City of Gardiner, Maine
Wastewater Committee Meeting

CSO Storage Tank & Screening Evaluation

December 11, 2013

Hoyle, Tanner & Associates, Inc.

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Introduction

- Update on field work
  - Flow monitoring
  - Survey
  - GIS
  - Borings
  - Assessment of private source inflow from Water St.

- Goals for tonight

Introduction – Agenda

- **CSO Storage Tank**
  - CSO 003 Data Analysis
  - CSO Storage Tank Layouts
  - MAPS & CSO 003 Flow Control
  - CSO Storage Tank Maintenance
  - Cost-Effectiveness Analysis
- **Screenings Options**
  - Equipment Types
  - Design Considerations
  - Alternatives Identification
  - Cost Estimating
- **Recommendations**
- **Funding**

CSO Storage Tank – the final product

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Data Analysis

CSO 003 from 2008 to 2013

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Previous Data Analysis: May 15 to Sept. 30
Outlier Removed from Data

- From 2008 to 2012 data:
  - 11 CSO events
  - 1.25 MG total
  - Mean: 0.11 MG
  - Median: 0.10 MG
  - Max: 0.41 MG

Event End	Total Rainfall	Total CSO
	in	gal
12/21/2012	1.28	471,600
8/16/2012	4.05	194,200
~~6/4/2012~~	~~5.02~~	~~2,897,500~~
4/24/2012	4.12	892,100
9/5/2011	1.54	135,000
6/10/2011	1.45	95,000
4/17/2011	1.52	915,000
3/7/2011	3.45	3,510,000
12/13/2010	3.05	1,519,000
11/7/2010	2.42	881,000
10/15/2010	1.06	142,883
7/21/2010	1.46	118,000
7/10/2010	1.00	95,578
3/30/2010	3.63	3,381,800
2/25/2010	4.00	2,819,000
1/28/2010	0.12	300
1/25/2010	1.40	1,496,200
11/14/2009	4.30	1,321,000
10/24/2009	1.70	9,000
10/9/2009	0.35	447,000
9/25/2009		5,000
8/11/2009	0.79	59,000
6/19/2009	0.48	800
11/25/2008	3.41	1,550,000
10/26/2008	2.02	505,000
9/27/2008	3.57	129,000
9/6/2008	4.15	408,000
7/1/2008	1.16	10,000
4/30/2008	4.48	2,051,000
3/8/2008	1.95	327,000
Total	**30**	**26,385,961**

Updated Data Analysis: May 15 to Sept. 30

Outlier Removed from Data

- From 2008 to 2013 data:
  - 13 CSO events
  - 2.11 MG total
  - Mean: 0.16 MG
  - Median: 0.12 MG
  - Max: 0.73 MG

Event End	Total Rainfall in	Total CSO gal
9/2/2013	2.50	133,000
8/9/2013	2.72	728,000
12/21/2012	1.28	471,600
8/16/2012	4.05	194,200
~~6/4/2012~~	~~5.02~~	~~2,897,500~~
4/24/2012	4.12	892,100
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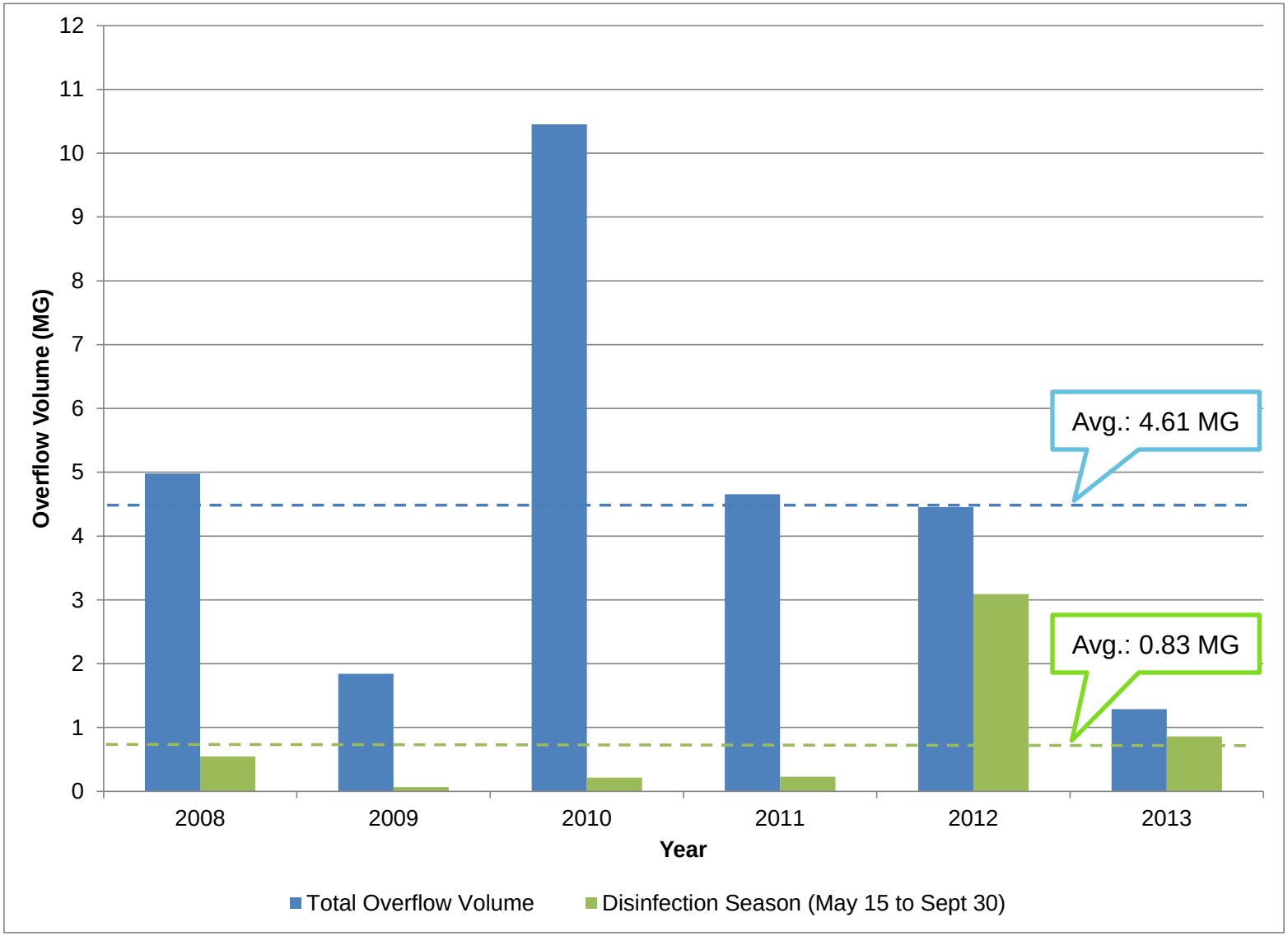
9/6/2008	4.15	408,000
7/1/2008	1.16	10,000
4/30/2008	4.48	2,051,000
3/8/2008	1.95	327,000
Total	**32**	**27,246,961**

Annual Overflow Volumes



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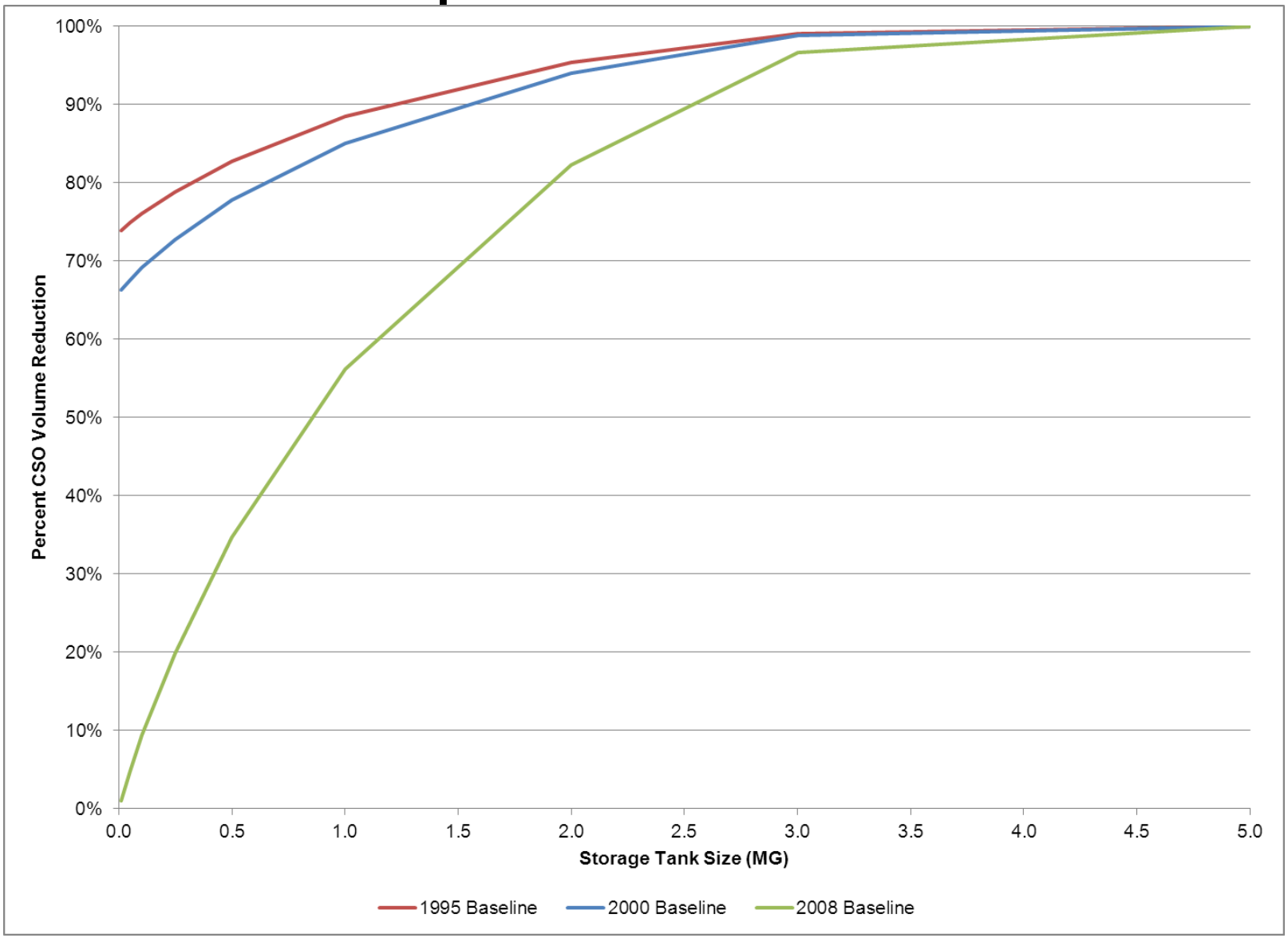
Percent Capture for Various Tank Sizes



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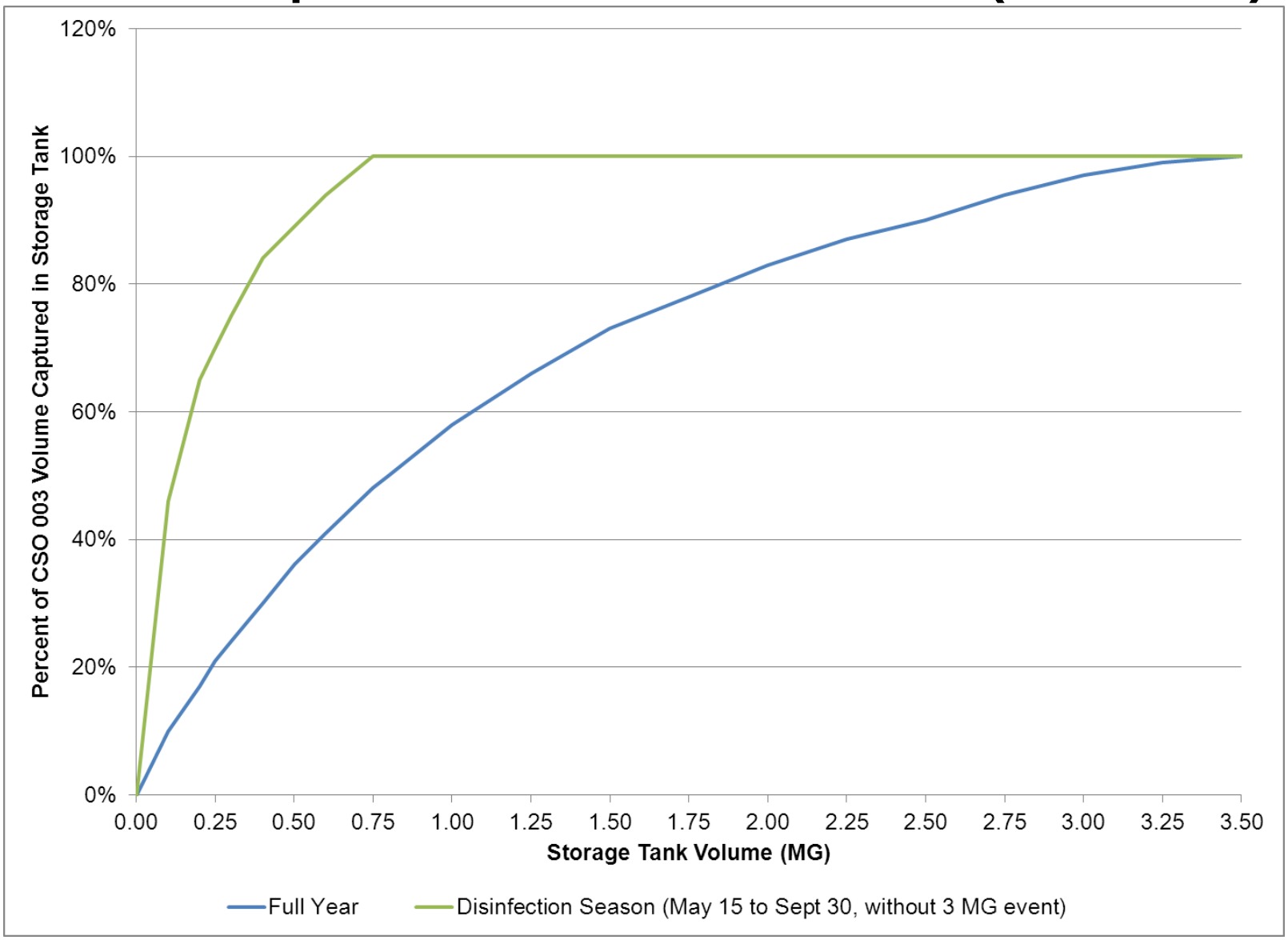
Percent Capture for Various Tank Sizes (2008-2013)



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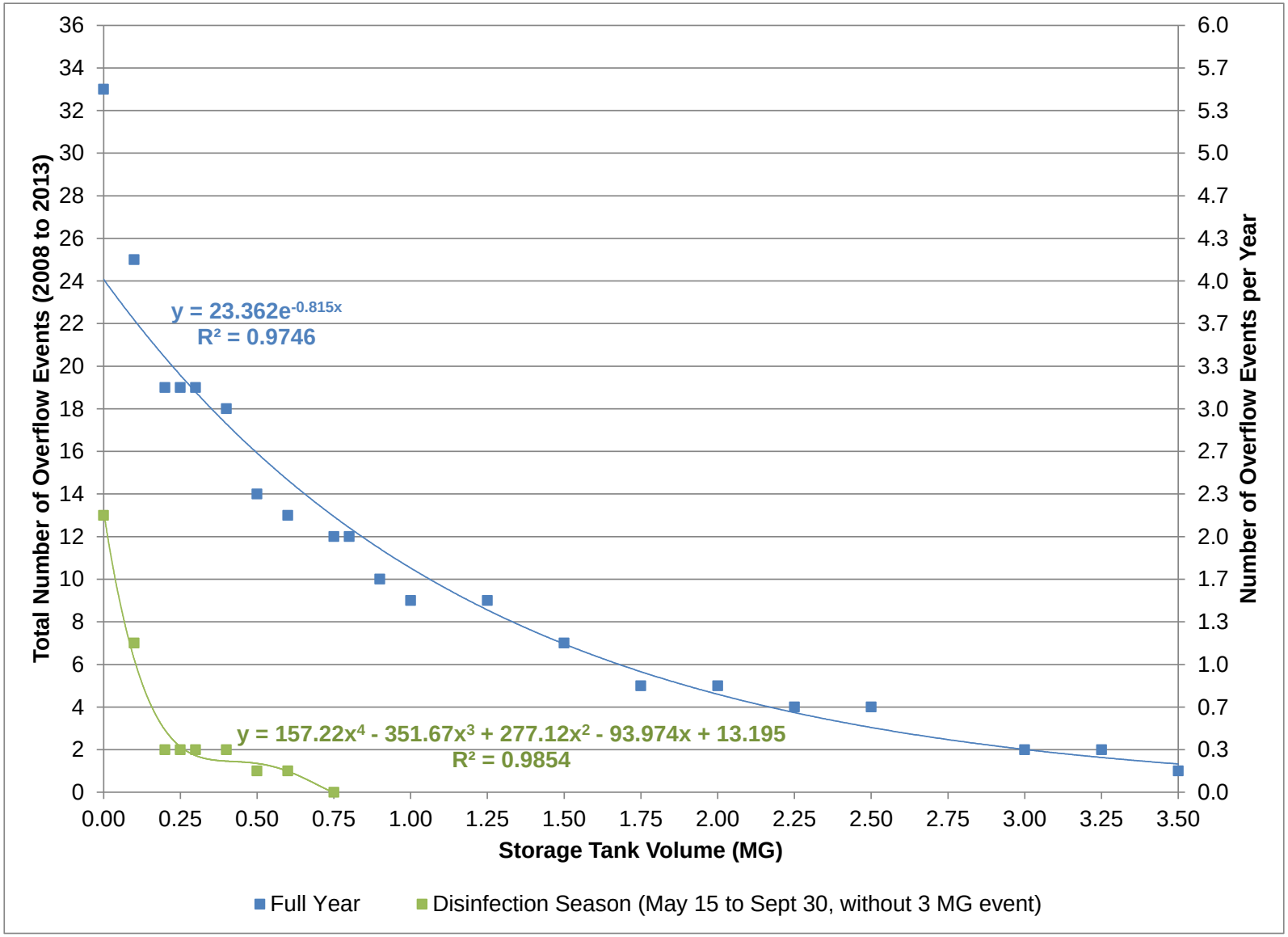
Number of Overflows for Various Tank Sizes



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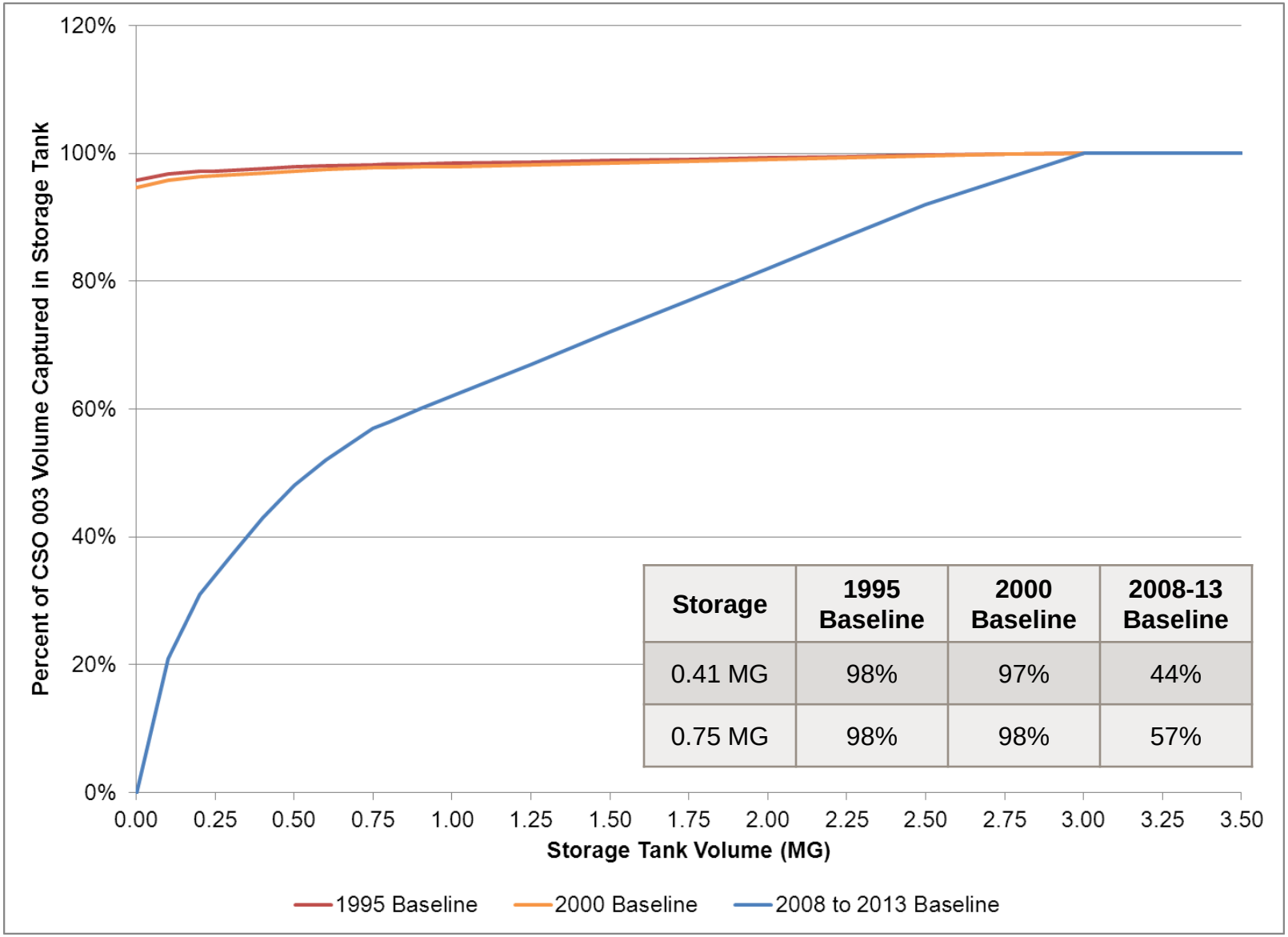
Percent Capture for Various Tank Sizes (1995, 2000)



Storage	1995 Baseline	2000 Baseline	2008-13 Baseline
0.41 MG	98%	97%	44%
0.75 MG	98%	98%	57%

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Concepts for Future Additional CSO Control (if warranted)

- Continued I/I removal
- Additional off-line storage at
  - Hannaford parking lot upstream of siphon
  - Arcade parking lot
- Disinfection of tank effluent for remaining disinfection season overflows
  - Use of emerging single-chemical process

CSO Storage Considerations

Potential Layouts

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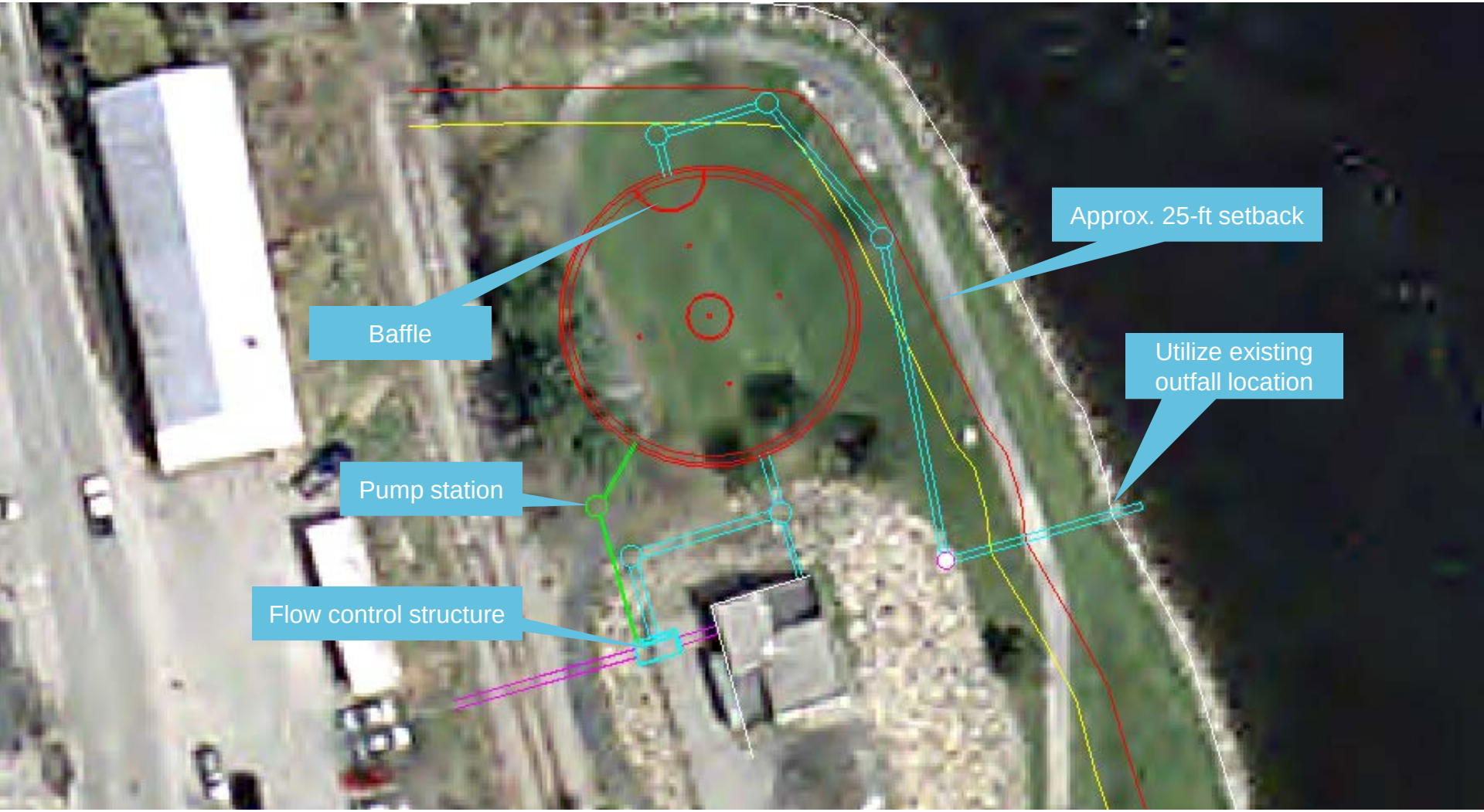
0.75 MG Circular Tank
84-ft diameter, 18-ft deep



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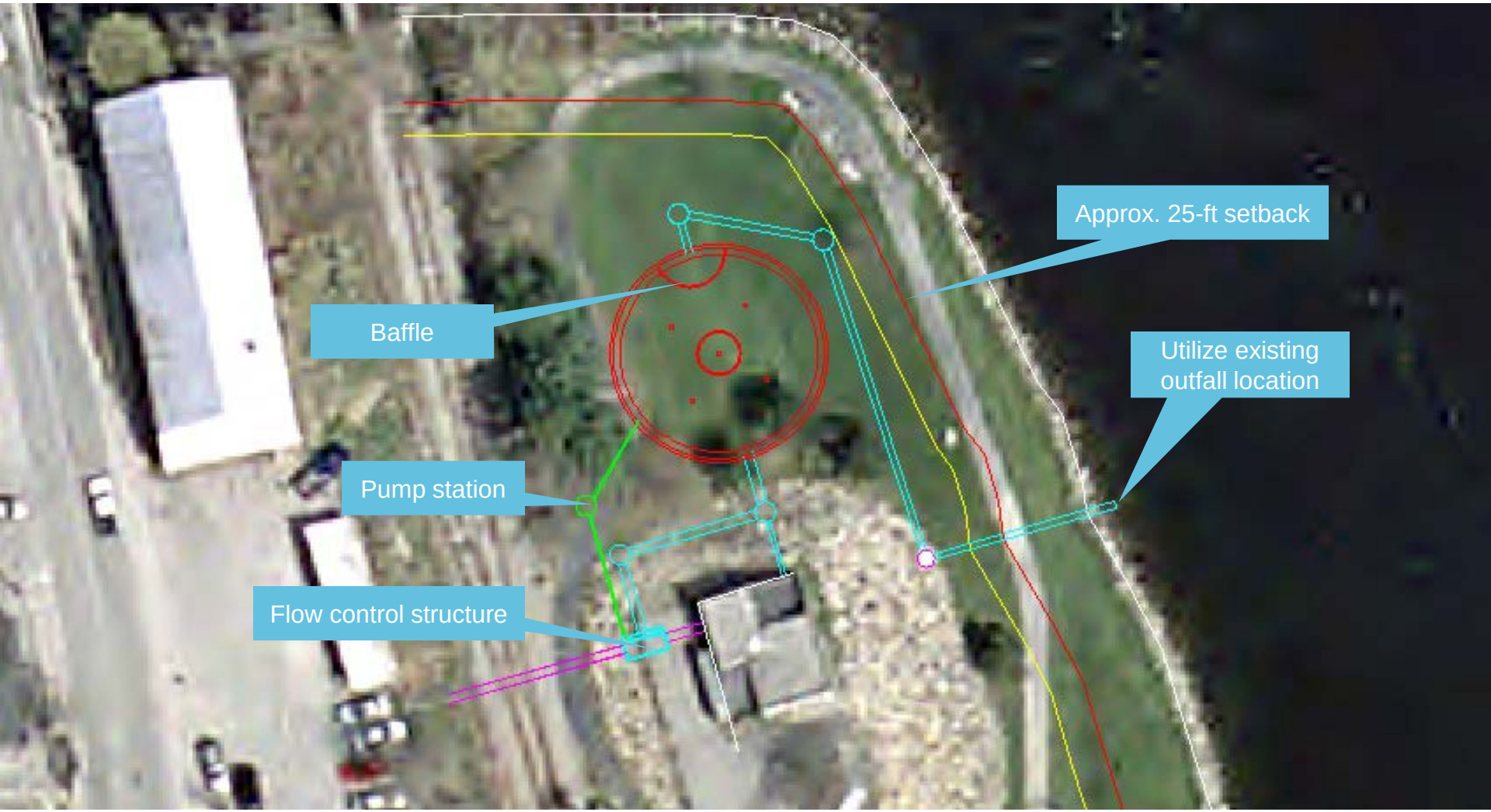
0.41 MG Circular Tank
62-ft diameter, 18-ft deep



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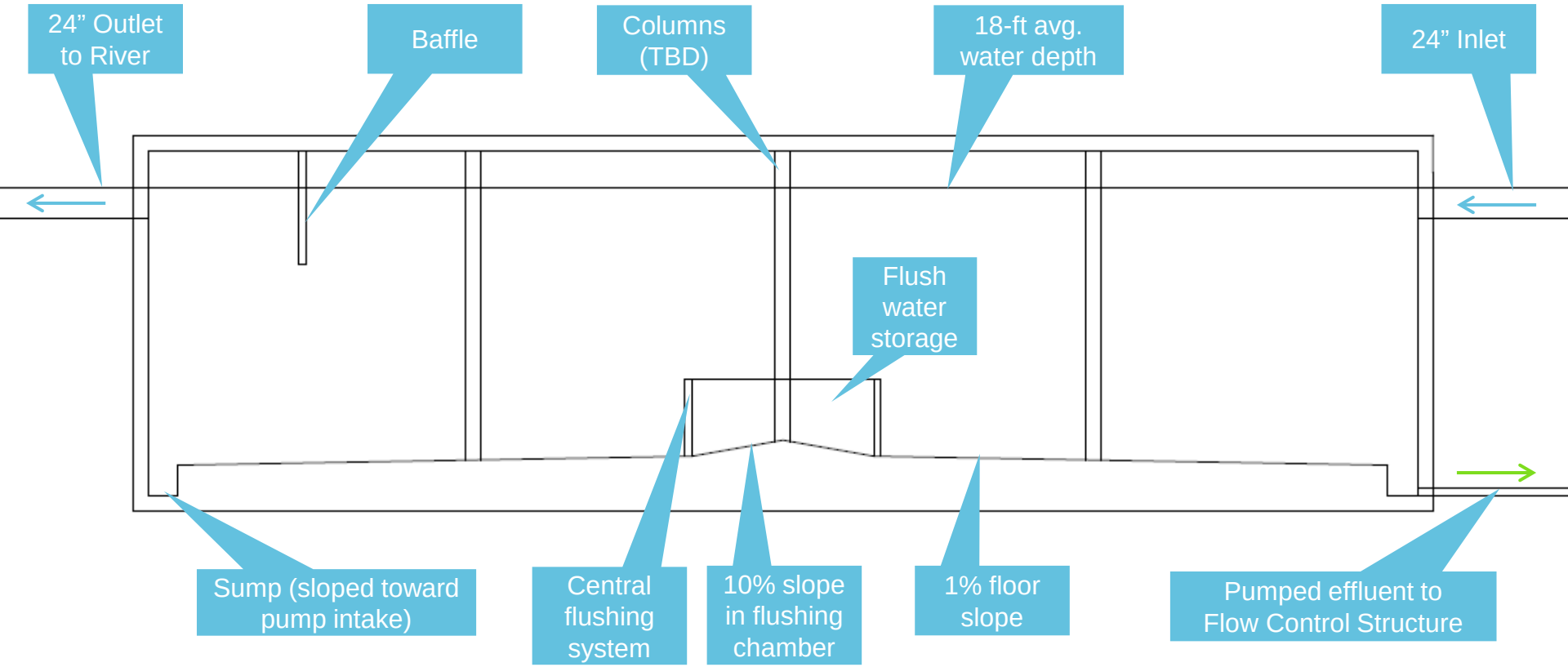
Circular Tank: Typical Profile



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0.75 MG Rectangular Tank
70-ft wide, 80-ft long, 18-ft deep

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0.41 MG Rectangular Tank
50-ft wide, 61-ft long, 18-ft deep

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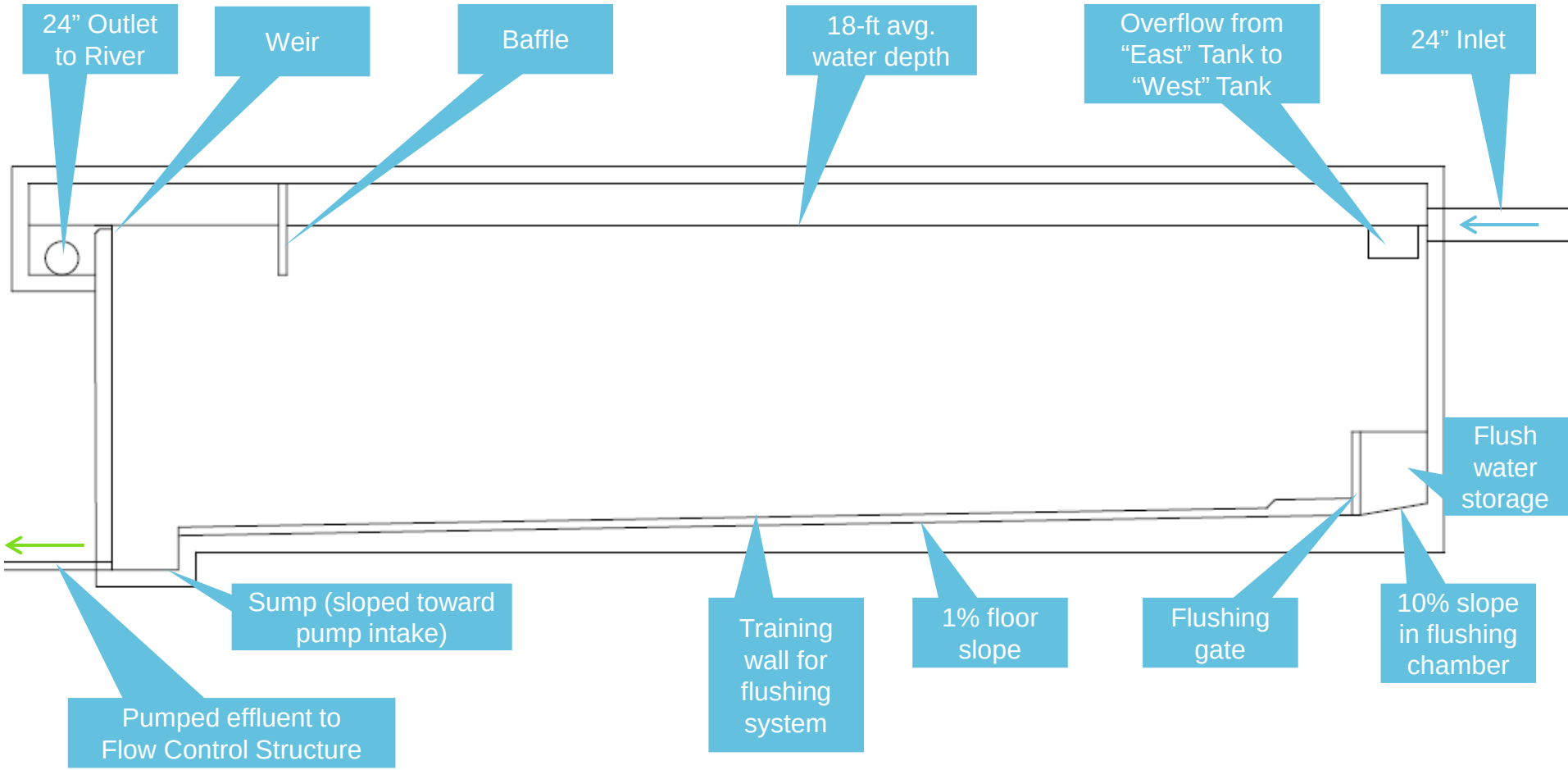
Rectangular Tank: Typical Profile



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Biddeford, Maine
Example of Off-line Storage Under a Park

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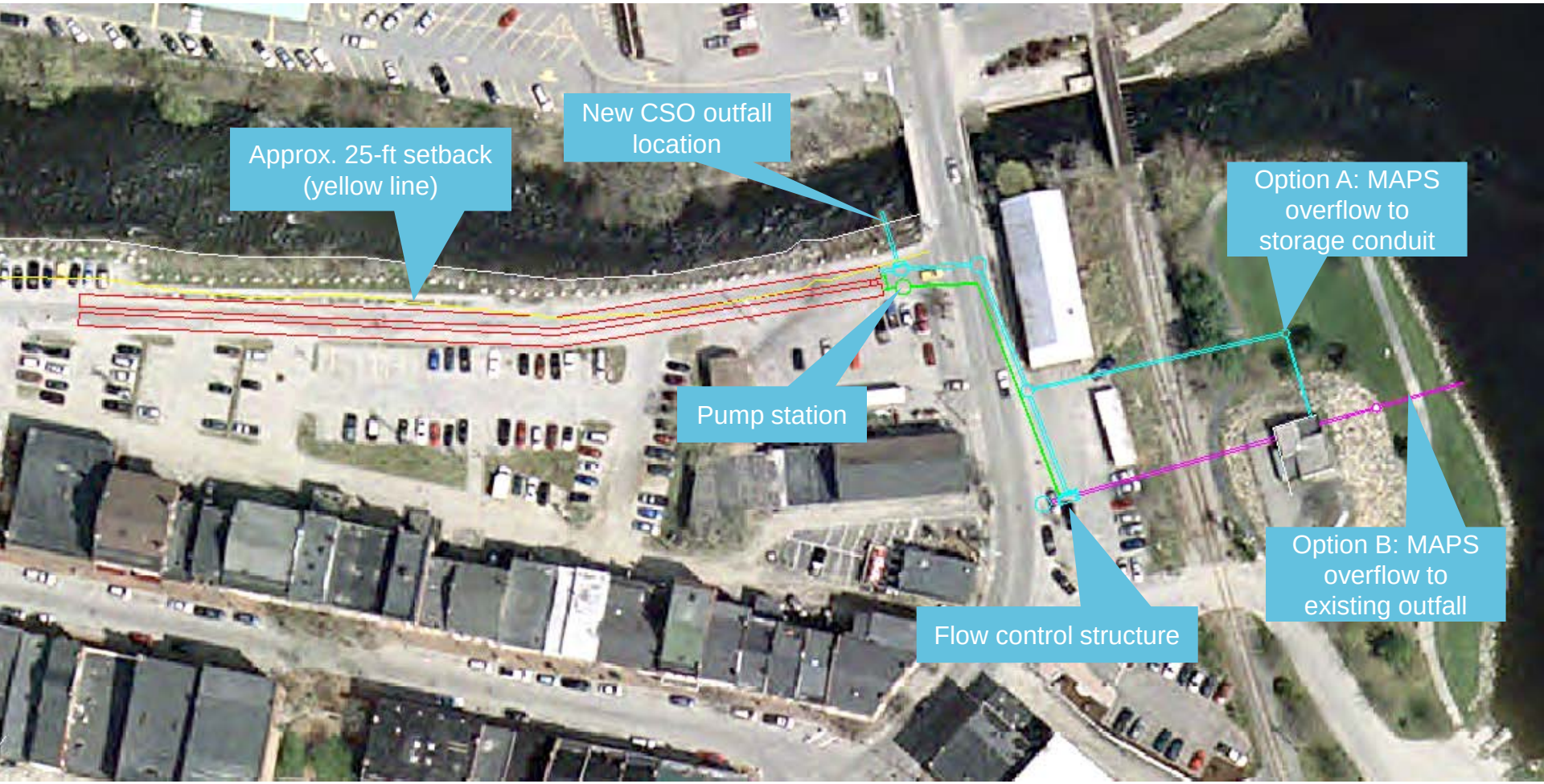
0.75 MG Linear Conduit
Two rows of 522 LF, 8-ft wide by 12-ft high conduit



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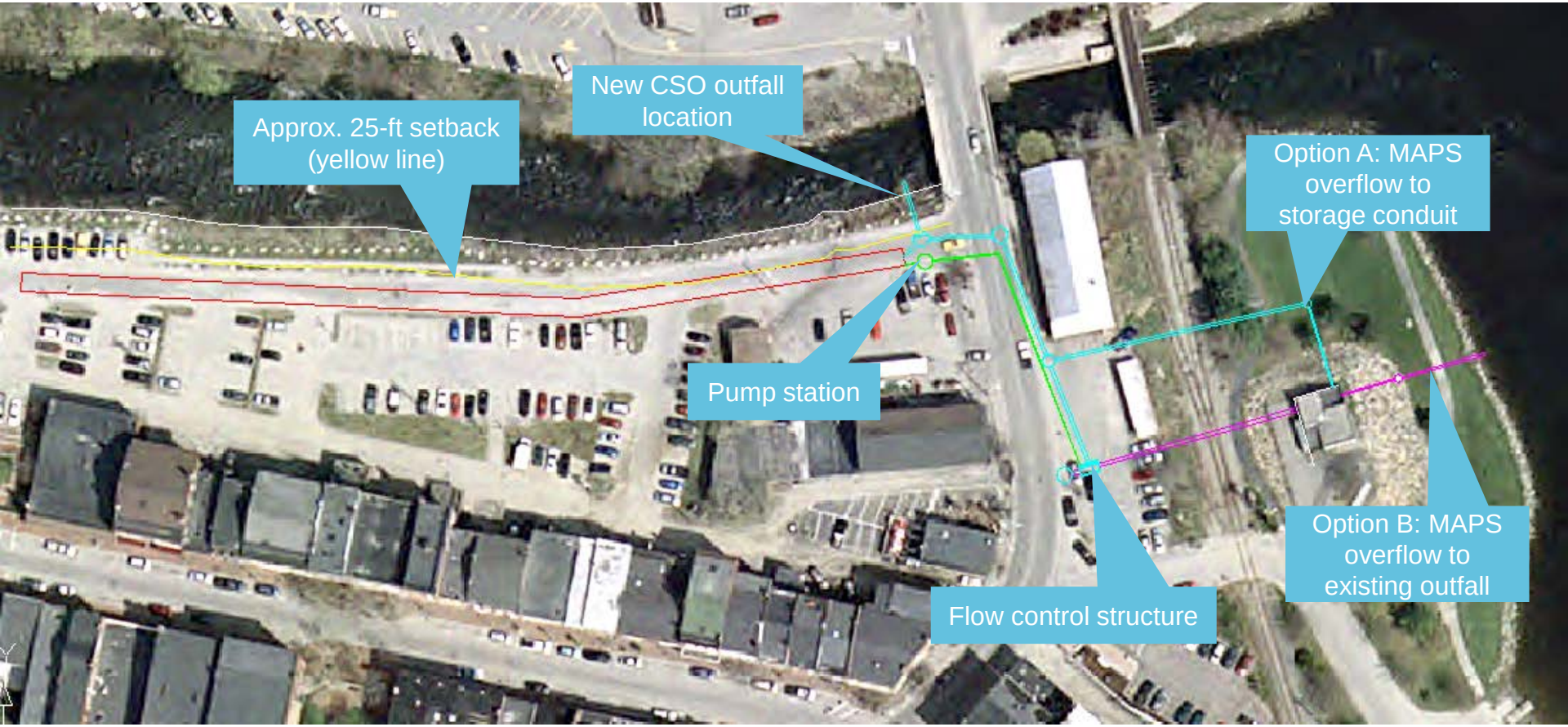
0.41 MG Linear Conduit
Two rows of 572 LF, 12-ft wide by 8-ft high conduit



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Potential Issues with Linear Conduit Design

- Storage located away from MAPS
  - Difficult to utilize storage for wet well augmentation (path crosses under railroad tracks)
  - Would require a new CSO outfall into Cobbossee Stream
  - Would need to cross under existing sewer/siphon and other utilities
  - Results in deep conduit to maintain gravity fed design
    - Potential storage inverts assuming 0.005 ft/ft conduit slope (and a max WSE = 8 ft +/- to prevent wet well flooding):
      - 0.75 MG layout: 12-ft deep conduit = -6.61 ft
      - 0.41 MG layout: 8-ft deep conduit = -2.86 ft
- Storage partially within the 25-ft setback zone
- Space is limited within the roadway

MAPS & CSO 003 Flow Control

Potential Solutions

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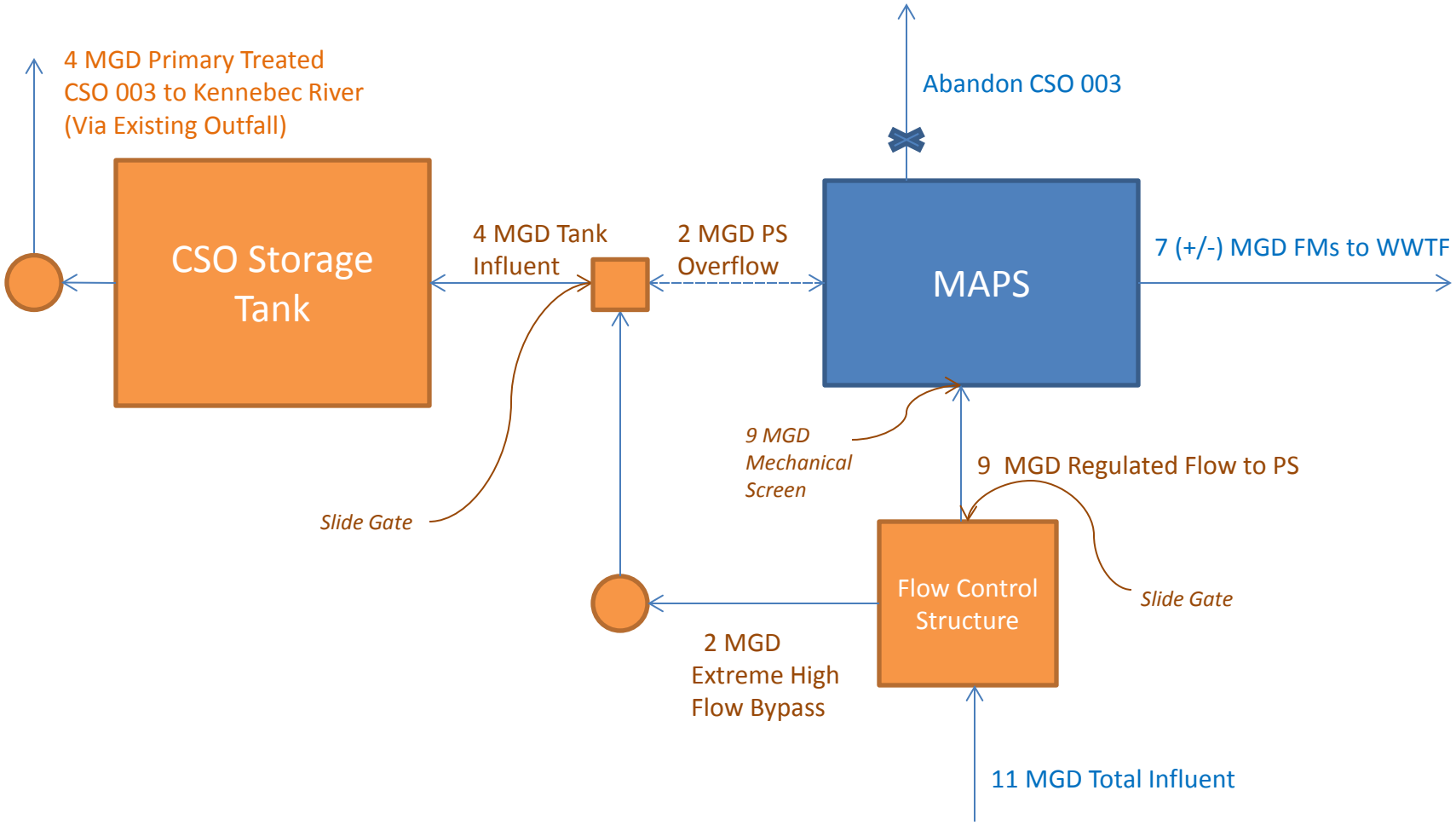
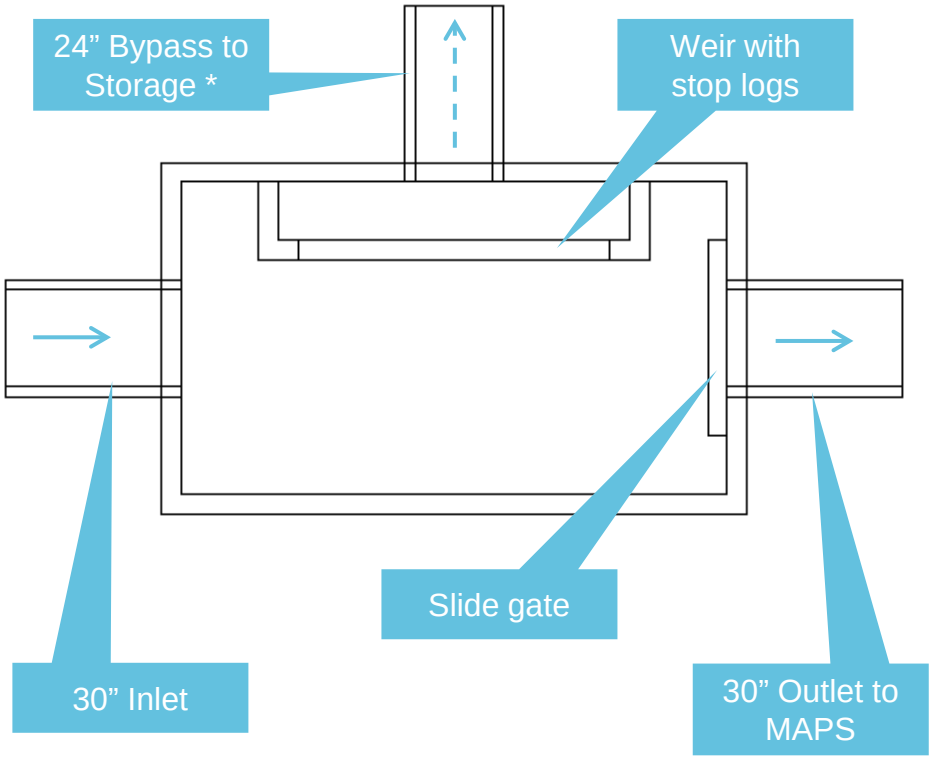
Peak Flow Water Balance
CSO 003 Storage Tank at MAPS

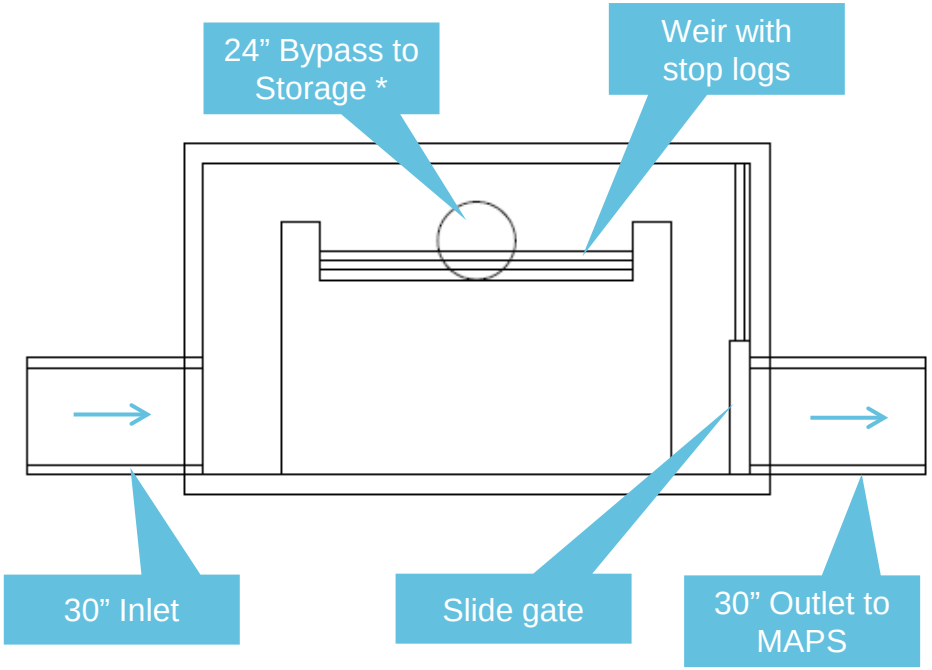


New Flow Control Structure Concept

Plan



Profile



**Note: Bypass pipe can be used to route flow to MAPS when slide gate is closed during screen maintenance*.

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CSO Storage Tank Maintenance

Flushing Systems

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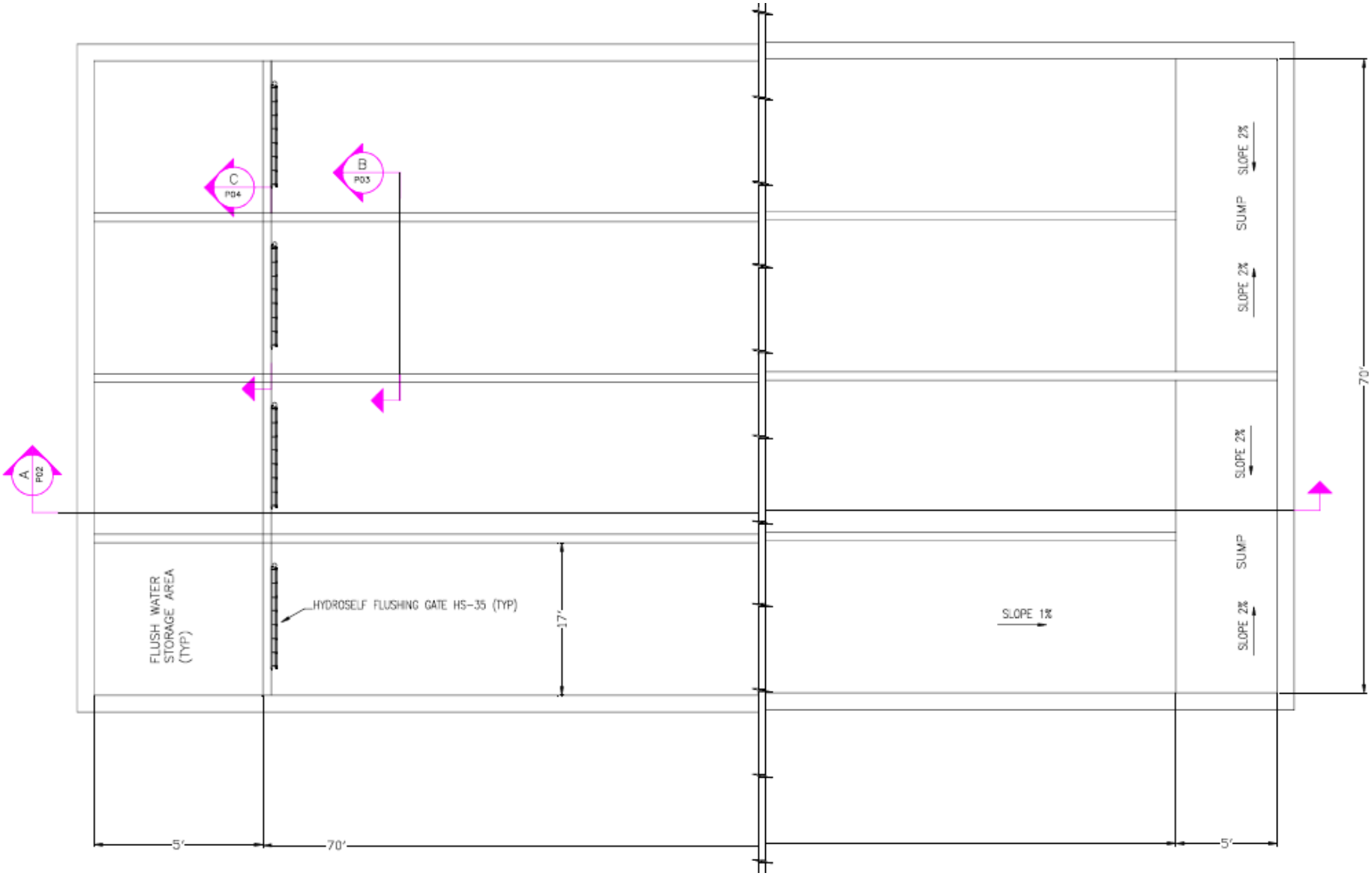
Potential Flushing System: Rectangular Tank



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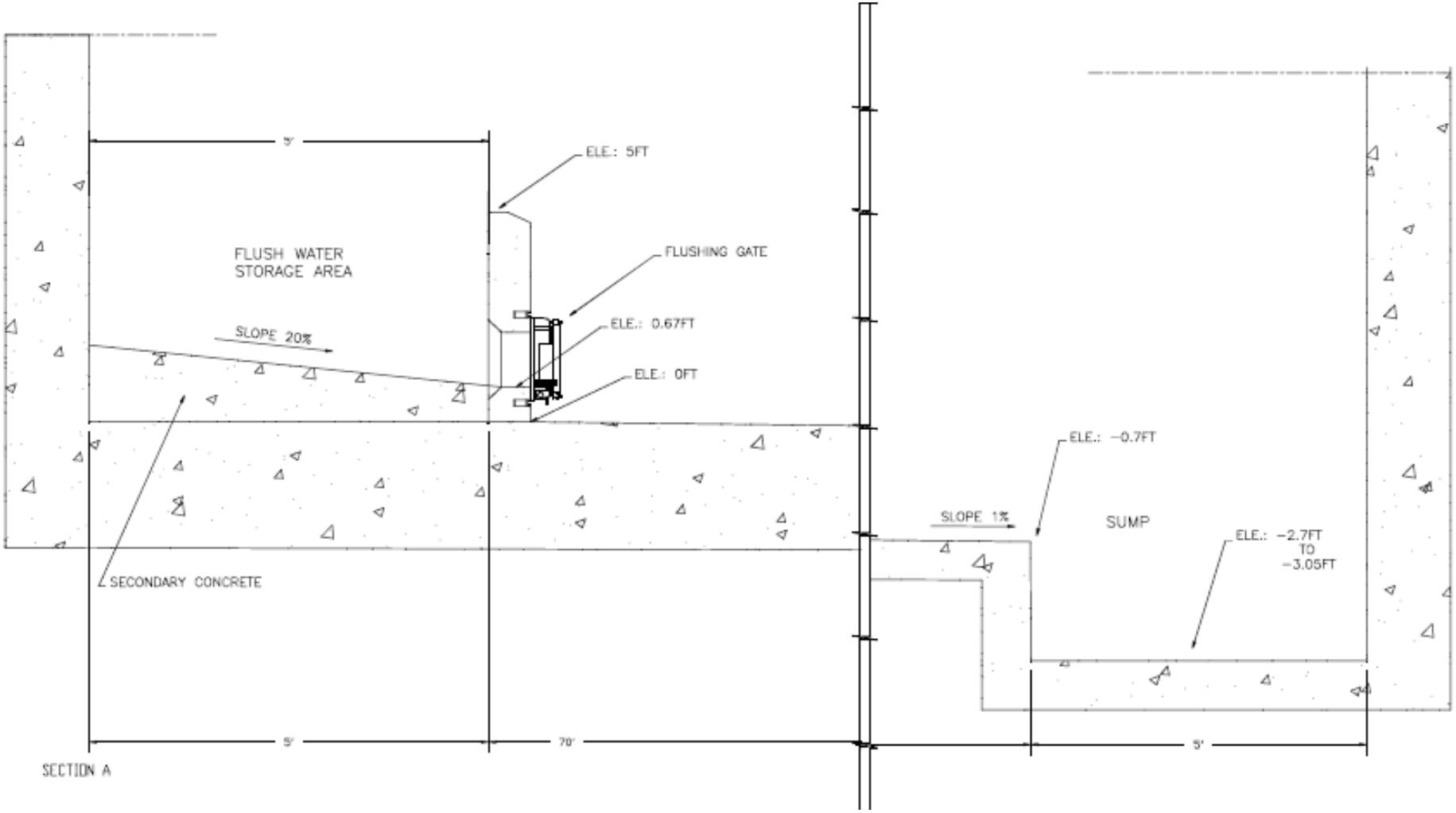
Potential Flushing System: Rectangular Tank



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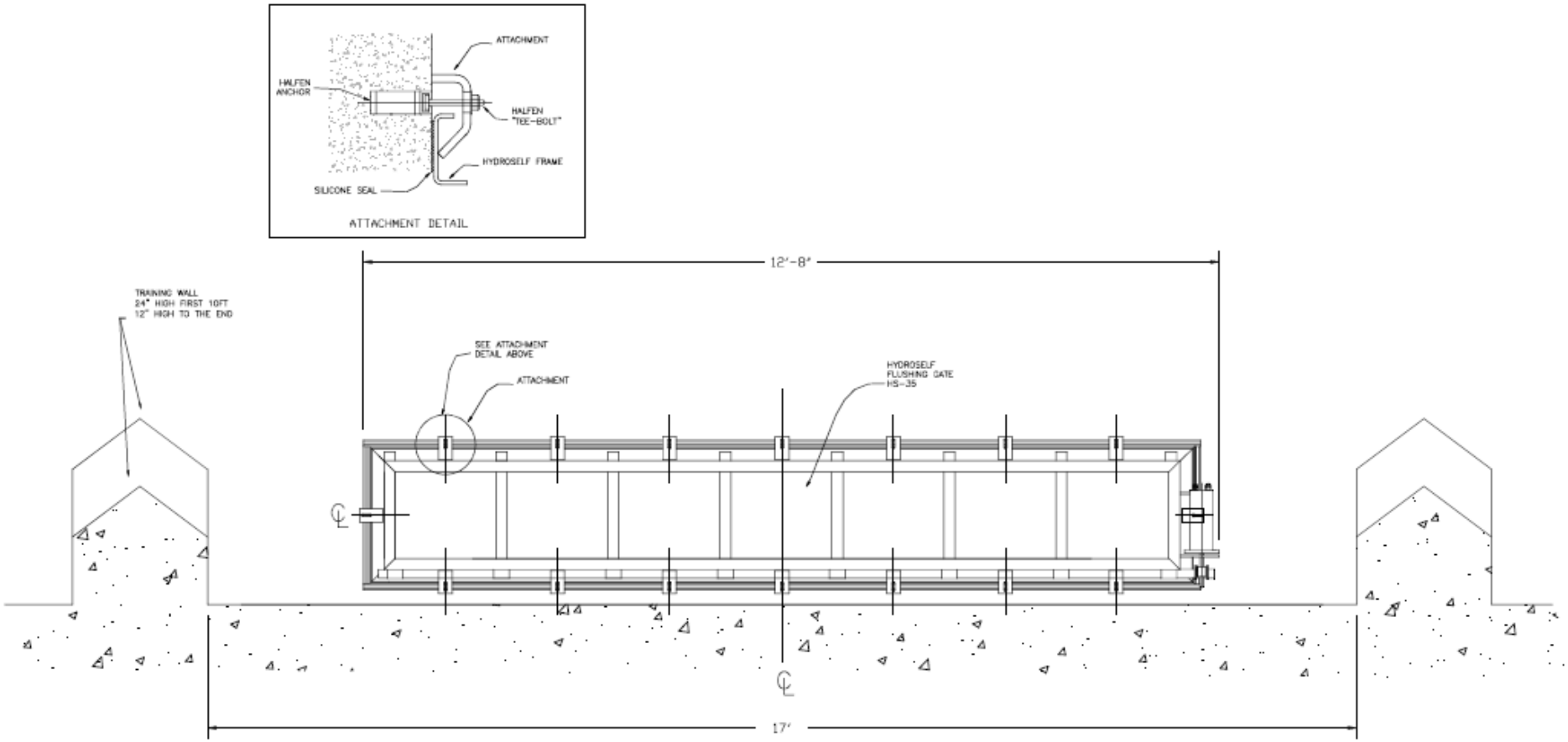
Potential Flushing System: Rectangular Tank



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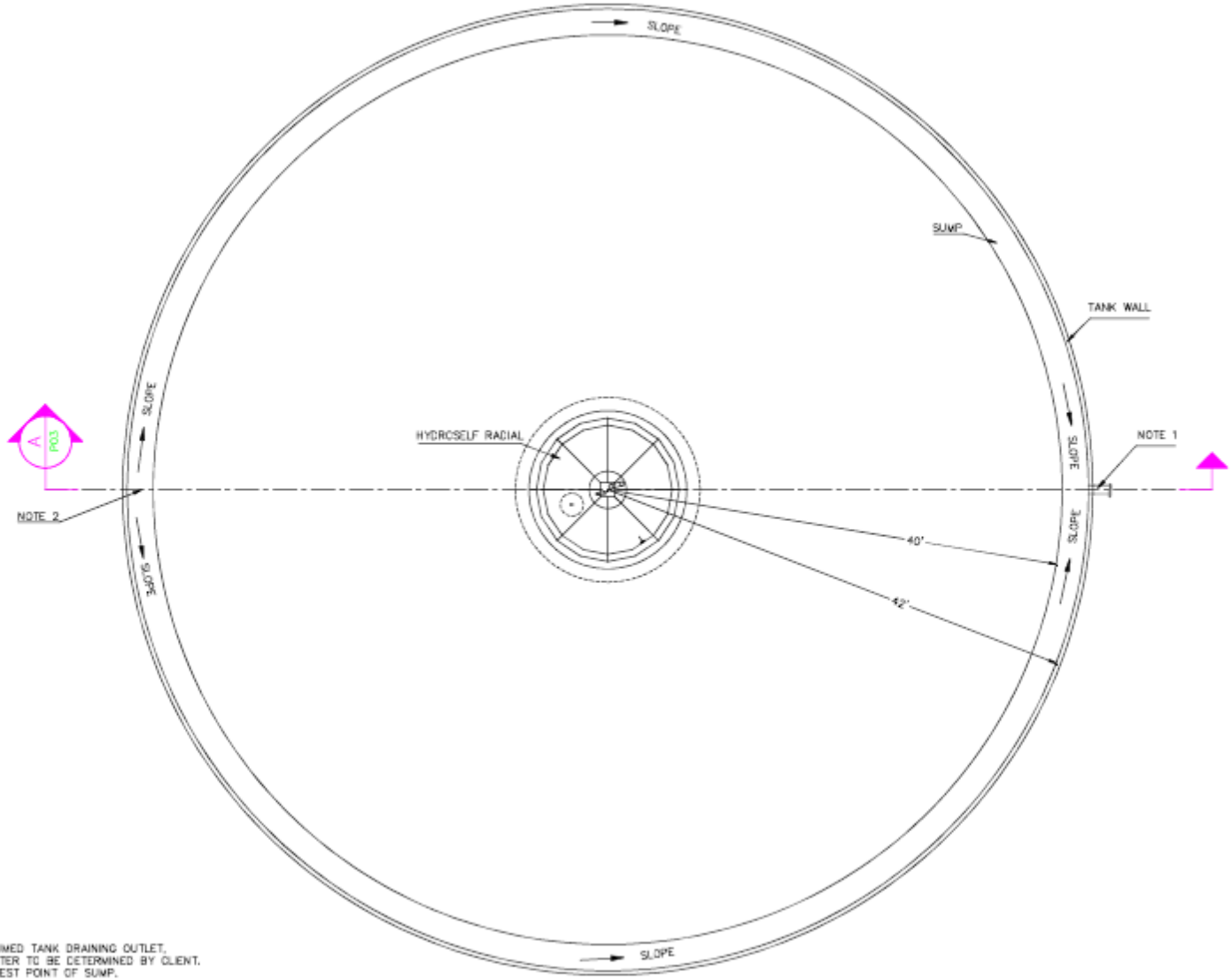
Potential Flushing System: Circular Tank



NOTE 1: ASSUMED TANK DRAINING OUTLET, DIAMTER TO BE DETERMINED BY CLIENT.
NOTE 2: HIGHEST POINT OF SUMP.

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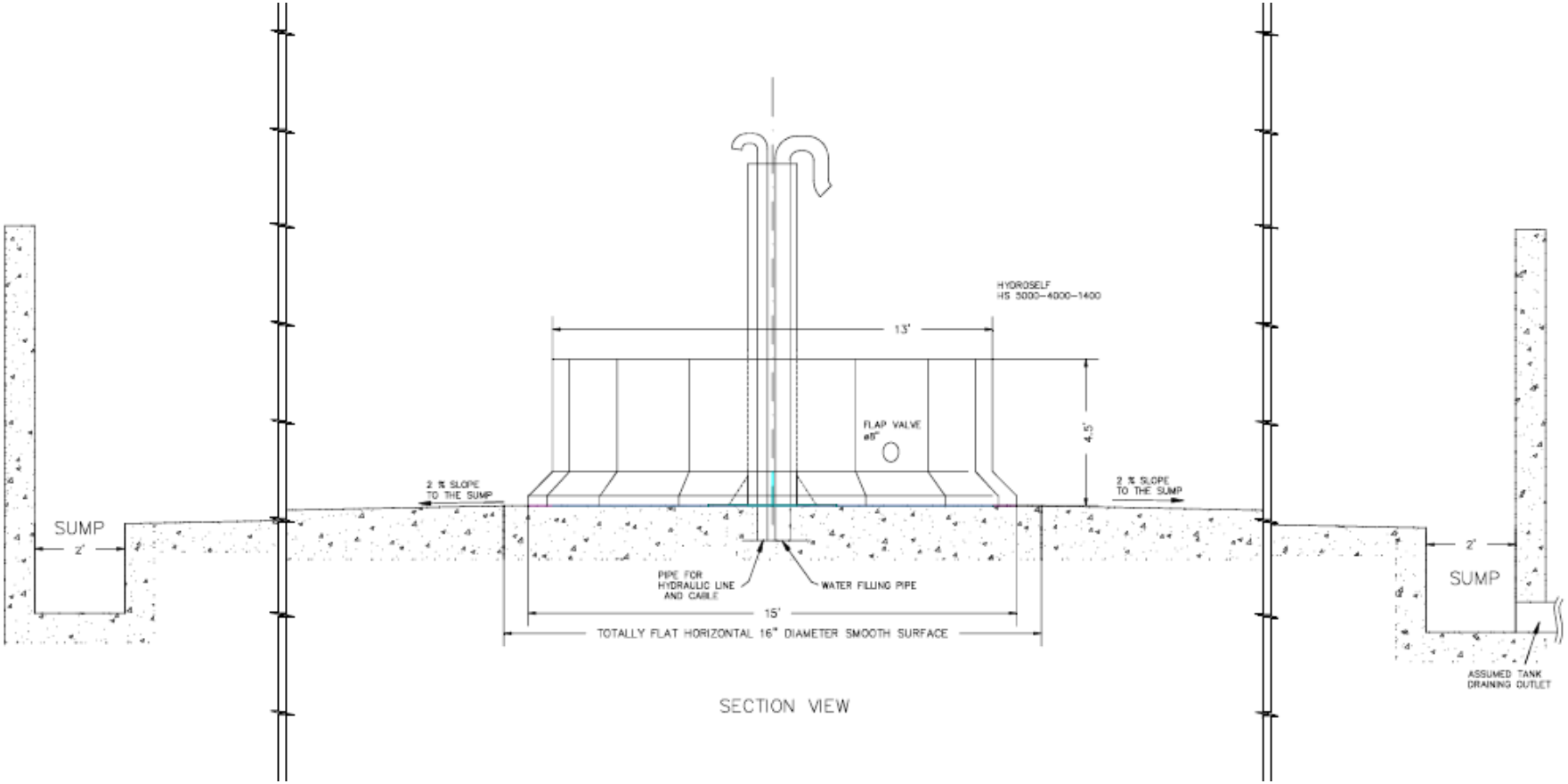
Potential Flushing System: Circular Tank



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CSO Storage Considerations

Cost-Effectiveness Analysis

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Storage Tank Cost Estimates

Alternative	Total Project Cost	Cost per Gallon of Storage
0.25 MG Rectangular Tank	$ 2,703,000	$ 10.80
0.41 MG Rectangular Tank	$ 3,544,000	$ 8.64
0.50 MG Rectangular Tank	$ 4,250,000	$ 8.50
0.75 MG Rectangular Tank	$ 5,583,000	$ 7.44
0.41 MG Circular Tank	$ 3,666,000	$ 8.94
0.75 MG Circular Tank	$ 4,995,000	$ 6.66

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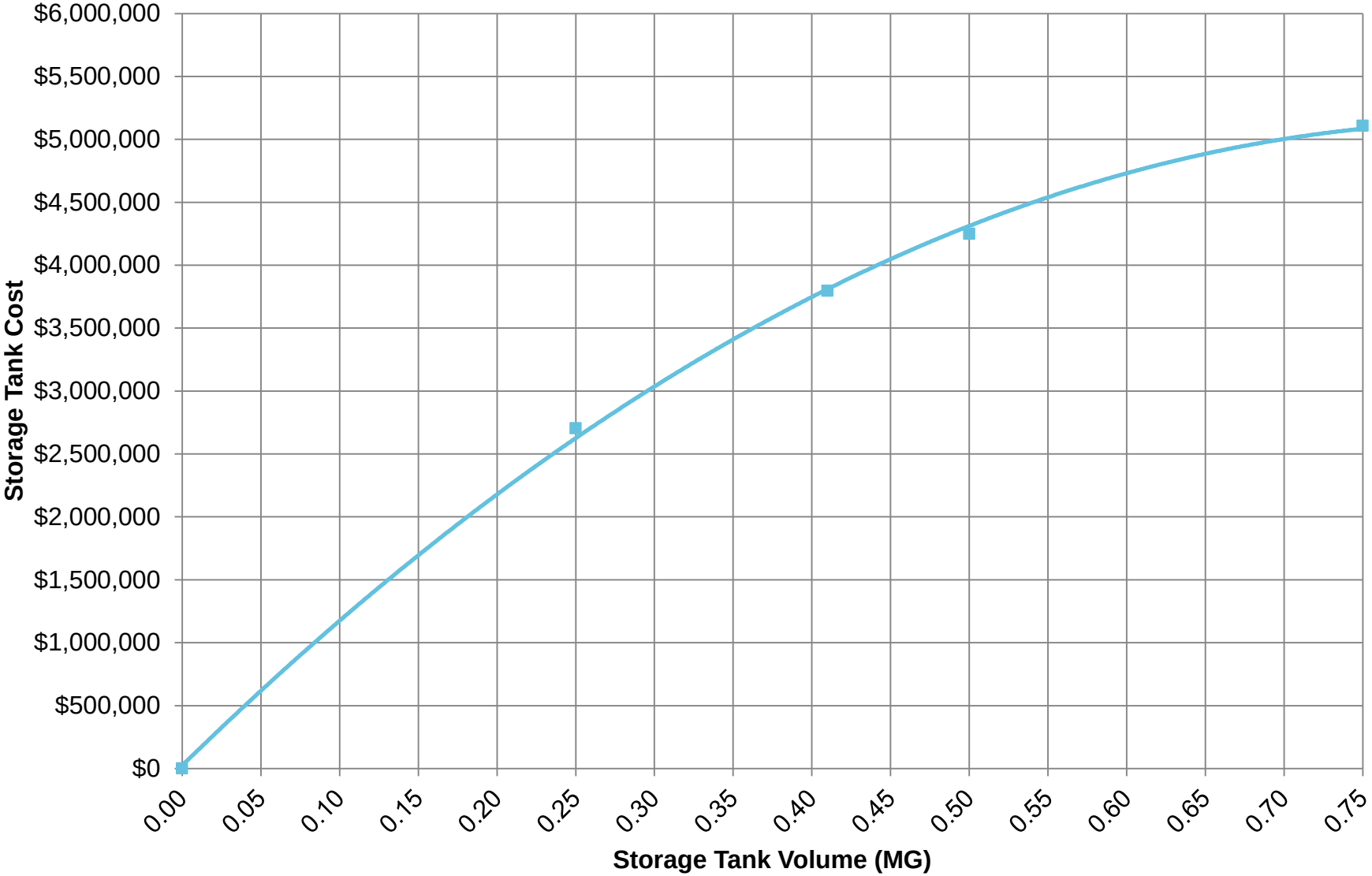
Total Cost vs. Tank Storage Volume



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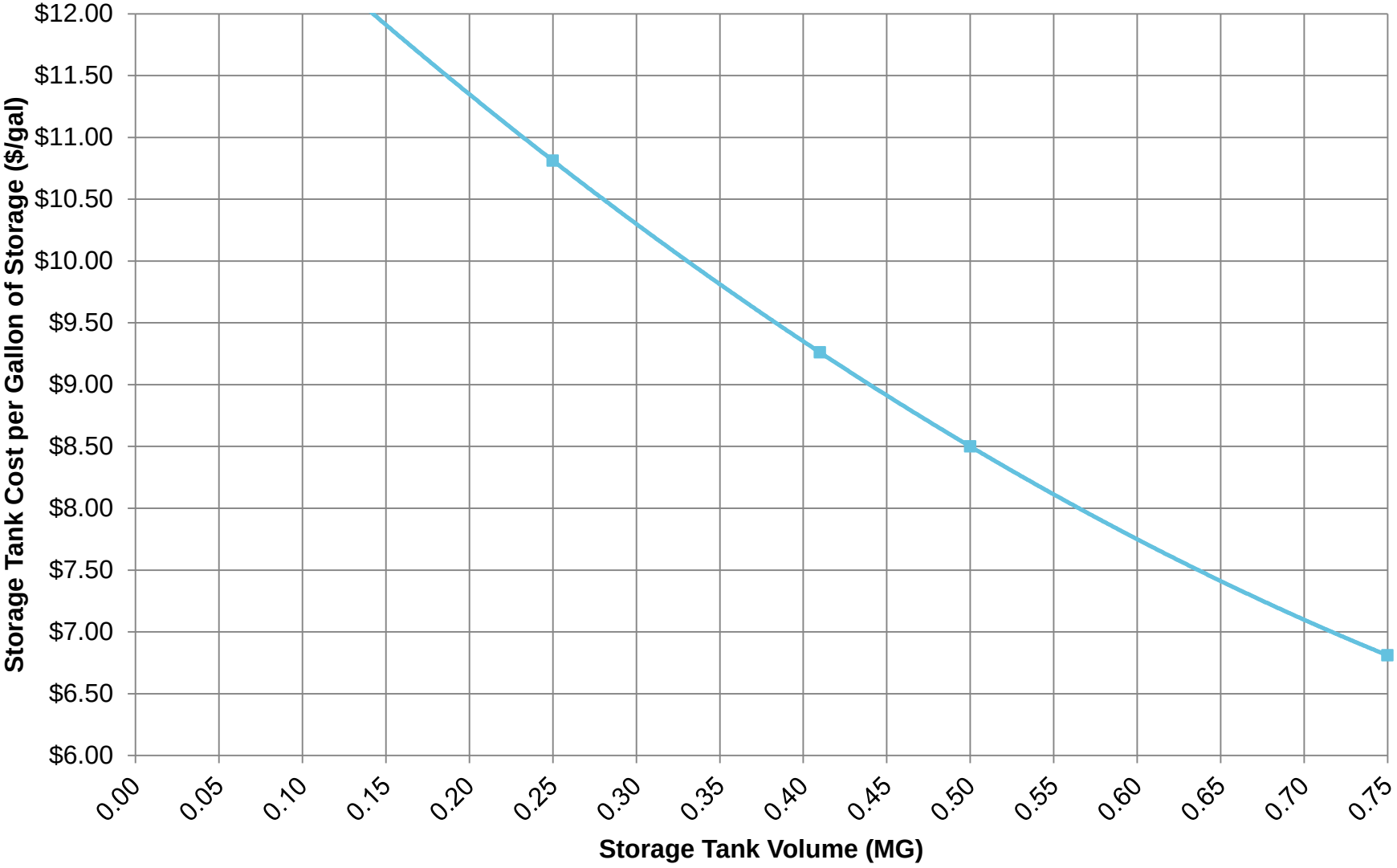
Total Cost per Gallon of Storage



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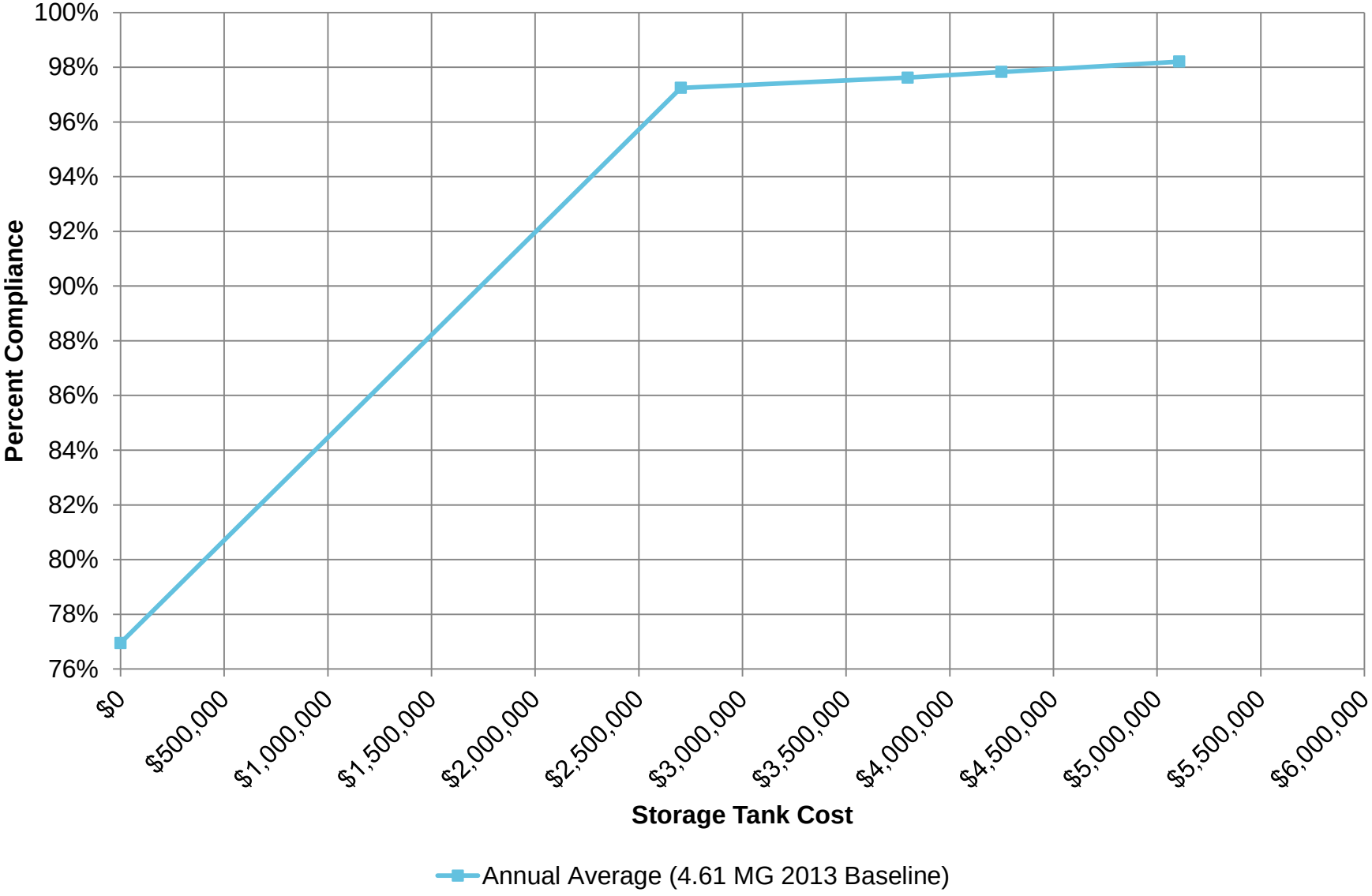
Total Cost vs. Percent Compliance



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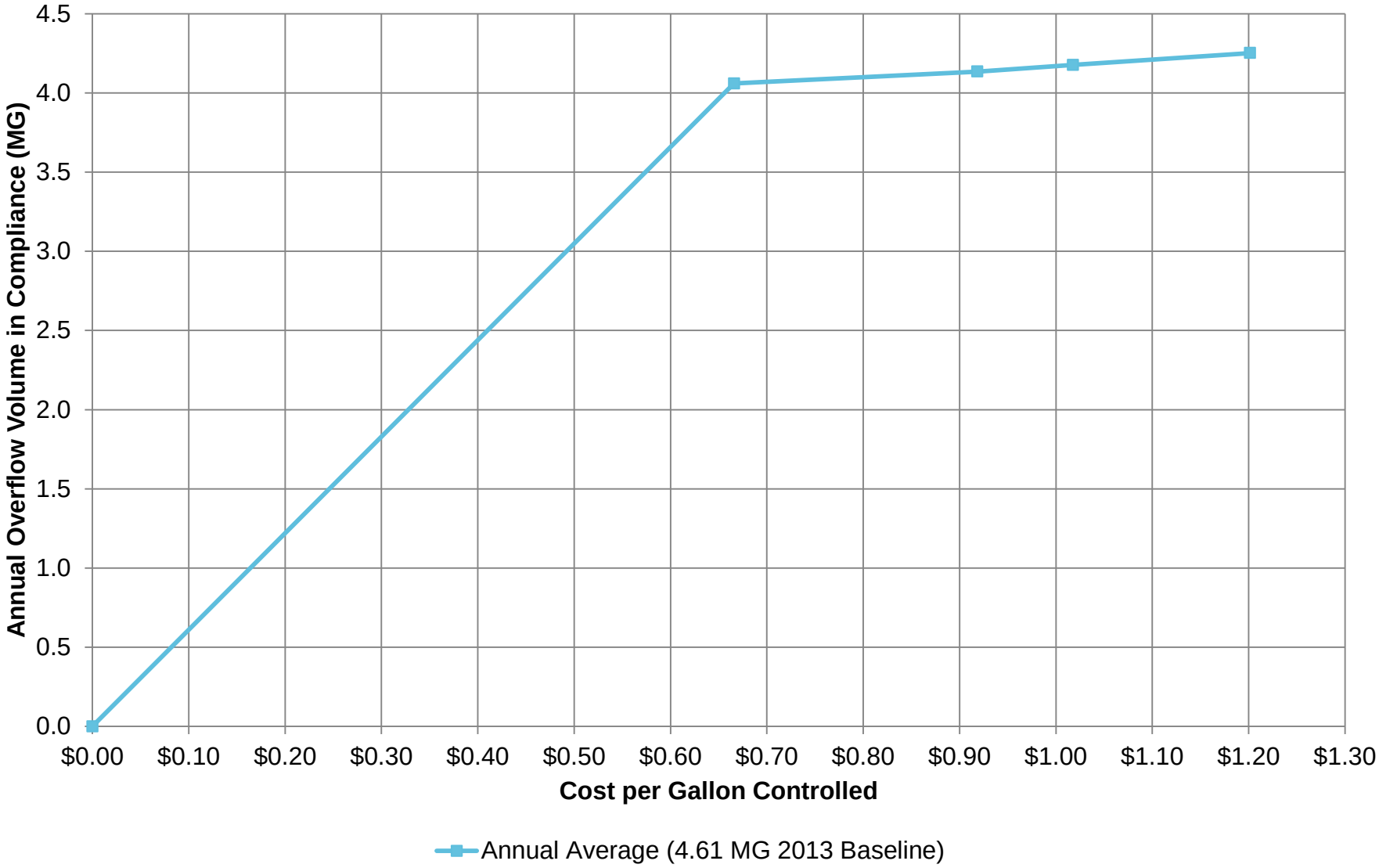
Cost per Gallon of Annual Controlled Overflow Volume



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Percent Compliance During Disinfection Season

	0.25 MG Storage Tank	0.41 MG Storage Tank	0.50 MG Storage Tank	0.75 MG Storage Tank
Disinfection Season (All Events Included)	21%	44%	48%	57%
Disinfection Season (2.9 MG Outlier Removed)	70%	85%	89%	100%
Overflow Event Frequency* (All Events Included)	1 event every 2 years	1 event every 3 years	1 event every 3 years	1 event every 6 years

**Note: 2.9 MG storage tank required for zero overflows.*

Annual disinfection season average volume was 0.83 MG from 2008 to 2013.

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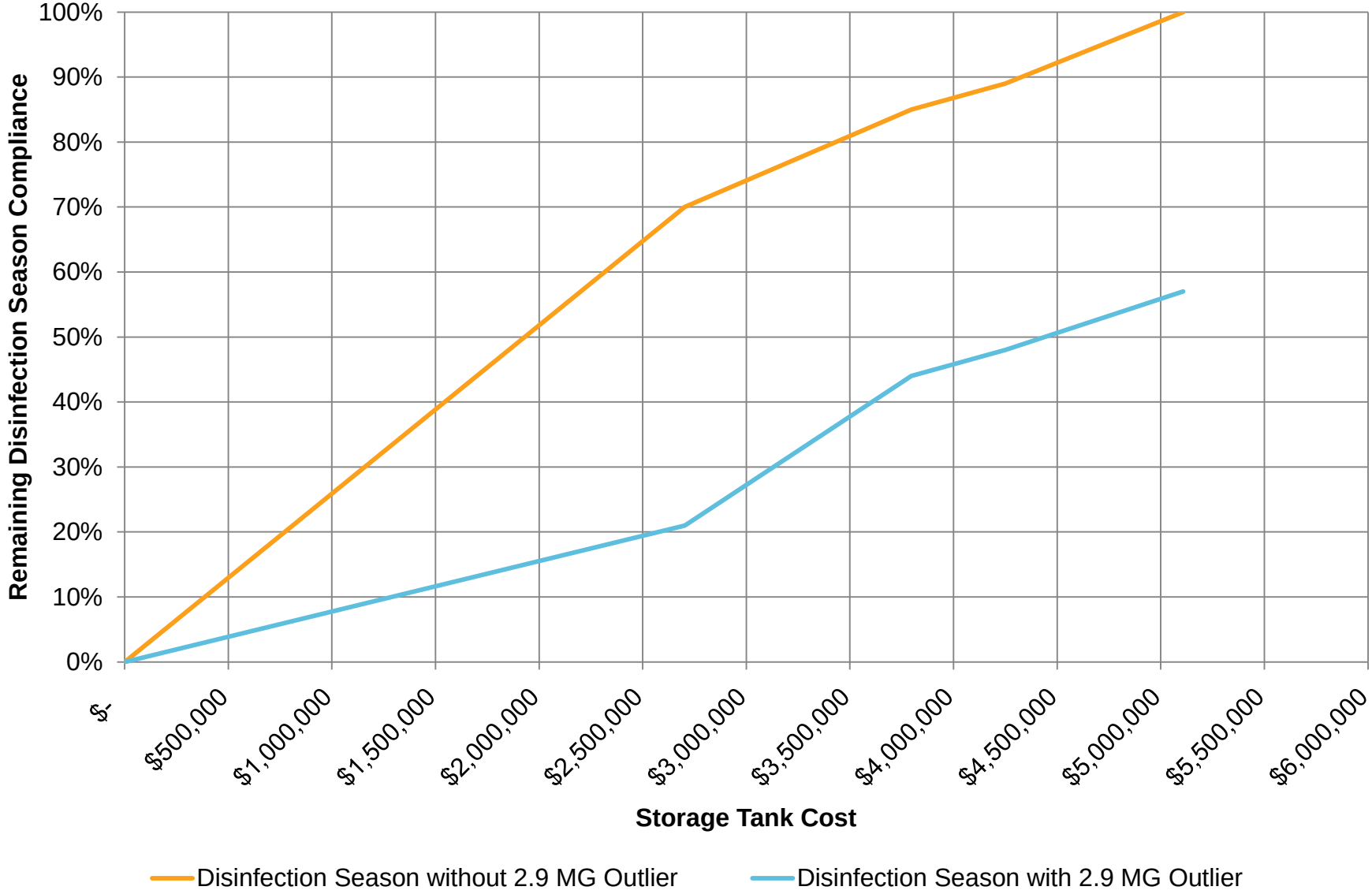
Percent Compliance During Disinfection Season



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Screening Systems

Assessment of Screening Options

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Screening Assessment – Progress

- Assessed types of screenings technologies
- Reviewed flow data into and out of MAPS & CSO 003
- Reviewed collection system – “do no harm”
- Met with various manufacturers
- Visited relevant installations
- Cost estimating

Band

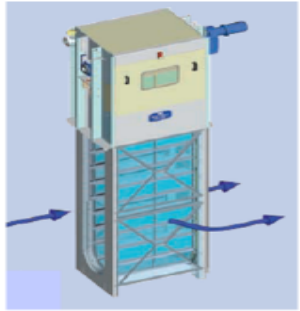


Image of Brackett Green CF200
(Central-flow pattern shown)

Operations: Screen panels are parallel to stream flow, doubling screening area, which creates a dual-flow stream pattern. Washwater removes screenings from either bar or perforated plates.

Advantages:

- Highest capture efficiency (6 mm perforations) at ~80%
- Minimal screenings carryover

Disadvantages:

- High cost to retrofit
- High headloss across screens
- Does not handle large debris well

Bar/Rake

Image of Huber Rakemax® Multi-rake Bar Screen

Operations: Longitudinal bars block large debris from passing through. Generally a raking mechanism removes the accumulated debris.

Advantages:

- Can remove heavy debris
- No washwater required
- Straightforward operation
- Existing system and thus most familiar to operator staff

Disadvantages:

- Current NDWWTP installation is bar screens with rakes, which have proven to be inefficient
- Low capture efficiency (6 mm bar spacing) at ~ 40%

Perforated Plate

Image of JWC Finescreen Monster®

Operations: Debris accumulates on continuous belt (made up of perforated plates) that spans screen width and rotates around sprockets to create 'flow through' pattern

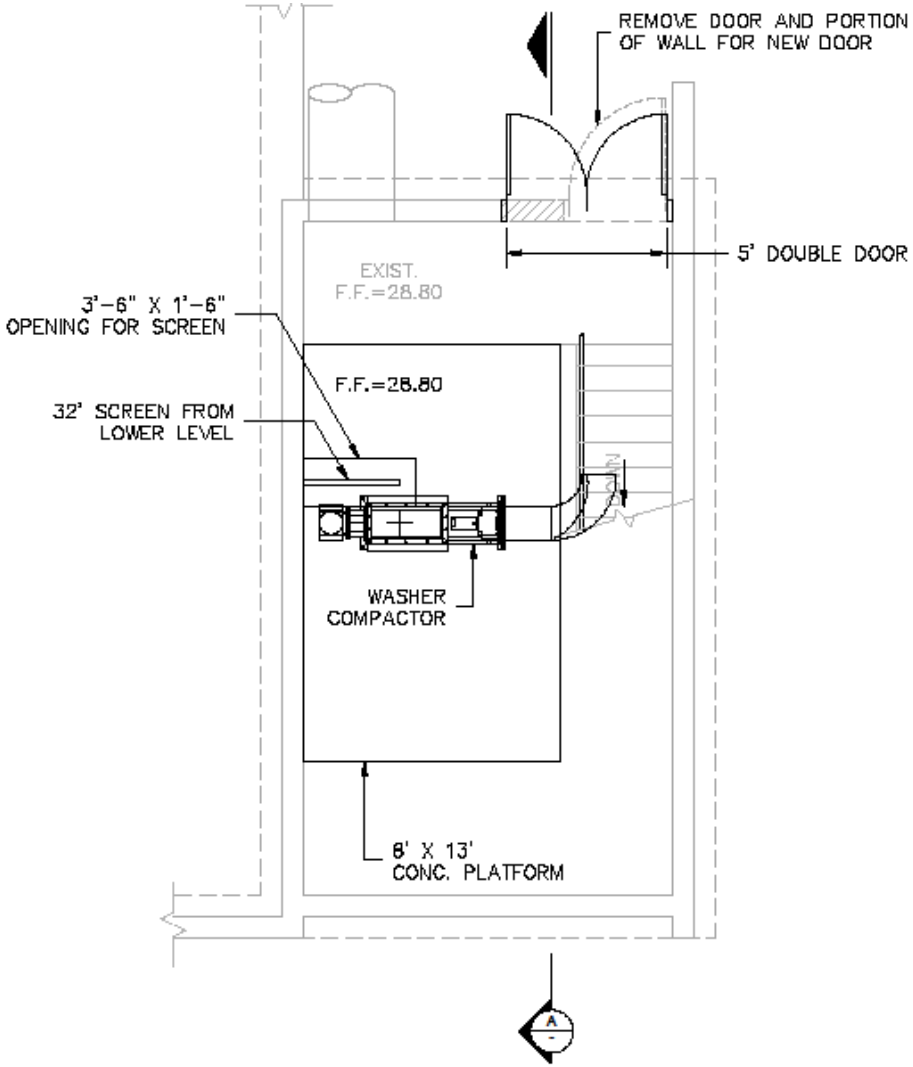
Advantages:

- Oldest mechanical screen design - reliable and simple
- Good capture efficiency (6 mm perforations) at ~70%
- Perforated plate enhances screenings capture
- Emerging popular screenings design

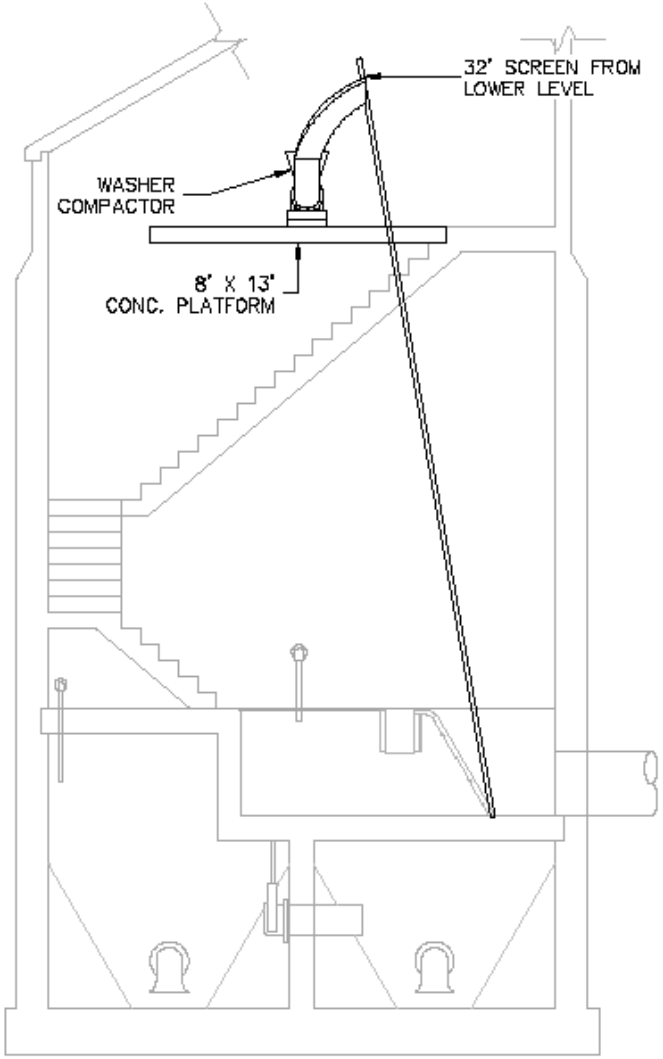
Disadvantages:

- Some screenings carryover occurs
- Hairpinning
- Highest washwater demand (i.e. ~ 30 gpm)

Screenings – Option 1



Upper Level Plan



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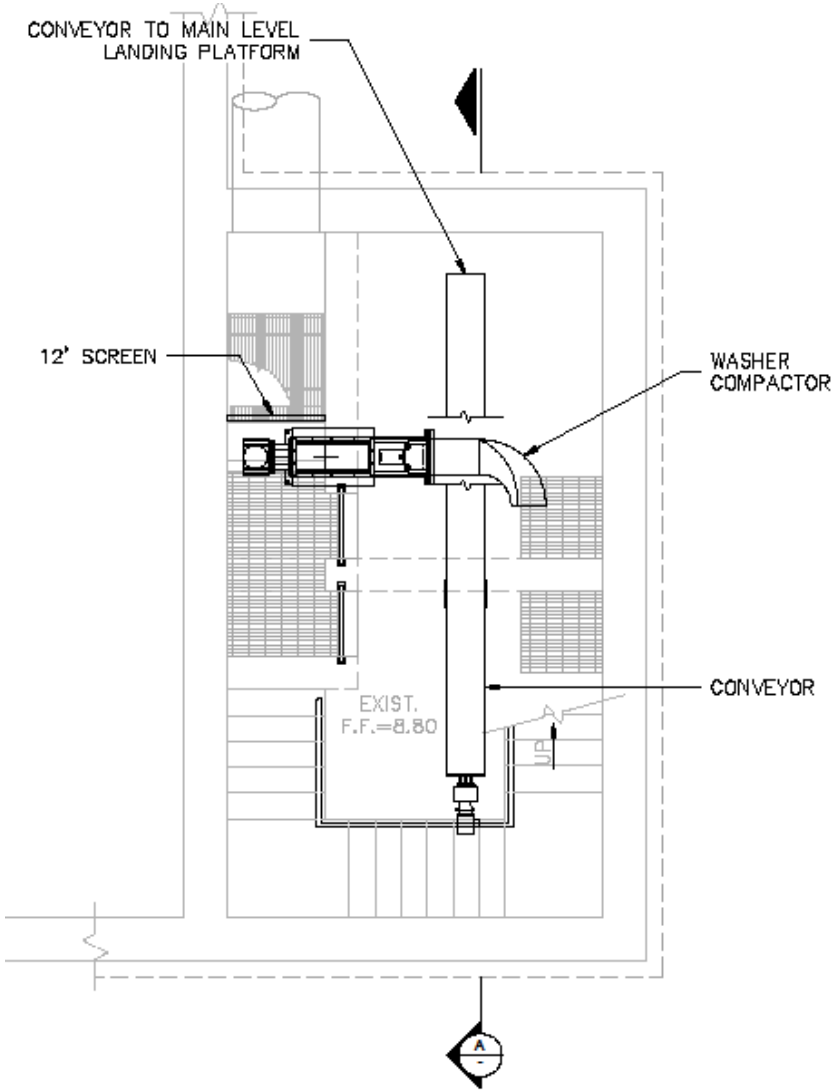
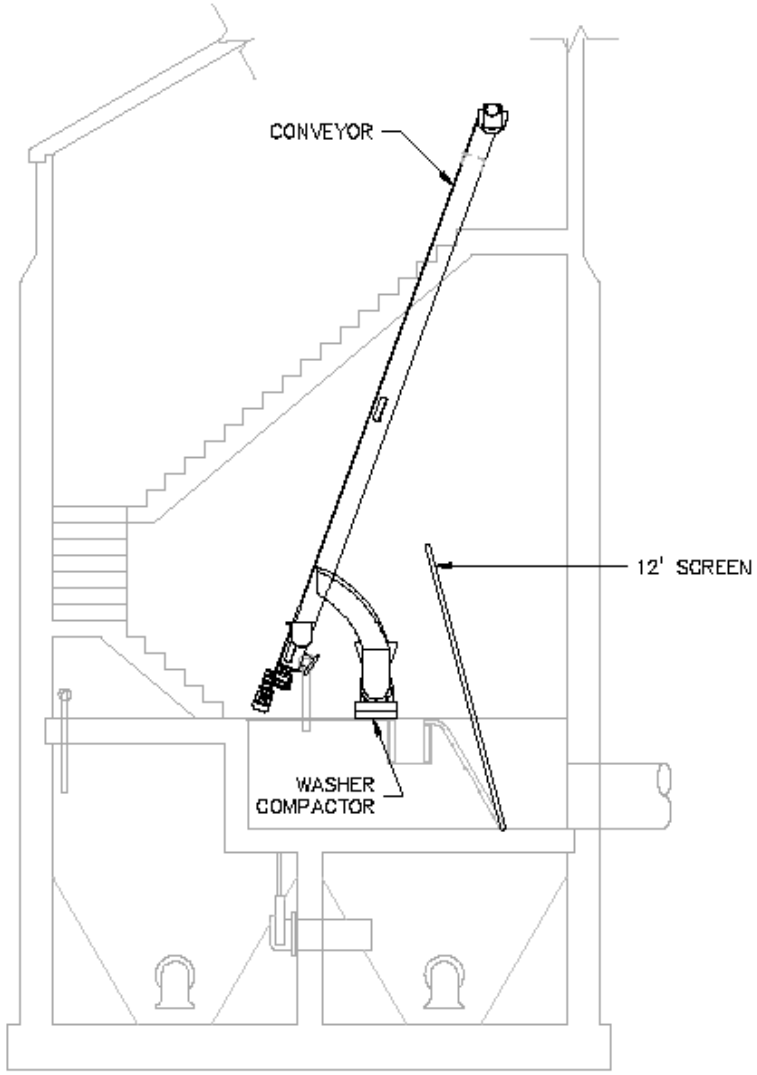
Screenings – Option 2



Lower Level Plan



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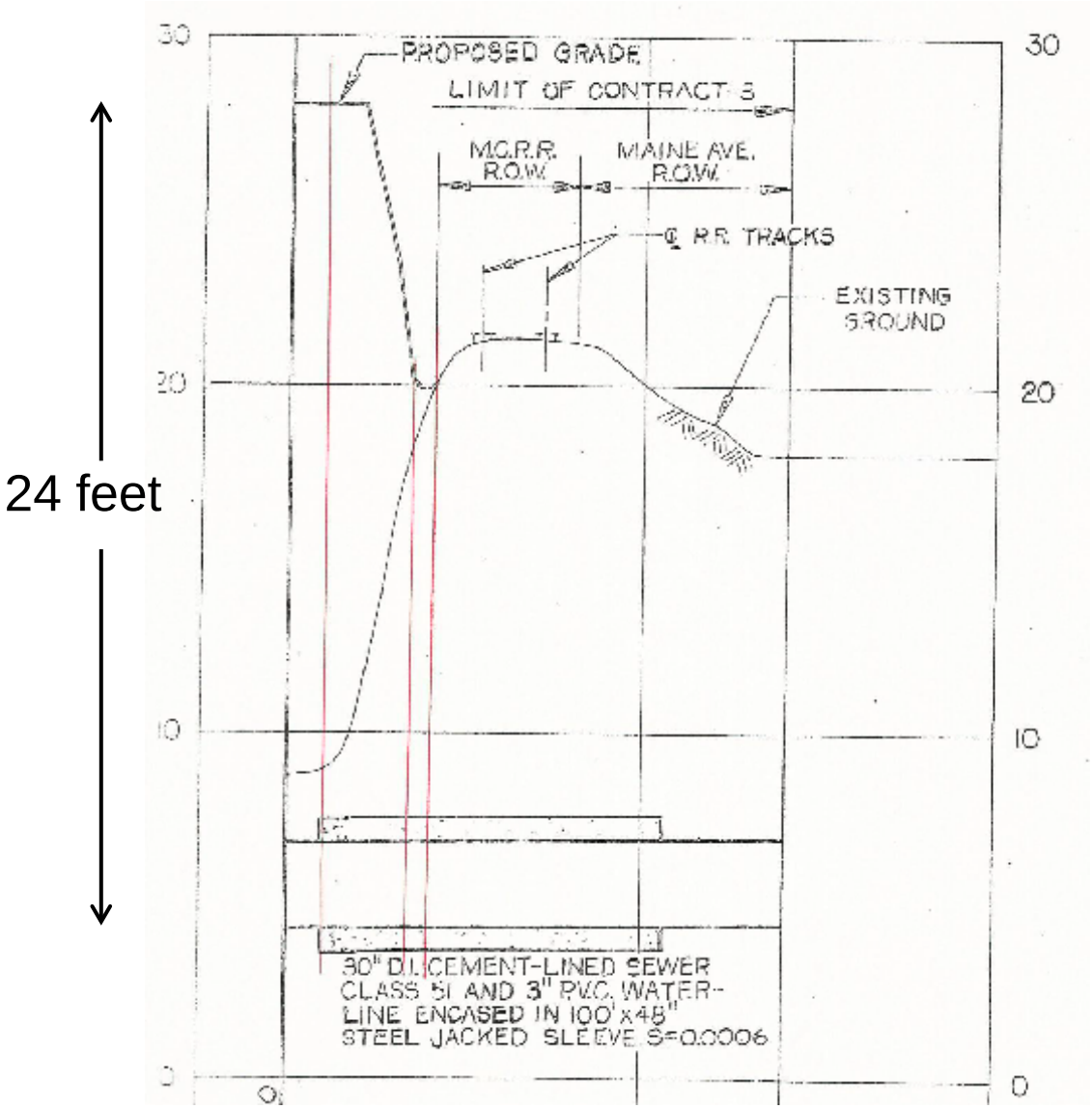
Screenings – Option 3



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	Option 1	Option 2	Option 3	Option 4
	Upper Level Screen in MAPS	Lower Level Screen in MAPS	Screen in Flow Control Structure	Grinder in MAPS or Flow Cntrl Str
MAPS Impacts				
MAPS peak influent flow rate?	9 MGD	9 MGD	11 MGD	9 or 11 MGD
Screenings removed ahead of pumps?	X	X	X	
Screenings processing location?	Upper Level MAPS	Upper Level MAPS	Flow Cntrl Str	WWTF
Additional above grade structure req'd?			X	
Length of screen?	Long	Short	Long or Short	N/A
Add'l screenings conveyance equipment?		X	Potentially	N/A
CSO/WWTF Impacts				
CSO 003 discharges are screened?	X	X	X	
Secondary bypass at WWTF screened?	X	X	X	
Potential redundency of screenings?	X	X	X	
Potential for re-formation of screenings?				X
O&M Impacts				
Regular operational needs?	X	X	X	
Regular maintenance needs?				X
Location of motors, electricals, etc.	Upstairs	Downstairs	In Structure	Downstairs
Protected from catastrophic flooding?	X			
Regular access in new structure reqiured?			X	

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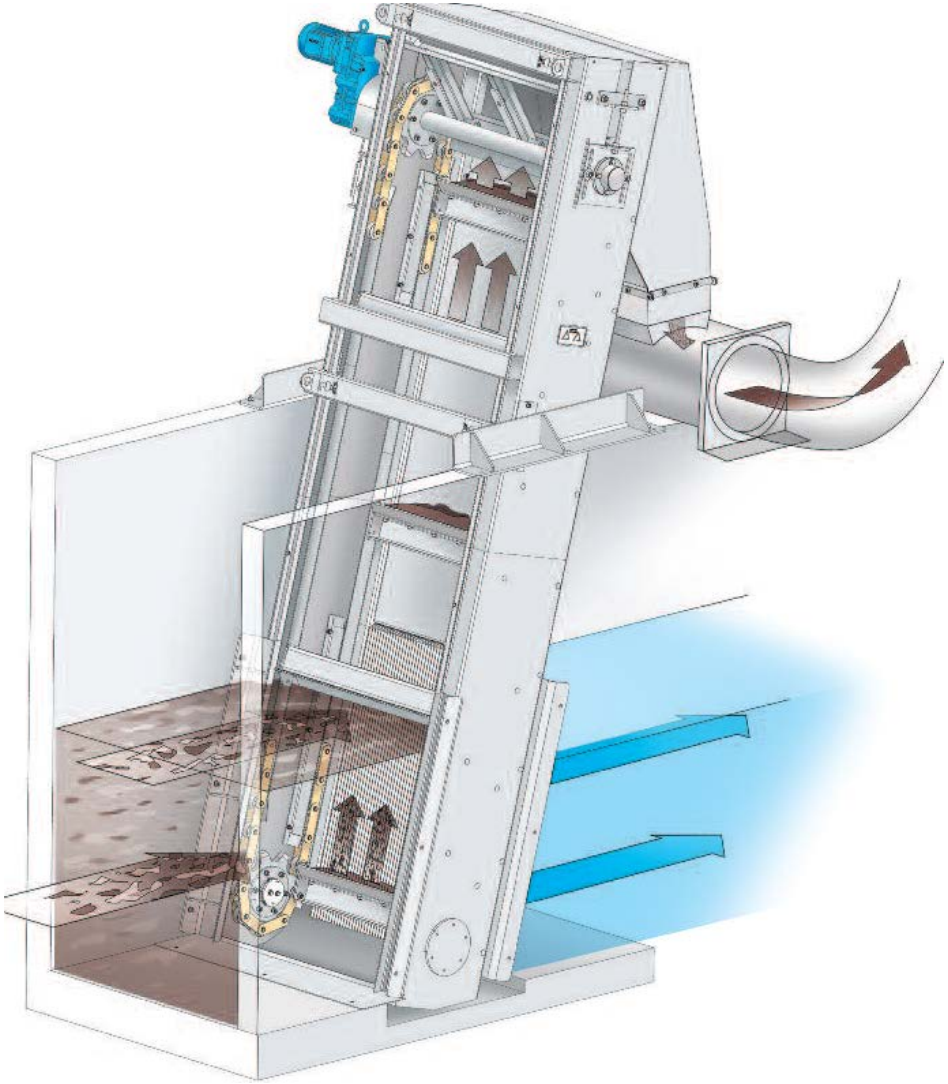
Duperon

Headworks, Huber, Vulcan



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Screen Alternatives	Total Project Cost
Screen Option 1: Long Screen	$ 635,000
Screen Option 2: Short Screen with Conveyor	$ 658,000
Screen Option 2b: Short Screen without Conveyor	$ 566,000

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