

# **Chatham, Massachusetts WPCF**

## **The Challenges Faced by a Small Community Removing Nitrogen to the Limit of Technology**

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# Overview

- Background
- Nitrogen TMDLs and CWMP
- Costs and funding
- Overview of WPCF
- Questions/discussions

# Background



# Town of Chatham

- Small residential community
- Year-round population of 6,125 (2010 Census)
- Summer population is 3x year-round
- Over 5,000 developed properties
- Year-round fishing industry and heritage



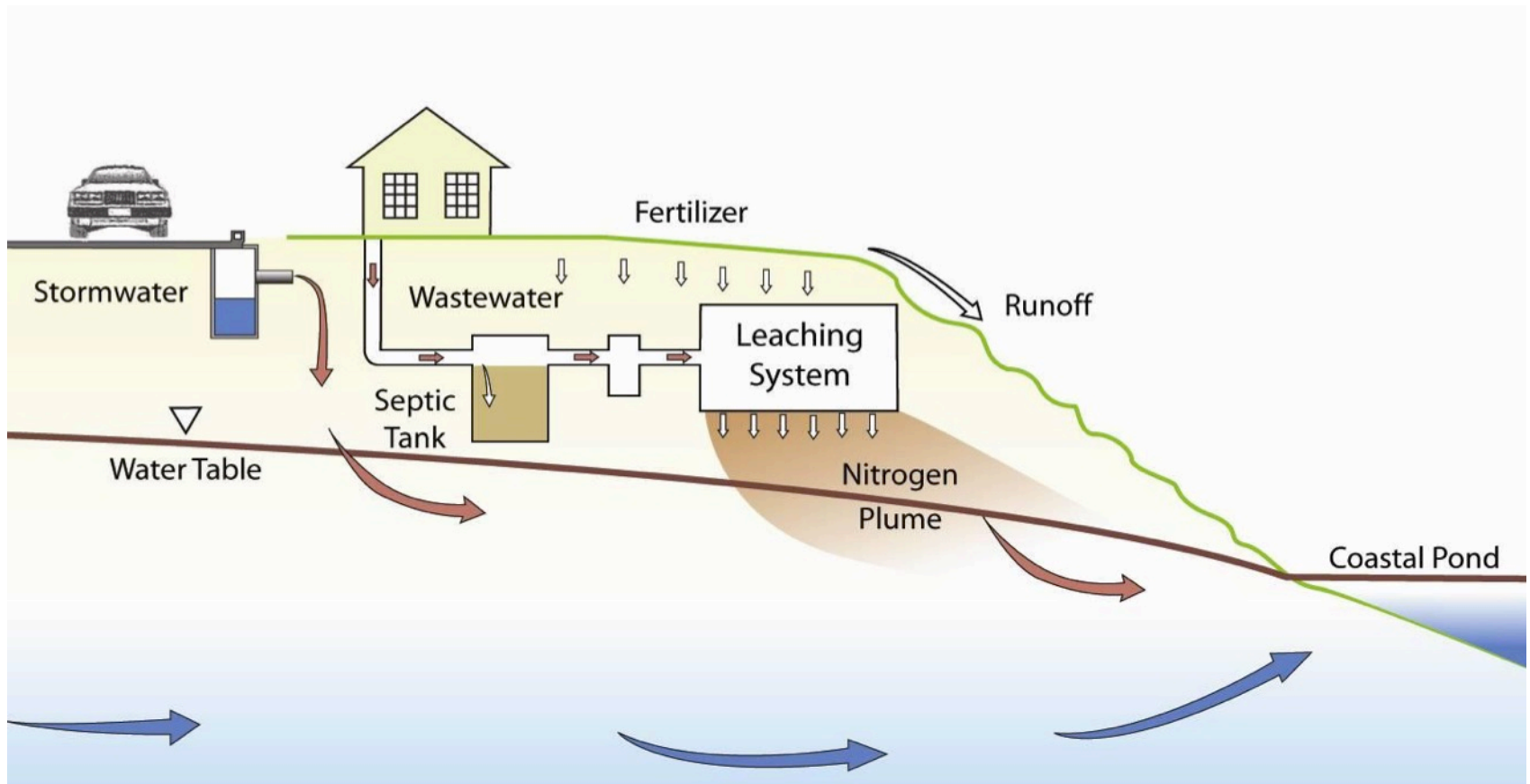


# Main issues and challenges

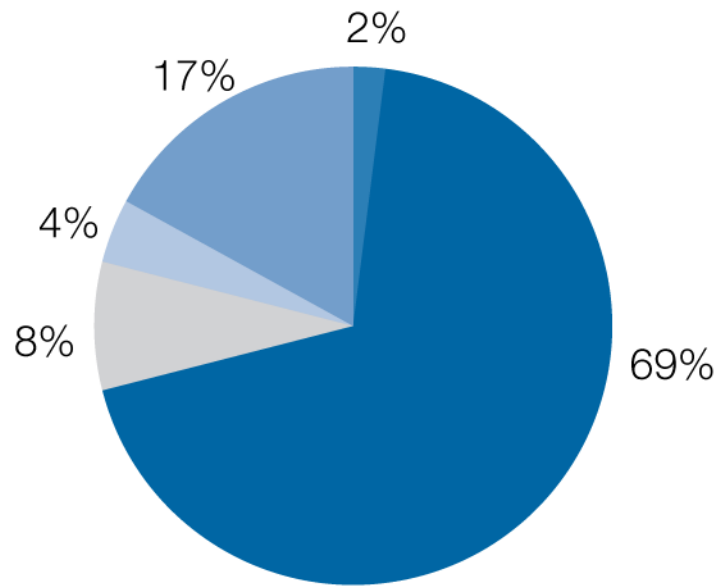
- Extensive use of septic systems in Chatham
- Small 40-year old existing WWTF
- Highly seasonal flow variations
- Nitrogen and phosphorus are causing eutrophication of the coastal estuaries and inland ponds
- Water supplies are becoming impacted



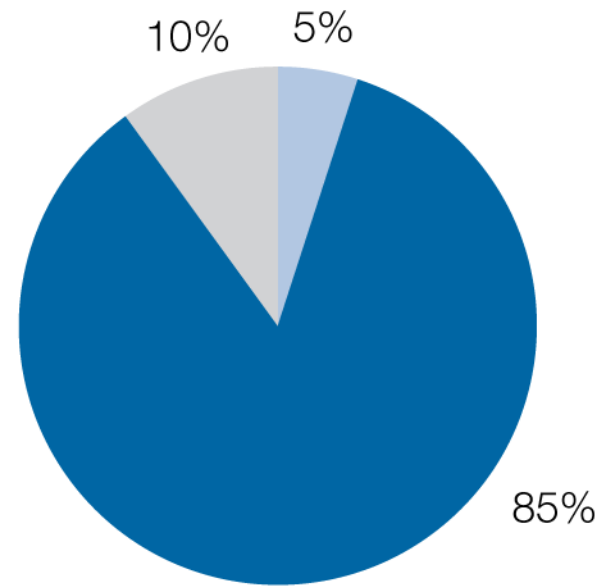
# Main issues and challenges



# Typical nitrogen sources and contribution percentage



**Total Sources**



**Controllable Sources**





# **Nitrogen** TMDLs and CWMP



# **CWMP** in Chatham

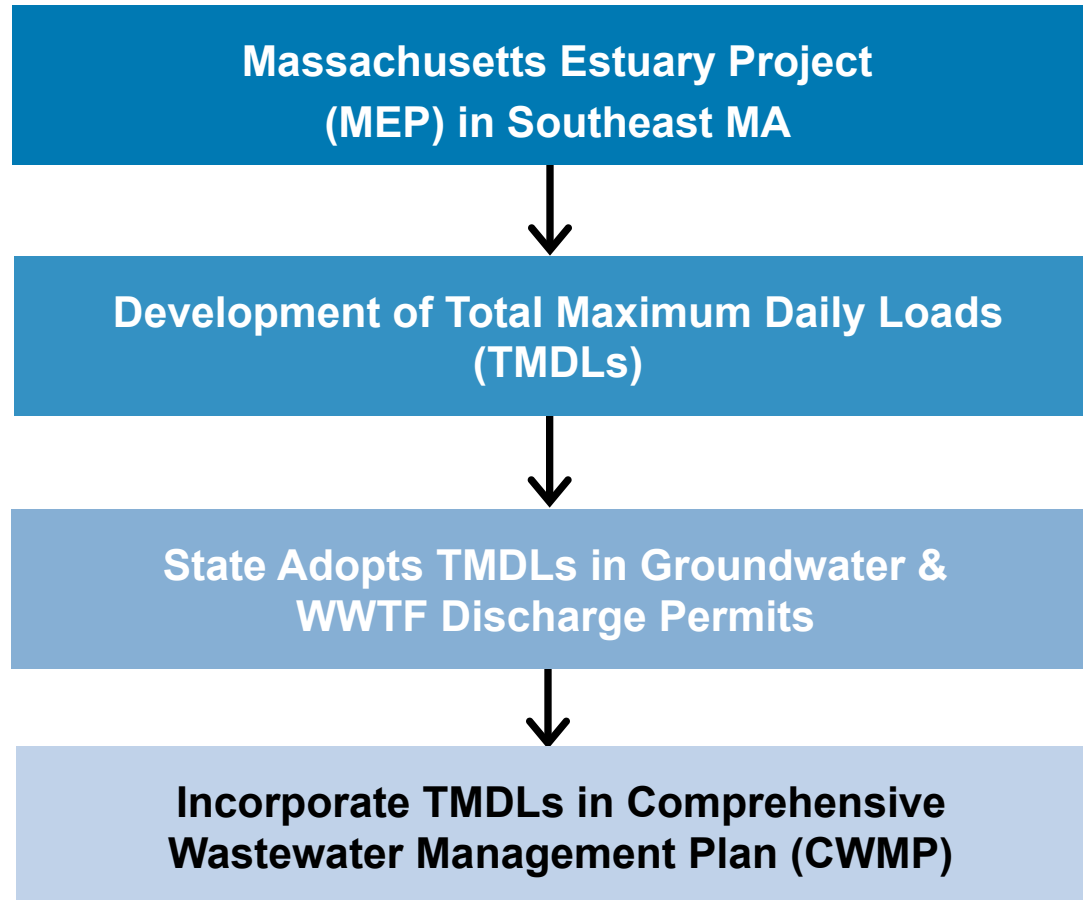
## **Wastewater facilities plan completed in 1982**

- Due to concerns about uncontrolled growth, it did not move forward
- Consent order in 1987 (by MADEP) to complete the CWMP

## **Comprehensive Wastewater Management Plan (CWMP)**

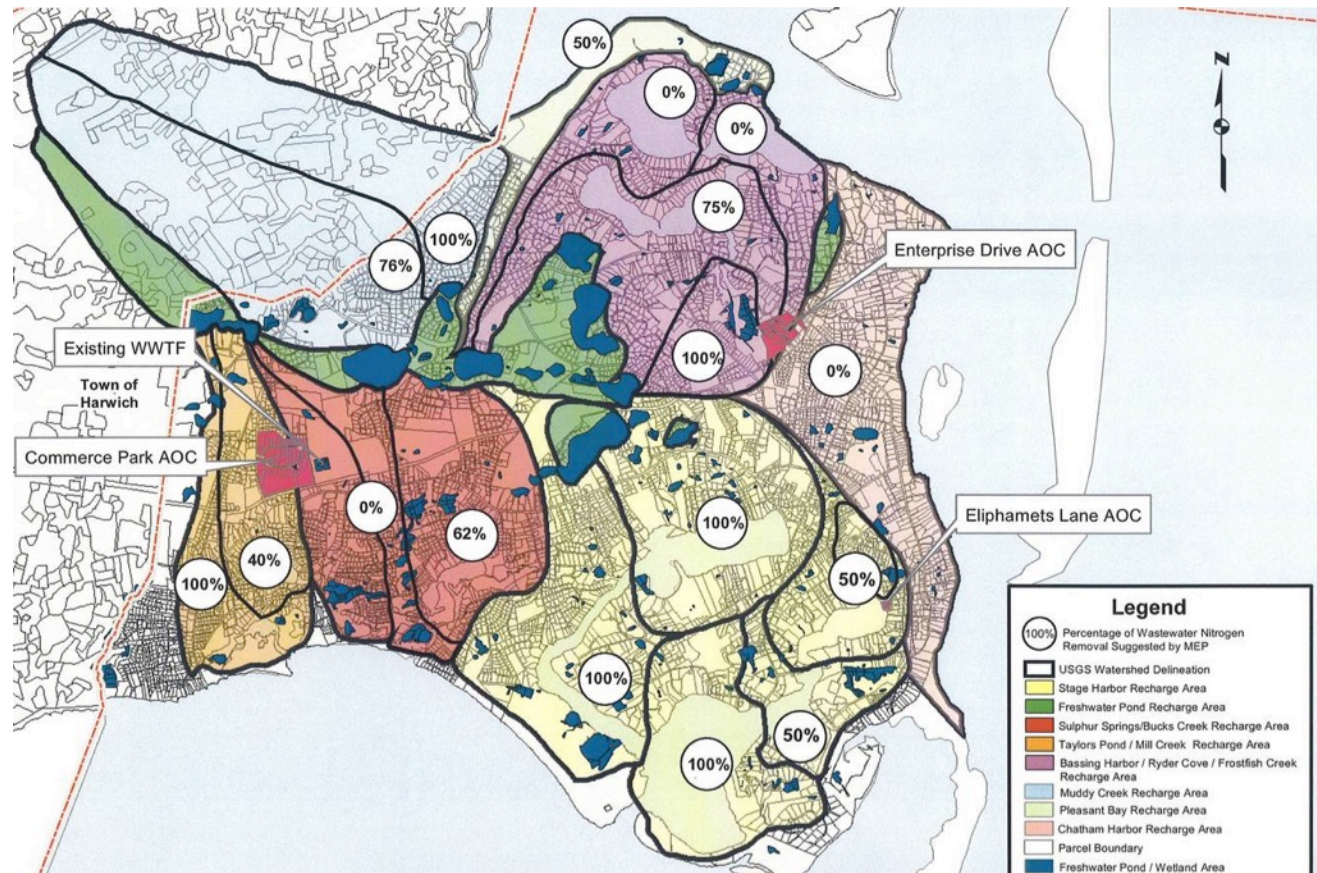
- Started in 1997
- Final CWMP approved in July 2009
- Took more than 10 years to complete (waiting for TMDLs)
- 20-year planning period from 2010 to 2030

# **History** of planning process





# Wastewater nitrogen that requires removal to meet the nitrogen TMDLs



# Wastewater nitrogen alternatives evaluation

## Summary of typical nitrogen removals for the wastewater management options

Technology	Typical nitrogen concentration in the effluent	Typical percent removal
Title 5 septic system	20 to 40 mg/l	23%
Individual nitrogen removal septic system	15 to 25 mg/l	50%
Community/cluster system	5 to 15 mg/l	75%
Upgraded Chatham WWTF	3 mg/l	93%



# **Design** considerations and phase approach

## **In order to meet TMDLs in all watersheds**

- Required sewerage 2/3 of the Town
- Improve WPCF performance
- 3 mg/L total nitrogen discharge limit

## **Phase 1 (to meet TMDLs)**

- Sewer 2/3 of the Town
- 61 sewer sheds
- WPCF upgrade (expand on existing site)

## **Phase 2**

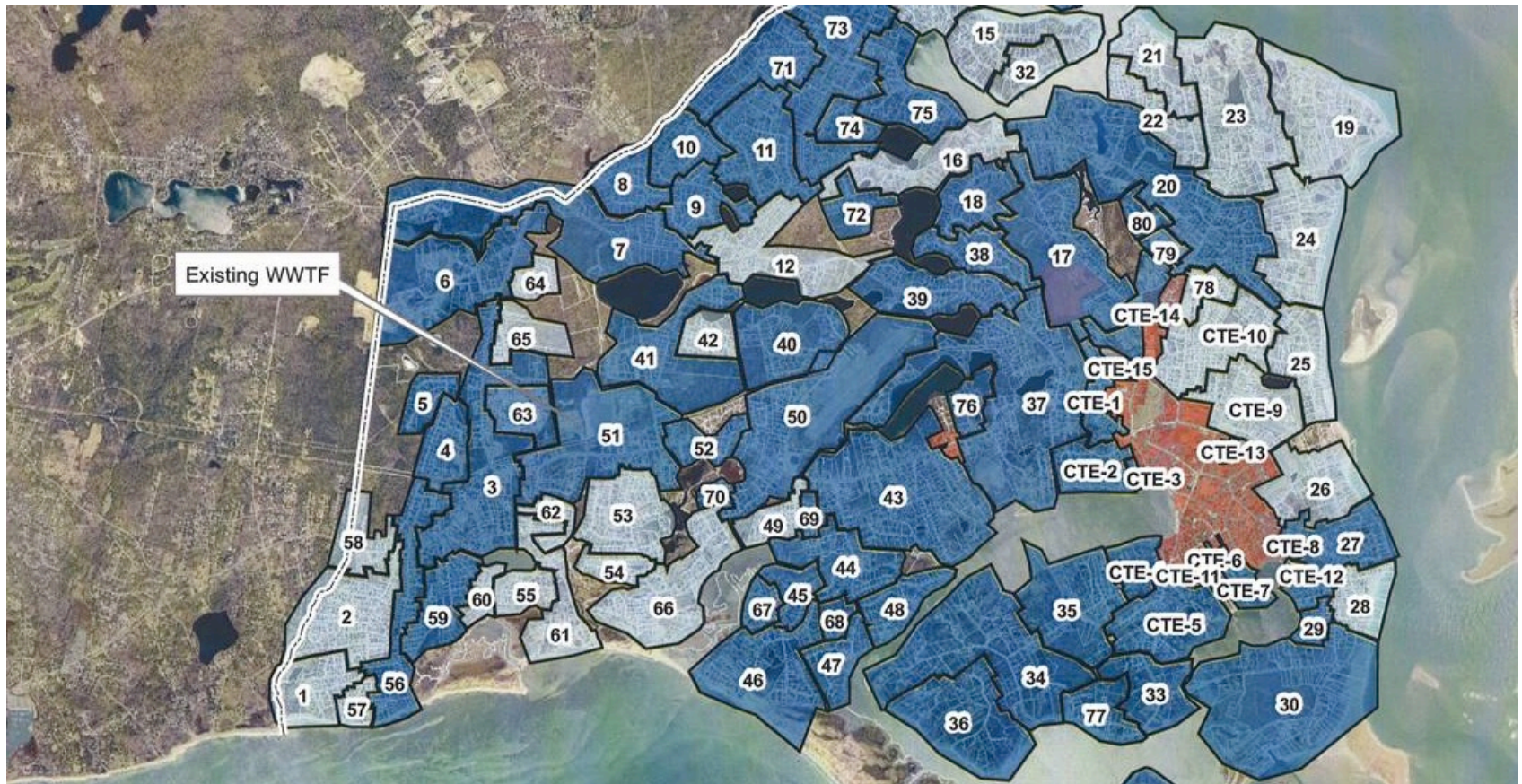
- Sewer the rest of the Town (a fiscally fair approach)
- Expect 33 additional sewer sheds
- Expand WPCF



# **Project** findings and town guidance

- The CWMP needs to be “growth neutral”
- Decentralized wastewater management is appealing; but not feasible for all parts of Town
- Phase 1 of the plan should allow for sewer extension to meet the TMDLs in first 20 years
- Phase 2 should allow for sewer extension to the rest of the Town in the following 10 years

# Phase 1 and 2 sewer expansion



# **Costs** and funding



# Estimated project costs

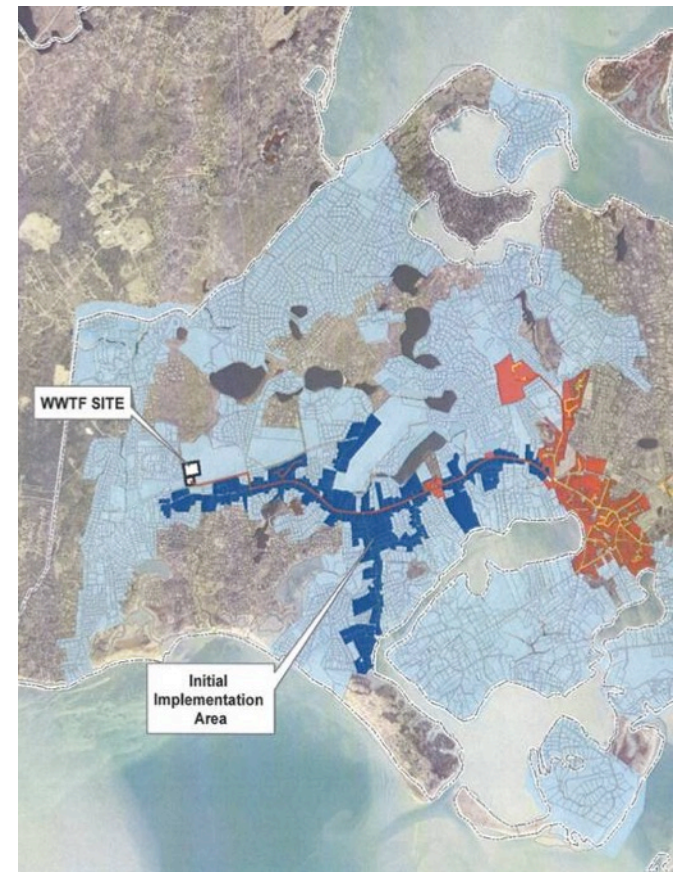
Phase	Collection system	WPCF
Phase 1 <ul style="list-style-type: none"><li>Initial Implementation</li><li>Remaining phase 1</li></ul>	\$20 M \$150 M	\$40 M -
Phase 2	\$80 M	\$10 M
Total	\$250 M	\$50 M

# Financing plan

- Stabilize debt (\$4.7 million) and use debt drop-off to help fund implementation of planning project (75%)
- Sewer users would eventually pay for 25% of debt (sewer and collection)

# CWMP initial implementation plan

- \$60 million appropriation in 2009
- Initial implementation of Phase 1 collection system and pump station expansion and upgrade
  - Construct backbone of collection system
- Phase 1 WPCF improvements
- Water quality improvements projects
  - Stormwater remediation projects
- Alum treatment of 2 freshwater ponds



# Funding



- Pay for capital costs with property taxes and the general fund (no betterments)
  - Most affordable way to fund the projects
- American Recovery and Reinvestment Act (ARRA) of 2009
- Evaluated funding options
  - State Revolving Fund (SRF) – 0%
  - United States Department of Agriculture (USDA) Rural Development Funding Options

## Elected to use

- SRF Funding for collection system and pumping stations
- USDA Funding for WPCF
- Chatham meets the small community threshold
- Received 45% construction grant of almost \$18 million and \$1.2 million for design
- Low interest loans

## **Project** costs – initial implementation

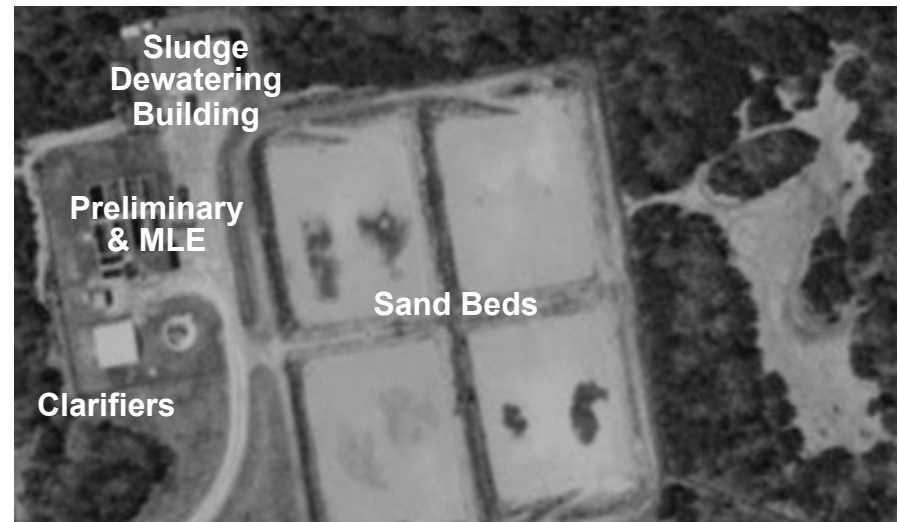
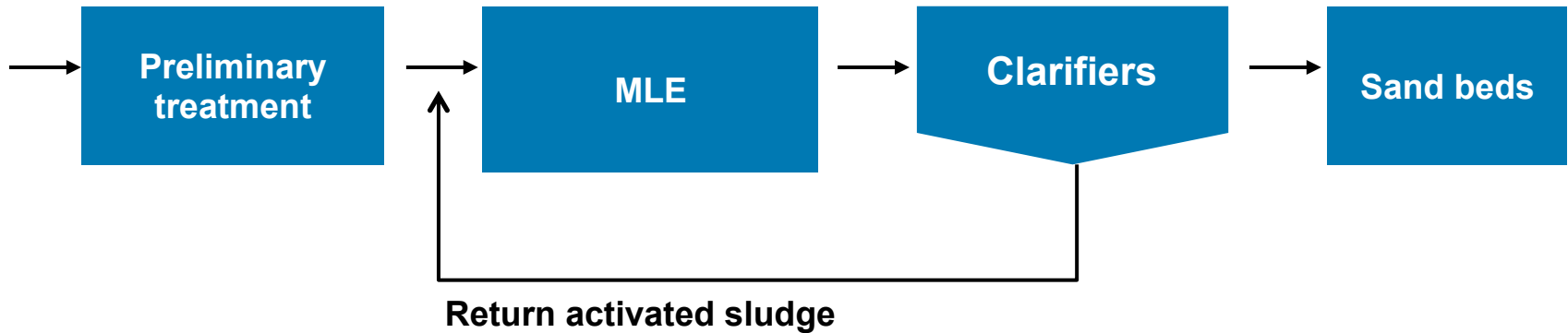
Phase	Total cost
WPCF – Contract 1	<b>\$40M</b>
Pumping Stations – Contract 2	<b>\$3M</b>
Collection System – Contracts 3 & 4	<b>\$10M</b>



# Overview WPCF

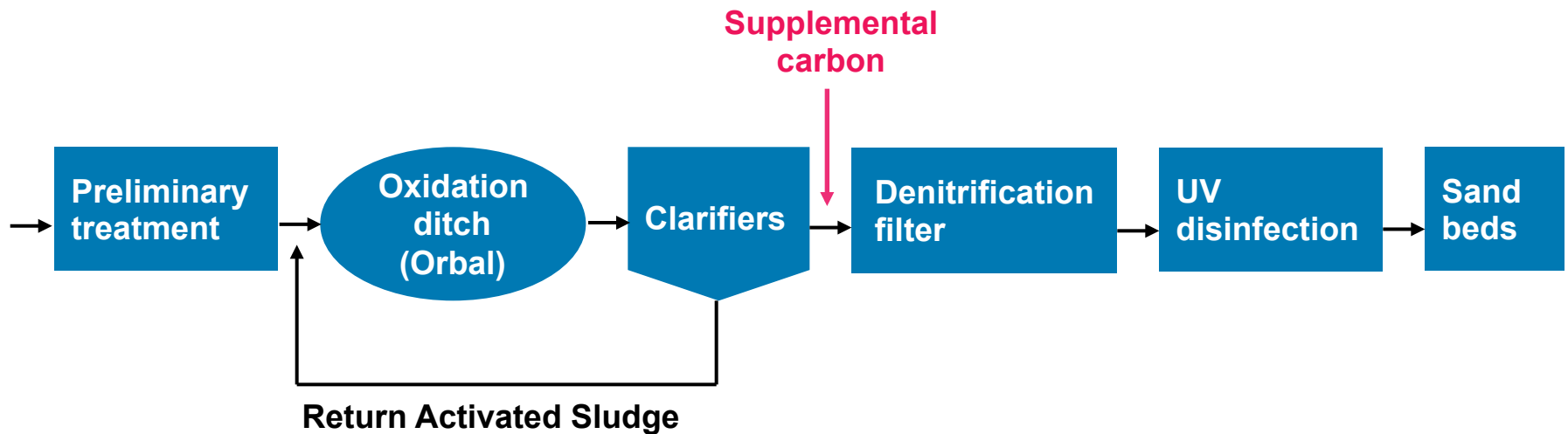


## **WPCF** schematics (liquid stream) before upgrade



# WPCF upgrade – Phase 1

- WPCF schematics (liquid stream)



# WPCF final aerial photo



Kelsey-Kennard Airview

# **WPCF** upgrade design challenges

- Wide range of flow (0.08 – 5.6 mgd) and load
- Very low winter wastewater temperatures – 7°C
- Low effluent nutrient limit (3 mg/L TN)
- Applied LEED principles in the design of the facility
- Compressed design phase to get funding



## **WPCF** upgrade design and construction timelines

Task	Date
Official design start of final design	July 6, 2009
Advertise	November 18, 2009
General contractor's bid opening	December 22, 2009
Construction start (notice to proceed)	March 1, 2010
Substantial completion (liquid stream)	April, 2012
Substantial completion (entire project)	June, 2012

# Discharge permit

Groundwater discharge permit issued by MADEP in December 2009

- Total nitrogen discharge limit
  - 3 mg/L (limit of technology) at design average annual flow
  - 10 mg/L maximum daily



# WPCF upgrade design flows and loads

- Flow ratio (peak hour/startup min) = 70
- Load ratio (BOD and ammonia) = 50

Design conditions (Phase 1)	Flow (mgd)	BOD (lbs/day)	TSS (lbs/day)	NH3-N (lbs/day)
Start-up minimum	0.08	100	160	10
Summer average	2.1	3,200	3,500	370
Maximum month	2.5	5,200	5,000	480
Peak hour	3.9			
Peak hour (Phase 2)	5.6			

# WCCF upgrade flow and load variations

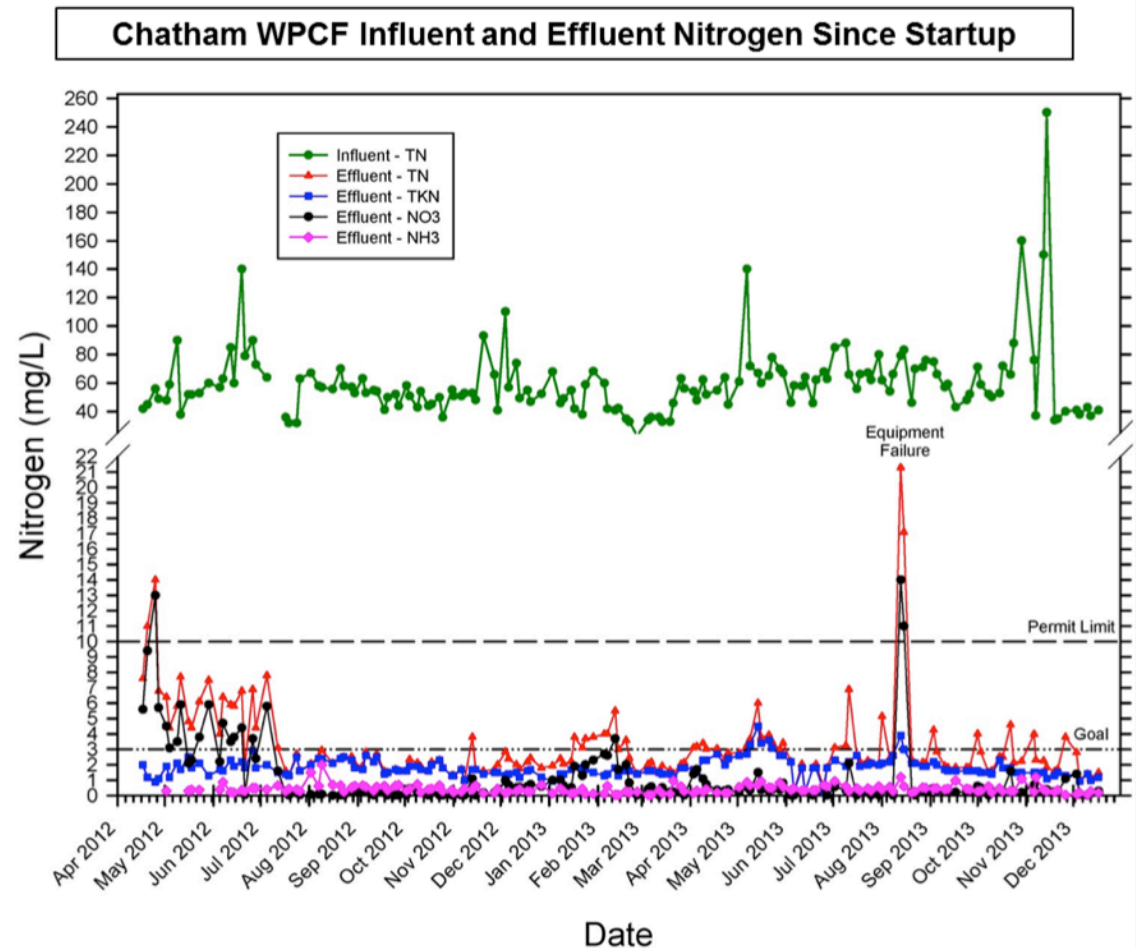
- Town goal – achieve  $TN < 3$  at all times while collection system grows by:
- Flushing - dual piping and flushing systems
- Special valving for denitrification filter influent
- Return activated sludge pumping system
  - Designed for 10 years of use
- Changing operating conditions of oxidation ditch and denitrification filters
- Future ring for Orbal® oxidation ditch
- Flexibility for future upgrades
  - Space allowed for additional clarifier, phosphorus removal, process equipment, etc.



# WPCF upgrade effluent nitrogen results – first year

## Challenges

- Target low nitrate
- Equipment failures





# Project status

- Phase I initial implementation
  - Substantially completed May 31, 2012 (entire project)
  - Have been meeting discharge permit limits
  - Below original budget and completed on schedule
- Collection system expansion
  - Completed the initial implementation (Phase 1A)
  - Completed Phase 1B
    - A main pump station upgrade (Stage Harbor PS)
    - Forcemain replacement and sewer extension near Stage Harbor PS
  - Phase 1C – extend sewers to new PS constructed as part of Phase 1A

# Non-wastewater plan components

- Targeted stormwater management and remediation
- Fertilizer management
- Pond treatment
- Wetland restoration by eliminating undersized culverts
- Growth(flow) neutral bylaw
- Increased flushing at Muddy Creek



# **Adaptive** management

- Program intended to monitor success of the implementation of the CWMP
- Intended to monitor program over life of the plan (20 years)

# Acknowledgement

All work was funded by the Town of Chatham

- Dr. Robert Duncanson  
Director of Chatham's Department of Health & Environment
- Michael Keller  
Chief Wastewater Operator of Chatham WPCF

**Thank you for your contributions!**







**Thank you!**

**Questions?**

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# **14-year** planning project 1997 - 2011

## Primary Components Comprehensive Wastewater Management Plan (CWMP)

- Technical review group formation and meetings
- Needs assessment
  - All water resources
  - Water and wastewater infrastructure
  - Buildout projections of Town landuse and wastewater flows
- Alternatives identification and screening
- Detailed evaluation and plan development
- Environmental review and approval

# **Public** outreach & participation

- Televised meetings and presentations
- Newsletters
- Town website

