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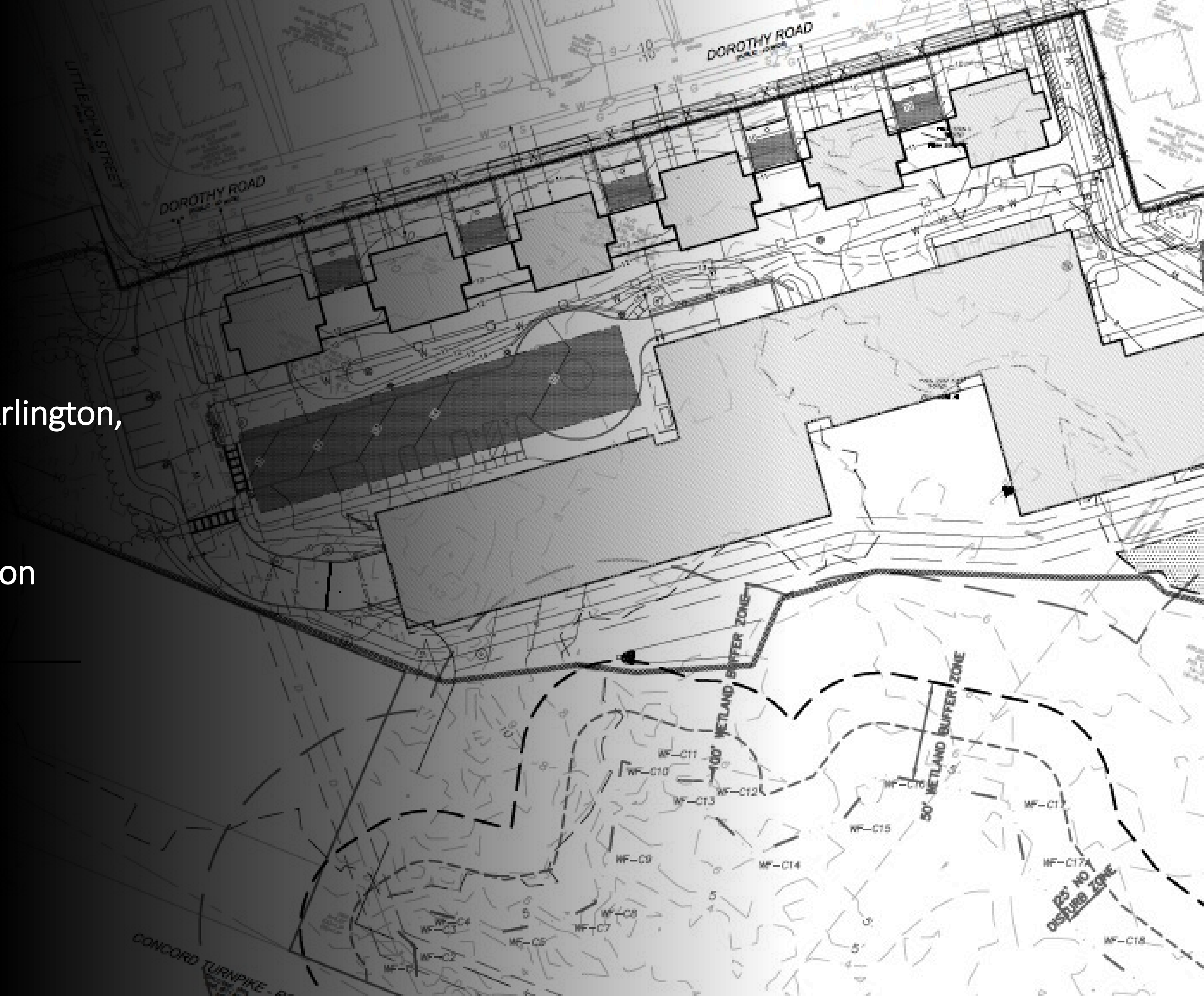
Arlington Land Trust

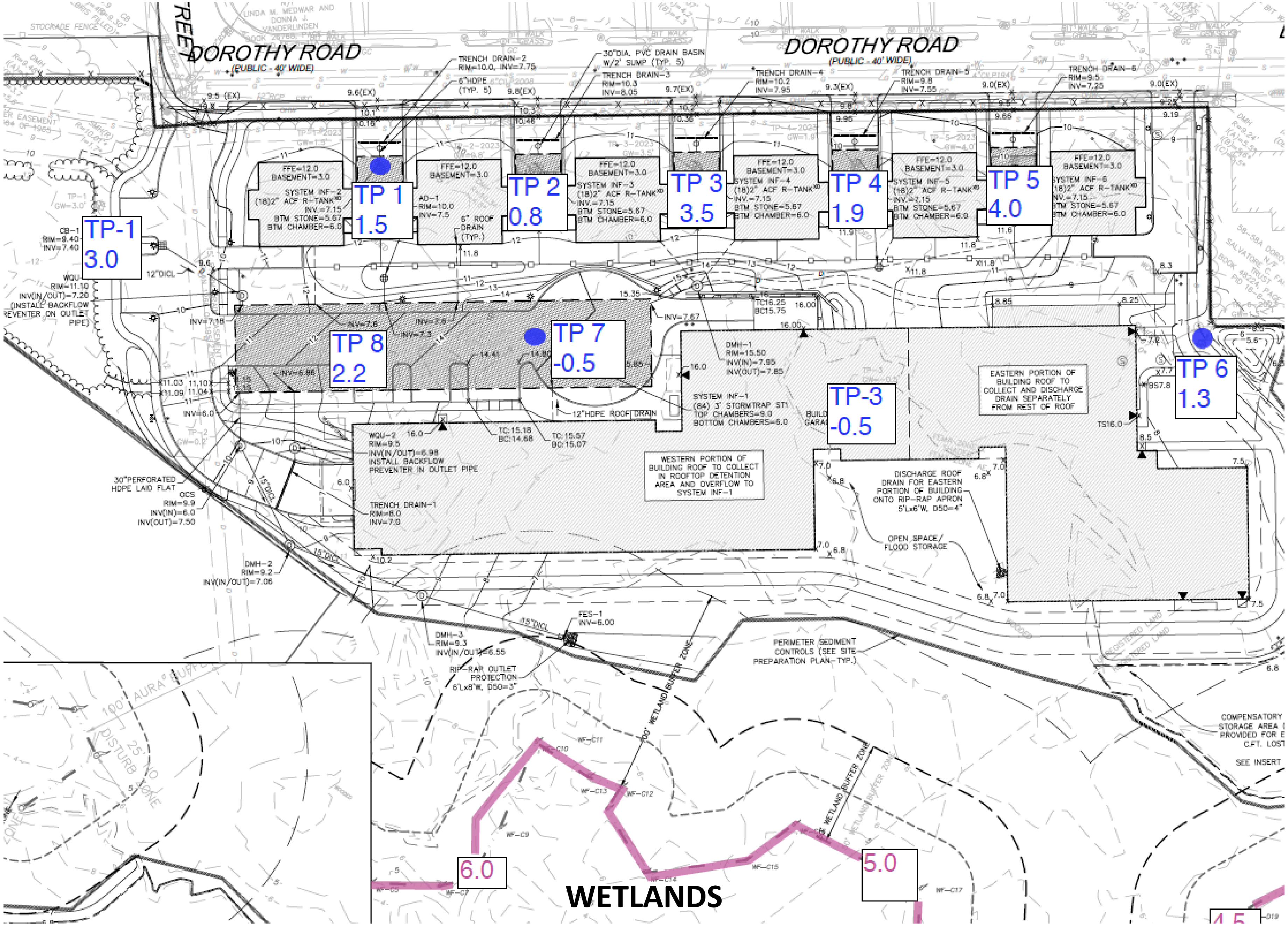
Peer Review of Thorndike Place Arlington, MA

Presentation to
Arlington Conservation Commission
February 1, 2024

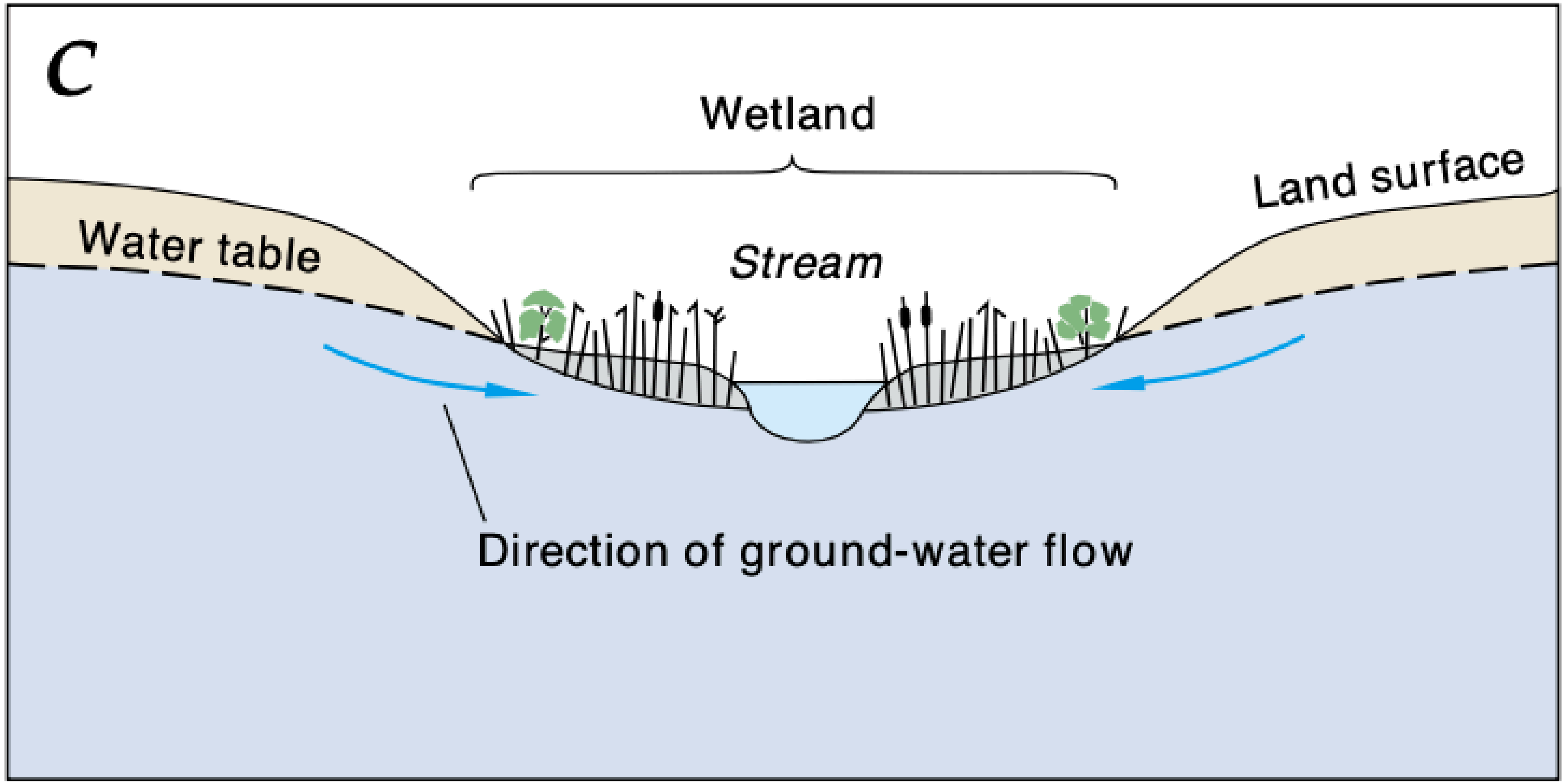


Scott Horsley • Qualifications

- 30+ years experience a water resources consultant to USEPA, The Nature Conservancy, MADEP, states, municipalities, non-profit organizations and industry
- Expert witness as hydrologist for U.S. Department of Justice (USDOJ) and USEPA in federal court, state courts and administrative hearings
- MADEP Stormwater Advisory Committee, Sustainable Water Management Initiative Committee, Title 5 Advisory Committee
- Teaches graduate level courses in water resources management at Tufts University and Harvard University



DOROTHY ROAD
(PUBLIC - 40' WIDE)
DOROTHY ROAD
(PUBLIC - 40' WIDE)
TP-1
3.0
TP 1
1.5
TP 2
0.8
TP 3
3.5
TP 4
1.9
TP 5
4.0
TP 6
1.3
TP 7
-0.5
TP 8
2.2
TP-3
-0.5
FFE=12.0
BASEMENT=3.0
WESTERN PORTION OF BUILDING ROOF TO COLLECT IN ROOFTOP DETENTION AREA AND OVERFLOW TO SYSTEM INF-1
EASTERN PORTION OF BUILDING ROOF TO COLLECT AND DISCHARGE DRAIN SEPARATELY FROM REST OF ROOF
DISCHARGE ROOF DRAIN FOR EASTERN PORTION OF BUILDING ONTO RIP-RAP APRON 5'Lx6'W, D50=4"
OPEN SPACE/ FLOOD STORAGE
PERIMETER SEDIMENT CONTROLS (SEE SITE PREPARATION PLAN-TYP.)
100' WETLAND BUFFER ZONE
6.0
5.0
WETLANDS

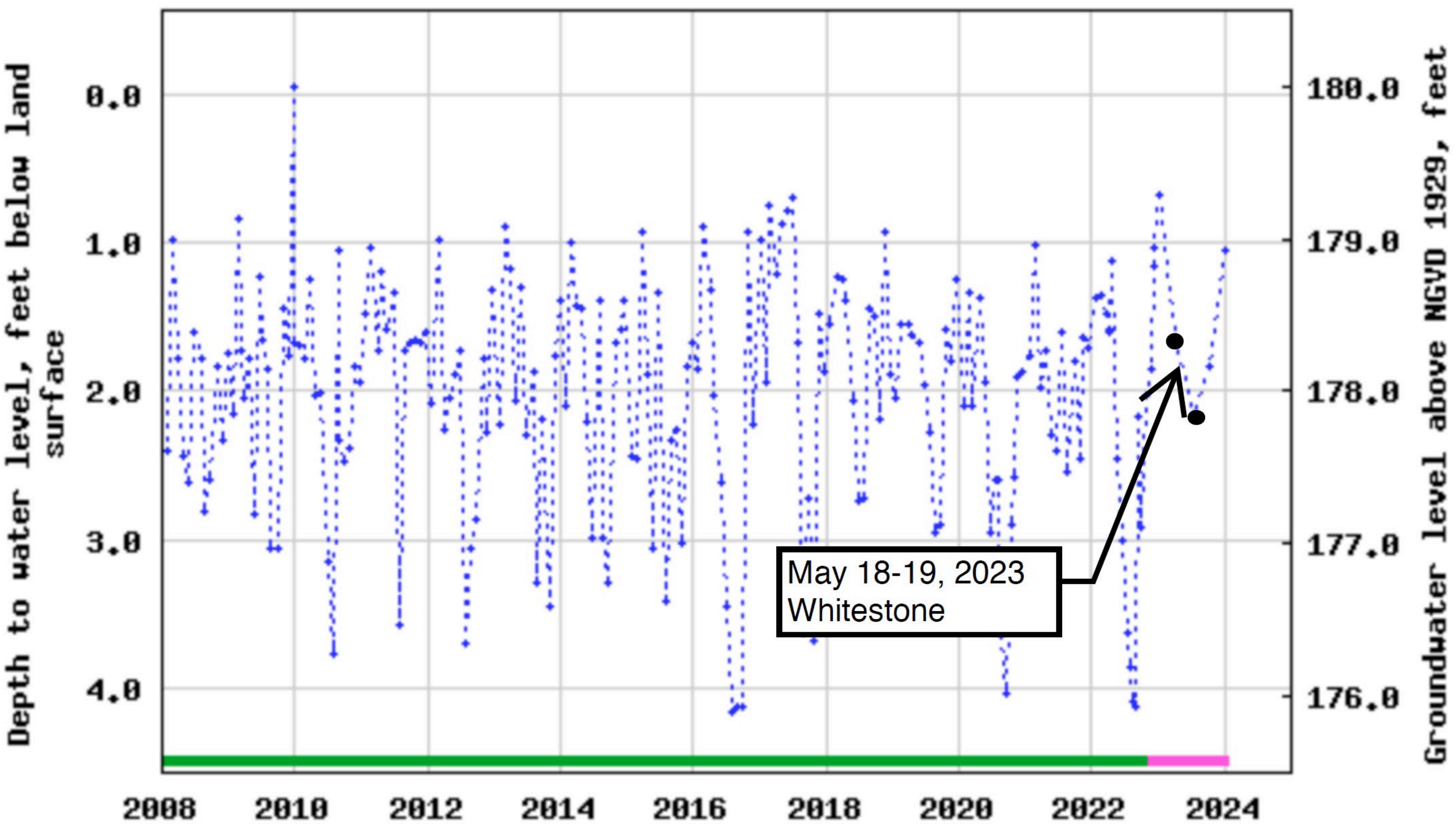


Source: United States Geological Survey (USGS)

Seasonal High Groundwater Levels

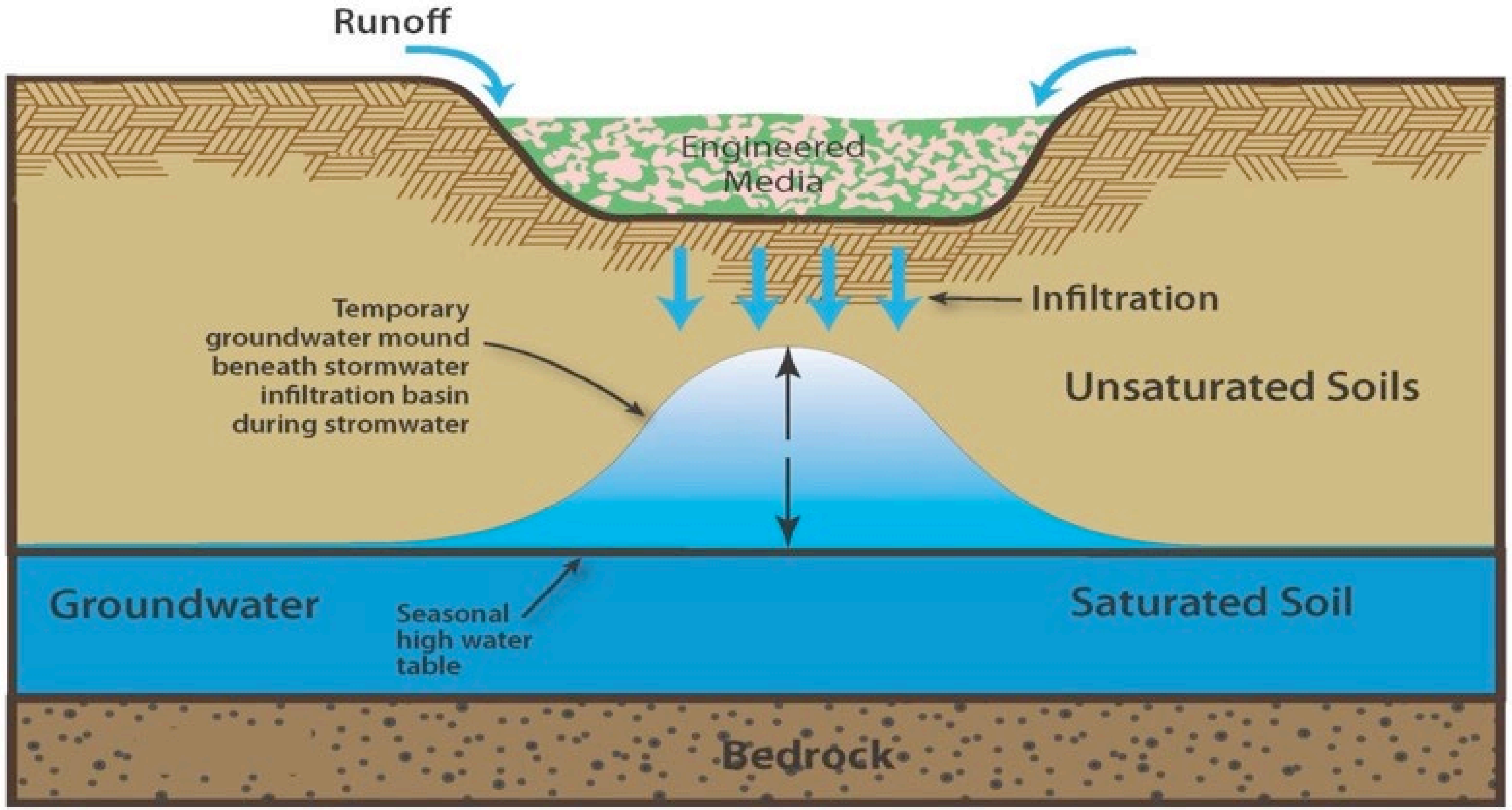
“Seasonal high groundwater represents the highest groundwater elevation. Depth to seasonal high groundwater may be iden4fied based on redox features in the soil (see Fletcher and Venneman listed in References). When redox features are not available, **installation of temporary push point wells or piezometers should be considered. Ideally, such wells should be monitored in the spring when groundwater is highest and results compared to nearby groundwater wells monitored by the USGS** to estimate whether regional groundwater is below normal, normal, or above normal (see: http://ma.water.usgs.gov)”.3

Reference: MADEP, Stormwater Handbook, Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards, page 12.



Reference: United States Geological Survey (USGS) Index Well Lexington 104

Groundwater Mounding



Required Recharge Volume

Rv = F x Impervious Area

Where:

Rv = Recharge Volume

F=Target Depth Factor associated with each Hydrologic Soil Group

(F=0.25-inch for Soil Type C)

Impervious Area = Proposed Pavement and Rooftop area on-site

$$Rv = \left(\frac{0.25in}{12}\right)(78{,}629sft) =$$

Rv = 1,638 cf (required recharge volume)

Existing recharge 1638 cf

As not all impervious surfaces are directed to an infiltration BMP, an adjusted Required Volume must be provided. The adjusted Required Volume (Rva) is calculated as:

$$Rva = \frac{Total\ Imp.Area}{Imp.Area\ to\ BMP}(Rv) =$$

$$Rva = \left(\frac{78{,}629sft}{62{,}920sft}\right)(1{,}638cf) =$$

$$Rva = 2{,}047\ cf$$

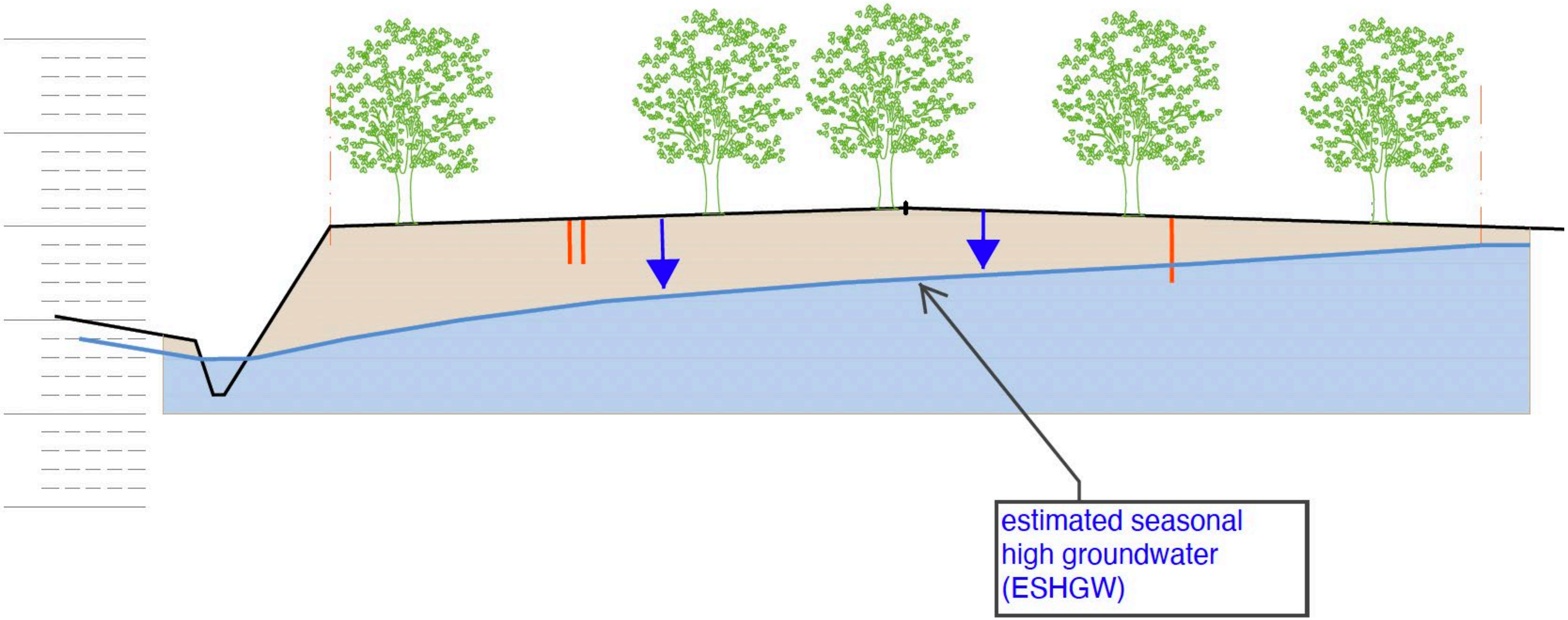
Proposed recharge 10,497 cf

An increase of more than 6 X

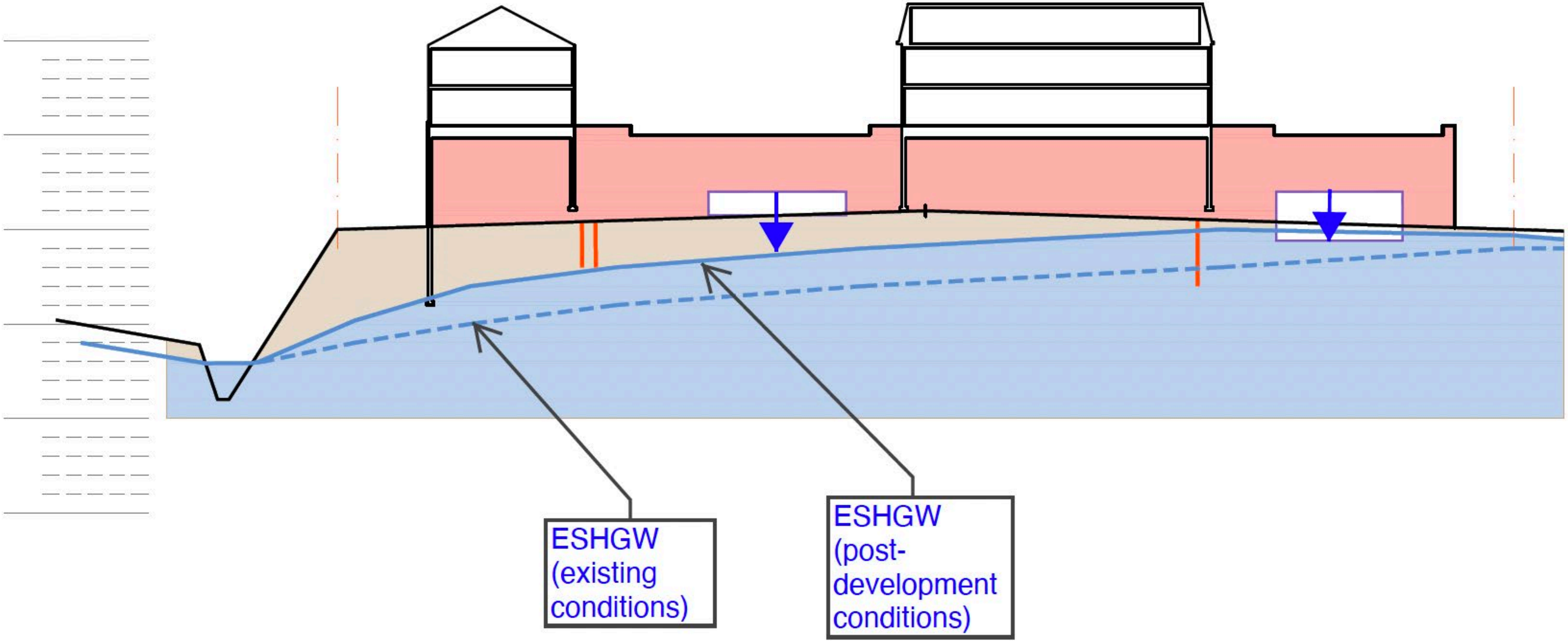
Storage Provided

- Underground Infiltration System = 10,497 cubic feet provided.
  Rain garden & duplex infiltration systems not required to meet volume, but provide additional infiltration above and beyond that required.
  Refer to the HydroCAD storage table provided for more information.

Existing Conditions
Recharge Rate = 17.5 inches/year

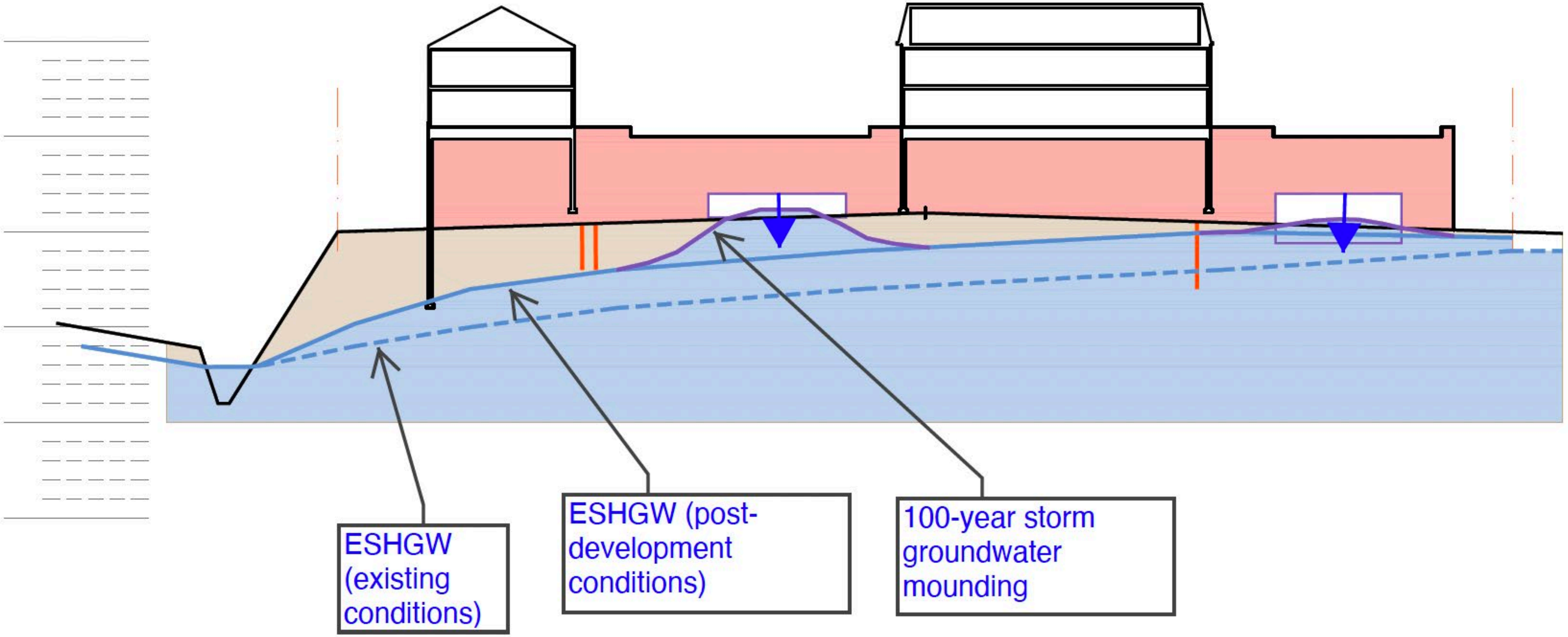


Post-Development Conditions
Recharge Rates (from impervious areas)= 38 inches/year



Post-Development Conditions

Recharge Rates (from impervious areas)= 38 inches/year + 100-year storm mounding



Pond 1P Mounding - Results

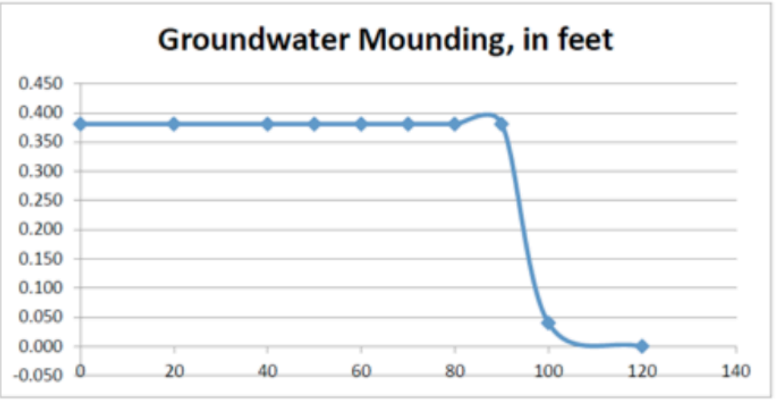
Input Values			inch/hour	feet/day
1.1430	R	Recharge (infiltration) rate (feet/day)	0.67	1.33
0.138	Sy	Specific yield, Sy (dimensionless, between 0 and 1)		
1.04	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00
98.420	x	1/2 length of basin (x direction, in feet)		
20.670	y	1/2 width of basin (y direction, in feet)	hours	days
0.046	t	duration of infiltration period (days)	36	1.50
5.000	hi(0)	initial thickness of saturated zone (feet)		

*In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

5.381	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.381	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.381	0
0.381	20
0.381	40
0.381	50
0.381	60
0.381	70
0.381	80
0.381	90
0.040	100
0.000	120

Re-Calculate Now



Disclaimer

Figure 3 – Hantush Model Results (Duration 0.46 Days - BSC, Stormwater Report, Revised September 2023)

use consistent units (e.g. feet & days or inches & hours) | Conversion Table

Input Values			inch/hour	feet/day	
1.0320	***R***	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.138	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
1.04	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the repo
98.420	x	1/2 length of basin (x direction, in feet)			SIR 2010-5
20.670	y	1/2 width of basin (y direction, in feet)	hours	days	assumed t
2.230	t	duration of infiltration period (days)	36	1.50	conductivit
5.000	hi(0)	initial thickness of saturated zone (feet)			

19.289	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
14.289	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
14.289	0
14.289	20
14.286	40
14.271	50
14.204	60
13.964	70
13.244	80
11.351	90
6.498	100
0.247	120

Re-Calculate Now

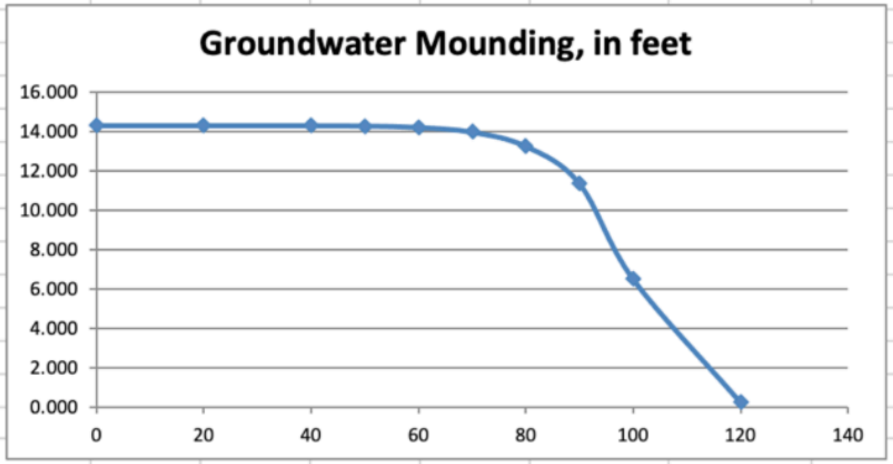


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Figure 4 – Hantush Model Results (Duration 2.23 Days)

Input Values			inch/hour	feet/day	
0.0320	*R*	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.138	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
1.04	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the repo
98.420	x	1/2 length of basin (x direction, in feet)			SIR 2010-5
20.670	y	1/2 width of basin (y direction, in feet)	hours	days	assumed tc
365.000	t	duration of infiltration period (days)	36	1.50	conductivit
5.000	hi(0)	initial thickness of saturated zone (feet)			

12.750	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
7.750	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
7.750	0
7.606	30
7.127	60
6.095	90
4.450	120
3.245	150
2.338	180
1.646	210
1.130	240
0.758	270

Re-Calculate Now

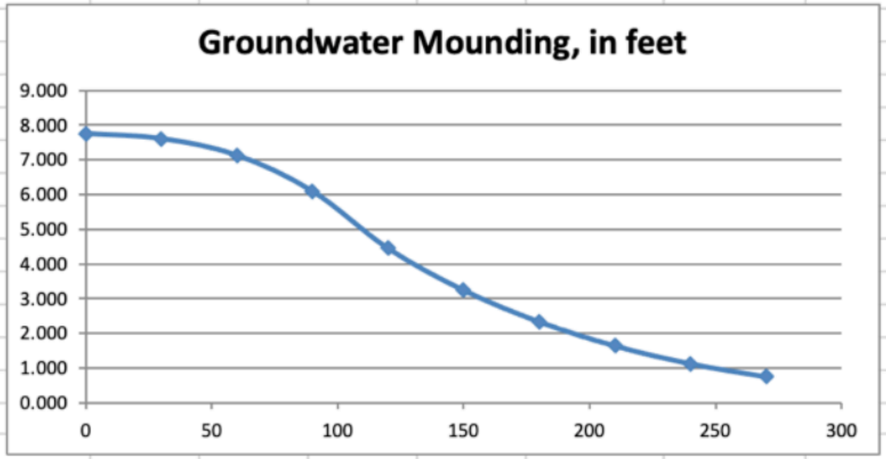

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Figure 5 – Hantush Model Results – Long-Term (Steady State Conditions)

Recommendations:

1. Install monitoring wells within footprints of proposed infiltration structures.

2. Install pressure transducers and continuously measure groundwater levels throughout spring months.

3. Conduct groundwater model to simulate post-development conditions including both long-term, steady-state conditions and design storms (10, 25, and 100-year).