ASTORIA, OR
OBSERVES MULTIPLE WATER BENEFITS BY COVERING IT'S OPEN RESERVOIRS

May 5, 2011

Jay D. Cooke, P.E.

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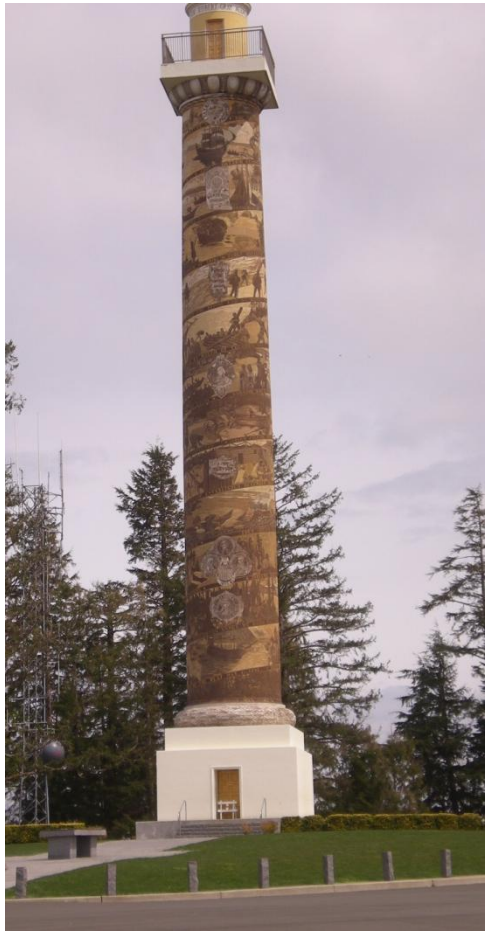
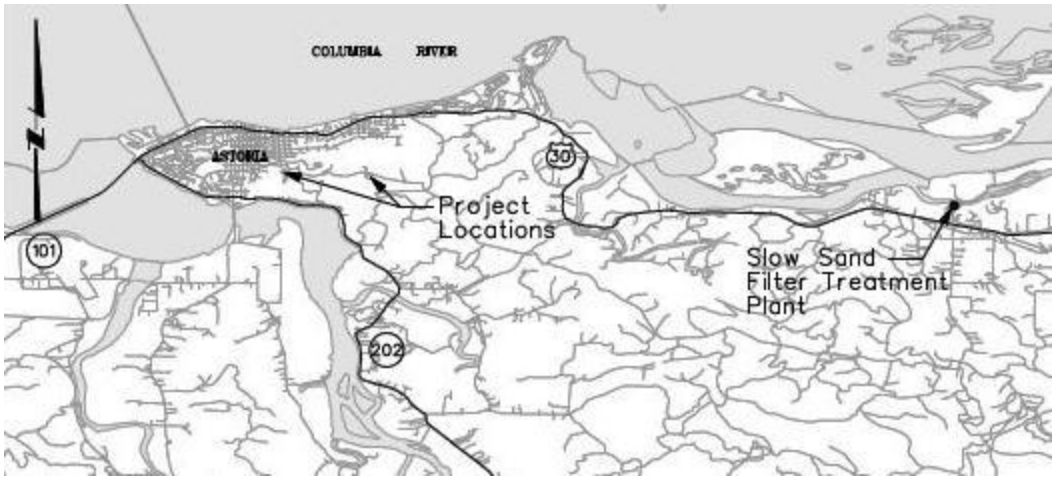
MWH

BUILDING A BETTER WORLD

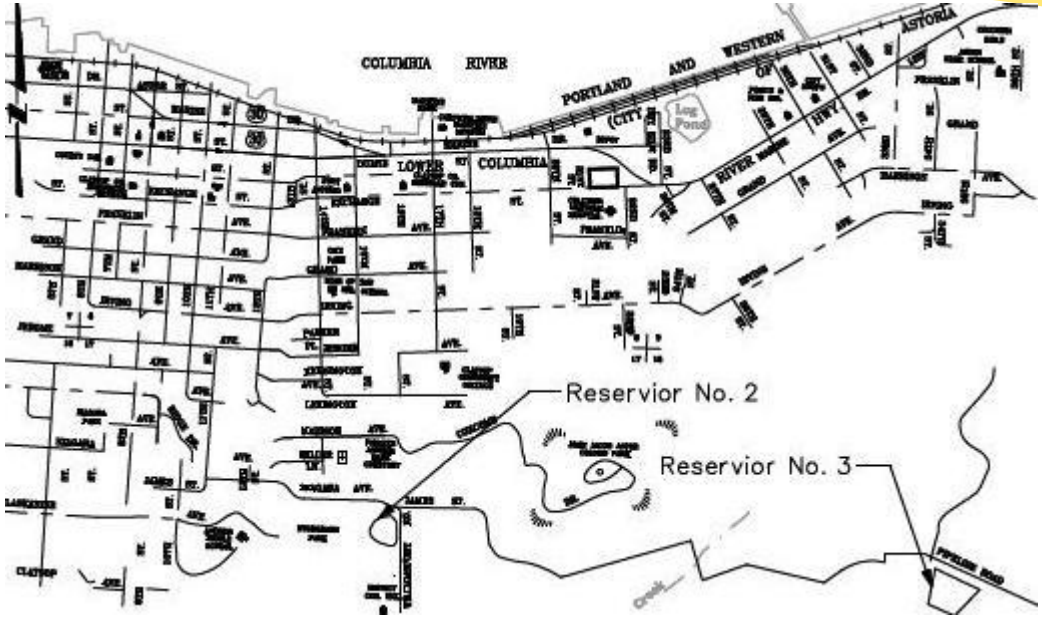
ASTORIA BACKGROUND





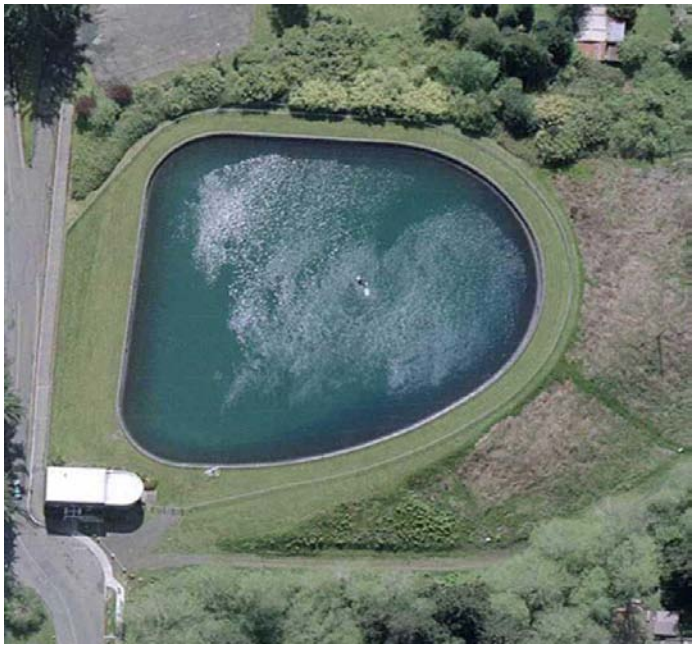
- City established in 1847
- Population: approx. 10,000
- 70-inch annual rainfall

ASTORIA'S WATER SUPPLY SYSTEM



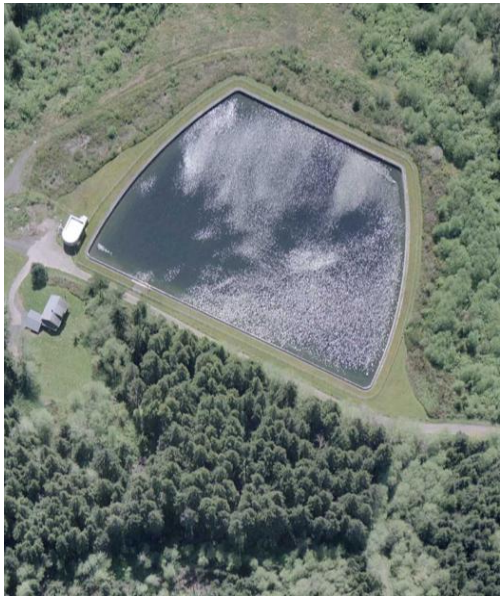
- Slow sand filtration plant (Max 6 MGD)
- 10.6-mile, 21-inch dia. CCP Transmission pipeline
- Reservoir No. 3
- 1.4-mile, 21-inch dia. CCP Transmission pipeline
- Reservoir No. 2
- Distribution mains
- ADD - 2.2 MG/ PDD – 4.0 MG

RESERVOIR 2



- Constructed in 1895
- 6 MG capacity
- Concrete liner
- 1.4 acre surface area
- Hypalon liner installed early 1980’s

RESERVOIR 3



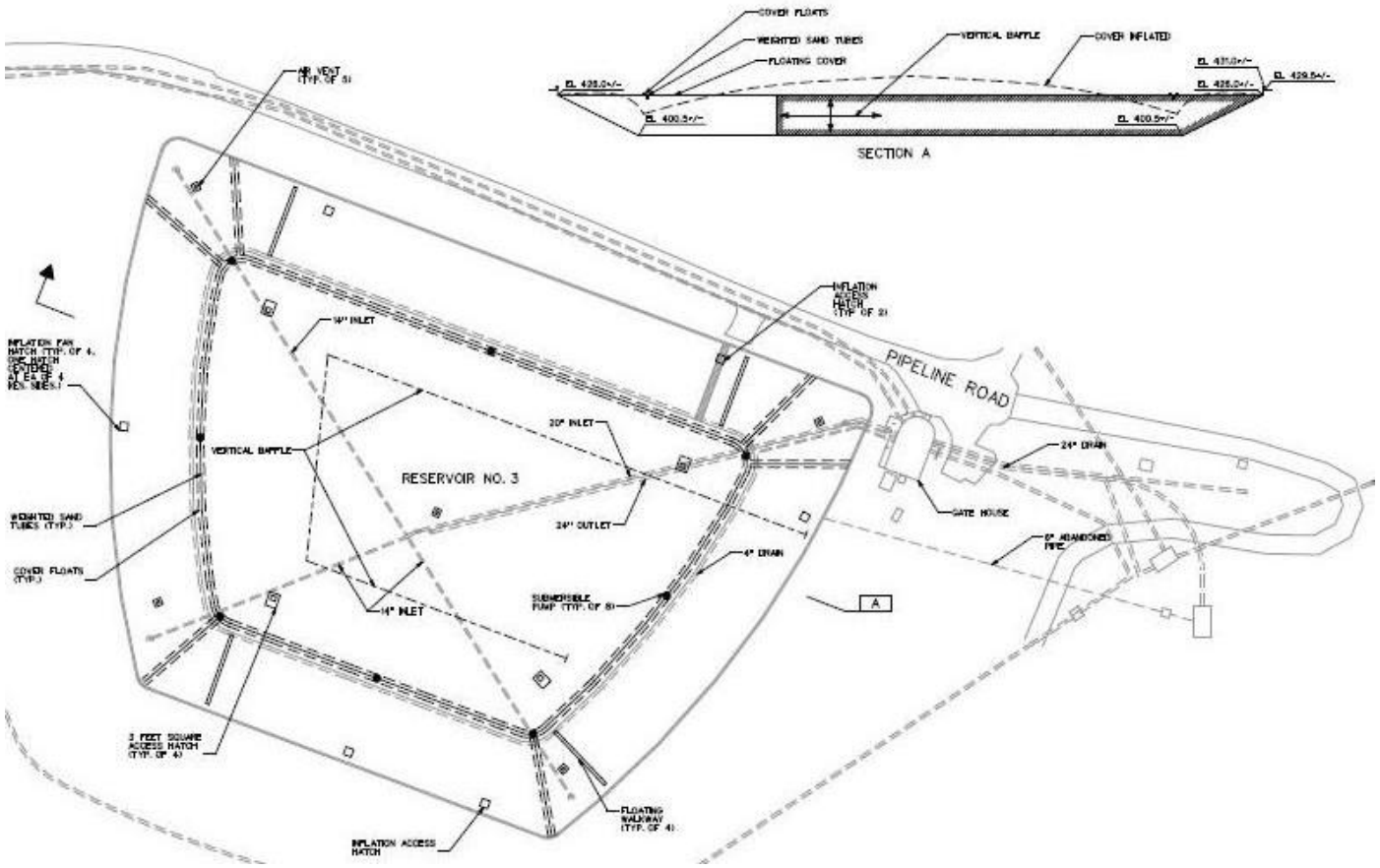
- Constructed in 1919
- 20 MG capacity
- Concrete liner
- 3.2 acre surface area
- Hypalon liner installed early 1970’s

ASTORIA INITIATES PROGRAM TO IMPROVE ITS DRINKING WATER SYSTEM

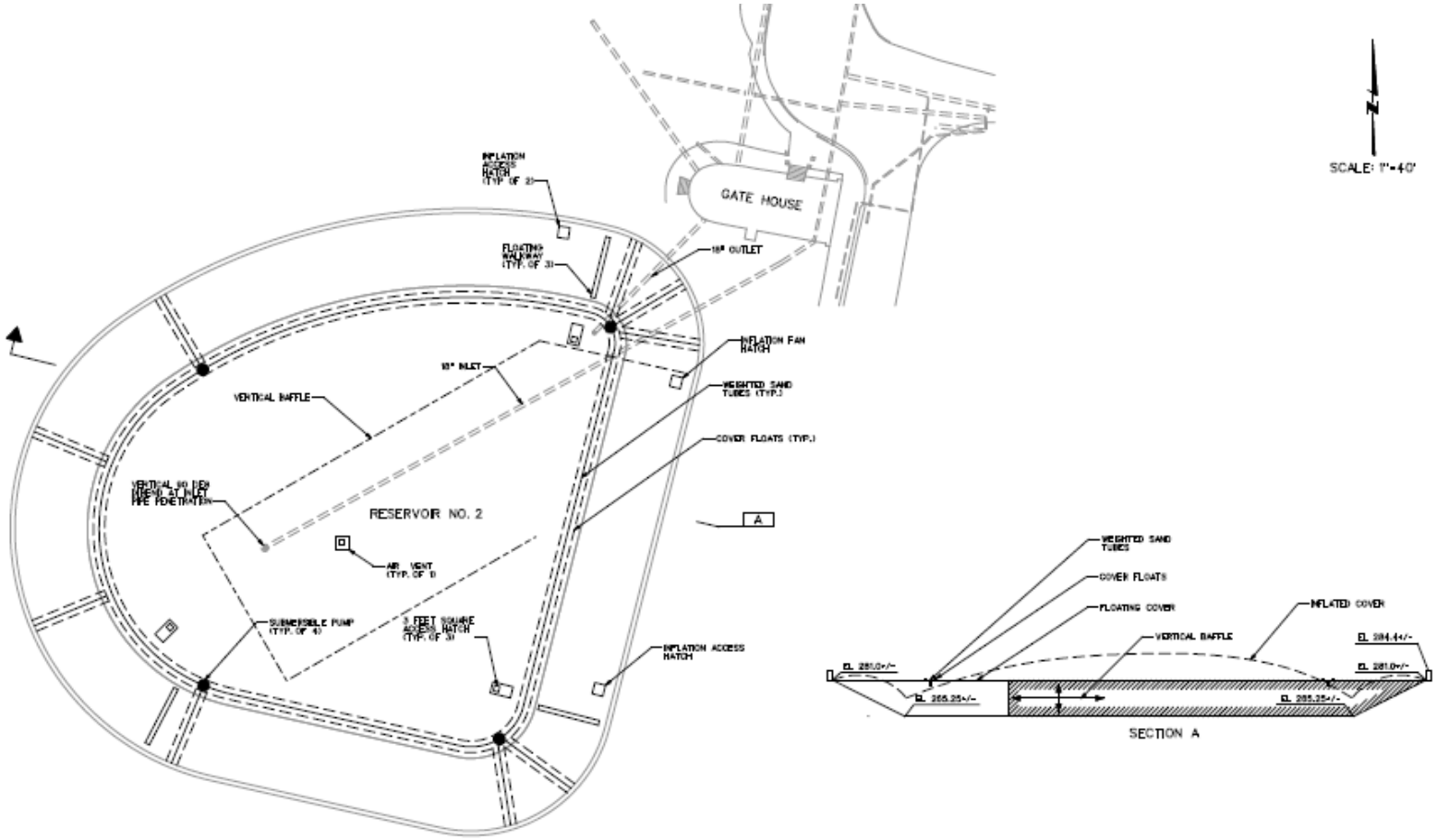
INSTALL FLOATING COVER & LINER ON EACH RESERVOIR

- Prevent contamination of water
- Improve circulation within reservoir to reduce water age
- Reduce chlorine demand
- Reduce security risks
- Reduce O&M costs
- New liners prevent leakage

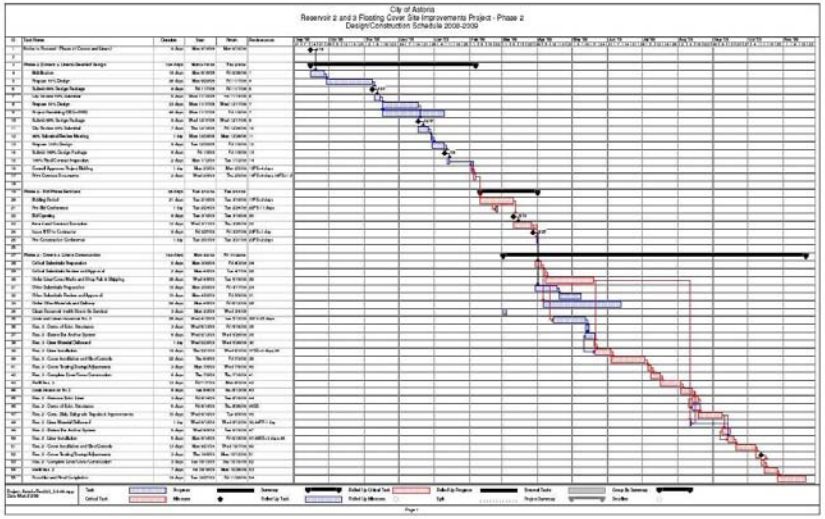
RESERVOIR NO. 3 LAYOUT



RESERVOIR NO. 2 LAYOUT



CONSTRUCTION SCHEDULE



- Short dry season in Astoria
- Phased construction over two summers
- Reservoir 3 constructed first (2009)
- Challenging piping improvements required to safely operate the system
- 3 month construction duration each reservoir

FLEXIBLE – MEMBRANE MATERIALS

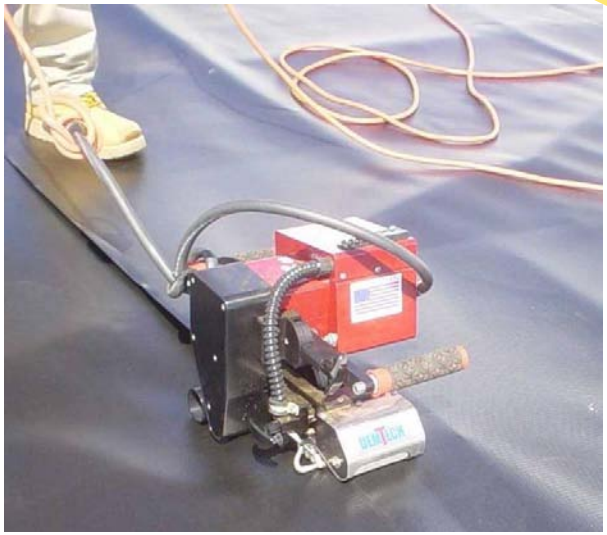
CHOICES INCLUDE:

Hypalon (CSPE)

- 35-yr installed experience
- Standard 30-year material warranty
- Proven repair procedures
- Heat and solvent weld
- Specific gravity of 1.45

Polypropylene (RPP)

- 35-yr installed experience
- Lower material cost
- Higher tear strength
- Long term reparability (not fully proven)
- Specific gravity of 0.92



Typical Thickness – 45 mil

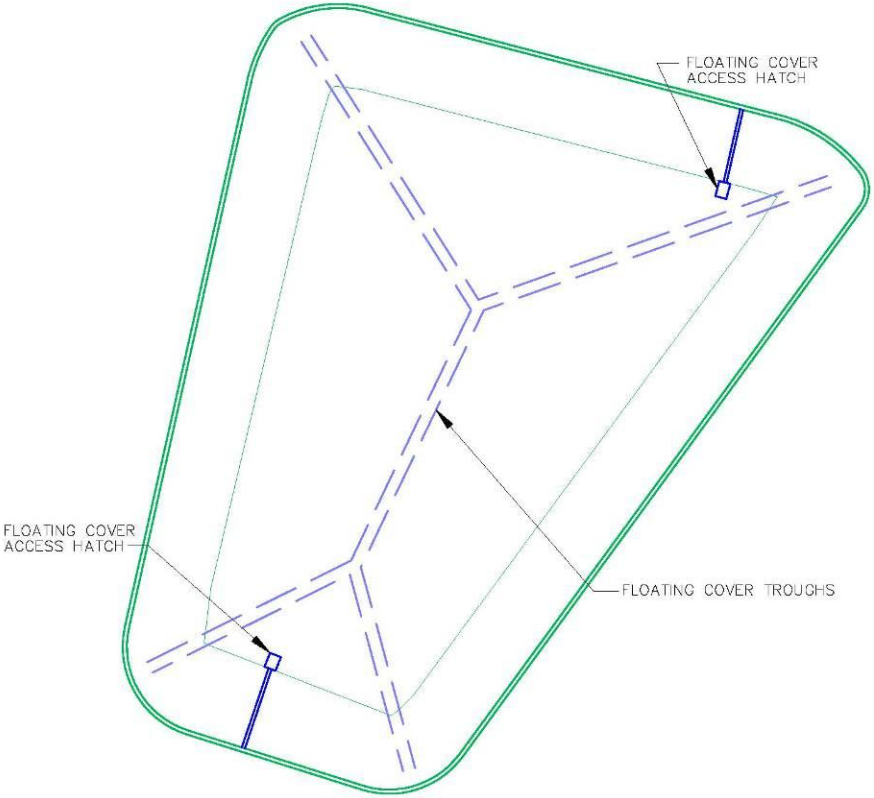
Astoria chose Hypalon material due to proven track record

ALTERNATIVE COVER DESIGN SYSTEMS

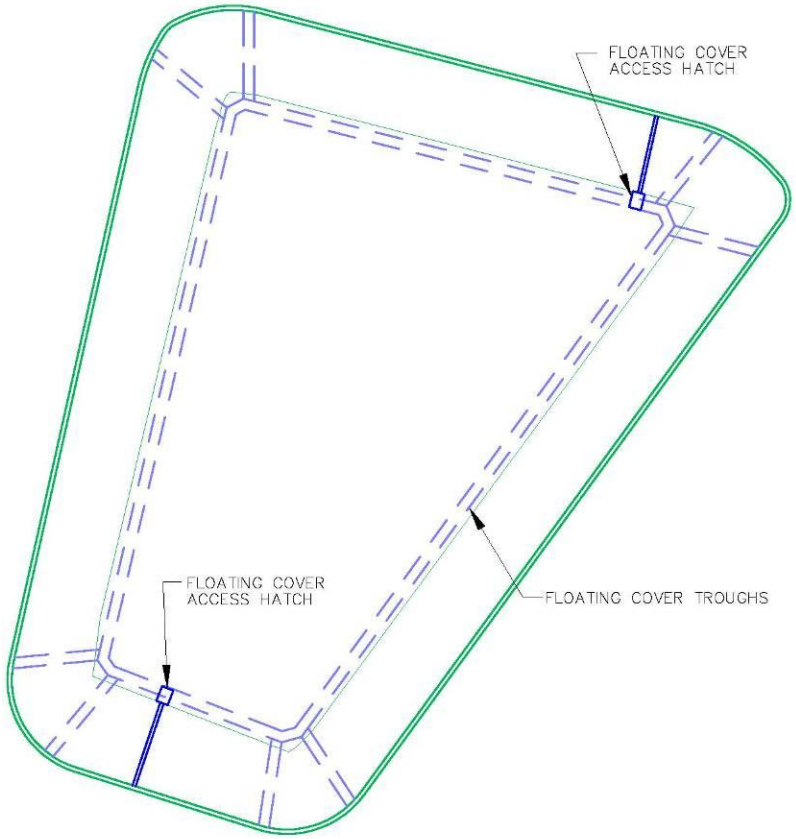
Weight-Tensioned

Mechanical-Tensioned

ALTERNATIVE WEIGHT-TENSIONED COVER LAYOUTS



“Double-Wye” Trough



Perimeter Trough

ALTERNATIVE PERIMETER ANCHOR SYSTEMS

Earth Anchor

Batten Bar Anchor

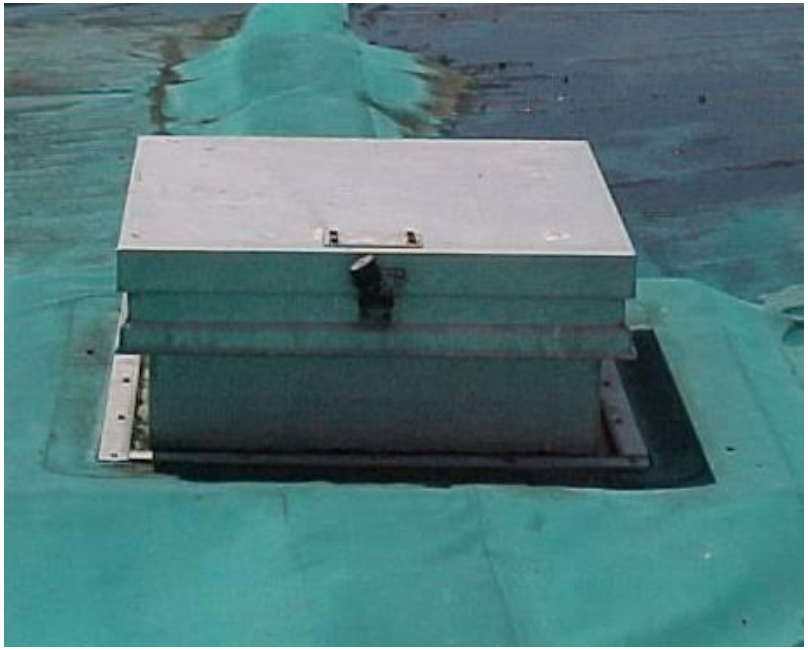
RESERVOIR COVER APPURTENANCES

Trough Floats

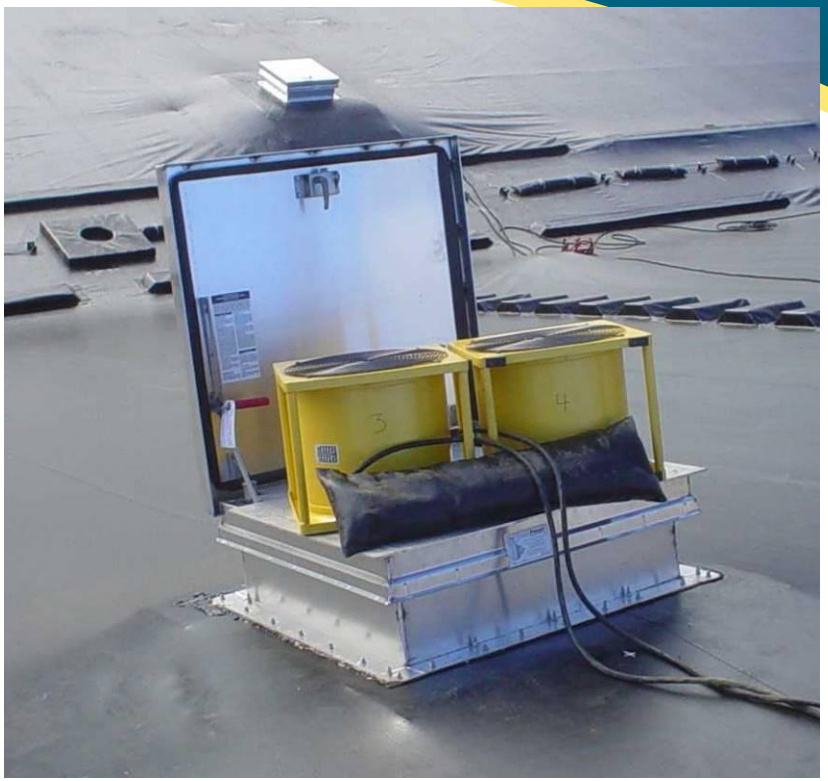
Walkway Floats to Hatch/Sump Pump

RESERVOIR COVER APPURTENANCES

HATCHES



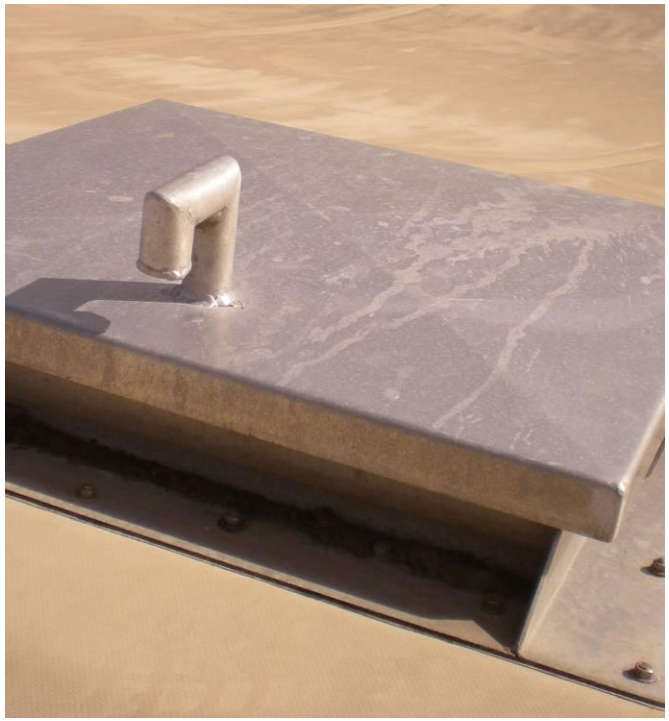
Access Hatch



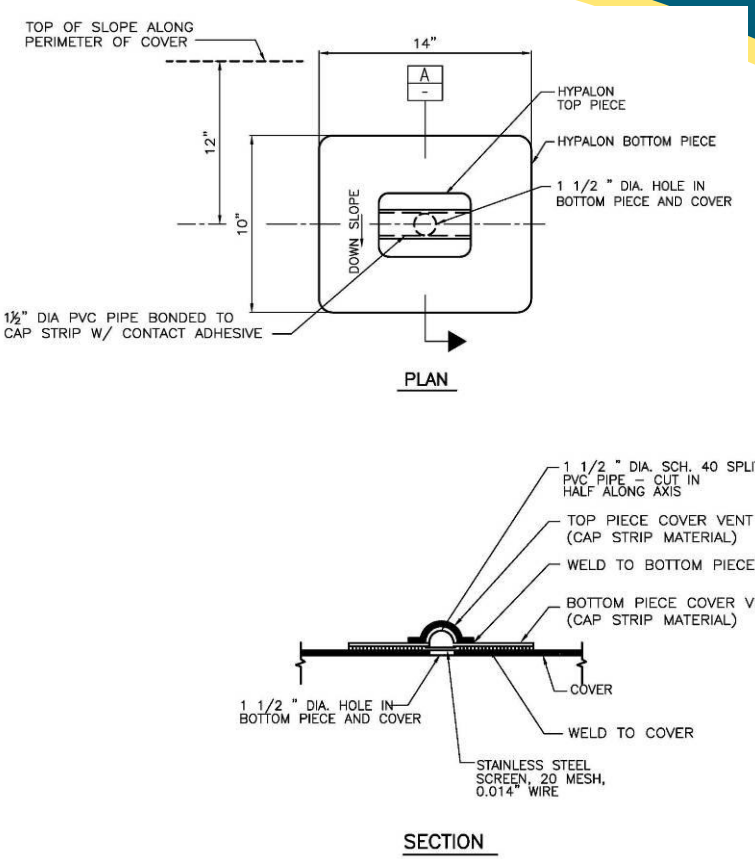
Inflation Hatch

RESERVOIR COVER APPURTENANCES

AIR VENTS



Hatch Vent

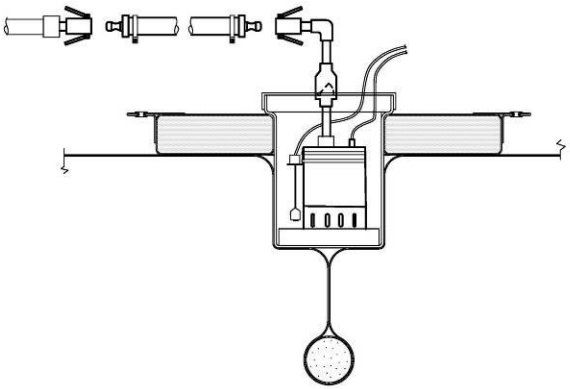


Perimeter Vent

RESERVOIR COVER APPURTENANCES

DEWATERING SYSTEM

- Size pumps for surface area and storm event
- 1/3 to 1/2 HP range
- Provide counter weight
- Locate in collection trough



Sump Pump Assembly

COVER INFLATION TO FACILITATE O&M

Cover Inflation

- Inspection
- Interior cleaning
- Repair

Caution!

- Avoid windy conditions
- Monitor inflation fans
- Minimize cover inflation height

Require installer to demonstrate cover inflation

O&M SAFETY MEASURES

Safety Procedures

- Min. 2 workers on-site
- Careful near trough area

Safety Equipment

- Floatation vest
- Life ring w/ rope
- Soft soled footwear
- Sharp knife!

FLOATING COVERS REQUIRE DILIGENT MAINTENANCE

Exterior Cleaning is Essential to Long Service Life

- Tree removal & trimming
- Daily visual inspection
- Routine cover inspection
- Surface cleaning
- Cleaning of water collection trough

Interior Cleaning (5 to 10 Years)

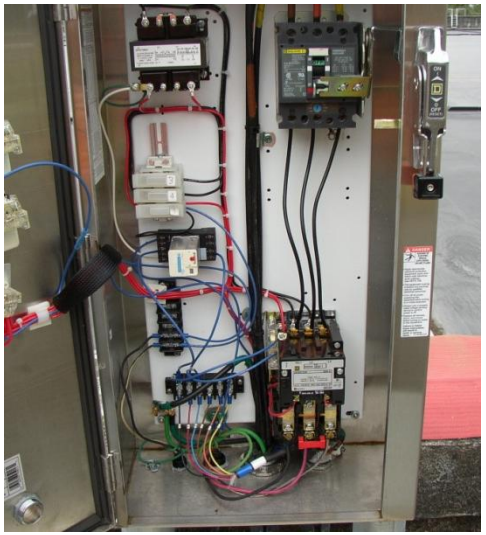
- Specialty underwater diving services
- Inflate cover

CONSTRUCTION AND STARTUP CHALLENGES FOR ASTORIA RESERVOIRS

Age of Reserviors Required Contingency Plans

- Res. 3 concrete liner in poor condition – Replaced two panels
- Res. 2 stone wall foundation different than original design drawings – Redesigned concrete apron

- “Temperature Blocking” of liner/cover membrane
- Sump Pump controls required delay timer



PROJECT SUMMARY

- Total construction costs - $1.9 M
- Chlorine boosting at both reservoirs has been eliminated
  - No need to replace original gas chlorination systems ($50k saved)
- Avoid bi-annual reservoir cleanings ($50k saved per year)
- Eliminated atmospheric/environmental contamination potential
- Astoria water system is safer!

ACKNOWLEDGEMENTS

- Ken Cook, Public Works Director
- Cindy Moore, P.E. Assistant City Engineer
- Ken Nelson, P.E. Public Works Superintendent

- Peter Kreft, P.E., MWH
- Denny Gerber, P.E., Subconsultant

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