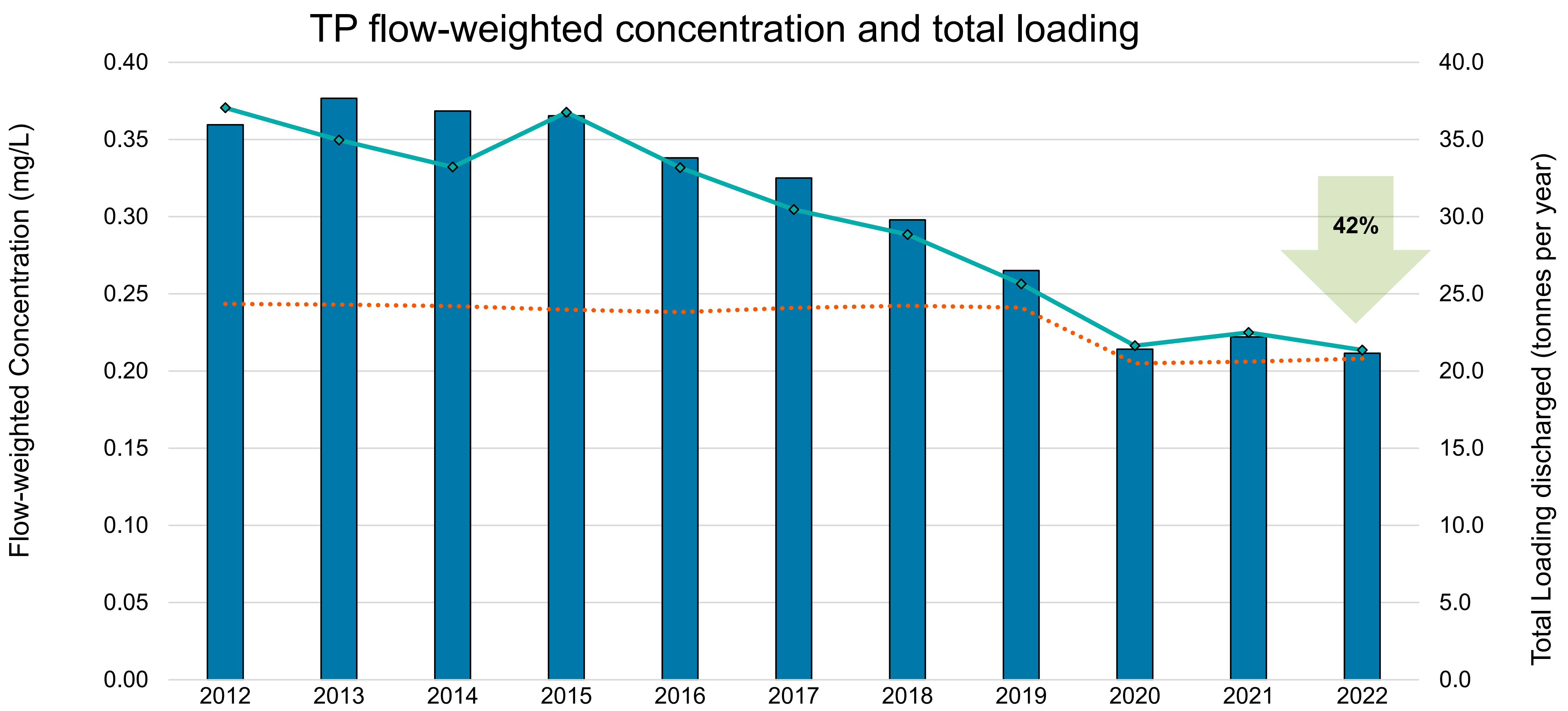
Kitchener WWTP - 2024

Watershed-wide Performance – Total Ammonia Nitrogen



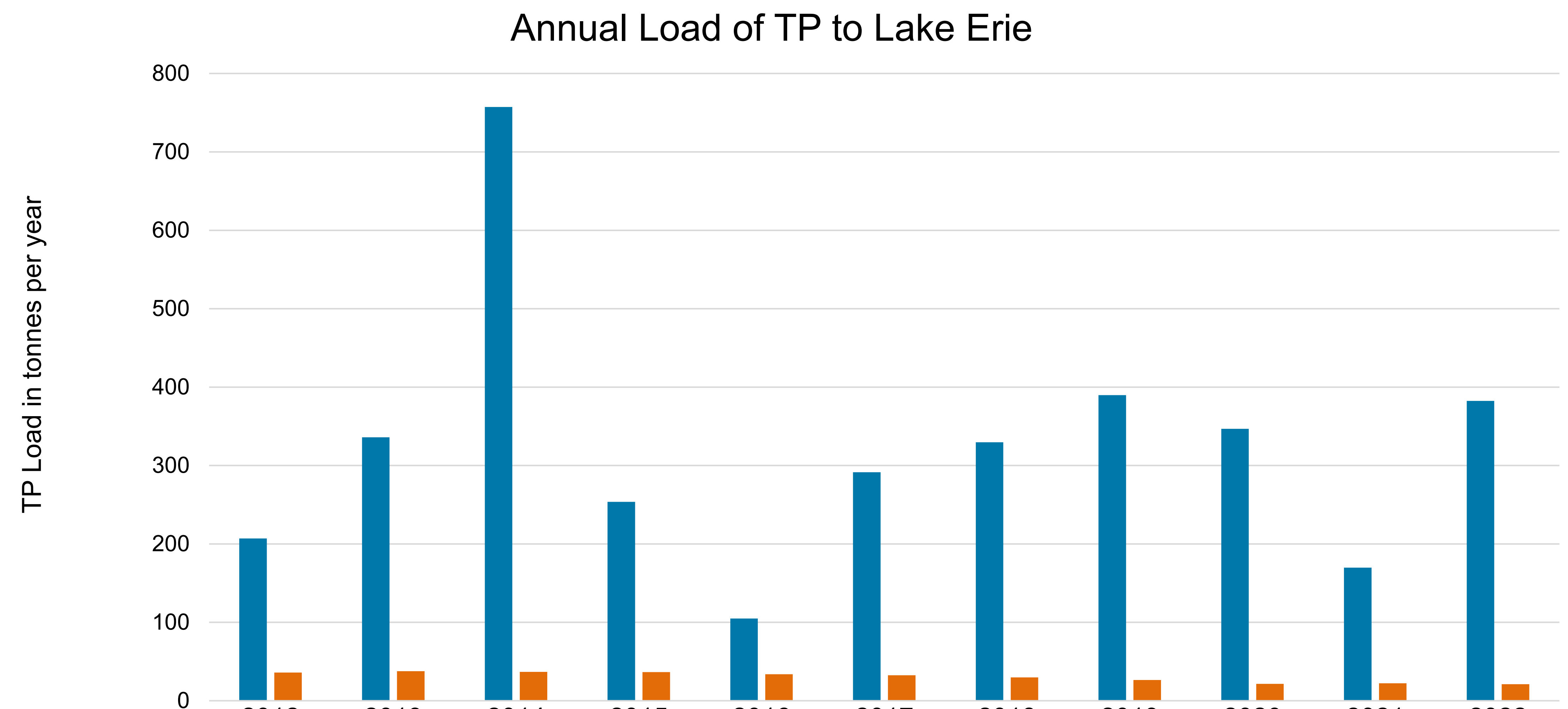
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TAN Loading (Tonnes)	954	773	855	561	338	259	144	154	70	68	58
Winter Flow wt. conc	10.6	7.6	9.2	7.0	4.0	3.3	1.7	2.3	1.0	0.9	0.9
Summer Flow wt. conc	9.0	6.7	6.2	4.2	2.6	1.5	1.0	0.6	0.3	0.5	0.3
Summer Target	1	1	1	1	1	1	1	1	1	1	1
Winter Target	2	2	2	2	2	2	2	2	2	2	2

Watershed-wide Performance – Total Phosphorus



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TP Loading	36.0	37.7	36.8	36.5	33.8	32.5	29.8	26.5	21.4	22.2	21.1
TP Flow-wt conc.	0.37	0.35	0.33	0.37	0.33	0.30	0.29	0.26	0.22	0.22	0.21
Flow-wt Target	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.20	0.21	0.21

Total Phosphorus Loading to Lake Erie from Grand River



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total TP Load	207	336	757	254	105	291	330	390	347	170	382.5
WWTP TP load	36.0	37.7	36.8	36.5	33.8	32.5	29.8	26.5	21.5	22.2	21.1

Voluntary Final Effluent Quality Targets

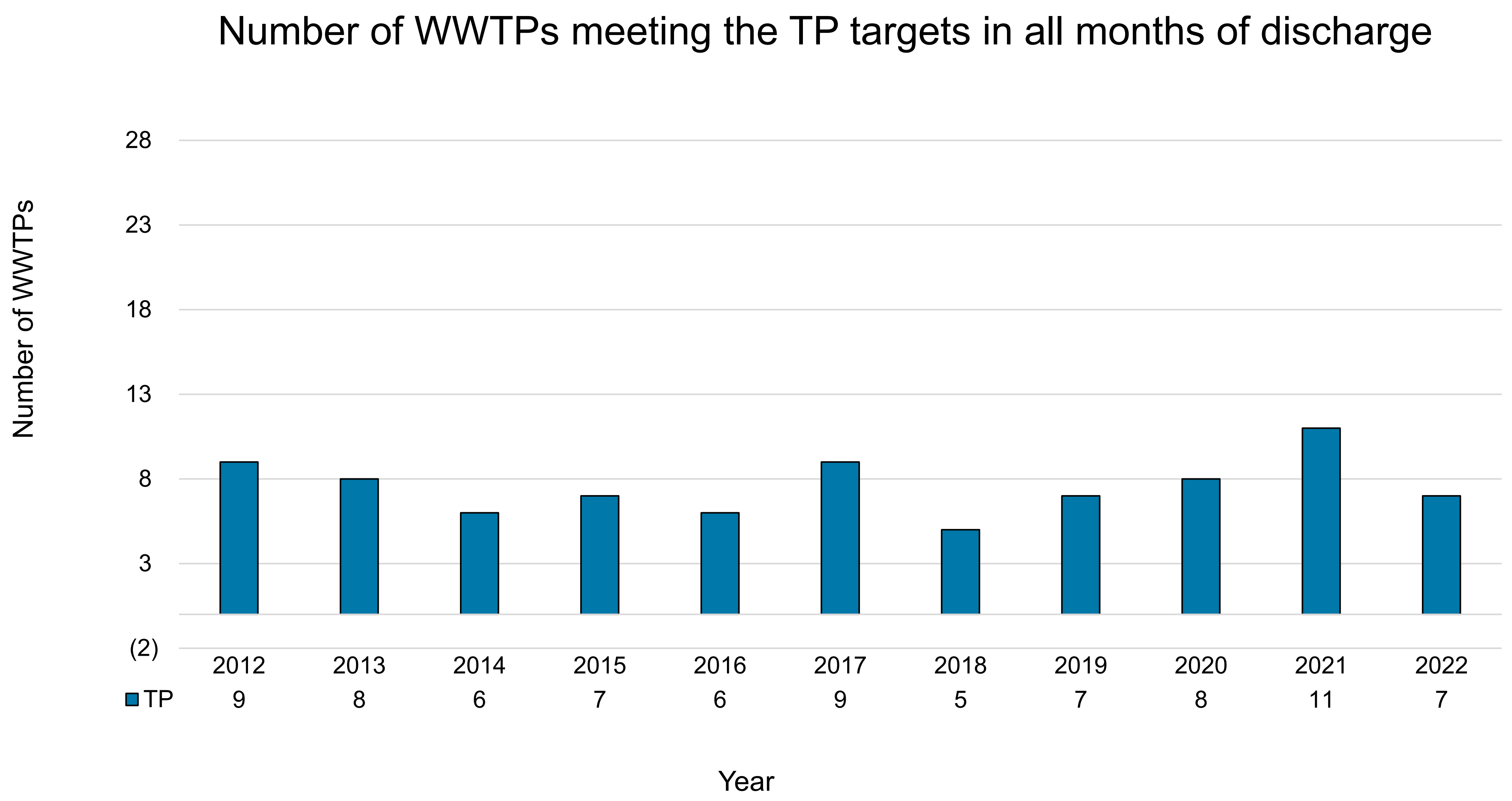
Total Phosphorous

Plant Type	Target (mg/L)
Lagoon	0.30
Tertiary Lagoon	0.15
Secondary	0.30
Tertiary	0.15

Total Ammonia Nitrogen

Plant Type	Summer Target (mg N/L)	Winter Target (mg N/L)
Lagoon	ECA objectives	ECA objectives
Secondary	1.0	2.0
Tertiary	1.0	2.0

Voluntary Final Effluent TP Targets



Voluntary Final Effluent TP Targets cont'd

WWTP	TP
Kitchener	83%
Guelph	92%
Waterloo	58%
Brantford	75%
Galt	0%
Preston	100%
Hespeler	0%
Dunnville	100%
Paris	83%
Fergus	0%
Elmira	67%
New Hamburg	83%
Caledonia	67%
Elora	92%
Ayr	100%
Arthur	50%
Dundalk	64%
Wellesley	67%
Grand Valley	100%
Cayuga	92%
St. George	83%
St. Jacobs	92%
Mapleton	80%
Plattsville	100%
Drumbo	33%
Cainsville	100%
Heidelberg	100%
Conestogo	83%

Percentage of months plants meeting TP targets in 2022:

- 11 plants were in green category (90-100%)
- 13 plants in the yellow category (50-90%)
- 4 plants in the red category (<50%)

Challenges

- Encouraging **buy-in** so all the plants meet the targets in all months
- Some municipal partners have limited capacity to support **on-site activities**.
- **Review** is required to verify self-reporting (QA/QC)
- **Staff** turn-over/shortage
- Determining how WWOP can best support with **training and technical assistance**


Caledonia WWTP - 2024

TP Survey – Objectives and Approach

- Select plants that consistently achieve the voluntary targets (6 plants)
- Document key metrics related to phosphorus removal
- Share experience and knowledge for achieving the GRCA targets
- Develop a strategy to support plants that are not currently achieving the voluntary TP targets;
- **The main goal is to demonstrate that it is economically feasible to achieve GRCA voluntary TP targets**

Kitchener WWTP - 2024

TP Survey – Data collection

- **Background information:** type of plant, coagulant used, where chemicals are added.
- **Performance data:** flow, raw sewage TP concentration, effluent TP concentration, etc.
- **Coagulant/chemicals usage:** dosage and cost
- **Chemical sludge produced:** production and haulage cost
- **Calculations:**
  - Chemical dosage to achieve the TP targets, and
  - Total daily cost for each kg of TP removed

Kitchener WWTP - 2024

TP Survey – Site visits

- **Review data**
- **Tour of the plant** with staff,
- Jointly perform **spot checks** for coagulant dosing at point of addition,
- **Sample and test** influent, and final effluent to determine performance
- Discuss **operational procedures** with the operators and document
- Review use of **data trending** by staff

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Summary

- GRCA has managed the voluntary program to reduce nutrient loads from 28 WWTPs in the Grand River watershed
- From 2012 to 2022, 94% TAN and 42% TP reductions have been achieved even with population increase
- Improving operational procedures for sampling, testing and chemical adjustment are key for achieving the effluent targets
- Key program challenges:
  - Increasing costs for chemicals to remove TP
  - Support for plants that are not currently achieving the voluntary TP targets (17 out of 28)
- At 6 plants consistently achieving voluntary TP targets, key metrics are being collected related to phosphorus removal
- The results will be shared with other partners to increase the number of plants achieving the voluntary TP targets


Brantford WWTP - 2024

Thank you!

For more information, please contact:

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Wastewater optimization - Grand River Conservation Authority