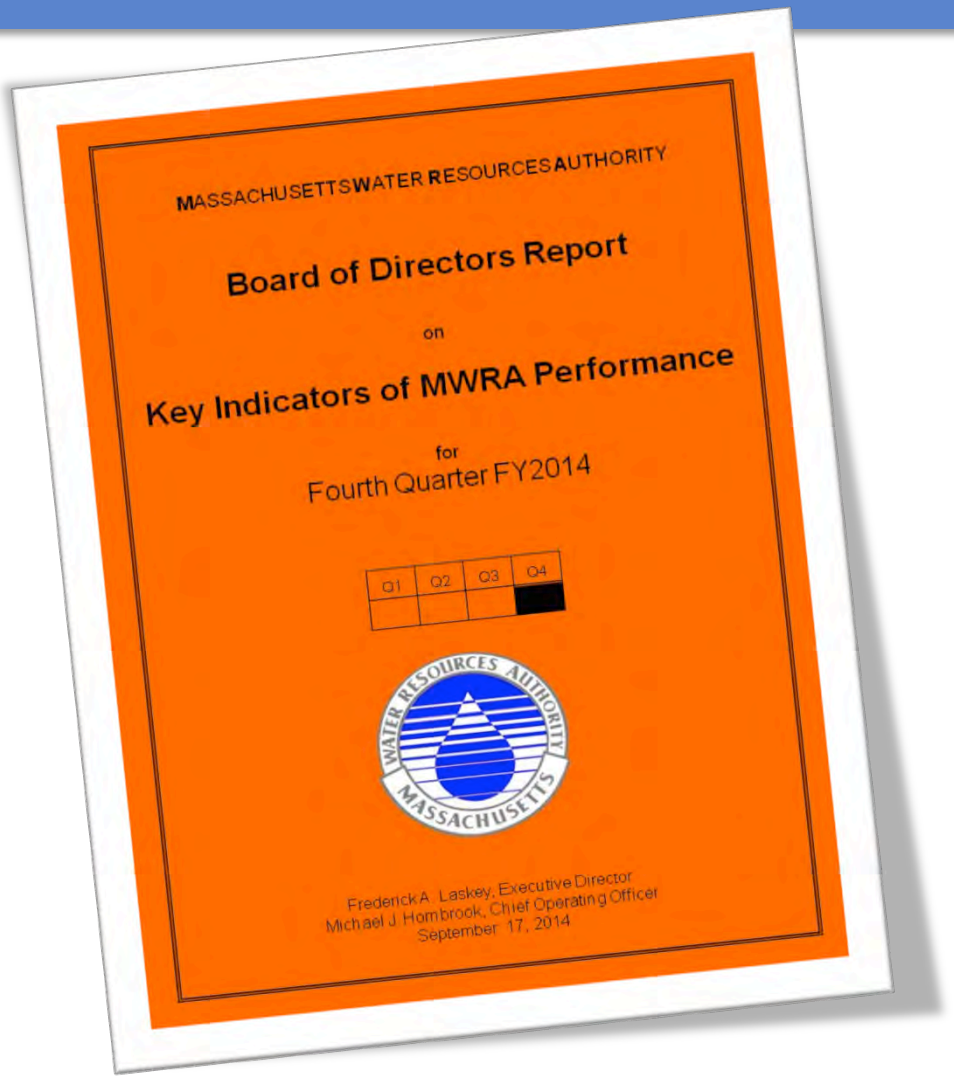
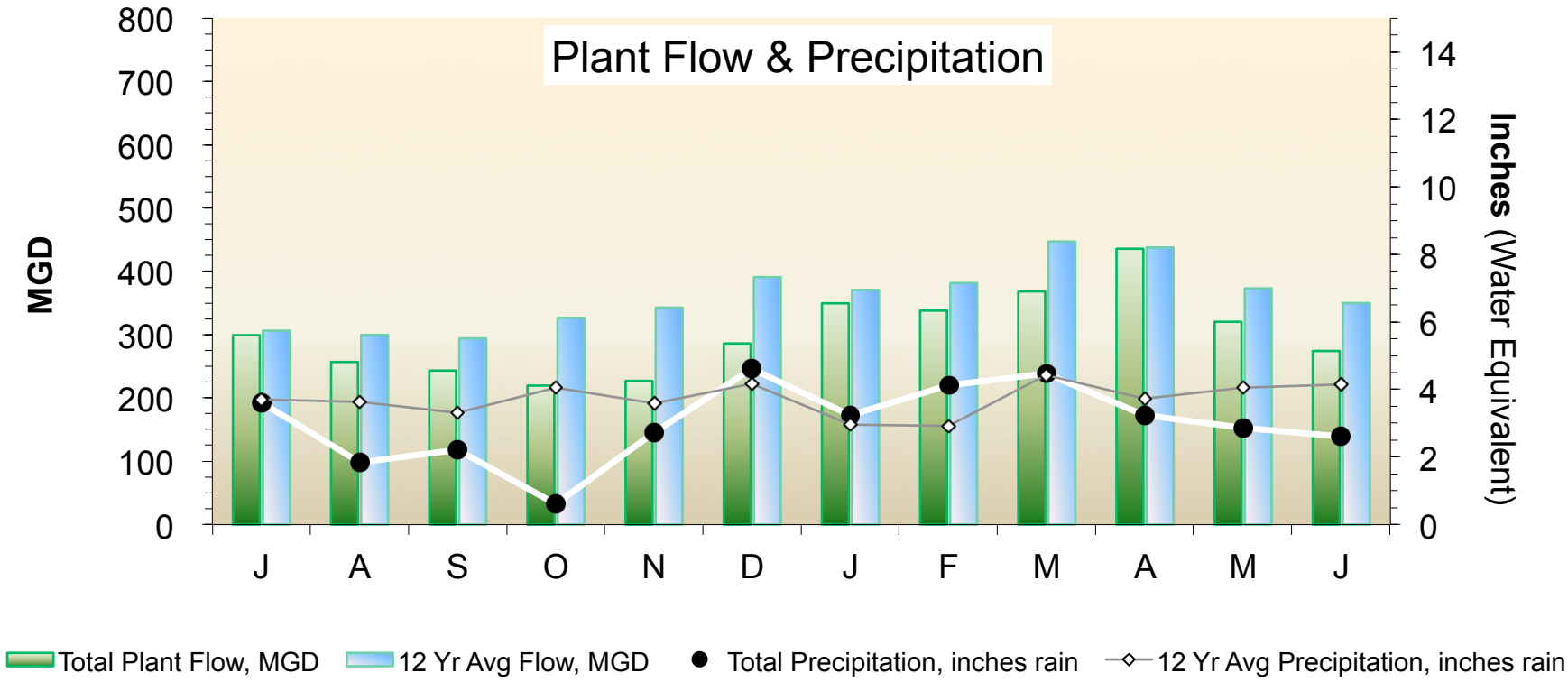

WATER RESOURCES AUTHORITY
MASSACHUSETTS

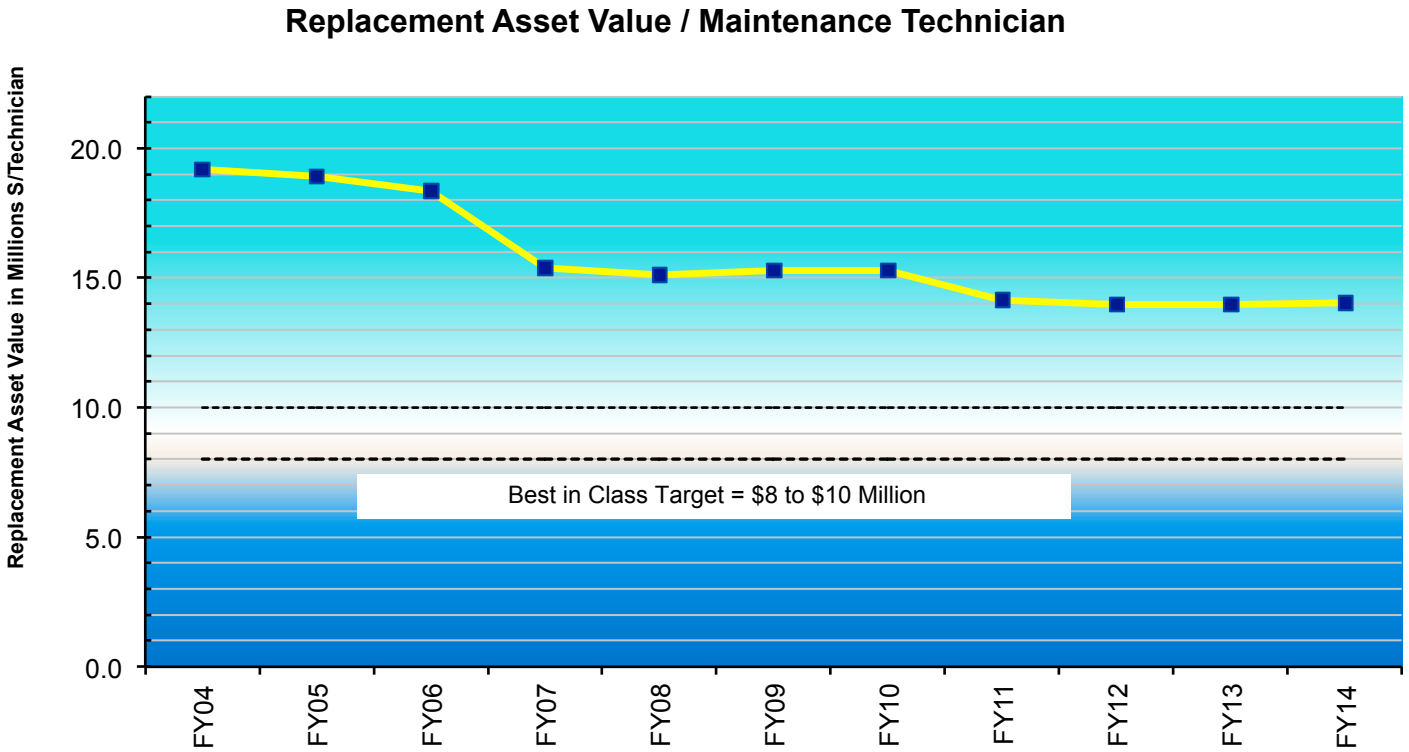
Massachusetts Water Resources Authority



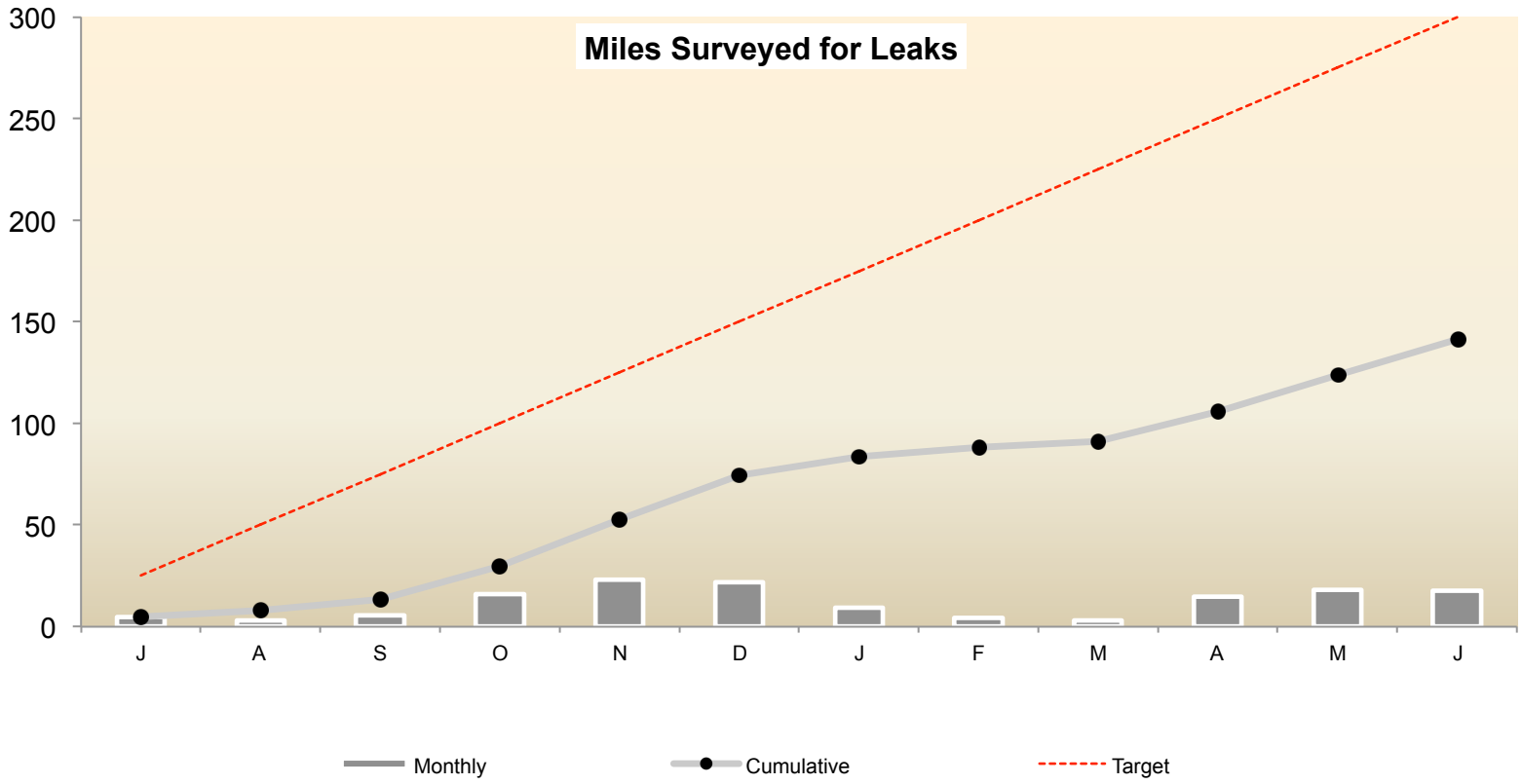
Deer Island Operations



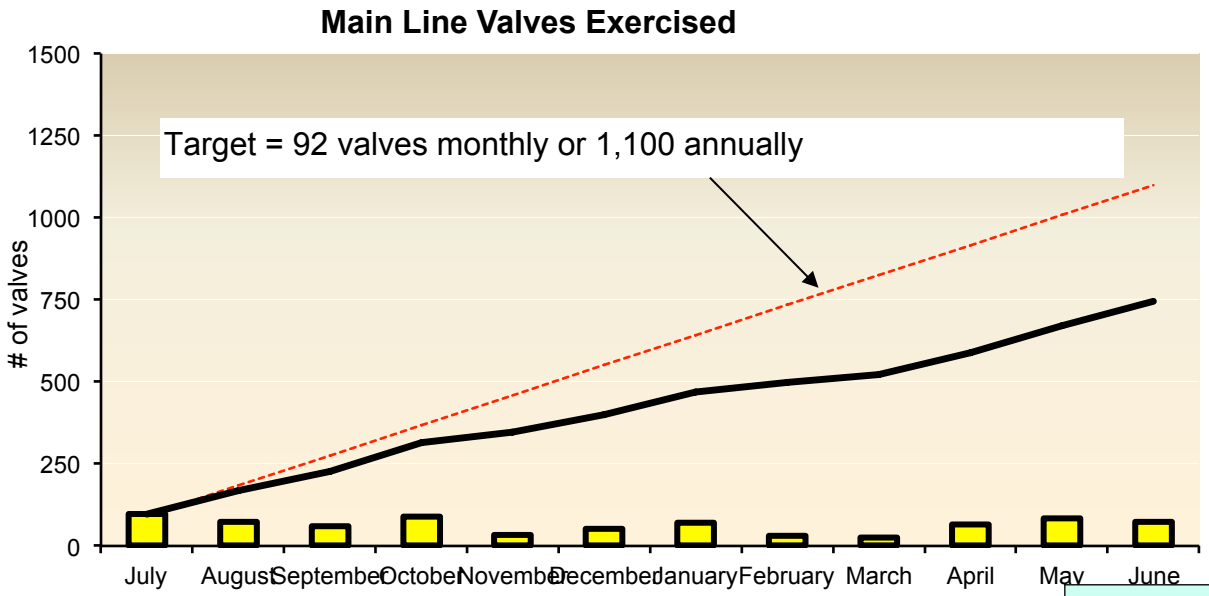
Deer Island Yearly Maintenance Metrics



Water Distribution System Pipelines

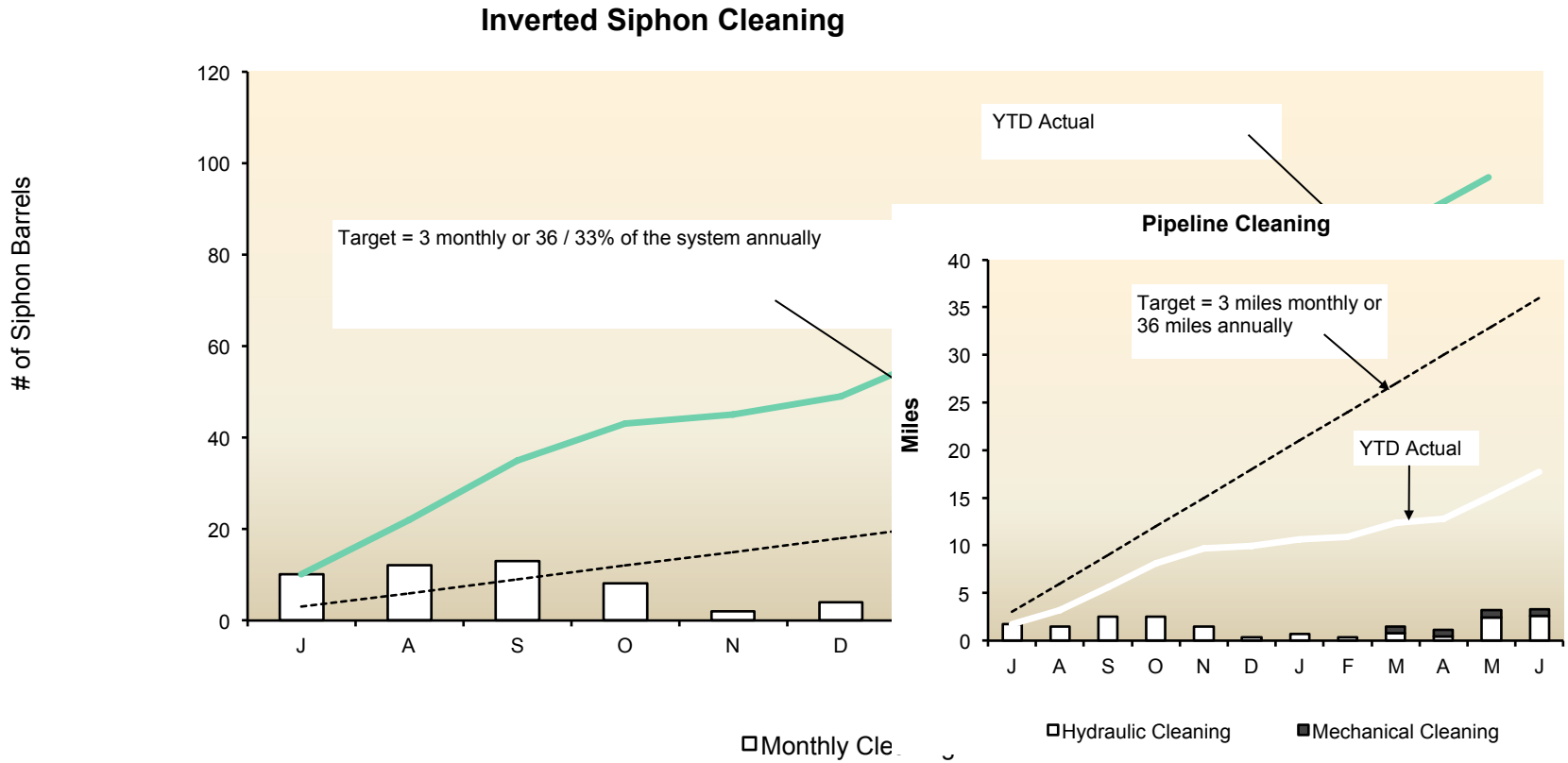


Water Distribution System Valves

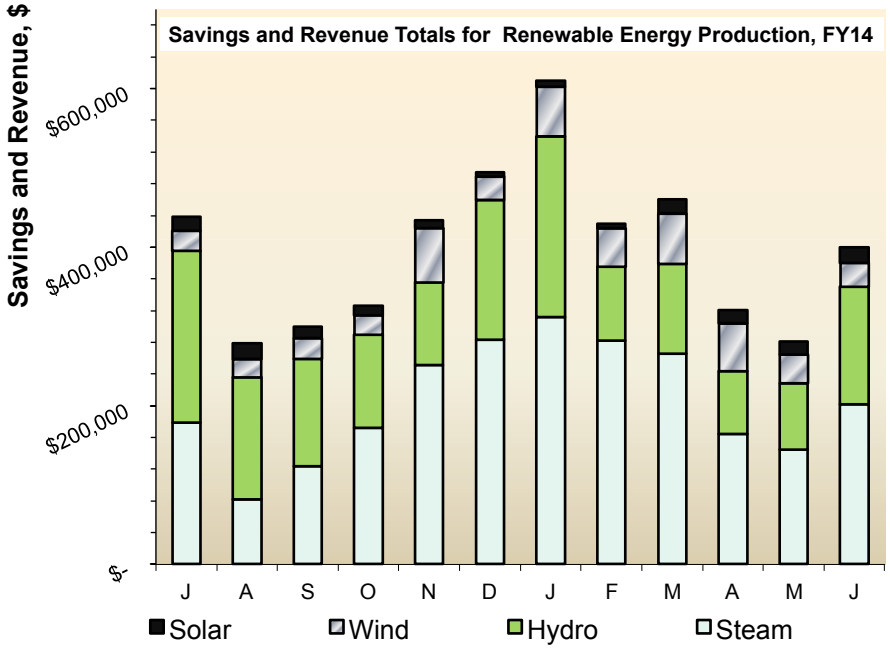


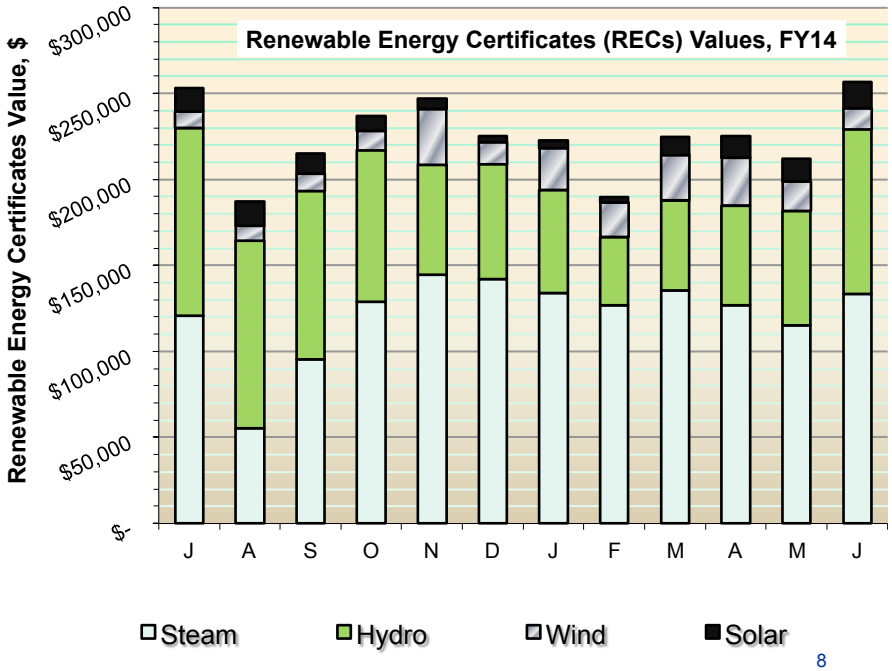
Type of Valve	Inventory #	Operable Percentage	
		FY14 to Date	FY14 Targets
Main Line Valves	2,092	97.7%	95%
Blow-Off Valves	1,206	95.1%	95%
Air Release Valves	1,335	93.1%	95%
Control Valves	48	100.0%	95%

Wastewater Pipeline and Structure Inspections and Maintenance

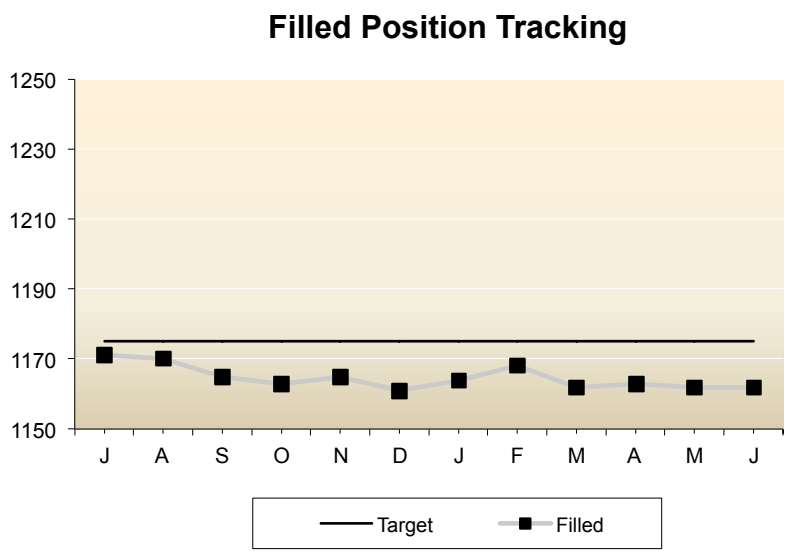


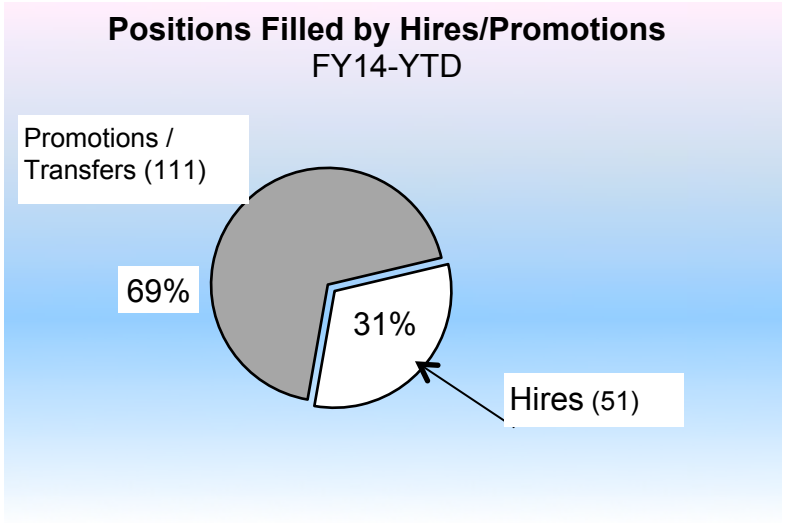
Renewable Energy at MWRA





Workforce Management





	Pr/Trns	Hires	Total
FY11	48 (62%)	30 (38%)	78
FY12	42 (61%)	27 (39%)	69
FY13	82 (64%)	47 (36%)	129
FY14	111 (69%)	51 (31%)	162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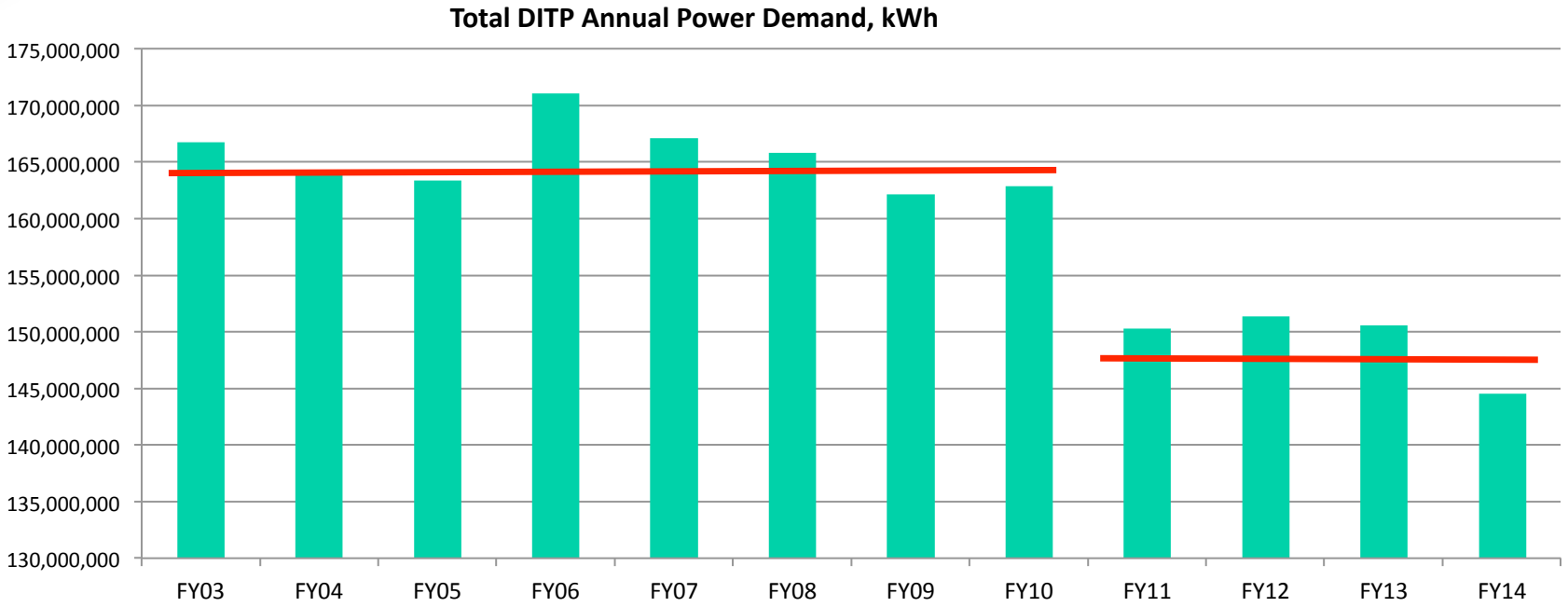
Presentation to the

Board of Directors

Existing and Future Combined Heat and Power (CHP) at DITP

September 17, 2014

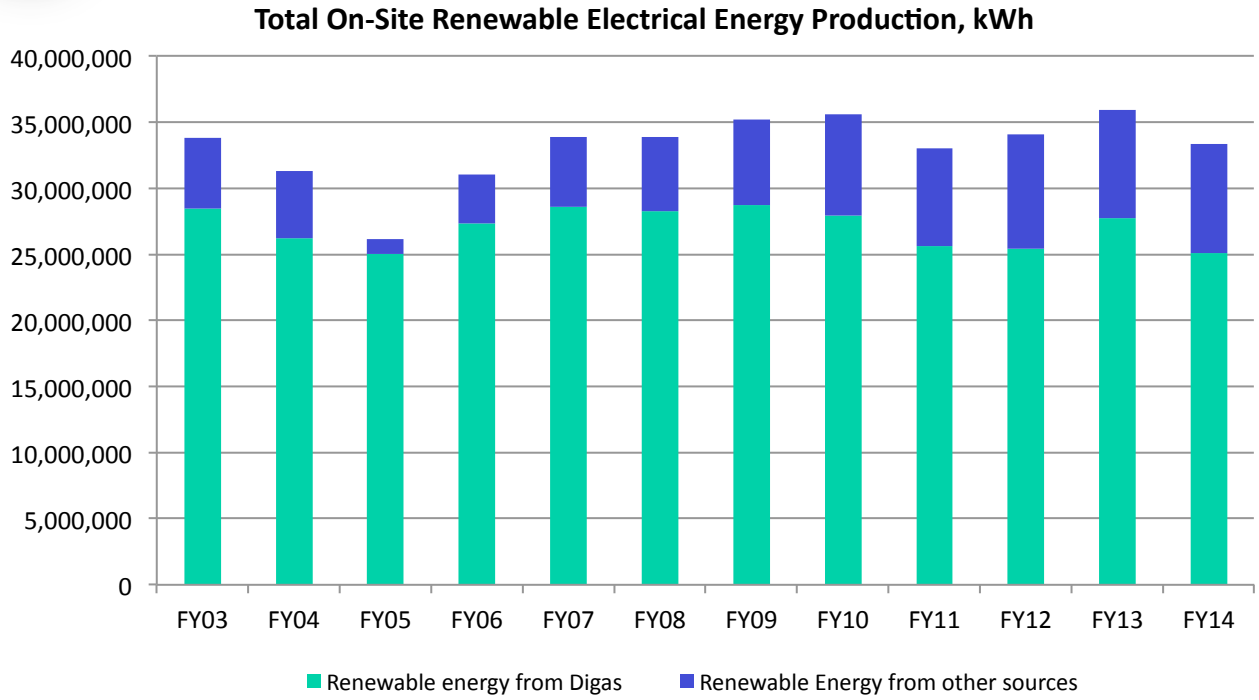
DITP – A Significant Energy User



Staff efforts have helped reduced plant electrical demand by 10%

- Process Optimization
- Installation of new energy efficient equipment

DITP – Green Energy Production (FY14)



Generation Assets:

- **Digas – STG/BPSTG – 25.1 M kWh – 17.4%**
- **Hydro Power – 5.89 M kWh – 4.1%**
- **Wind Power – 1.48 M kWh – 1.0%**
- **Solar – 0.86 M kWh – 0.6%**

Maximizing On-Site Green Energy Production is a priority for MWRA

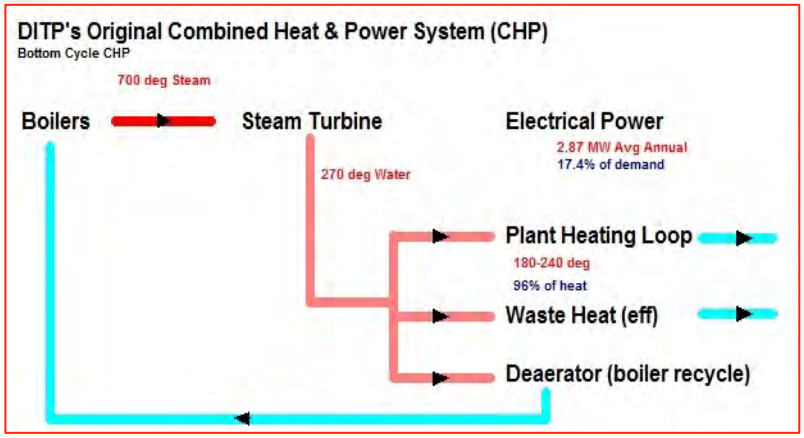
- 23% of DITP's total electricity demand met by green energy
- 60% of DITP's energy needs (heat + power) met by Digester Gas (62.5% for all)

DITP – Digester Gas Generation & Use (FY14)

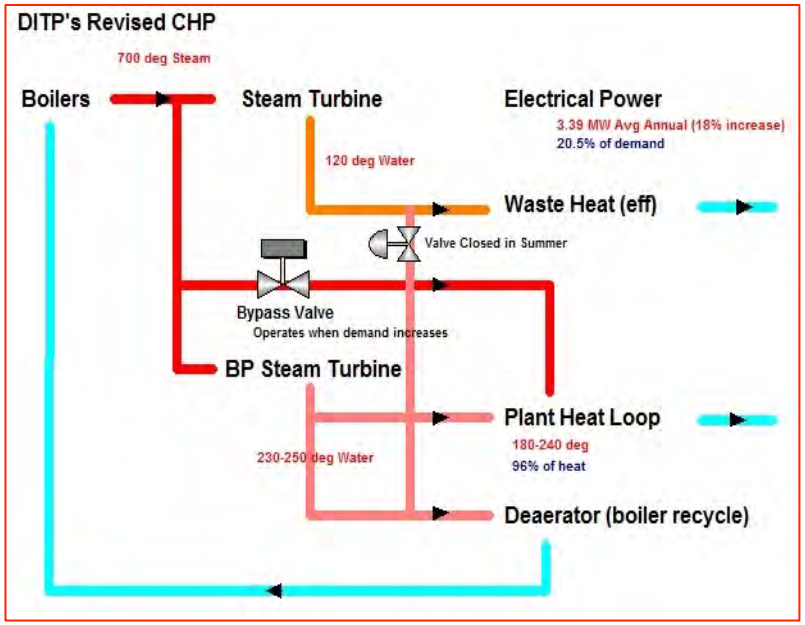
- Anaerobic Digestion:
  - 240 dtpd solid in, 100 dtpd to FRSA for pellet conversion
  - Digas generated on average is 60% methane

- OSTPP: Bottom-Cycle Generation
  - Digas – 95% utilized
  - 95% of heat demand met by Digas ($17.6 million annually) (remainder by Fuel Oil)
  - 25.1 M kWh generation from Steam Turbine ($2.4 million annually)

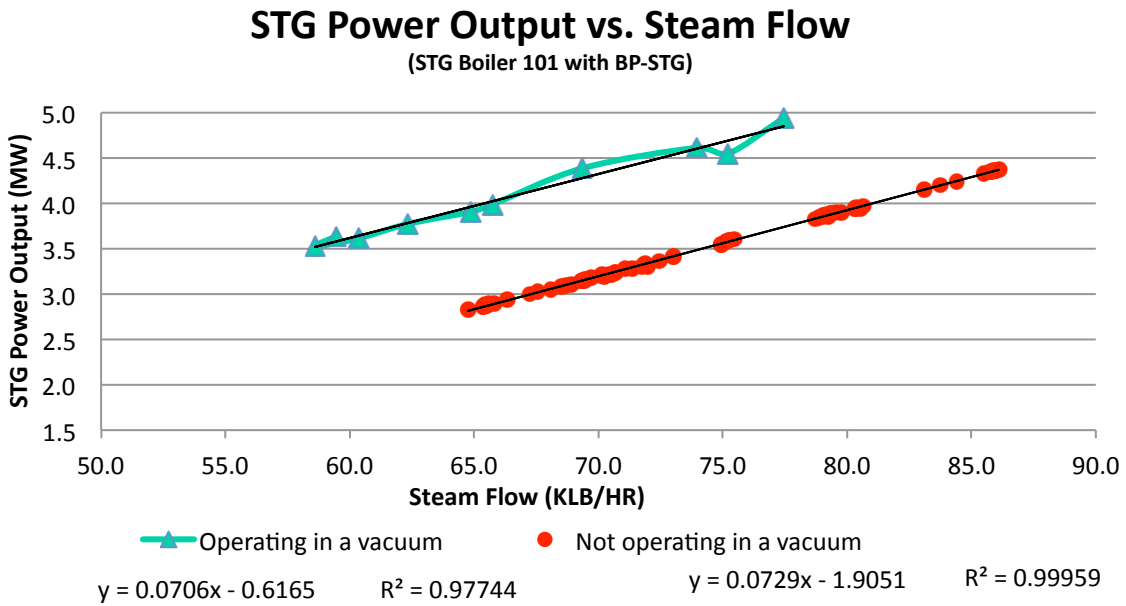
Combined Heat & Power Process – Currently Used by DITP



- **Bottom Cycle Generation**
  - Heat First – 60% efficient
    - Generate Steam then Hot Water
  - Power Second – 9% efficient
    - Generate Electricity from Steam
- New BPSTG / Steam Bypass Valve improves steam to electricity conversion process by extracting more heat per unit steam



Combined Heat & Power Process – Improved Performance



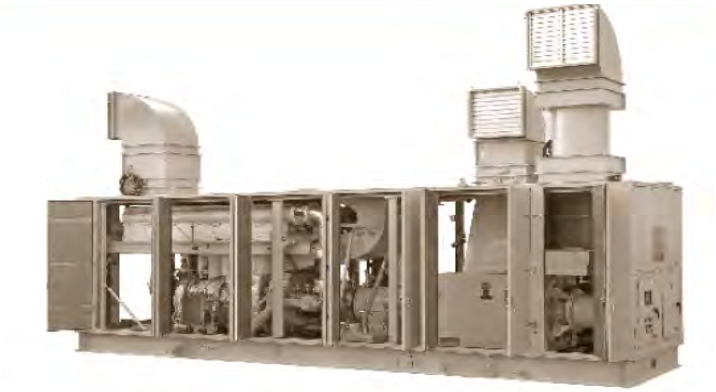
- **New BPSTG / Steam Bypass Valve improve steam to electricity conversion process**
  - 18% improvement (10.6% efficiency overall)
  - +1.3 MW increase in generation from steam generators
  - Sustainable May - November
  - Should see an increase of +4.5 M kWh / year
  - ~30 M kWh total/year from steam (25.1 M kWh currently)

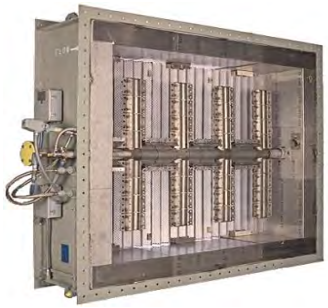
CHP Study Objectives – CDM Smith Residuals Technology Assessment

- Develop engineering and economics for new CHP
- Compare and recommend more efficient generation technologies
  - Internal Combustion Engines
  - Gas Turbines
- Develop Simple Payback Analysis / Economic benefits
- Evaluate implementation options

Internal Combustion Engines versus Gas Turbines

- Exhaust emissions (NOx, CO) – GT ↓
- Space required (Capacity) – GT ↓
- Capital and operating costs – GT ↓
- Energy efficiency (Electricity and Heat) ↔
- Flexibility – GT ↑

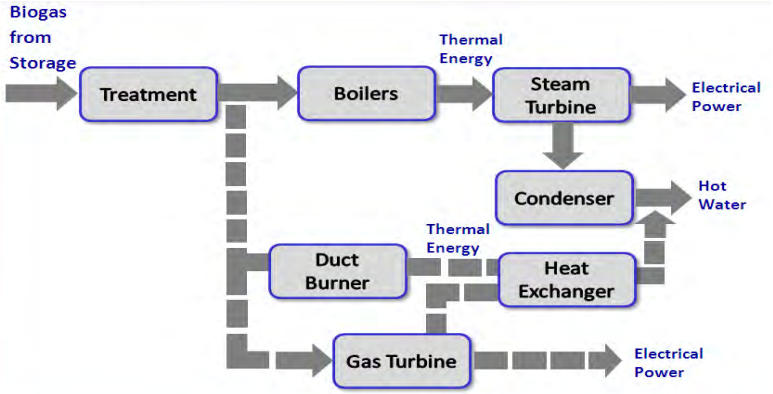




CHP Technology Change

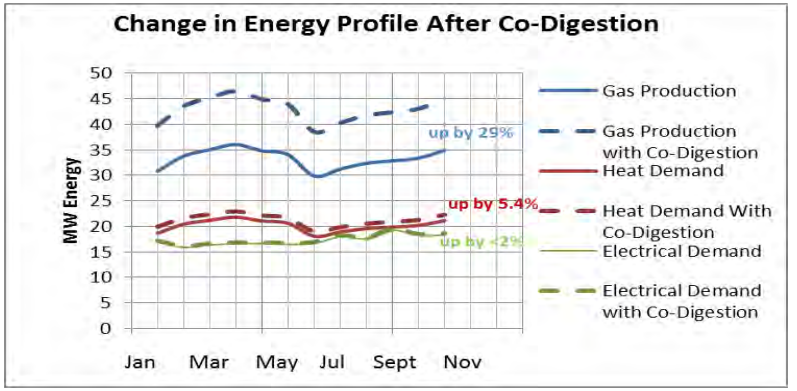
CHP Technology Change

- Change from Bottom to Top cycle generation
- Improve efficiency
- Increased electrical production
- Better use of all digas - summer months
- Continue to meet plant heating needs



CHP Benefit from Co Digestion

- Expected 29-42% increase in biogas
- Results in more electrical output
- Heat demand increase 5-10%
- Electrical demand increase <2%



Cost Benefit Analysis – Simple Payback

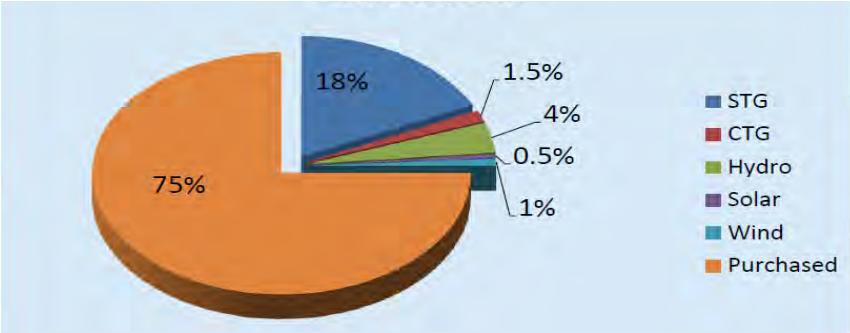
Payback Without and With Co-Digestion

Parameter	OSTPP with 1 Gas Turbine*	OSTPP with 1 Gas Turbine* With Co-digestion	3 Gas Turbines*	3 Gas Turbines* With Co-digestion
Capital Cost	$24.9 M	$24.9 M	$75.0 M	$75.0 M
Annual O&M Cost	$2.2 M/yr	$2.2 M/yr	$1.6 M/yr	$1.6 M/yr
Annual Electrical Savings	$5.2 M/yr	$7.0 M/yr	$11.4 M/yr	$14.7 M/yr
Net Annual Savings	$3.0 M/yr	$4.8 M/yr	$9.8 M/yr	$13.1 M/yr
Simple Payback Period	8 years	5 years	8 years	6 years

- Single Gas Turbine capacity: 4.6 MW
- Payback does not include potential funding for green energy projects to pay for the capital.

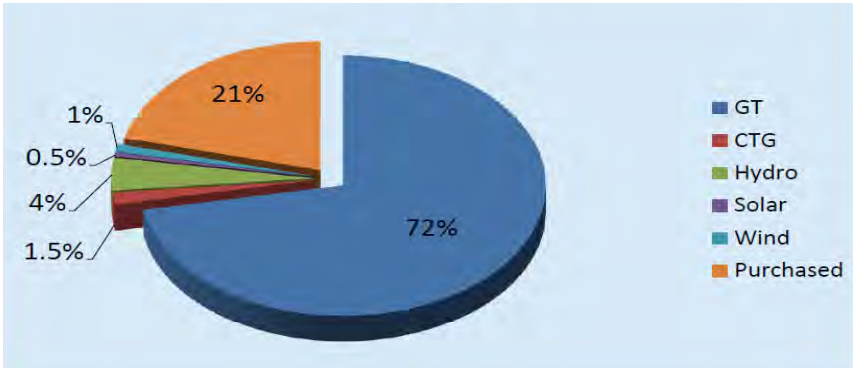
Potential Energy Benefit with CHP

Existing Thermal Plant



- 23% green generation* (18% w/digas)
- 75% purchased electricity

CHP with 3 Gas Turbines – Co-Digestion

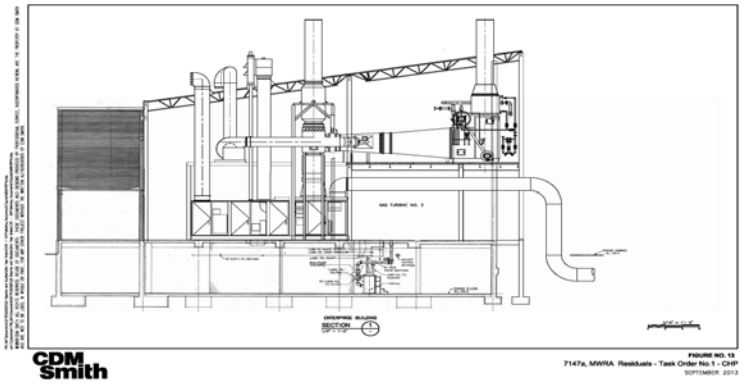


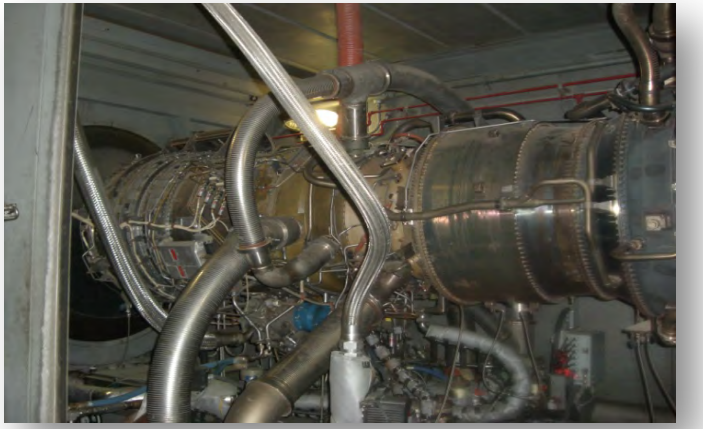
- Can reverse energy profile
- More sustainable
- 77% green generation* (72% w/digas)
- 21% purchased electricity

*Note: 1.5% generation by CTG backup power.

Recommendation

- Gas Turbine CHP is recommended technology
- Staff will move forward with design to
  - Confirm economics
  - Investigate additional equipment needed
  - Review economics with and without co-digestion
  - Confirm full implementation approach
  - Develop specific gas system changes
  - Develop plans and specs for bidding new CHP



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Presentation to the

Board of Directors

Struvite , Scum, Sludge, and Grit Removal Contract

September 17, 2014

Struvite Removal

Cause

- Struvite forms a pipe scale and consists of phosphate, ammonia, and magnesium
- Struvite coats digested sludge pipelines
  - Digester overflow box piping
  - Centrifuge piping
- Difficult to remove

Prevention

- Ferric chloride added to control

Remediation

- Specialized equipment and services in confined spaces needed for removal

Scum, Sludge and Grit Removal

- Removal of severe blockages beyond in house capability in:
  - Gravity thickeners
  - Primary clarifiers
  - Influent channels
  - Scum receiving wells
- Vactor trucks and boxes used
- Off site material disposal


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Presentation to the

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Deer Island Clarifier Rehabilitation Contract 7394

September 17, 2014

Deer Island Stacked Clarifiers

Condition of Concrete


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Presentation to the

Board of Directors

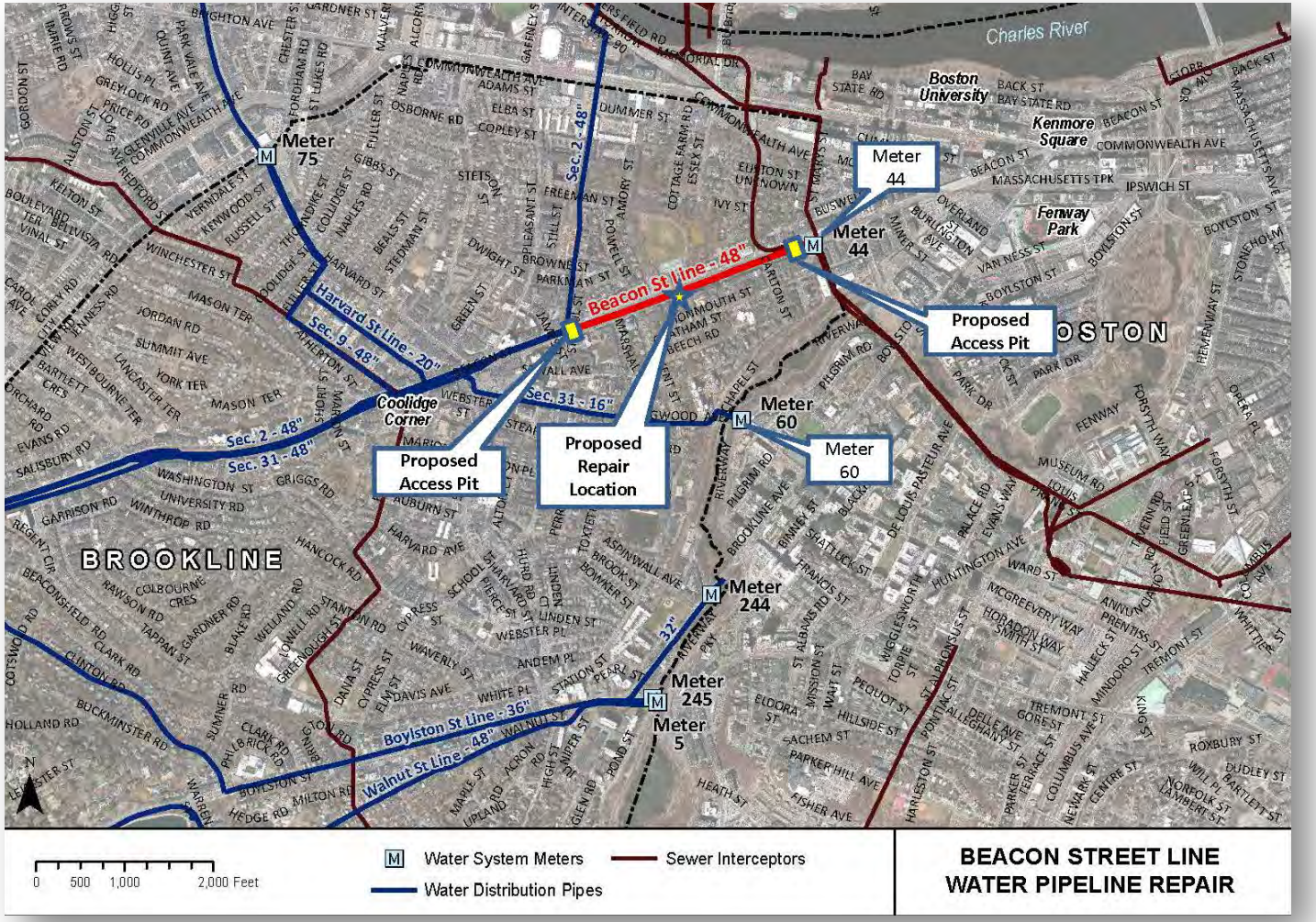
Beacon Street Line: Water Pipeline Repair Contract 7474

September 17, 2014

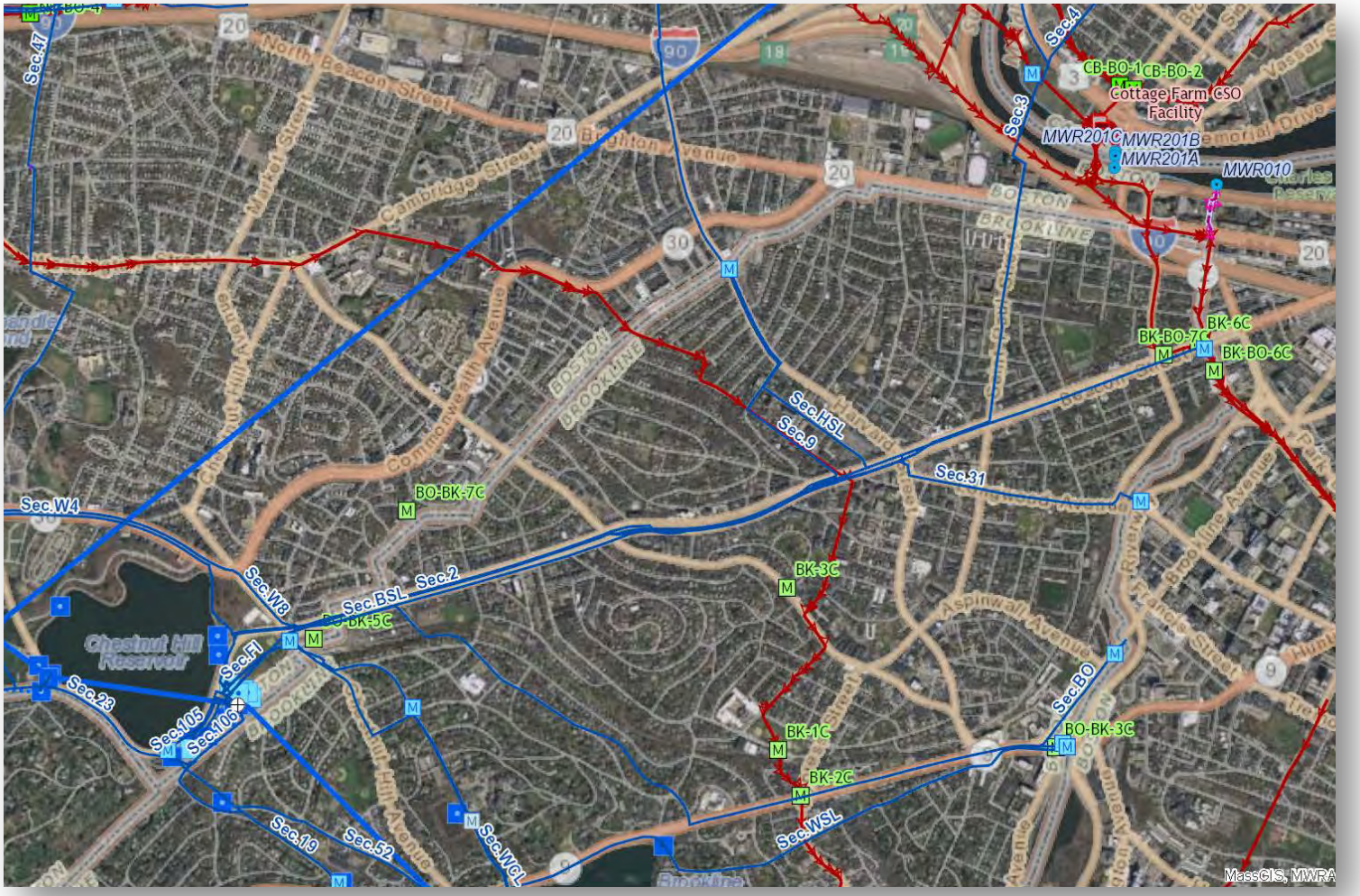
Beacon Street Line - Brookline

- 48-inch cement mortar lined cast-iron pipe
- Constructed in the 1870sIt is part of MWRA's Boston Low Service System
- A significant portion of it is located underneath the MBTA's Beacon Street Green Line tracks
- The Beacon Street Line provides important the Longwood Medical area

Beacon Street Line - Brookline



Beacon Street Line - Brookline



Location of Access Pits

CFRP Installation

Massachusetts Water Resources Authority

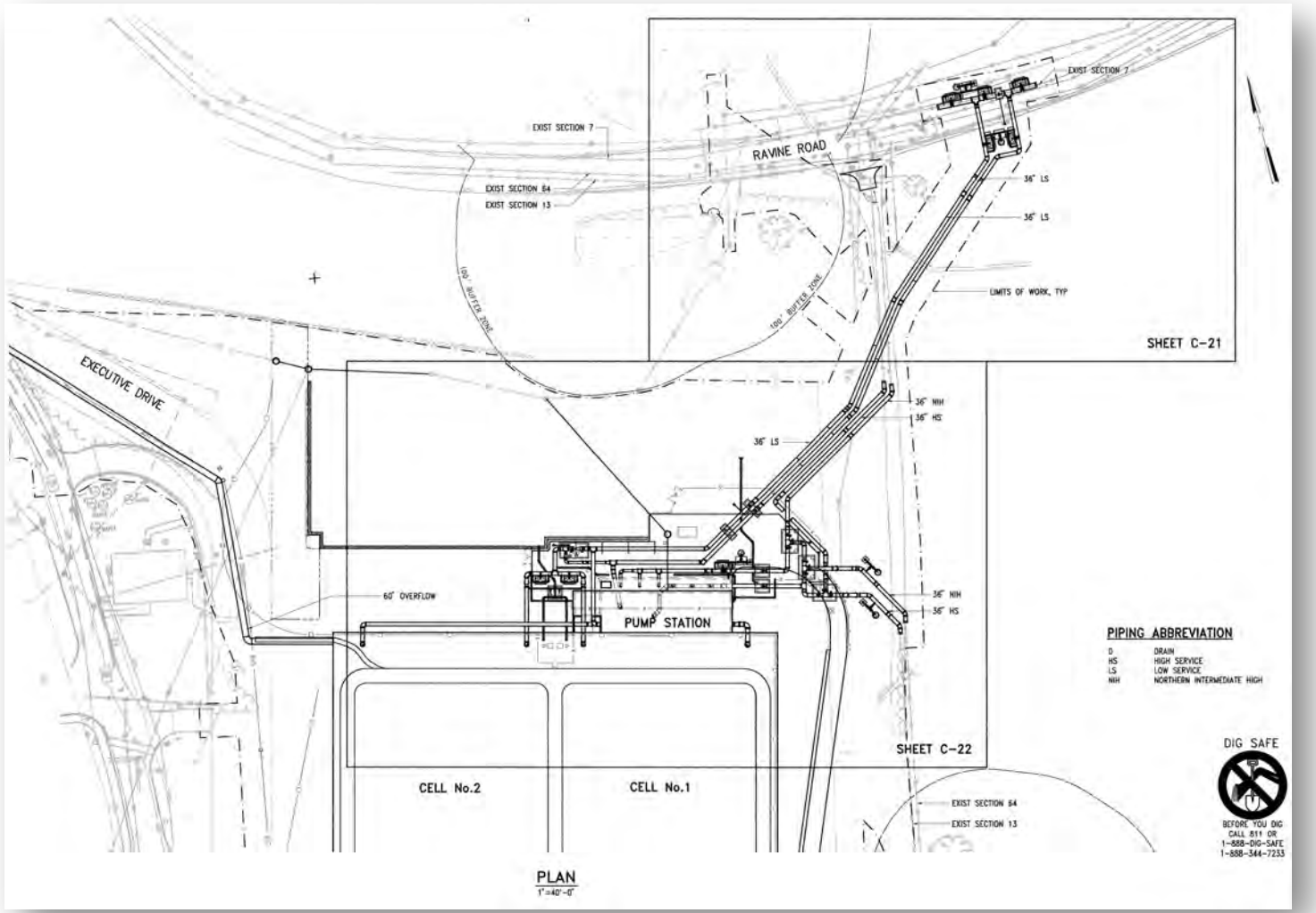
Presentation to the

Board of Directors

Spot Pond Water Storage Facility
Contract 6457, Change Order 7

September 17, 2014

Spot Pond Tank and Ravine Road Piping



Remove Ledge to Install 36-Inch Pipelines and Valve Vaults at Ravine Road

Remove 87 Linear Feet of 16-Inch-Diameter, Cast-Iron Water Main and Replace with Restrained-Joint, Ductile-Iron Pipe

Current Progress

Massachusetts Water Resources Authority

Presentation to the

Board of Directors

Gillis Pump Station Short-Term Improvements Contract 7260, Change Order 3

September 17, 2014

Additional Valve Work

Ledge Croppings Inside Excavated Pit

Selector Switch for Three VFD Bypasses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