Town of Orleans Massachusetts

Board of Selectmen
Water Quality and Wastewater Planning

FY18 Town Meeting
Warrant Article Workshop

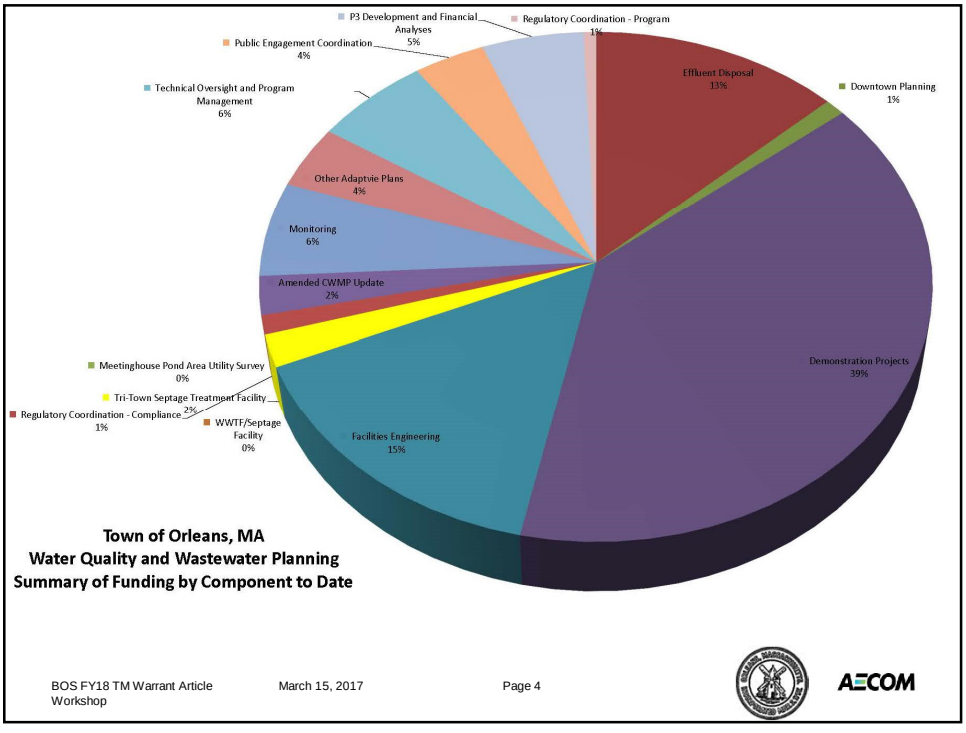
March 15, 2017

Agenda

- Summary of Funding by Project Component
- Lonnies' Pond Aquaculture - Year 1 Review and Year 2 Funding
- Draft FY18 Capital Budget Article for CWRMP Funding
- Task 10.1.B.2 – PRB – Town Land Fill Assessment – Phase 2
- Task 10.1.C.4 – Update Collection System Type Evaluation and Preliminary System Configuration
- Task 10.3.C – P3 Development and Financial Analysis
- Questions

Town of Orleans Massachusetts

Summary of Funding by Project Component



Town of Orleans, MA
Water Quality and Wastewater Planning
Summary of Funding by Component to Date

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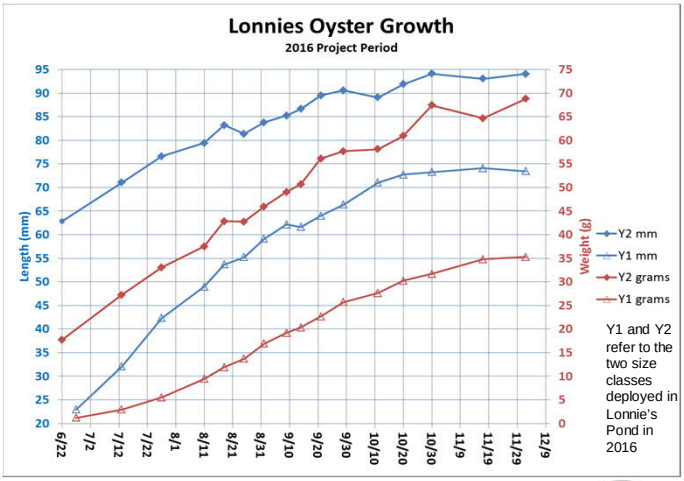
Lonnies' Pond Aquaculture - Year 1 Review and Year 2 Funding

Non-Traditional Technologies
Shellfish/Aquaculture – Background of Demo Projects

- **Shellfish demonstrations in general are designed to:**
  - Evaluate the efficacy of oysters and quahogs in achieving reduced nitrogen concentrations within the Town's impaired waters;
  - Determine the most advantageous approaches for growing the quantities of shellfish prescribed to meet nitrogen removal goals; and
  - Develop realistic cost estimates for the preferred approaches to growing shellfish to meet nitrogen removal goals in specific waterbodies.
- **Four Aquaculture Demonstrations in Orleans:**
  - Town Cove: enhanced quahog propagation (population and species assessment);
  - Kent's Point: oyster bed development (viability study);
  - Pleasant Bay: enhanced aquaculture (working with growers); and
  - Lonnie's Pond: scientific analysis of uptake and denitrification caused by oysters (continuation from Year 1).

Non-Traditional Technologies (cont.)
Shellfish/Aquaculture
Lonnie's Pond - Year 1 Growth



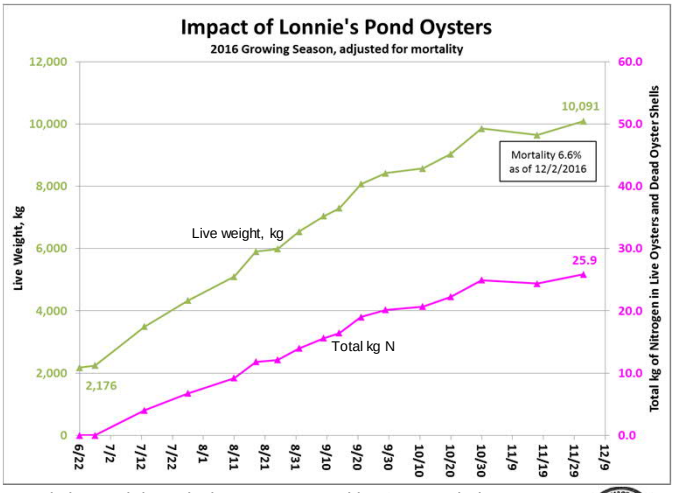
Non-Traditional Technologies (cont.)
Shellfish/Aquaculture
Lonnie's Pond Year 1 - Nitrogen Content

Lonnie's Pond Oysters as Compared to Results from Other Studies

Location	Sample Time	Length (mm)	Whole Weight (g)	Dry Tissue Weight (g)	Total N, Shell and Tissue (g)	N as a percent of Dry Tissue Weight (%)
Pleasant Bay (other studies)	Spring	77.8	64.9	2.31	0.29	12.6
Pleasant Bay (other studies)	Fall	80.92	54.3	2.99	0.30	10.0
Y2 Lonnie's Incoming	Spring	62.9	17.73	0.66	0.0683	10.3
Y2 Lonnie's New Growth	Fall	100	80.4	2.49	0.257	10.3
Y1 Lonnie's New Growth	Fall	74.3	37.4	1.20	0.126	10.5

Note: Y1 and Y2 refer to the two size classes of oysters that were deployed in Lonnie's Pond during the growing season of 2016

Non-Traditional Technologies (cont.)
Shellfish/Aquaculture
Lonnie's Pond - Year 1 Nitrogen Uptake

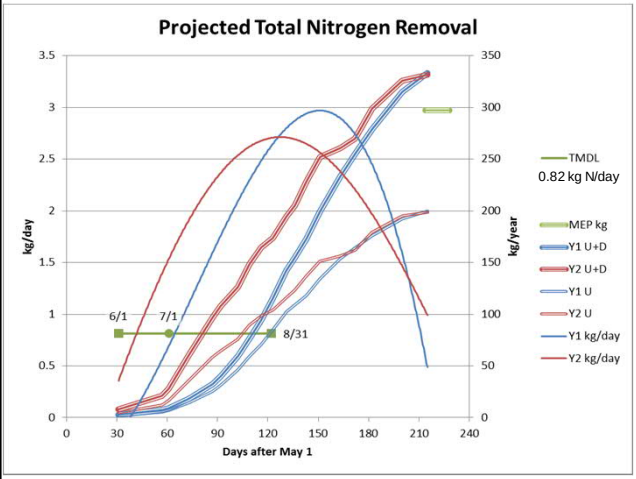


Total Live Weight and Nitrogen Removed by Oysters during Year 1

Non-Traditional Technologies (cont.)
Shellfish/Aquaculture
Lonnie's Pond - Nitrogen Removal Considerations

- **Target nitrogen reduction load (~300 kg/year)**
- **Total Maximum Daily Load (TMDL): ~0.82 kg/day**
- **Critically impaired period is July and August**
- **Timing matters for TMDL**

Non-Traditional Technologies (cont.)
Shellfish/Aquaculture
Projected N-Removal for Full Scale Implementation



Year 1 (Y1) Oysters:
3,000 bags at 600 oysters/bag

Year 2 (Y2) Oysters:
4,500 bags at 250 oysters/bag

Note: Year 1 and Year 2 refer to seed sizes that could be deployed in full scale implementation scenarios
U = Uptake of N by oysters
D = Denitrification

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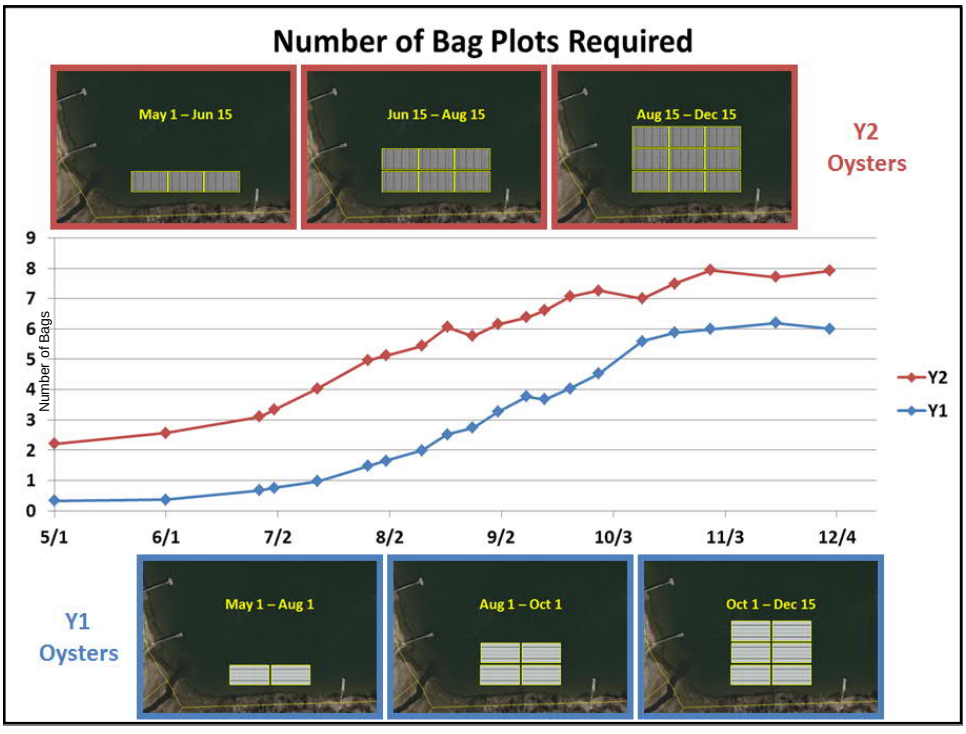
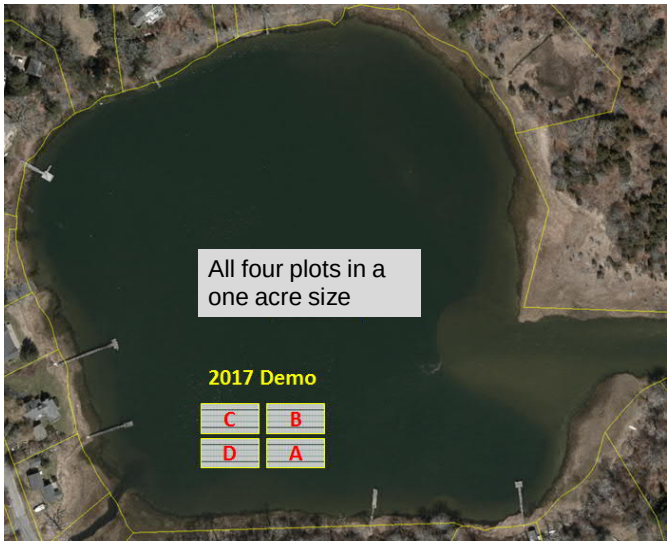


Non-Traditional Technologies (cont.)
Shellfish/Aquaculture - Lonnie's Pond Year 2 Details



Plot A:
- 140,000 Y2 oysters @ ~280 oysters/bag
- Adding biodeposits on top of the same area used by last year's site

Plot B:
- 60,000 Y2-L oysters @~150 oysters/bag and 28,000 Y2 oysters @ ~280 oysters/bag
- Over deeper water and softer bottom than last year's site

Plot C:
- 590,000 Y1 oysters @ ~1,000 oysters/bag
- Over bottom similar to that used by last year's site

Plot D:
- 360,000 Y1 oysters @ ~600 oysters/bag
- Over deeper water and softer bottom than last year's site

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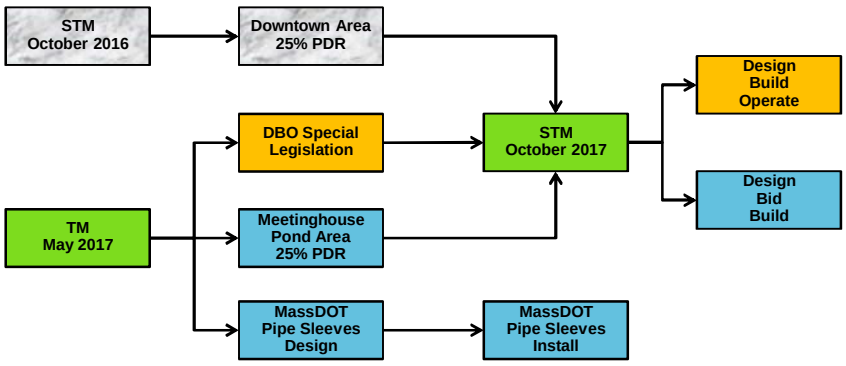
Draft FY18 Capital Budget Article for CWRMP Funding

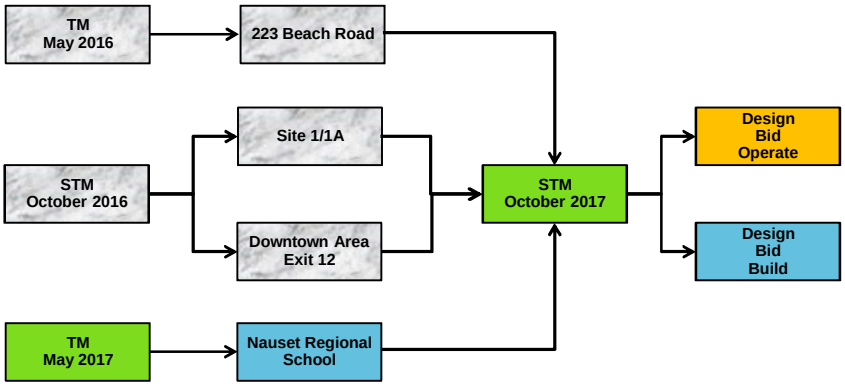
FY18 - Town Meeting Warrant Article Details Summary

Task	Description	Amount
1	Continued Planning and Engineering	$3,434,600
2	Adaptive Management Implementation	$509,600
3	Program Management, Financial Planning and Regulatory Coordination	$424,400
4	Miscellaneous	$144,700
	Total	$4,513,300

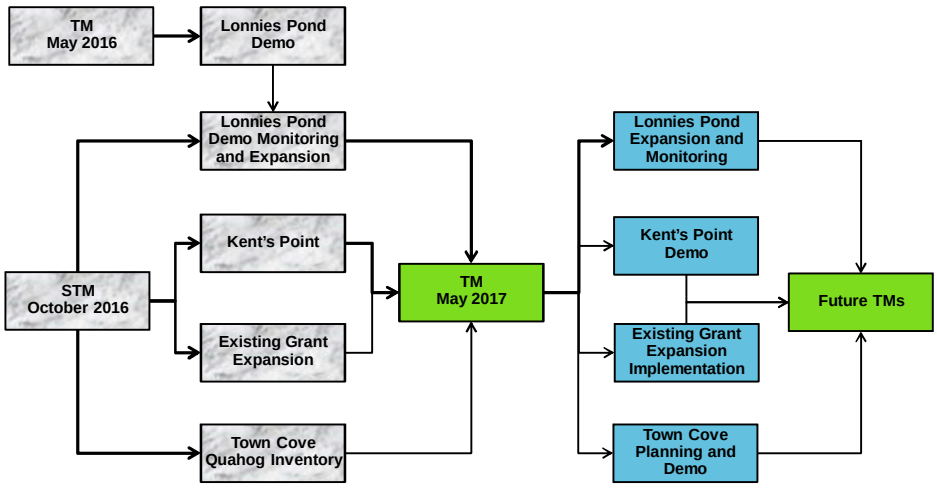
FY18 - Funding Request Rationale for Traditional Technologies



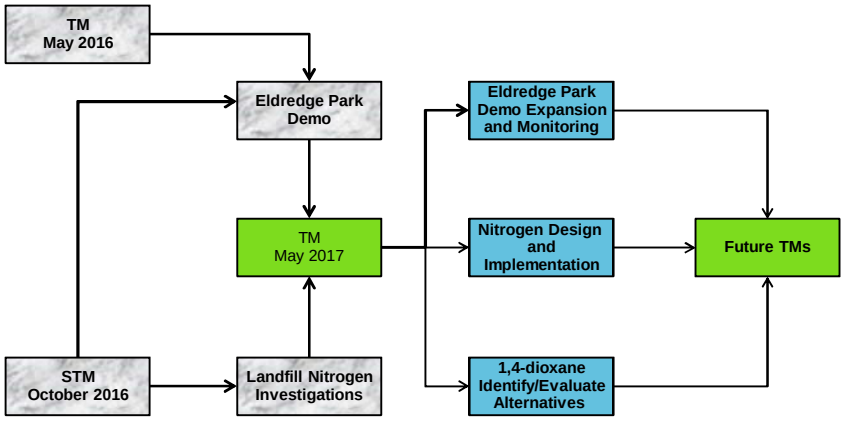
FY18 - Funding Request Rationale for Effluent Disposal



FY18 - Funding Request Rationale for Aquaculture



FY18 - Funding Request Rationale for Permeable Reactive Barriers



FY18 - Funding Request Rationale for Nitrogen Removing Barriers

FY18 - Town Meeting Warrant Article Details
Continued Planning and Engineering

Task	Description	Amount
1a	Effluent Disposal ● Hydrogeologic Evaluation At One Discharge Site	$301,700
1b	NT Technologies - Demonstration Project Planning and Pre-Design, Final Design and Implementation	
	● Aquaculture – (a) O&M and Monitoring at Lonnies Pond and (b) Kent's Point Design and Implementation at Demonstration Site	$475,500
	● PRB – (a) Expansion and Monitoring at Eldredge Park and (b) Design and Implementation of Landfill Nitrogen Response Action Note: Monitoring and Reporting at the Landfill via Separate Funding Article(s)	$1,503,400
	● NRB - Monitoring at 4 Private Property Sites	$43,700

FY18 - Town Meeting Warrant Article Details
Continued Planning and Engineering (cont.)

Task	Description	Amount
1c	Design and Construction - Collection and WWTF	
	● PDR - Meetinghouse Pond Area (Collection - PDR Design 25%)	$612,600
	● MassDOT - State Intersection Projects (Lawrence Lynch) - 4 Sleeve Locations	$250,000
1d	Design and Construction - NT Technologies	$0
1e	Tri-Town Transition Requirements - Separate Funding Article(s)	$0

FY18 - Town Meeting Warrant Article Details
Continued Planning and Engineering (cont.)

Task	Description	Amount
1f	Regulatory Coordination ● Coordination at Project Level	$27,700
1g	Meetinghouse Pond Utility Survey ● Field Survey - Utilities and Wetlands	$147,500
1h	Update of Amended CWMP	$72,500

FY18 - Town Meeting Warrant Article Details
Adaptive Management Implementation

Task	Description	Amount
2a	Water Quality Monitoring: MEP compliance ● Allowance for NT Project Performance	$59,000
2b	Water Quality Monitoring: Project Baselines ● Allowance for NT Project Performance	$59,000
2c	MEP Study & Report Updates	$75,800
2d	Namskaket and Little Namskaket Adaptive Plans ● Allowance for Watershed Protection Actions	$40,800
2e	Stormwater and Fertilizer Management ● Separate Funding Article(s)	$0
2f	Cedar Pond and Rock Harbor Creek ● Allowance for Planning	$75,000
2g	Fresh Water Ponds ● Allowance for Planning, Design and Implementation	$200,000

FY18 - Town Meeting Warrant Article Details Program Management, Financial Planning and Regulatory Coordination

Task	Description	Amount
3a	Technical Oversight & Projects Management	$97,200
3b	Public Engagement Coordination ● OWQAP Meetings ● OWQAP Subcommittee Meetings ● Other Public Meetings ● Status Reports and FAQ Flyers	$196,400
3c	DBO/P3 and Financial Analyses	
	● Design-Build-Operate - Development of Special Legislation	$23,800
	● Financial Analysis - Perform Additional Model Runs	$71,400
3d	Regulatory Coordination	$35,600

FY18 - Town Meeting Warrant Article Details Miscellaneous

Task	Description	Amount
4a	Other Miscellaneous Town Costs	$100,000
4b	Town Contingency	$44,700

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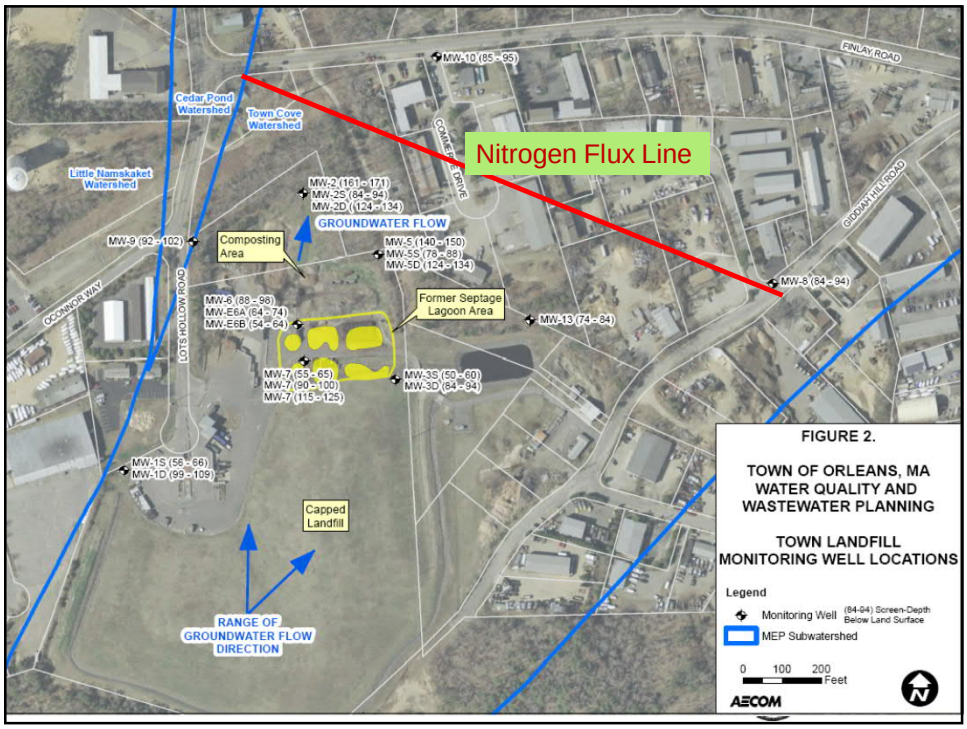
Task 10.1.B.2 – PRB – Town Land Fill Assessment – Phase 2



Town of Orleans, Massachusetts
Water Quality and Wastewater Planning
Non-Traditional Technologies - Landfill Nitrogen Flux
Estimated Nitrogen flux (mass per time) from the Orleans Landfill.

Parameter	Units	Low Range Flux	High Range Flux	Mid Range Flux
Groundwater Seepage Velocity (variable)[1]	ft/d	2.00	4.00	3.00
Porosity	unitless	0.25	0.25	0.25
Darcy Velocity	ft/d	0.50	1.00	0.75
Vertical Extent	feet	60	60	60
Length of Affected Aquifer[2]	feet	1,540	1,540	1,540
Groundwater Flux	ft3 / d-ft length	30	60	45
Groundwater Flux	ft3 / day	46,200	92,400	69,300
Groundwater Flux	L/day	1,308,236	2,616,472	1,962,354
Groundwater Flux	Gallons/min	240	480	360
Nitrate Concentration (variable)[3]	mg/L	6.00	24.00	12.00
Nitrate Flux	kg /yr-ft length	1.86	14.88	5.58
Nitrate Flux	kg/year	2,865	22,920	8,595

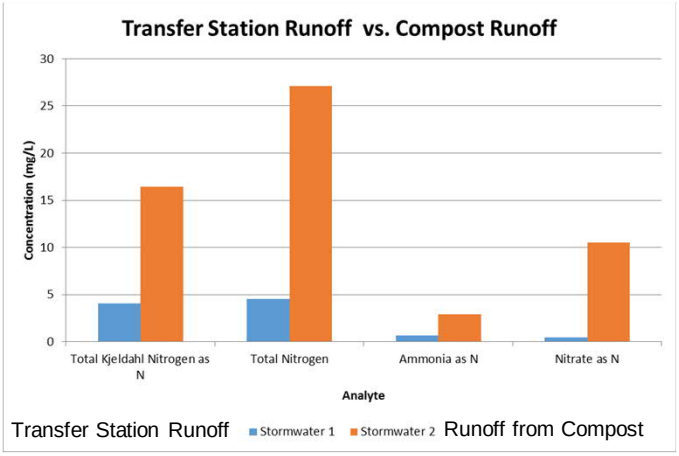
1. Variable - sensitive to hydraulic conductivity Groundwater velocity is variable based on a range of hydraulic conductivity (Low 60 - High 250 ft./day)

2. Affected Aquifer length - line across watershed from corner Lots Hollow Rd and Finlay Rd. to Giddiah Hill Rd. at corner Industrial Way

3. Variable -sensitive to total nitrogen concentration - Data set average concentration 12 mg/L, range 1 mg/L to 27 mg/L, n=32

Sources of Nitrogen at the Landfill

Compost Operation Significant Nitrogen Source



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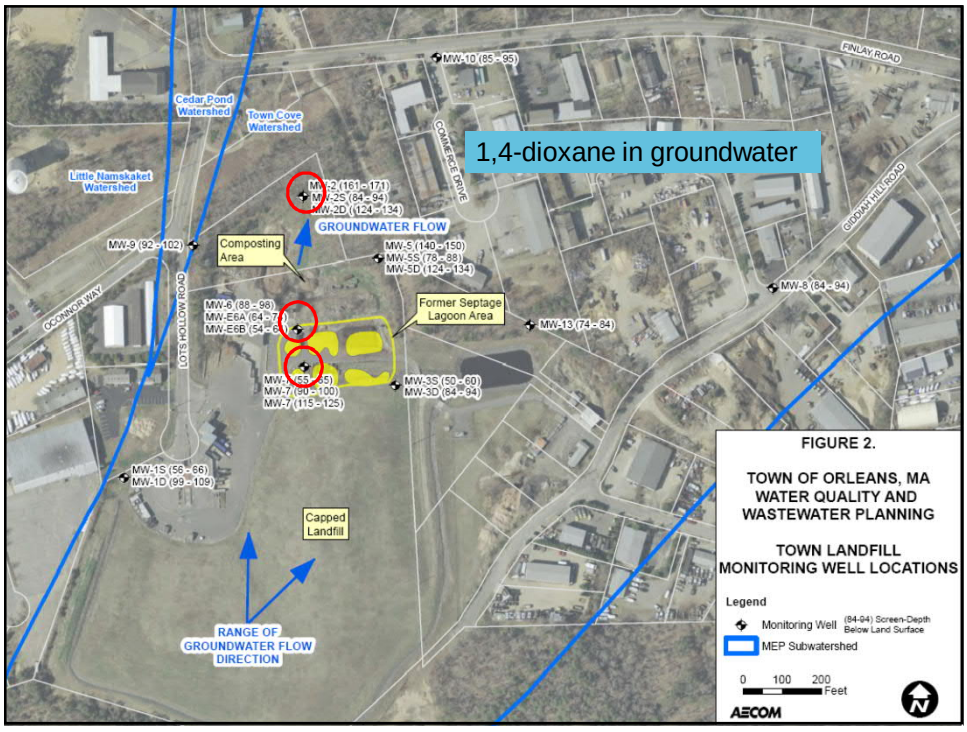


Landfill - Summary

- **Groundwater Affected by Significant Nitrate Concentrations Shallow and by Ammonia and 1,4-dioxane Deep**
- **Sources of 1,4-dioxane and Nitrogen Identified**
  - 1,4-dioxane source appears to be solid waste in the landfill
  - Nitrogen sources:
    - Landfill (mainly ammonia)
    - Septage Lagoons (ammonia and nitrate)
    - Compost operation (organic nitrogen, ammonia, and nitrate)
    - Transfer Station runoff (ammonia and nitrate)
- **Landfill Area Nitrogen flux Estimated –Mid-range estimate ~ 8,500 kg/yr**
- **1,4-dioxane Detected in More monitoring Wells > 0.0003 mg/L Standard**
- **Potential Area of Downgradient Migration Area in Watershed Identified**

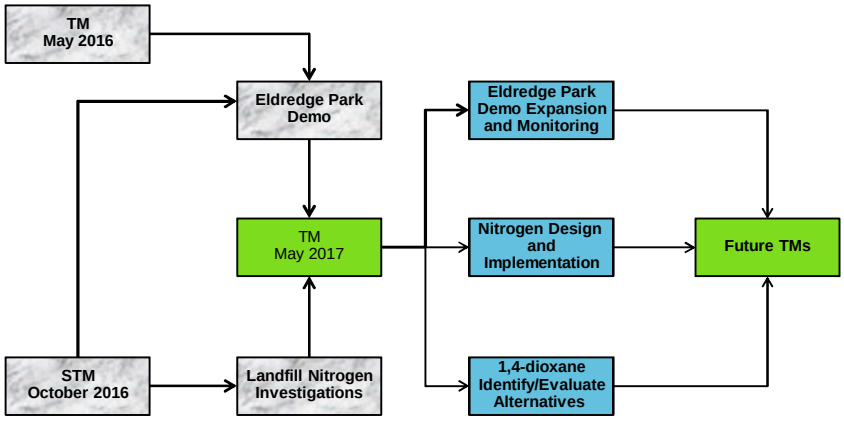
Landfill Potential Corrective Actions for Nitrogen - Nitrogen Flux

- **Reduce/Eliminate Infiltration of Transfer Station Stormwater/landfill Cap drainage through the Septage Lagoon Area**
- **Move Compost Operation to a Location with an Impermeable Surface (already in planning by DPW)**
- **Consider Treatment of Stormwater, Landfill Cap Drainage and Compost Area Runoff with Best Management Practices to Maximize Denitrification**
- **Consider Active Capture and Treatment of Landfill Area Nitrogen Flux with Groundwater Extraction and Treatment with Nitrification/Denitrification Bio-filter Systems**

Next Steps Landfill Site

- Continue to Evaluate Risks Associated with 1,4 –dioxane
- Identify Immediate Actions to Limit Additional Contamination of Groundwater
- Identify Short and Long-term Goals for Cleanup of Contaminated Groundwater
- Implement Phased Design, Permit, and Construction Plan

FY18 - Funding Request Rationale for Permeable Reactive Barriers



Town of Orleans Massachusetts

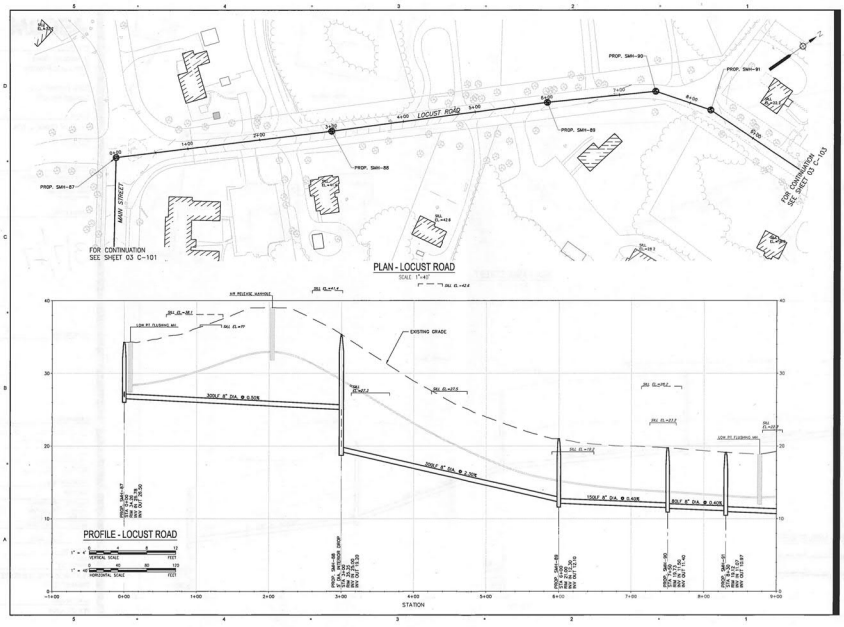
Task 10.1.C.4 – Update Collection System Type Evaluation and Preliminary System Configuration

Downtown Area PDR (25% Design) – Status

- **Topographic Survey**
  - Ground Survey
    - Survey at the Route 6A/Route 28/Canal Road Roundabout Has Been Completed
    - Differential Leveling for Benchmarks and Plan Check is on Going
    - Acquiring Sill Elevations in the Downtown Area Has Been Completed
  - Aerial Survey
    - Ground Control Survey Has Been Completed
    - Aerial Flight Completed on 2/27/17
    - Data Processing Scheduled to be Completed by 3/17/17
- **Subsurface Investigation**
  - 125 Locations
    - Over 50% Complete (66 Borings)
    - Scheduled to Complete by 3/24/17
  - Nothing Unexpected Observed/Discovered to Date
    - Groundwater: Locus Road and Canal Road Area
    - Bike Path (Old Railroad) Bed Material: Old Pavement

Downtown Area PDR (25% Design) – Status (cont.)

- **Cultural Resource Evaluation**
  - Received Draft Report from PAL
    - Not Recommending Conducting Any Intensive Level Testing
    - Recommending Development of an Unanticipated Discoveries Plan and Monitoring During Construction
  - Preparing Draft Technical Memorandum
- **Update Collection System Type Evaluation and Preliminary System Configuration**
  - Added Sills
  - Updated Profiles Showing Gravity Sewer and Pressure Sewer
  - Updated Quantities
  - Reviewing Impacts from Existing Utilities



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PROJECT
Downtown Area Plans and Profiles

25% Preliminary Design Report

CLIENT
Town of Orleans, MA

CONSULTANT

CONSULTANTS

REGISTRATION

ISSUE/REVISION

NO.	DATE	DESCRIPTION

PROJECT NUMBER
60476644

Designed By	M. CURRAN
Drawn By	M. CURRAN
Dept Check	T. PARECE
Proj Check	M. DONOGHUE
Date	
Scale	AS NOTED

DISCIPLINE
CIVIL

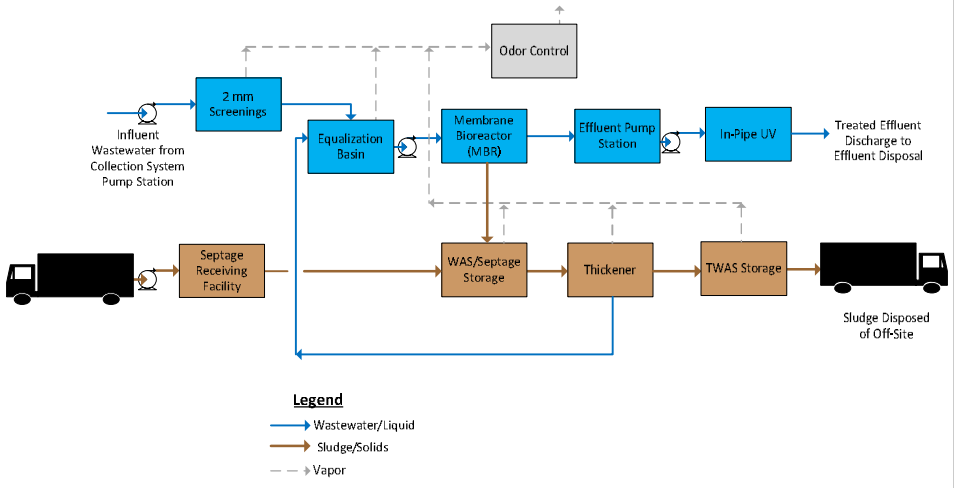
SHEET TITLE
PLAN AND PROFILE SEWER LOCUST ROAD I

SHEET NUMBER
03 C-102

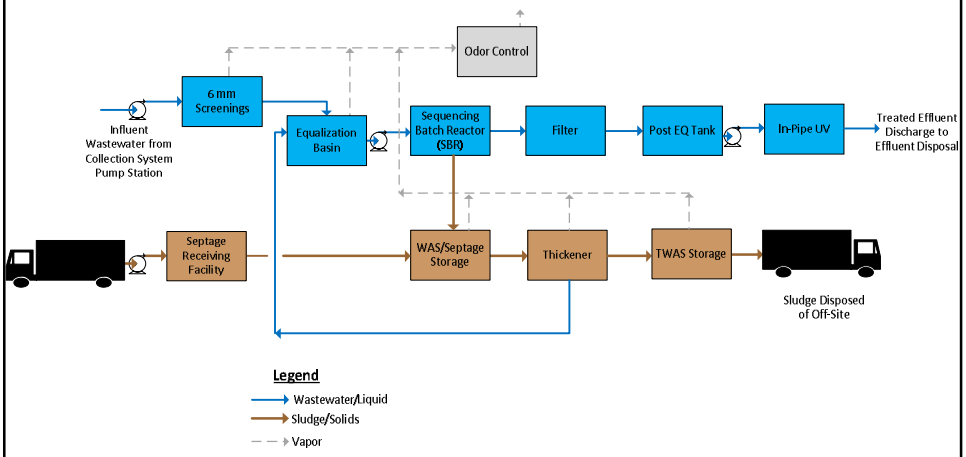
Downtown Area PDR (25% Design) – Status (cont.)

- **Update WWTF Process Selection**
  - Design for Sewage and Septage Receiving/Treatment
  - Two Top Candidates Identified in Concept Design Phase Being Further Explored (SBR and MBR)
  - Design to Include Biosolids Thickening but Not Dewatering
- **Design Data**
  - Flows Derived from Collection System Evaluation
  - Sewage Strength (Assumed medium to strong)
    - Provincetown and Chatham Used as a Reference
  - Tri-town Septage Treatment Facility Data Used for Septage Characteristics
  - Anticipated Effluent Requirements
    - BOD & TSS <= 30 mg/l
    - TN <= 10 mg/l
    - Designing for Lower Limits

Wastewater Treatment Facility Process Evaluation
MBR Conceptual Design



Wastewater Treatment Facility Process Evaluation (cont.)
SBR Conceptual Design



Wastewater Treatment Facility Process Evaluation (cont.)
Process Component Caparison

	Option – 1 SBR Treating Sewage/Septage	Option – 2 MBR Treating Sewage/Septage	MBR Treating STEP Effluent
Screening	X (6 mm)	X (2 mm)	X (2 mm)
Pre-Equalization	X	X	X
Biological Process	X	X (smaller than Opt–1)	X (smaller than Opt-2)
Post Filtration	X		
Post-Equalization	X		
Disinfection	X	X	X
Septage Receiving	X	X	X
Biosolids Storage	X	X	X (slightly smaller than Opt-2)
Biosolids Thickening/Storage	X	X	X
Supplemental Carbon Addition			X

Wastewater Treatment Facility Process Evaluation (cont.)
Comparison of Wastewater Characteristics

	Sewage[1]	Septage[2]	Sewage/Septage Blend[3]	STEP Effluent[4]	Comments
BOD, mg/l	270	2,300	275	270	
TSS, mg/l	310	3,600	300	75	
TN, mg/l	55	1,600	60	120	Achieving Effluent TN of 10 mg/l or less with STEP Effluent Could Prove Difficult

Notes:

1. Sewage characteristics based on "medium to strong" typical values, cross checked with Provincetown and Chatham data where available.
2. Septage characteristics based on Tri-town Septage Treatment Facility supplemented with EPA guidelines as needed.
3. Sewage/septage blend characteristics assume blending after septage thickening.
4. STEP effluent characteristics based on Septage Characteristics, but assuming 98% solids capture in septic tank.

Effluent Disposal Investigations

- **MassDEP Approved Hydrogeology Evaluations**
  - Orleans Market Place – 140,000 gpd
  - 223 Beach Road – 200,000 gpd
- **Ongoing / Planned Hydrogeology Evaluations**
  - Site 1/1A
  - Route 6 – Exit 12 Cloverleaf
  - Nauset Regional School District Pending FY18 Town Meeting Funding

The Town of Orleans Has Not Decided on the Location(s) for Effluent Disposal

Town of Orleans Massachusetts

Task 10.3.C – P3 Development and Financial Analysis

Financial Plan Development

- **Developed Detailed Model with Functionality**
- **Developed Initial Scenarios and Average Costs per User Category using Total Number of Users/Owners per User Area**
- **Incorporated Implementation Phasing Program for Downtown Area and Meetinghouse Pond Area Systems**
- **Incorporated Parcel Level Water Use and Property Assessment Data (to Better Refine Rates for User Categories)**
- **Updated and Adjusted Project Costs**
- **Estimated Average and Parcel-specific Rates for User Categories**
- **Compared User Costs to EPA Affordability Benchmark (2% MHI) and 2010 Approved CWMP**

Scenario Development and Assumptions

- **Produced Approximately 24 Scenarios**
- **Key Considerations**
  - Cost Allocation Across User Groups
  - Direct and Indirect Benefit to the Users
  - Reasonable "Affordability" using EPA Affordability Benchmark
  - Contribution from Downtown Businesses
  - Delivery Options Feasibility and Savings

Key Issues and Consideration

- **User Fees for O&M&R Costs are Major Factor in Total Annual Rates:**
  - Non-Traditional O&M Costs are Higher than for Traditional Solutions
  - Monitoring Costs and Uncertainty of Performance are Key Factors for NT Areas
- **Meetinghouse Pond Area Annual Charges Higher than Downtown Area Due to Fewer Users and has a Separate WWTF**
- **Overall Factor: Construction of Collection, Treatment and Disposal Systems in One 20-year to 30-year Program is Key Difference Compared to Systems Built Over Several Generations**
  - Program Phasing is Imperative

Adjustments to Address Potential Equity and Affordability Concerns

- **Finalized Phasing of all Program Components**
- **Assigned Special Assessment / Betterments for Capital Costs to Various User Groups**
- **Tested Different Options for Percentage of Specials Assessments vs General Fund**
- **Evaluated Effects of Different Percentage Split of Assessments Between Residential and Non-Residential Assessments**

Current Financial Planning Scenarios

- **Base Case (Capital Costs on 100% Tax Rate)**
- **Majority of Capital Cost via Special Assessments to Owners in Sewered Areas**
- **Split Residential and Non-Residential Assessments in Sewered Areas**

Current Financial Planning Scenarios (cont.)

"Constant" Scenario Assumptions for Current Scenarios:

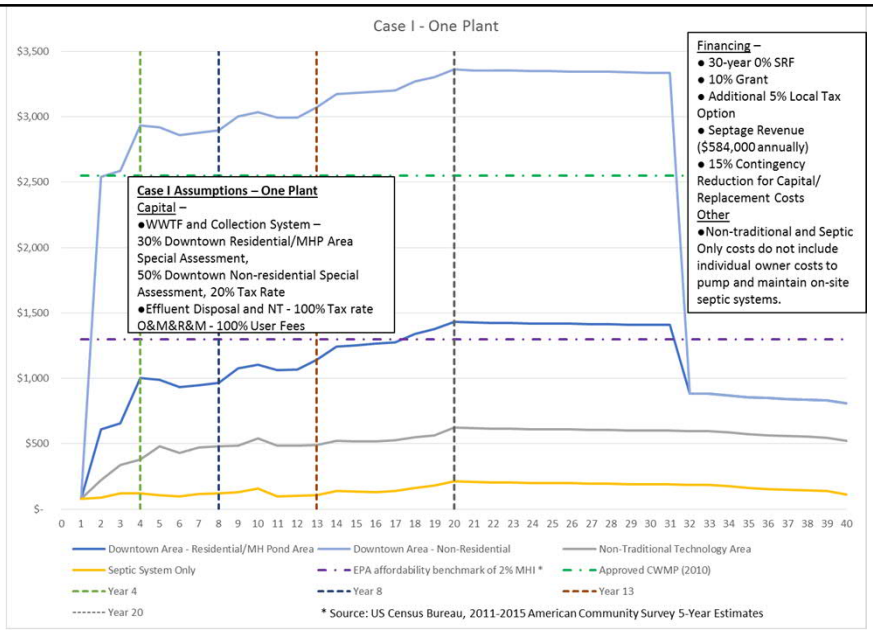
- **30-Year SRF Financing at 0%**
- **10% State Grant or Debt-Forgiveness**
- **Additional 5% Local Tax Option Revenue**
- **15% Contingency on Traditional and Non-Traditional Capital/Replacement Costs**
- **Regional Septage Revenue**
- **No DBO Delivery Method**

Current Financial Planning Scenarios (cont.)

- **Majority Special Assessment**
  - Majority of Capital Costs on Assessments (as opposed to General Fund)
- **Split Residential and Non-Residential Assessments in Sewered Areas**
  - Reduced Assessment on Residential Properties Because Limited Opportunity for Increased Property Value as Opposed to Non-Residential Properties Unless Change in Use
- **Non-Traditional Technologies**
  - All on Tax Rate Because no Direct Increase in Property Value from NT Systems
  - Town-Wide Water Quality Benefit
- **Existing On-Site Systems**
  - Property Owners Maintain Costs for Existing On-Site Systems

Reducing Costs: Two WWTFs vs One WWTF Scenario Cost Allocation

Scenario	Two WWTFs		One WWTF	
	Tax Rate	Special Assessment	Tax Rate	Special Assessment
Base Case	100%	---	100%	---
Sewered Areas: Majority Special Assessment	20%	80%	20%	80%
Sewered Areas: Split Res / Non-Res Private Burden				
Downtown Area	20%	30% - Res 50% - Non-Res	20%	30% - Res 50% - Non-Res
Meetinghouse Pond Area	70%	30%		
Non-Traditional Technologies	100%	---	100%	---
Existing On-Site Systems	---	100%	---	100%



Example Financial Model Output – Per Parcel Data

Case I – Two Plants

Key	GISNum	Address	Classification	Phasing	Land Use Classification	2015 Assessed Value	2014-2015 Avg. Daily WW Usage	Year 8 Assess	Year 8 Prop Tax	Year 8 U Charge	Year 8 Total
2512	2207	2 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$934,600	866.76	$ 4,825	$ 293	$ 15,541	$ 20,659
10155	2180	4 ACADEMY PLACE	Downtown	2	Residential	$668,500	263.58	$ 1,615	$ 210	$ 4,726	$ 6,551
5923	2279	5 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$19,700	407.04	$ 2,266	$ 6	$ 7,298	$ 9,570
2511	2180	6 ACADEMY PLACE	Downtown	2	Residential	$423,900	183.94	$ 1,127	$ 133	$ 3,298	$ 4,558
2513	2254	8 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$597,200	69.94	$ 389	$ 187	$ 1,254	$ 1,831
2514	2171	10 ACADEMY PLACE	Downtown	2	Residential	$1,073,500	132.30	$ 811	$ 337	$ 2,372	$ 3,519

Case I – One Plant

Key	GISNum	Address	Classificati	Phasing	Land Use Classification	2015 Assessed Value	2014-2015 Avg. Daily WW Usage	Year 8 Assess	Year 8 Prop Tax	Year 8 U Charge	Year 8 Total
2512	2207	2 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$934,600	866.76	$ 8,828	$ 183	$ 15,966	$ 24,977
10155	2180	4 ACADEMY PLACE	Downtown	2	Residential	$668,500	263.58	$ 1,301	$ 131	$ 4,855	$ 6,287
5923	2279	5 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$19,700	407.04	$ 4,146	$ 4	$ 7,498	$ 11,647
2511	2180	6 ACADEMY PLACE	Downtown	2	Residential	$423,900	183.94	$ 908	$ 83	$ 3,388	$ 4,379
2513	2254	8 ACADEMY PLACE	Downtown	2	Non-Residential/Mixed Use	$597,200	69.94	$ 712	$ 117	$ 1,288	$ 2,117
2514	2171	10 ACADEMY PLACE	Downtown	2	Residential	$1,073,500	132.30	$ 653	$ 210	$ 2,437	$ 3,300

Next Steps

- **Review, Discuss and Take Action on FY18 Funding Requests**
- **Provide Summary of BOS Key Decisions for BOS Review, Discussion and Action**
- **Review and Discuss Input from OWQAP, Downtown Business and Residents Regarding Cost Allocation**

Town of Orleans Massachusetts

Thank You