MBTA

Groundwater Action Plan

Dr. Steve J. Poulos, P.E.

Topics to Cover

- **Groundwater System in Back Bay**
- **Description of MBTA's Interim Step**
- **Steps to select MBTA's Long Term Solution**

Groundwater System in Back Bay

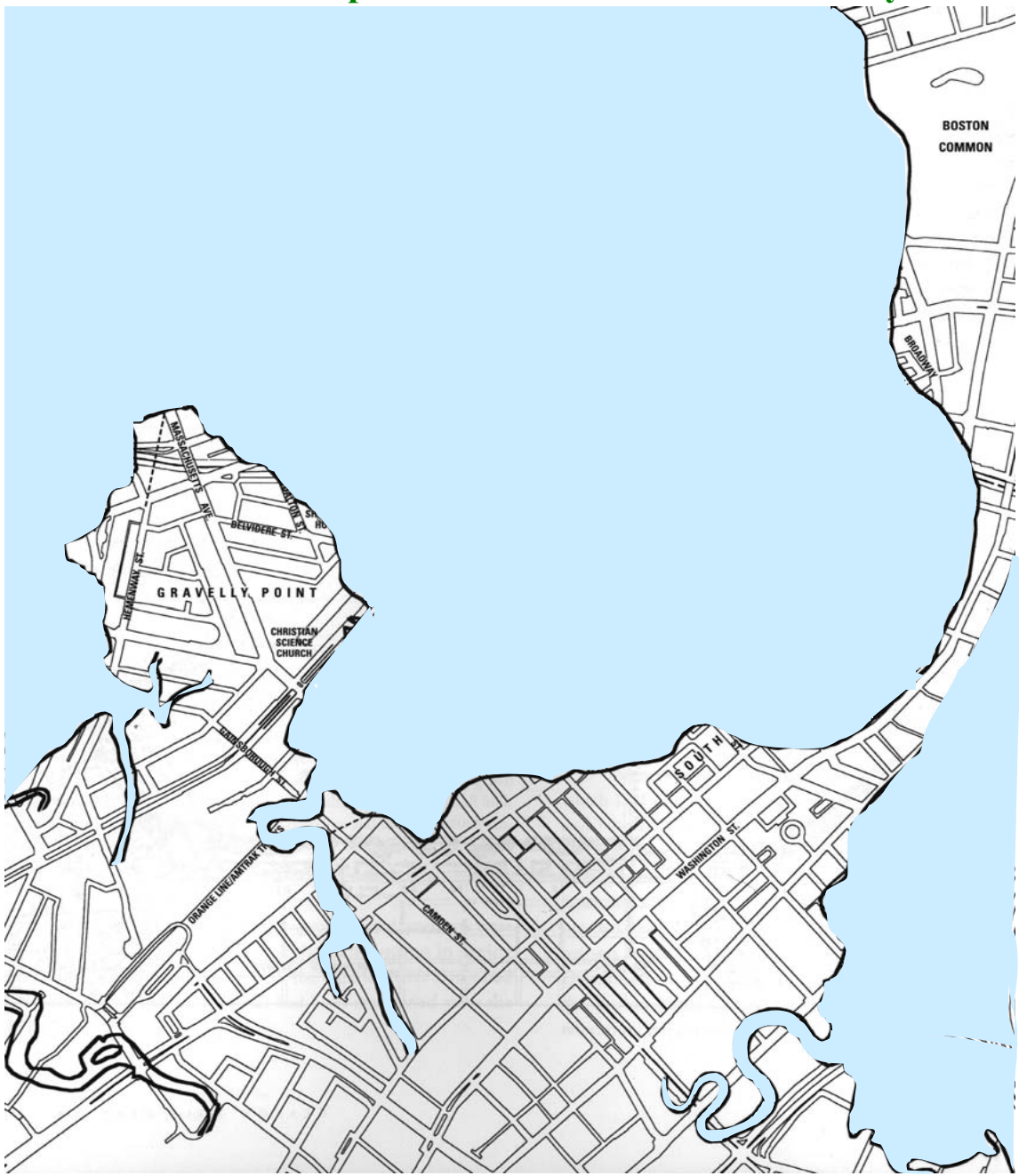
Groundwater in Back Bay/South End Fill

The groundwater in the Back Bay fill is, for the most part, contained within certain low-permeability boundaries that form the Back Bay. Addition or removal of groundwater in one location will affect wide areas within the fill to some degree.

1858 Photograph of Back Bay (from State House)

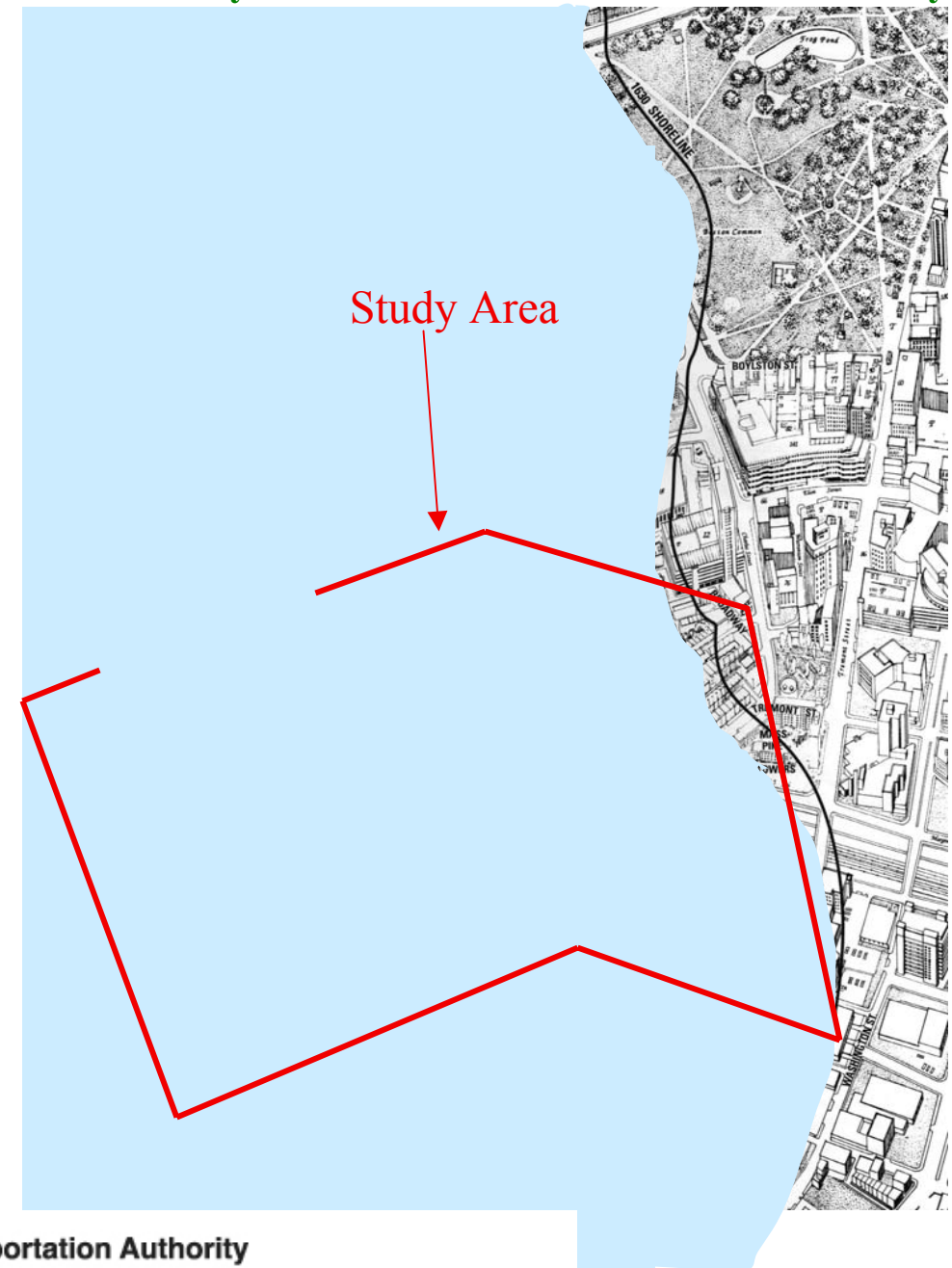
From *Gaining Ground* (2003), Figures 7.19 and 7.20

2001 Street Map with 1630 Shoreline of Back Bay



From *Gaining Ground* (2003), Figure 7.1

1992 Bird's Eye View with 1630 Shoreline of Back Bay



From *Gaining Ground* (2003), Figure 7.9 (Courtesy of Kane Maps)

Groundwater in Back Bay/South End Fill

- The infiltration of groundwater into the fill, if it were not covered with impervious or other low permeability surfaces, would average approximately 16 in./yr.
- This infiltration is equivalent to continuous inflow from rainfall of 500 gpm, on average, within the 600 acres bounded by Beacon Street (Mill Dam), Arlington Street, Washington Street and Massachusetts Avenue.

Groundwater in Back Bay/South End Fill

- If 500 gpm of infiltration were to occur with no removal, the groundwater level would be at the surface of the fill.
- Due to present surface cover, we estimate the infiltration to be 3-4 in./yr, on average, and that about 100 gpm to 125 gpm now enters the fill.
- As a result of the surface cover, we have lost about 375 gpm of infiltration into the groundwater.

Groundwater in Back Bay/South End Fill

Current sources of inflow to groundwater:

- Infiltration from rainfall
- Leaky water mains
- Leaky sewer pipes above El. 5 BCB
- Leakage from Charles River
- Existing recharge systems

Groundwater in Back Bay/South End Fill

Current causes of groundwater removal:

- Construction dewatering
- Leakage into deep sewer pipes
- Sump pumping from residences
- Sump pumping from deep basements
- Pumping for transportation corridors
- Flow into lower sand layer
- Loss of infiltration due to surface cover

Groundwater in Back Bay/South End Fill

- But the groundwater levels are below El. 5 BCB in some zones, and nearby untreated timber piles are exposed to decay.
- At each zone of low groundwater levels the balance between inflow and outflow is changed due to local groundwater removal.
- **At each location of low groundwater the causes, and therefore the methods used to solve the problem, both vary**.

Groundwater System in Back Bay/South End

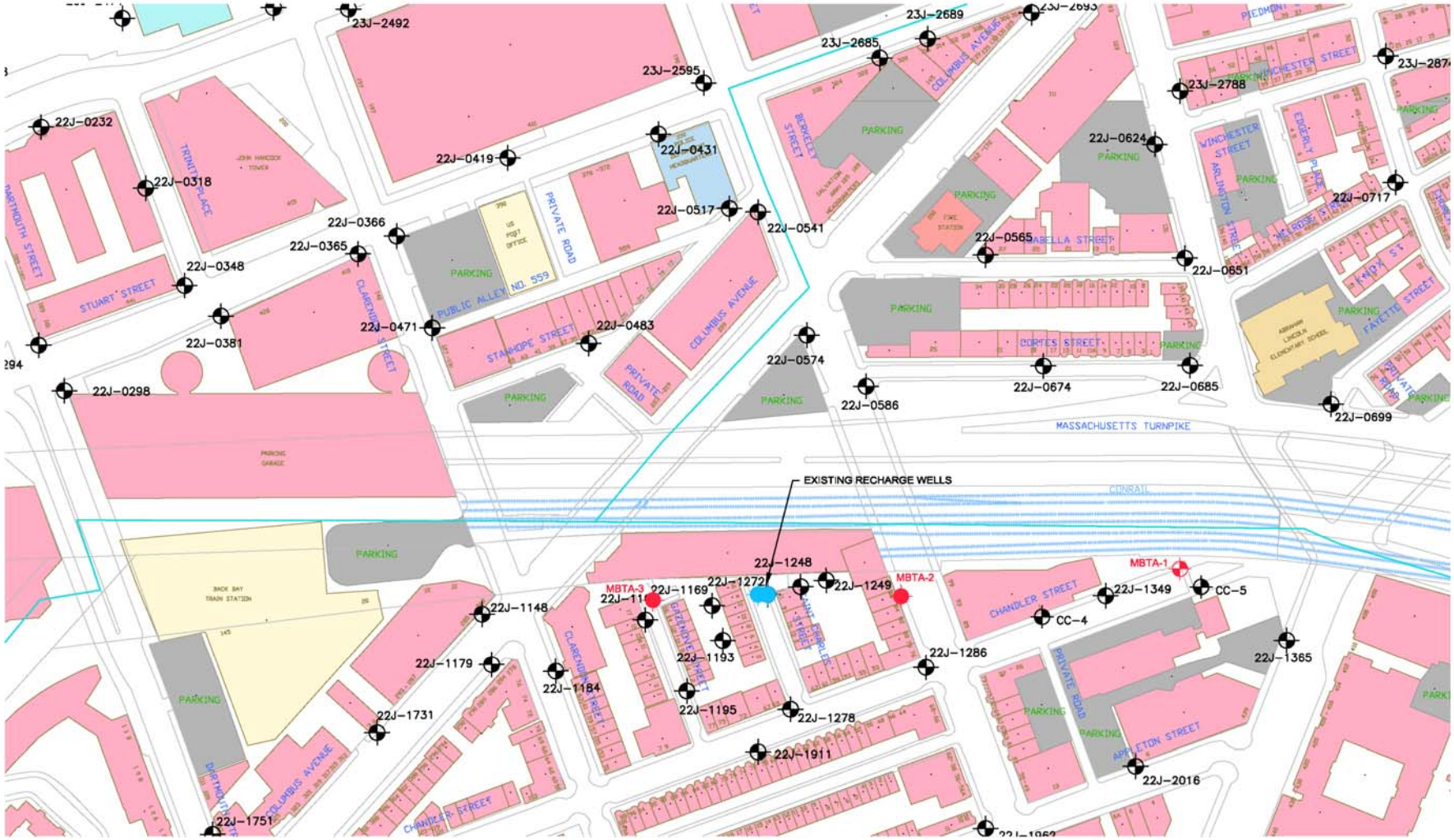
Questions?

Description of MBTA's Interim Step

Purposes of Interim Step

- To make an in-situ test of an interim recharge system using two **new** wells while continuing to recharge the two existing wells on St. Charles St.
- To **raise** groundwater levels nearby.
- To make measurements needed to design and estimate cost of a permanent groundwater mitigation system.
- To help identify nearby significant causes of groundwater lowering.

View of Interim Recharge System near Back Bay Station



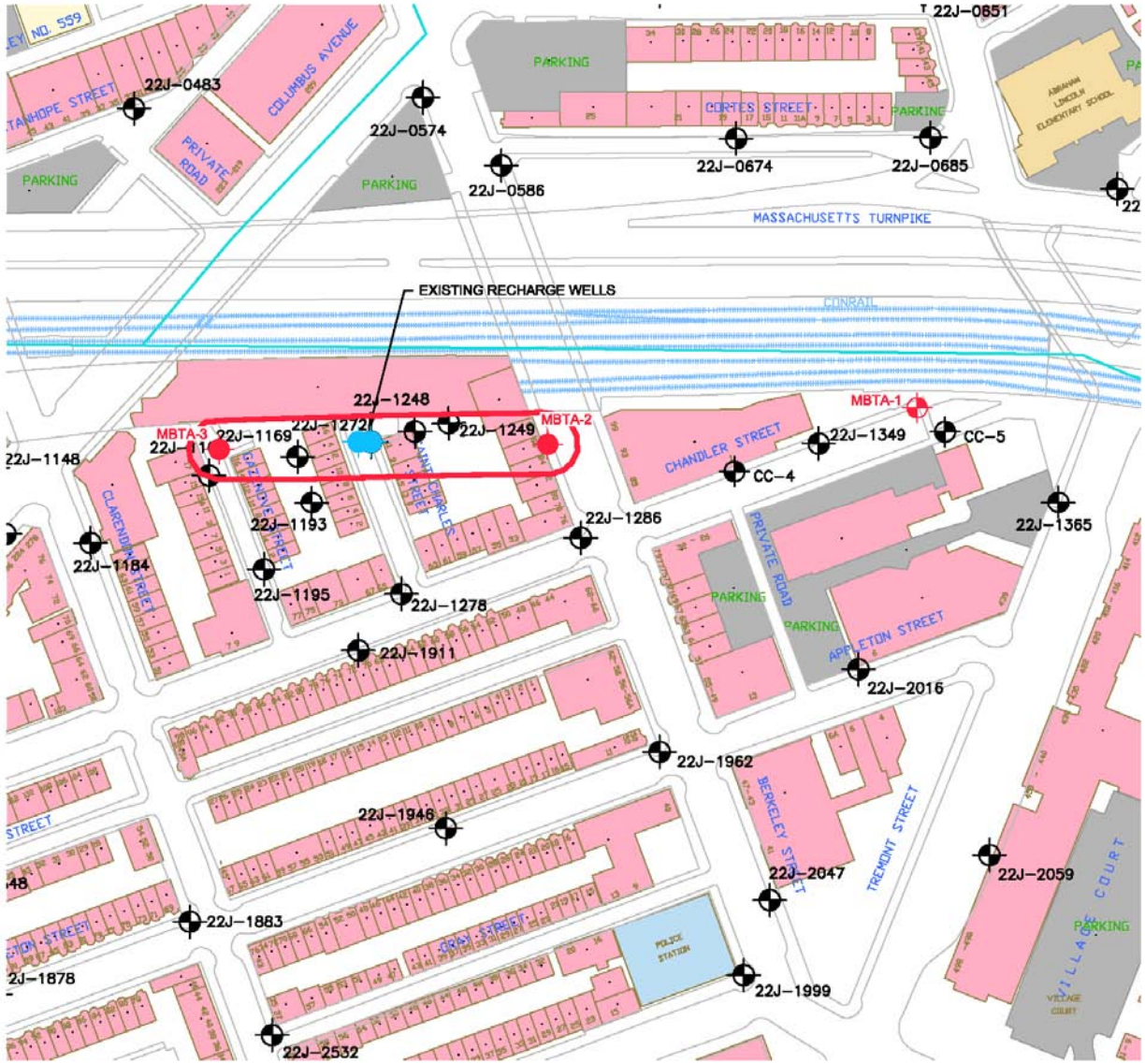
Details of Testing – 1 of 3

- Monitor selected existing observation wells weekly prior to starting new recharge.
- Install two new recharge wells, one at the north end of Cazenove St. and one on west side of Berkeley St. toward the tracks.
- Install one new observation well.
- Survey owners nearby to learn basement elevations and presence of sump pumps.

Survey of Owners

- Completed surveys will be collected tonight.
- Extra copies of the survey are at door.
- Staff are available to help you complete the surveys after this presentation.

Closer View of Interim Recharge System



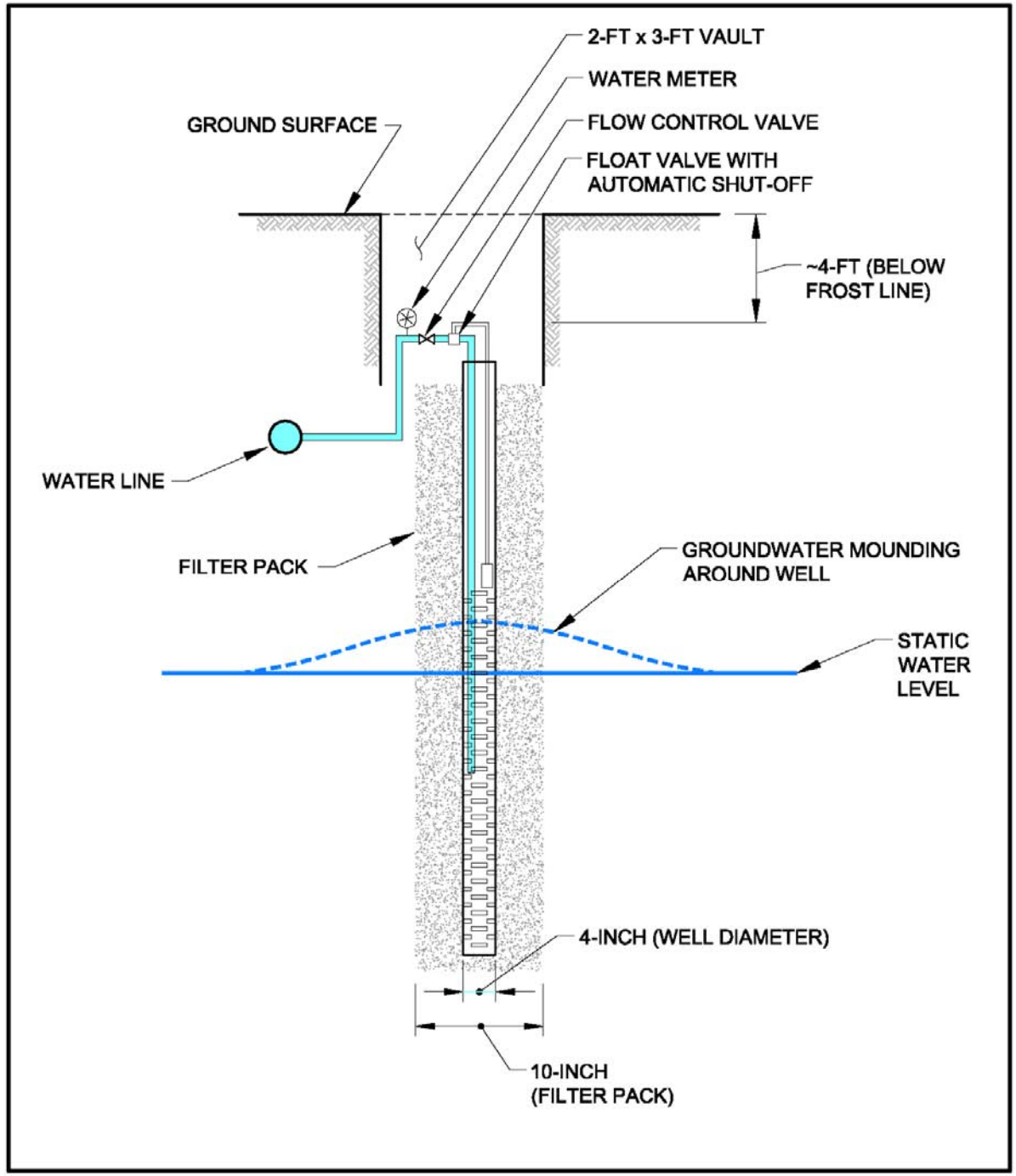
Massachusetts Bay Transportation Authority

Driven by Customer Service

GEI Consultants

Details of Testing – 2 of 3

- Recharge well on Cazenove St. at ~5 gpm using City water and monitor effect on groundwater levels.
- Estimate how much the flow rate can be increased without affecting low basements.
- Increase recharge rate accordingly.
- Measure effect of increased recharge rate on groundwater levels.
- Follow the same steps for the well on Berkeley St.


2-FT x 3-FT VAULT
WATER METER
FLOW CONTROL VALVE
FLOAT VALVE WITH
AUTOMATIC SHUT-OFF
GROUND SURFACE
~4-FT (BELOW
FROST LINE)
WATER LINE
FILTER PACK
GROUNDWATER MOUNDING
AROUND WELL
STATIC
WATER
LEVEL
4-INCH (WELL DIAMETER)
10-INCH
(FILTER PACK)

Details of Testing – 3 of 3

- After testing is complete, for the interim step, set the flow rates appropriately for continued recharging in the two new and two existing recharge wells.
- Continue groundwater level measurements and make adjustments as needed to keep the wells operational until a permanent solution is installed and operating – perhaps in three years.

Schedule
Interim Step

July to August 2006	Permitting for Monitoring Well
August 2006	Install Monitoring Well
July to September 2006	Permitting for Recharge Wells
November 2006	Install Recharge Wells
September 2006 to December 2006	Weekly Groundwater Measurements
December 2006 to December 2009	Monthly Groundwater Measurements

Solutions that could be Implemented now by Others

- Reduce pumping as much as practicable.
- Direct roof drains into recharge or dry wells.
- Repair leaks in deep sewers.
- Repair specific leaks if practicable.

Description of MBTA's Interim Step

Questions?

Steps to Select MBTA's Long Term Solution

Some Long Term Solutions for the MBTA

- Reduce pumping as much as practicable.
- Recharge into the fill any groundwater that is pumped to keep the tracks dry.
- Repair specific leaks if practicable.
- Install additional permanent recharge if needed.
- Install impervious walls below ground if needed.

Steps to be taken by MBTA to Select a Long Term Solution

- Preliminary evaluation of each option to eliminate those that are not feasible.
- Obtain necessary field data and carry out design analyses to evaluate remaining options.
- For the remaining options, prepare preliminary designs so that costs of construction and maintenance can be satisfactorily estimated.
- Select not more than three options for detailed evaluation.
- Select recommended option based on evaluation of advantages and disadvantages of each.

Steps being taken by MBTA to Select a Long Term Solution

- Review MBTA plans to understand where leakage may occur.
- Measure water flow in manholes within track drainage system.
- Measure water quality in manholes and at selected pumping stations.
- Use results of Interim Step recharging to obtain good estimate of permeability of fill and check against direct in-situ measurement in the new observation well.
- Use results of Interim Step to help find any local causes of groundwater removal and the estimated rates of removal.

Steps being taken by MBTA to Select a Long Term Solution

- Evaluate solutions applicable to mitigate or eliminate effect of groundwater pumping.

- Select a solution that is effective, is environmentally appropriate, and has acceptable initial and long-term costs.

Draft Schedule
Long Term Solution

Fall 2006 – Winter 2006	Evaluate, Recommend, Public Involvement
Winter 2006 – Spring 2007	Plan, Design, Public Involvement
Spring 2007 – Winter 2007	Bid, Permit, Public Involvement
Winter 2007 – Winter 2008	Construct, Public Involvement
Winter 2008 – Spring 2009	Observe, Monitor, Public Involvement
Spring 2009 – Winter 2009	Phase Out Interim Step, Public Involvement

Draft Schedule
Long Term Solution Recommendation

August 2006 – December 2006	Data Acquisition and Public Involvement
January 2007 – February 2007	Data Evaluation and Analysis, and Public Involvement
March 2007	Recommend Long Term Solution and Public Involvement

Steps to Select MBTA's Long Term Solution

Questions?