Vermont Clean Water Board Meeting Minutes

Date/Time: Tuesday, December 5, 2023, 2:30-4:00 pm

Virtual Option to Attend: Microsoft Teams Meeting

Physical Location to Attend In-Person: Agency of Natural Resources, One National Life Drive, Montpelier, VT 05620-3510 in the Catamount Room (Davis Building, 2nd Floor, Room D215).

Meeting details, materials, and recordings available at: https://dec.vermont.gov/water-investment/cwi/board/meetings

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Clean Water Board Members/Designees:
Douglas Farnham, Agency of Administration (AoA) Chief Recovery Officer and Designated Clean Water Board Chair (Present)
Tayt Brooks, Agency of Commerce and Community Development (ACCD) Deputy Secretary (Present)
Alison Conant, public member (Present)
Bob Flint, public member (Present)
Joe Flynn, Agency of Transportation (VTrans) Secretary (Absent)
Julie Moore, Agency of Natural Resources (ANR) Secretary (Present)
Jim Giffin, public member (Present)
Anson Tebbetts, Agency of Agriculture, Food and Markets (AAFM) Secretary (Absent)
Chad Tyler, public member (Present)

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1. Welcome **Recording Time Stamp 00:00**[1]
Douglas Farnham, Agency of Administration Chief Recovery Officer and Clean Water Board Chair
- Welcome and review of agenda
- Review of meeting minutes for October 9 and November 2 meetings, and Clean Water Operating Statement from September 15. No comments from the Board and materials were adopted through consent.

2. Review summary of public comment on draft SFY 2025 Clean Water Budget **Recording Time Stamp 1:40**
Staff from the Dept. of Environmental Conservation Clean Water Initiative Program
- Colleen Miller provided an overview of the public comment process and related outreach.
- Gianna Petito provided an overview of the Agency of Natural Resources' (ANR) approach to developing the Public Comment Responsiveness Summary and then walked through each public comment category and a suggested response for Board consideration. No edits were proposed.

3. Board discussion on draft SFY 2025 Clean Water Budget **Recording Time Stamp 25:15**
All, led by Douglas Farnham
- The Clean Water Board focused on the request for increased funding for Line 1.2 Basin Planning, Basin Water Quality Council Participation, Education and Outreach.
  a. Chad Tyler, public member of the Board, commented that he thinks this funding change is fair if it becomes part of base funding.
  b. ANR Secretary Moore said she thought this change threads the needle well. There is increased work but also state agencies have pressure on their budgets and it balances those two competing financial dynamics. She said the Board can take it up again next year if concerns remain.

[1] Please refer to the available meeting recording to learn more about discussion content under each agenda item. Recording Time Stamps are highlighted to direct focus on the recording. Recording can be directly accessed here: https://www.youtube.com/watch?v=0ZpG9-RoVjs&t

c. Emily Bird, Clean Water Initiative Program Manager, shared that there is roughly $1 million of clean water workforce capacity development rolling out this year. It is complementary to basin planning funds in terms of being responsive to their needs.
d. Chair Farnham said he supported retuning to this next year and agreed that inflationary pressure has been unstable.

- Board discussed the Legislature's request, via Act 69 of 2023, for the Board to make a recommendation on alternative funding sources for municipal pollution control grants outside of the Capital Bill. Board members indicated strong support to continue to fund municipal pollution control grants out of the Capital Bill given their fit as an eligible use of Capital dollars and the state's reliance on a Capital Bill contribution in the realm of $10-12 million annually to meet Clean Water Initiative funding statutory obligations under 10 V.S.A. § 1387.
  a. Chair Farnham suggested that even $10-12 million per year may be too low in the long term if the entire Clean Water Initiative funding target must be adjusted for inflation.
  b. Secretary Moore asked for this conclusion to be documented somewhere for the Legislature. Chair Farnham identified the paperwork that accompanies the Capital Bill Budget Adjustment Act as a suitable home. ANR staff will provide language to support this.

- Chair Farnham invited the Board to discuss any other items in the proposed SFY2025 Clean Water Budget
  a. Jim Giffin, public member of the Board, asked if the Board had any estimates on flood damages and how the summer flooding may have impacted the state's progress towards the Lake Champlain TMDL. Emily Bird indicated that the Clean Water Initiative Program will host a Clean Water Conversation in January highlighting the research and findings from the Lake Champlain Basin Program on this matter. Emily will share the event details with the Clean Water Board once scheduled. Chair Farnham and Secretary Moore also discussed some of the state's strategies for funding recovery efforts.
  b. Bob Flint and Chad Tyler, public members of the Board, both expressed concern about the public comment period participation levels. Bob encouraged making the materials and content more relatable and Chad suggested improved reach.
  c. Chad Tyler, public member of the Board, asked for more clarification about how the volume of funding in the system may have lowered public comment participation. Other Board members and DEC staff explained the unprecedented funding levels and the impact on capacity it has had on typical partners to engage with budgeting processes. Chad indicated, conversely, he wasn't confident the Board was meeting it's $50-60 million funding target. Emily Bird acknowledged that target may need to increase given inflation and also reminded the Board that this target is not necessarily the target size for the Clean Water Budget but for all statewide investments in Clean Water.

4. Public comment **Recording Time Stamp 57:20**
Led by Douglas Farnham

- Ernie Englehart– Thanked the Board for its support. He shared photos of blue-green algae in Lake Carmi and requested that the Clean Water Board continue to support lake Carmi through restoration efforts.
- James Maroney – Read from submitted written comment regarding conventional agriculture and its impacts on clean water.
- Sylvia Knight – Thanked the Board for a detailed discussion. She offered thoughts from her experience working in pesticides and encouraged the Board to reexamine principles and assumptions affecting our relationship with water.
- Peter Benevento – Shared details on Lake Carmi algae blooms. He requested full funding for treatment of the lake and a resolution to permitting obstacles.

- Chair Farnham shared that the Board has narrow purposes and authority to affect the larger environment. He said that he appreciated the comments and encouraged the public to connect directly with their legislative representatives.

5. Adoption of the SFY 2025 Clean Water Budget for recommendation to Governor Scott
Recording Time Stamp 1:17:50

Douglas Farnham

- Secretary Moore made a motion to approve adoption of SFY 2025 Clean Water Budget recommendation as proposed. Tayt Brooks, Agency of Commerce and Community Development Deputy Secretary seconded. Motion passed.

6. Other business, determine next steps, closing remarks **Recording Time Stamp 1:18:59**

Douglas Farnham and Emily Bird

- Emily Bird provided some information to the Clean Water Board about the Clean Water Performance Report, the agenda for the February Clean Water Board meeting and next steps. She also noted that some public Board members' terms expire in February 2024.

7. Adjourn **Recording Time Stamp 1:23:00**

FINAL STATE FISCAL YEAR 2025 (SFY25) CLEAN WATER BUDGET RECOMMENDATION

Recommended by the Clean Water Board on (12/5/2023) and Recommended by the Governor on (01/23/2024)

			SFY25 BASE FUNDS					SFY25 ONE-TIME FUNDS					
No.	**Agency**	**Activity**	**Clean Water Fund**	**Capital Bill (SFY25 Capital Budget Target = $6m)[1]**	**Filling the $4m Base Gap from SFY25 Capital Bill with Clean Water Fund Unallocated/ Unreserved**	**Subtotal Base Funds**	**SFY25 Compared to SFY24 Base Funds**	**Clean Water Fund Prior Year Unallocated/ Unreserved**	**American Rescue Plan Act (ARPA)[2]**	**Subtotal One-Time Funds**	**SFY25 Compared to SFY24 One-Time Funds**	**Total SFY25 (Base + One-Time)**	**SFY25 Total Compared to SFY24 Total**
Clean Water Budget Statutory Priority Tier 1 (Items of Equal Priority)													
1.1	ANR-DEC (CWIP)	Water Quality Restoration Formula Grants to Clean Water Service Providers & O&M	7,210,000			**7,210,000**	-	1,150,000		**1,150,000**	-	**8,360,000**	-
1.2	ANR-DEC (CWIP)	Basin Planning, Basin Water Quality Council Participation, Education, and Outreach	750,000			**750,000**	100,000			-	-	**750,000**	100,000
1.3	*Water Quality Enhancement Grants*												
1.31	ANR-DEC (CWIP)	Statewide Non-regulatory Clean Water Projects	5,000,000			**5,000,000**	-			-	-	**5,000,000**	-
1.32	VHCB	Land Conservation and Water Quality Projects			2,000,000	**2,000,000**	-			-	-	**2,000,000**	-
1.4	AAFM	Water Quality Grants to Partners and Farmers	6,696,887	550,000	1,200,000	**8,446,887**	426,238	213,113		**213,113**	(2,786,887)	**8,660,000**	(2,360,649)
1.5	*Agency and Partner Operating Support*												
1.51	AAFM	Program Support	900,000			**900,000**	33,750			-	-	**900,000**	33,750
1.52	ANR-DEC (CWIP)	Program and Partner Support	930,000			**930,000**	(23,750)	700,000		**700,000**	298,750	**1,630,000**	275,000
Tier 1 SUBTOTAL			**21,486,887**	**550,000**	**3,200,000**	**25,236,887**	**536,238**	**2,063,113**	**-**	**2,063,113**	**(2,488,137)**	**27,300,000**	**(1,951,899)**
Tier 1 % of Total			**83%**	**9%**	**80%**	**71%**		**54%**		**54%**		**69%**	
Clean Water Budget Statutory Priority Tier 2 (Items of Equal Priority)													
2.1	*Outreach and Implementation of Forestry Acceptable Management Practices for Maintaining Water Quality*												
2.11	ANR-FPR	Forestry Water Quality Practices and Portable Skidder Bridges	144,000			**144,000**	387			-	-	**144,000**	387
2.12	ANR-FPR	Implement BMPs at State Forests, Parks, and Recreational Access Roads		550,000		**550,000**	-			-	-	**550,000**	-
2.2	*Municipal Stormwater Implementation*												
2.21	VTrans	Municipal Roads Grants-in-Aid (MRGP)	3,000,000			**3,000,000**	-			-	-	**3,000,000**	-
2.22	VTrans	Municipal Better Roads (MRGP)	1,000,000			**1,000,000**	-	1,000,000		**1,000,000**	1,000,000	**2,000,000**	1,000,000
2.23	VTrans	Missisquoi Bay Federal Earmark (Non-Federal Match)[3]				-	-			-	(1,000,000)	-	(1,000,000)
2.24	ANR-DEC (CWIP)	Municipal Three-Acre General Permit and MS4[4]				-	(1,000,000)			-	(7,000,000)	-	(8,000,000)
2.3	VHCB	Water Quality Farm Improvement and Retirement Projects			800,000	**800,000**	-			-	-	**800,000**	-
2.4	ANR-DEC (CWIP)	Innovative or Alternative Technologies or Practices to Improve Water Quality				-	-	750,000		**750,000**	550,000	**750,000**	550,000
Tier 2 SUBTOTAL			**4,144,000**	**550,000**	**800,000**	**5,494,000**	**(999,613)**	**1,750,000**	**-**	**1,750,000**	**(6,450,000)**	**7,244,000**	**(7,449,613)**
Tier 2 % of Total			**16%**	**9%**	**20%**	**15%**		**46%**		**46%**		**18%**	
Clean Water Budget Statutory Priority Tier 3													
3.1	ANR-DEC (WIFP)	Developed Lands Implementation Grants[5]				-	-			-	-	-	-
Tier 3 SUBTOTAL			-	-	-	-	-	-	-	-	-	-	-
Tier 3 % of Total			**0%**	**0%**	**0%**	**0%**		**0%**		**0%**		**0%**	
Clean Water Budget Other Priorities													
4.1	ANR-DEC (Lakes)	Lakes in Crisis Fund	120,000			**120,000**	-			-	-	**120,000**	-
4.2	AoA	Stormwater Utility Payments ($25K each)	25,000			**25,000**	25,000			-	(100,000)	**25,000**	(75,000)
4.3	ACCD	Better Connections and Downtown Transportation Fund				-	-	-		-	-	-	-
	Capital Bill Priorities										-		
4.4	ANR-DEC (WIFP)	State Match to Clean Water State Revolving Fund (CWSRF) Federal Grant[6]		1,600,000		**1,600,000**	1,267,019			-	-	**1,600,000**	1,267,019
4.5	ANR-DEC (WIFP)	Municipal Pollution Control Grants		3,300,000		**3,300,000**	(700,000)	-		-	-	**3,300,000**	(700,000)
Other SUBTOTAL			**145,000**	**4,900,000**	**-**	**5,045,000**	**592,019**	**-**	**-**	**-**	**(100,000)**	**5,045,000**	**492,019**
Other % of Total			**0.6%**	**82%**	**0%**	**14%**		**0%**		**0%**		**13%**	
		Total Proposed for Appropriation[7]	**25,775,887**	**6,000,000**	**4,000,000**	**35,775,887**	**128,644**	**3,813,113**	**-**	**3,813,113**	**(9,038,137)**	**39,589,000**	**(8,909,493)**
		Anticipated SFY25 Revenue/Sources	25,495,887	6,000,000		**31,495,887**			-	-		**31,495,887**	
		Estimated Unallocated/Unreserved Clean Water Fund Revenue	280,000		4,000,000	**4,280,000**		4,161,669		**4,161,669**		**8,441,669**	
		Anticipated Total Available[8]	25,775,887	6,000,000	4,000,000	**35,775,887**		4,161,669	-	**4,161,669**		**39,937,556**	
		Balance=Total Available-Total Requested	-	-	-	-		348,556	-	**348,556**		**348,556**	

Final SFY 2025 Clean Water Budget Recommendation by Agency

	SFY25 BASE FUNDS					SFY25 ONE-TIME FUNDS					
Agency	**Clean Water Fund**	**Capital Bill (SFY25 Capital Budget Target = $6m)[1]**	**Filling the $4m Base Gap from SFY25 Capital Bill with Clean Water Fund Prior Year Unallocated/ Unreserved**	**Subtotal Base Funds**	**SFY25 Base Compared to SFY24 Base**	**Clean Water Fund Prior Year Unallocated/ Unreserved**	**American Rescue Plan Act (ARPA)[2]**	**Subtotal One-Time Funds**	**SFY25 Compared to SFY24 One-Time Funds**	**Total SFY25 (Base + One-Time)**	**SFY25 Total Compared to SFY24 Total**
AAFM	7,596,887	550,000	1,200,000	**9,346,887**	459,988	213,113	-	**213,113**	**(2,786,887)**	**9,560,000**	(2,326,899)
ACCD	-	-	-	-	-	-	-	-	-	-	-
ANR (DEC)	14,010,000	4,900,000	-	**18,910,000**	(356,731)	2,600,000	-	**2,600,000**	**(6,151,250)**	**21,510,000**	(6,507,981)
ANR (FPR)	144,000	550,000	-	**694,000**	387	-	-	-	-	**694,000**	387
AoA	25,000	-	-	**25,000**	25,000	-	-	-	**(100,000)**	**25,000**	(75,000)
VHCB	-	-	2,800,000	**2,800,000**	-	-	-	-	-	**2,800,000**	-
VTrans	4,000,000	-	-	**4,000,000**	-	1,000,000	-	**1,000,000**	-	**5,000,000**	-
Total Proposed for Appropriation[7]	**25,775,887**	**6,000,000**	**4,000,000**	**35,775,887**	**128,644**	**3,813,113**	**-**	**3,813,113**	**(9,038,137)**	**39,589,000**	**(8,909,493)**

Footnotes:

[1] - The Capital Bill operates on a biennial basis, with the 2023 Capital Bill covering SFY24-25. The Capital Bill "as passed" (Act 69 of 2023) reduced the SFY25 total for allocation by the Clean Water Board in the SFY25 Clean Water Budget from the roughly $10-12 million target to $6 million.

[2] - The State of Vermont Legislature appropriated American Rescue Plan Act (ARPA) funds to be recommended for allocation by the Clean Water Board in SFY22, SFY23, and SFY24. ARPA funds are no longer available in SFY25. The ARPA column is included in this SFY25 Clean Water Budget sheet for purposes of comparison to the SFY24 Clean Water Budget.

[3] - The "Missisquoi Bay Federal Earmark (Non-Federal Match)" line item was a one-time expense in SFY24 and is not needed to continue in SFY25. It is included here for purposes of comparison between SFY24 and SFY25. See SFY24 Clean Water Budget materials for more information.

[4] - The "Municipal Three-Acre General Permit and MS4" line item was primarily funded with American Rescue Plan Act (ARPA) dollars, no longer available in SFY25, but will be encumbered/expended through December 2026. In SFY25, activities previously supported by this line item will transition to a combination of Lake Champlain Basin Program federal funding and CWSRF financing.

[5] - Three-Acre General Permit projects, which are the focus of the "Developed Lands Implementation Grants" line item, were primarily funded with American Rescue Plan Act (ARPA) dollars. ARPA dollars are no longer available for budgeting in SFY25, but will be encumbered/expended through December 2026. Three-Acre General Permit projects will eventually transition to a financing structure.

[6] - The SFY24 Appropriations Bill as enacted (Act 78 of 2023) established a "Cash Fund for Capital and Essential Investments" to cover required state match to secure Bipartisan Infrastructure Law (BIL) resources through the Clean Water State Revolving Fund (CWSRF). In SFY25, $2.208 million in match has been authorized by the General Assembly under the SFY25 Capital Bill from the Cash Fund to draw down BIL CWSRF resources.

[7] - The SFY24 Clean Water Budget total amount proposed for *appropriation* was $48,498,493, shown here for purposes of comparison between SFY24 and SFY25 Clean Water Budgets. In addition to the total proposed for *appropriation*, $2 million were *transferred* in the SFY24 Clean Water Budget to the Clean Water Fund Contingency Risk Reserve. Total SFY24 Clean Water Budget *appropriations and transfers* was $50,498,493.

[8] - Projected SFY25 Clean Water Fund revenue are based on the consensus revenue forecast adopted by the Vermont Emergency Board at its January 2024 meeting, summarized in the February 2024 Clean Water Fund operating statement. Unallocated/unreserved Clean Water Fund revenue are determined based on the difference between total revenue and total appropriations based on updated current year revenue forecast also adopted by the Vermont Emergency Board at its January 2024 meeting, and summarized in the February 2024 Clean Water Fund operating statement

Total SFY24 and SFY25 Clean Water Budget Appropriations

Funding Source	**SFY24**	**SFY25**	**SFY25 Compared to SFY24**
Clean Water Fund Revenue	25,762,243	25,775,887	13,644
Capital Bill	9,885,000	6,000,000	(3,885,000)
Clean Water Fund Revenue - Unallocated/Unreserved	-	4,000,000	4,000,000
Base Appropriation Subtotal	**35,647,243**	**35,775,887**	**128,644**
ARPA	10,000,000	-	(10,000,000)
Clean Water Fund Revenue - Unallocated/Unreserved	2,851,250	3,813,113	961,863
One-Time Appropriation Subtotal	**12,851,250**	**3,813,113**	**(9,038,137)**
Total Appropriation	**48,498,493**	**39,589,000**	**(8,909,493)**

Clean Water Fund Operating Statement - Appropriation Basis - February 2024

		Actual	Jan 2023 Rev. Update / Gov Rec. Budget	July 2023 Rev. Update / As Passed Budget	Jan 2024 Rev. Update	Jan 2023 Rev. Update	July 2023 Rev. Update / Draft Budget	Jan 2024 Rev. Update / Gov Rec Budget	July 2023 Rev. Update	Jan 2024 Rev. Update
	Revenue	**FY2023**	**FY 2024**	**FY 2024**	**FY 2024**	**FY 2025**	**FY 2025**	**FY 2025**	**FY 2026**	**FY 2026**
(a)	Clean Water Surcharge (PTT)	9,197,201	9,120,000	7,900,000	7,690,000	8,800,000	7,340,000	7,240,000	7,500,000	7,350,000
(b)	Interest Income	1,516,339	-			-				
(c)	Reversions	-	-	100,000	100,000	-				
(d)	Donations	-	-			-				
(e)	Escheats	3,548,336	2,985,808	3,420,761	3,420,761	2,985,808	3,507,887	3,507,887	3,492,328	3,492,328
(f)	Meals and Rooms Tax	14,259,513	14,130,000	14,514,000	14,364,000	14,556,000	14,928,000	14,748,000	15,396,000	15,258,000
(g)	Subtotal Sources	28,521,390	26,235,808	25,934,761	25,574,761	26,341,808	25,775,887	25,495,887	26,388,328	26,100,328
	Appropriations									
	Base Appropriations									
(h)	DEC	15,360,540	14,813,750	14,813,750	14,813,750		13,890,000	13,890,000		
(i)	DEC Adjustments	-	-	-	-		-	-		
(ii)	Fish & Wildlife	-	-	-	-		-	-		
(j)	ACCD	200,000	-	-	-		-	-		
(k)	ACCD Adjustments	-	-	-	-					
(l)	VCGI	-	-	-	-					
(m)	VTRANS	4,317,498	4,000,000	4,000,000	4,000,000		4,000,000	4,000,000		
(n)	VTRANS Adjustments	-	-	-	-		-	-		
(o)	FPR	110,000	50,000	143,613	143,613		144,000	144,000		
(p)	AOA	25,000	-	-	-		25,000	25,000		
(pp)	VHCB						2,800,000	2,800,000		
(q)	Subtotal Base Appropriations	20,013,038	18,863,750	18,957,363	18,957,363		20,859,000	20,859,000		
(r)	One-Time Appropriations									
(s)	DEC		1,751,250	1,751,250	1,751,250		2,600,000	2,600,000		
(t)	AOA		100,000	100,000	100,000		-	-		
(u)	VTRANS		1,000,000	1,000,000	1,000,000		1,000,000	1,000,000		
(v)	FPR		93,613	-	-		-	-		
(w)	Subtotal One-Time Appropriations	-	2,944,863	2,851,250	2,851,250	5,986,910	3,600,000	3,600,000	-	-
(x)	**Subtotal All Appropriations**	20,013,038	21,808,613	21,808,613	21,808,613	5,986,910	24,459,000	24,459,000	-	-
(y)	**Revenue Surplus/Deficit**	8,508,352	4,427,195	4,126,148	3,766,148	20,354,898	1,316,887	1,036,887	26,388,328	26,100,328
	Transfers (To)/From									
(z)	Transfer (to) Agriculture CWF	(5,816,111)	(6,684,880)	(6,684,880)	(6,684,880)		(9,010,000)	(9,010,000)		
(aa)	AAFM Adjustment	-	-	-	-		-	-		
(ab)	Transfer (to) Lakes in Crisis Fund	(50,000)	(120,000)	(120,000)	(120,000)		(120,000)	(120,000)		
(ac)	Transfer (to)/From Contingency Reserve	-	(2,000,000)	(2,000,000)	(2,000,000)		-	-		
(ad)	Subtotal Transfers	(5,866,111)	(8,804,880)	(8,804,880)	(8,804,880)	-	(9,130,000)	(9,130,000)		
(ae)	**Current Year Unallocated/Unreserved**	2,642,241	(4,377,685)	(4,678,732)	(5,038,732)	20,354,898	(7,813,113)	(8,093,113)	26,388,328	26,100,328
	Reserve									
(af)	Contingency Reserve	500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
	Available Funds									
(ag)	Prior Year Balance Unreserved/Unallocated	10,838,160	12,186,819	13,480,401	13,480,401	7,809,134	8,801,669	8,441,669	988,556	348,556
(ah)	Current Year Unallocated/Unreserved	2,642,241	(4,377,685)	(4,678,732)	(5,038,732)	20,354,898	(7,813,113)	(8,093,113)	26,388,328	26,100,328
(ai)	**Summary of Unallocated/Unreserved**	**13,480,401**	**7,809,134**	**8,801,669**	**8,441,669**	**28,164,032**	**988,556**	**348,556**	**27,376,884**	**26,448,884**

Draft Updated Clean Water Fund (CWF) Contingency Reserve Plan

Introduced at the February 22, 2023 Clean Water Board Meeting

Revisited at the February 14, 2024 Clean Water Board Meeting

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Summary of 2018 Plan

- $0.5 million held unallocated in Reserve (~10% of CWF annual revenue at the time)
- Use of Reserve funds: to maintain positive cash balance in the Fund if revenue underperform compared to projected/appropriated amounts
- If revenue overperform compared to projected/appropriated amounts, actual unallocated/unreserved balance is programmed in subsequent SFY Clean Water Budget proposal(s)

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Overview of 2023 Plan Updates

The Clean Water Board reviewed the updated Plan and provided input during its February 22, 2023 meeting; 2023 Plan updates included:

- Adds <u>secondary purpose</u> to manage risk in the event of <u>Clean Water Project loss</u>
- References Clean Water Board's State Fiscal Year 2024 recommendation to increase the Reserve amount from $0.5 million to $2.5 million (~10% of Clean Water Fund's annual revenue)

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Overview of 2024 Plan Updates

Following Clean Water Board input on the Plan, the Plan was updated to:

- Clarify and emphasize Plan's intent and value of holding a contingency reserve to mitigate risks
  - Clarify CWF is an indirectly managed special fund
- Add process/considerations for Board to recommend changes to the Reserve balance
- Clarify/refine process for secondary Reserve purpose (i.e., Clean Water Project loss)

VERMONT

Summary of Plan's Primary Purpose: Revenue Underperformance

- Purpose: Maintain positive cash balance in CWF and avoid/minimize risk of expending more funds than revenues available in any SFY, if revenues underperform compared to projections/appropriations.
- Definition of Risk: Revenue projections for upcoming SFY are basis of annual Budget targets and appropriations. Actual revenue accrue in parallel with implementation of each SFY Budget. If revenue underperform compared to projections the CWF could approach a negative cash balance.
- Mitigation of Risk: Reserve reduces risk and related program impacts of spending above available amounts and streamlines Budget processes by minimizing the need for a mid-year reprioritization of the Budget. *See pages 3-4 for more details on risks.*

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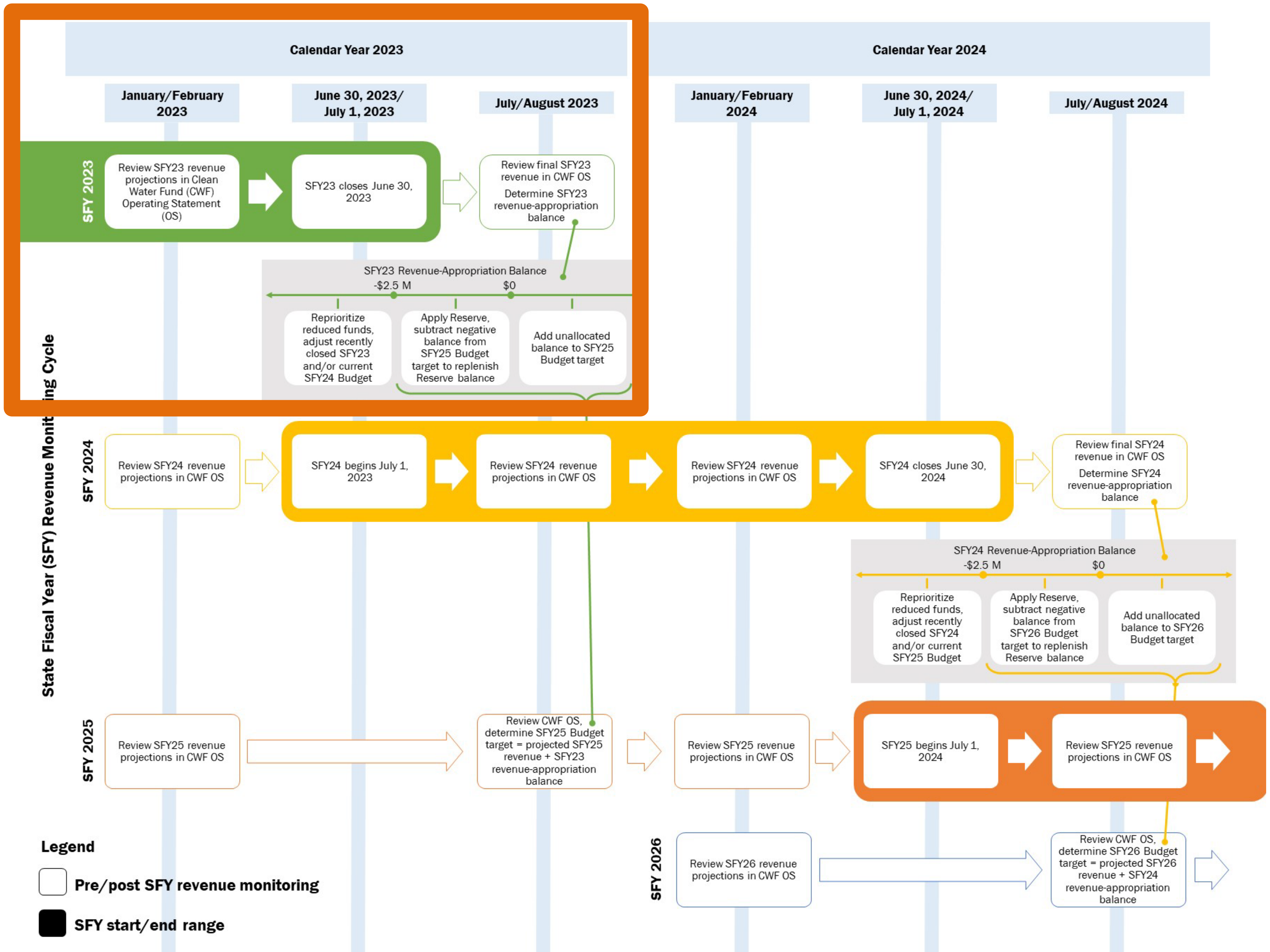
Application of the Reserve's Primary Purpose



Excerpt from Figure 1 on page 6 of Clean Water Fund Contingency Reserve Plan

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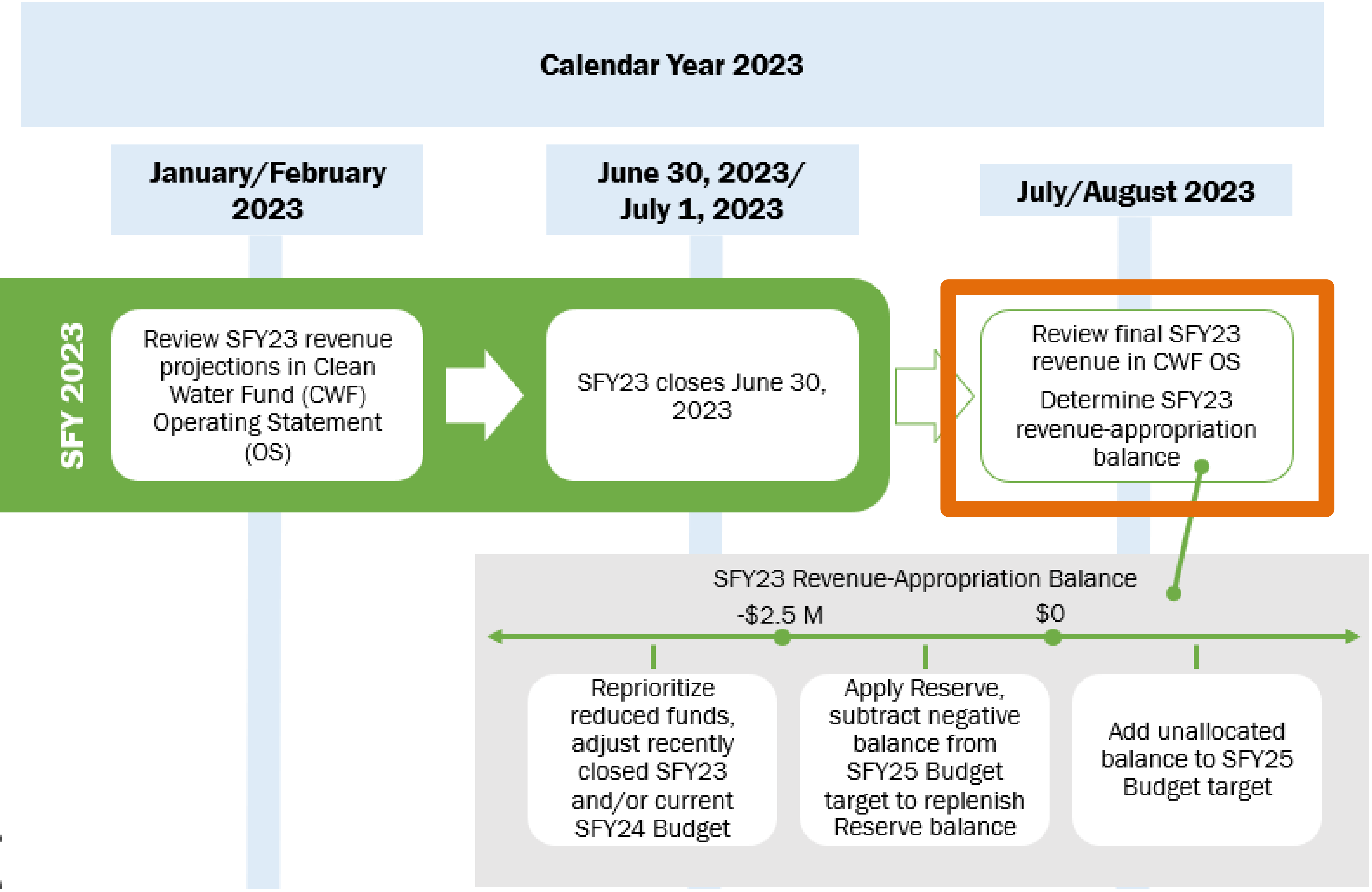
Application of the Reserve's Primary Purpose



July/August CWF Operating Statement determines final actual revenues for the recently closed SFY, ending June 30th.

Excerpt from Figure 1 on page 6 of Clean Water Fund Contingency Reserve Plan

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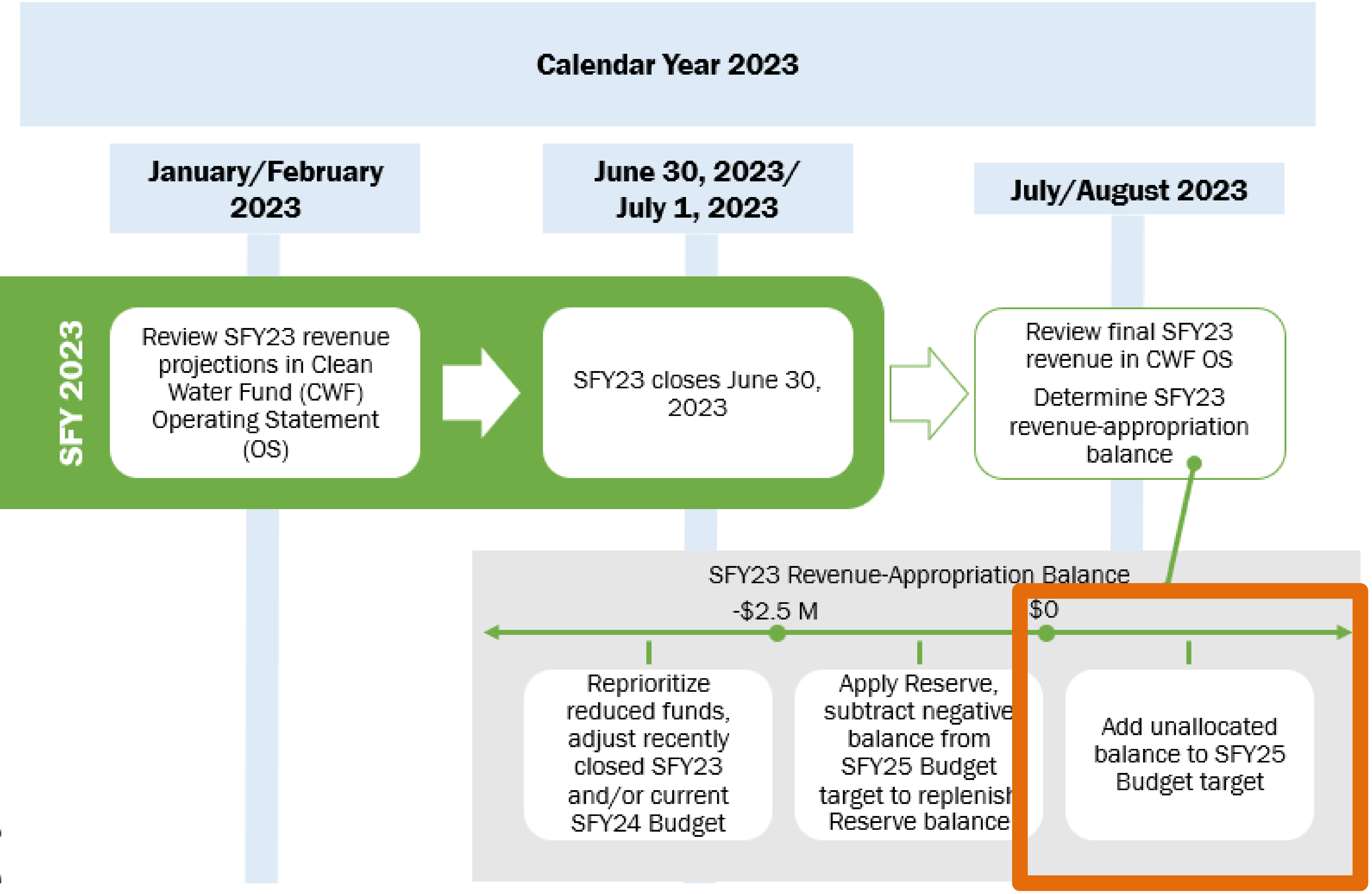
Application of the Reserve's Primary Purpose



If revenues overperformed, Board programs actual unallocated/ unreserved balances in subsequent SFY(s) Budget proposal(s).

Excerpt from Figure 1 on page 6 of Clean Water Fund Contingency Reserve Plan

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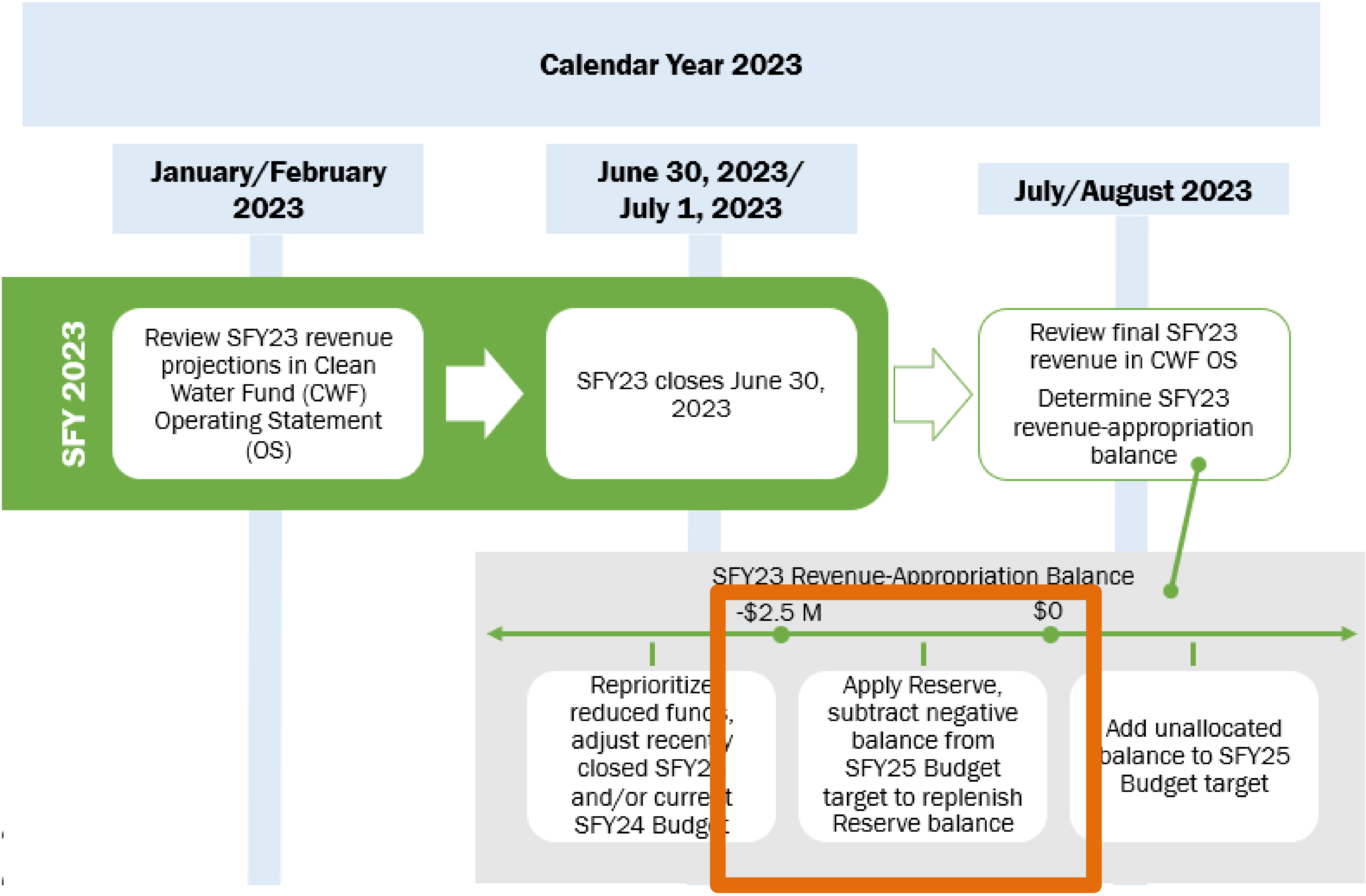
Application of the Reserve’s Primary Purpose



If revenues underperformed equal to or less than the Reserve amount, activate Reserve to maintain positive cash balance. Replenish Reserve balance in the next SFY’s budget.

Excerpt from Figure 1 on page 6 of Clean Water Fund Contingency Reserve Plan

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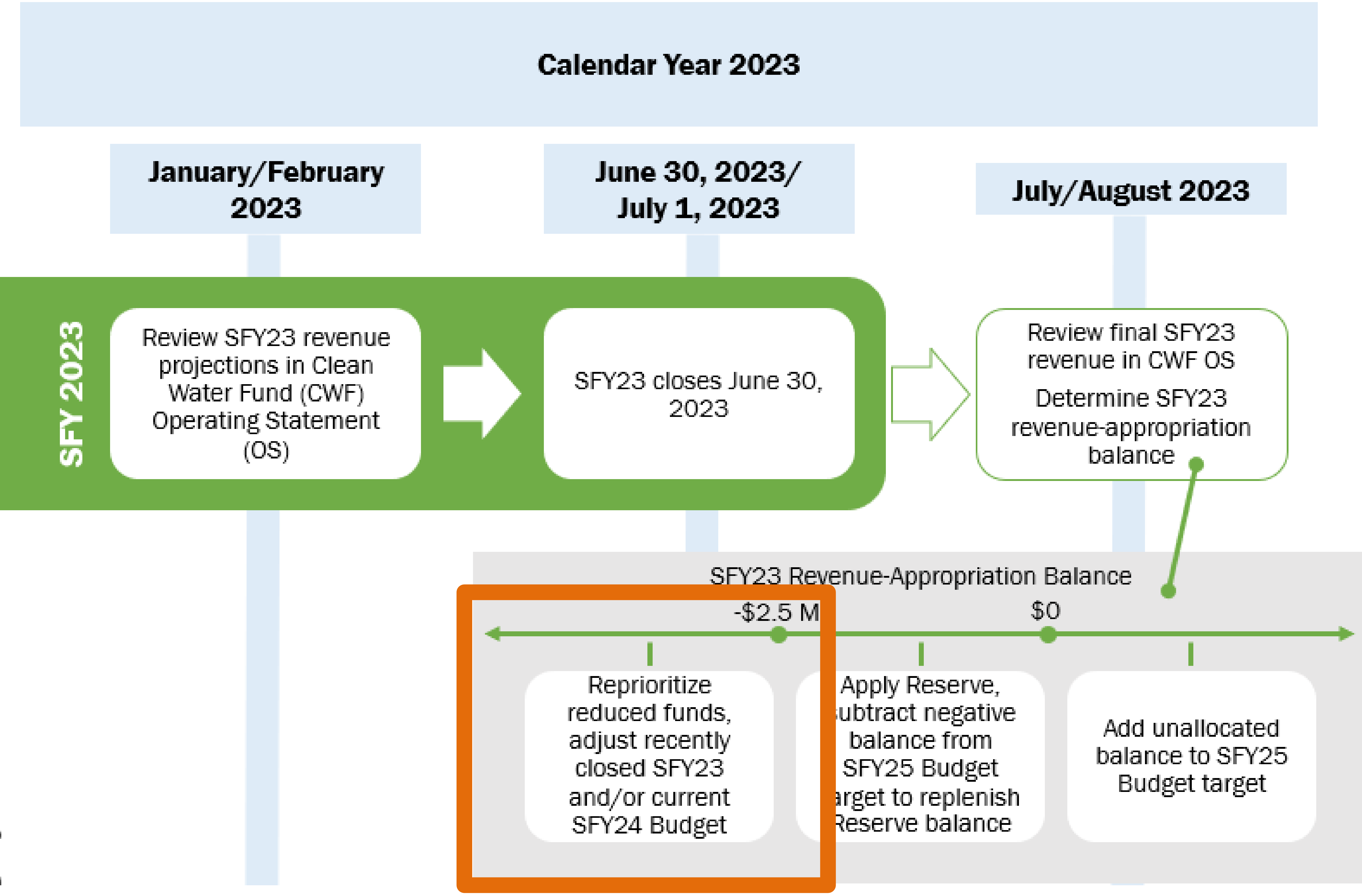
Application of the Reserve's Primary Purpose



If revenues underperformed greater than the Reserve amount, Reserve will be insufficient to maintain positive cash balance. Board must reconvene and adjust recently closed and/or current SFY Budget(s).

Excerpt from Figure 1 on page 6 of Clean Water Fund Contingency Reserve Plan

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Summary of Plan's Secondary Purpose: Clean Water Project Loss

- Purpose: Avoid/minimize risk of losing pollution reduction performance of Clean Water Projects contributing to Clean Water Service Provider (CWSP) targets, if projects are lost/fail due to eligible circumstances outlined in CWSP Rule § 39-404.
- Definition of Risk: VT relies on Formula Grants to CWSPs to meet non-regulatory portion of pollution load reductions required to achieve total maximum daily loads (TMDLs). If a project is lost/fails, its pollution reduction performance is lost. Redirecting funds intended for new projects to restore the lost project performance could slow progress meeting TMDL targets.
- Mitigation of Risk: The Board may choose to allocate Reserve funds to restore the lost project pollution reduction performance. Use of the Reserve may partially mitigate project loss by effectively spreading the costs across all Clean Water Budget activities (as use of the Reserve funds will reduce revenues available for appropriation in the subsequent SFY budget planning process) rather than costs being borne solely by CWSP Formula Grants.

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Application of the Reserve’s Secondary Purpose

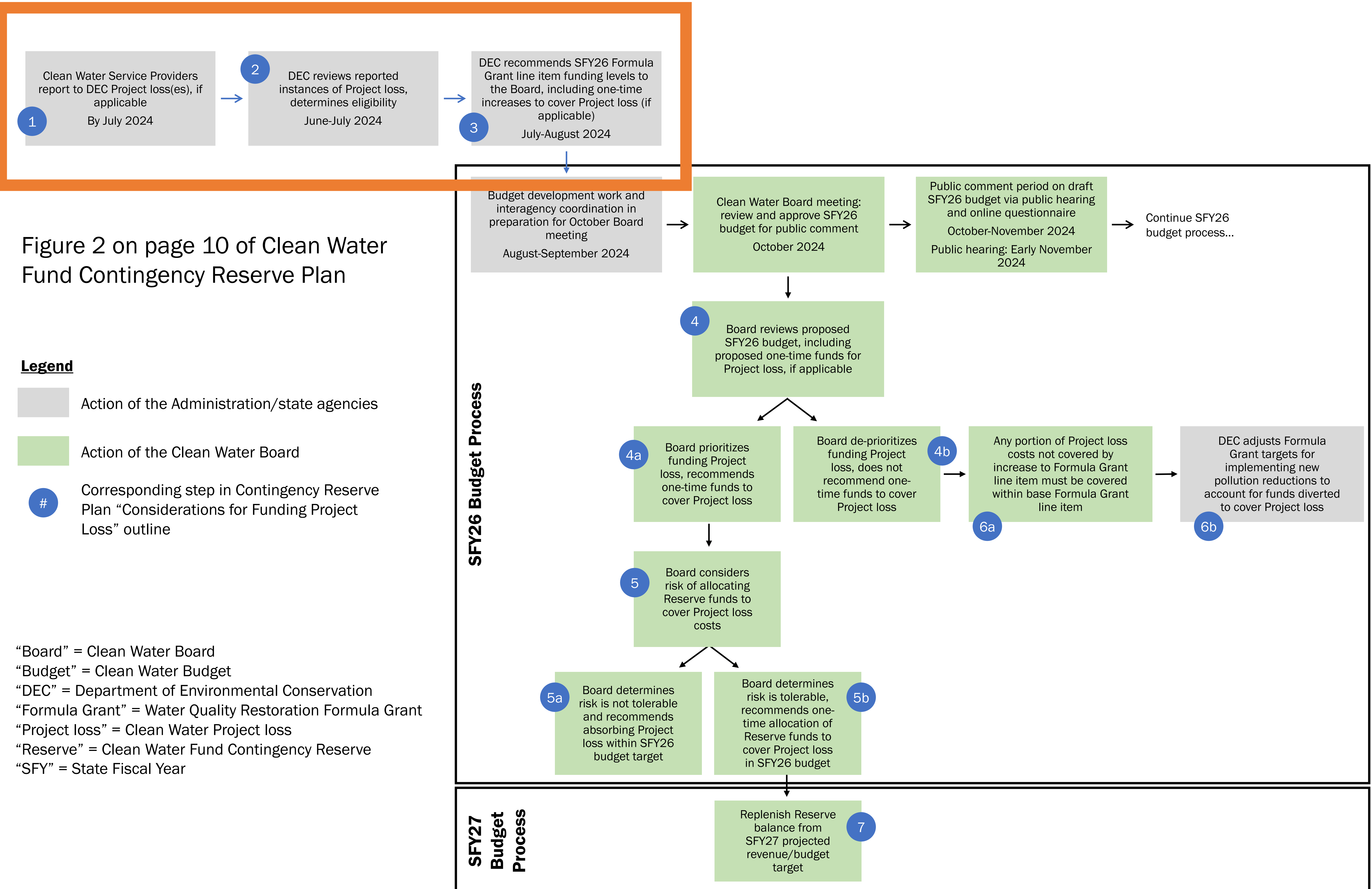

Figure 2 on page 10 of Clean Water Fund Contingency Reserve Plan

“Board” = Clean Water Board
“Budget” = Clean Water Budget
“DEC” = Department of Environmental Conservation
“Formula Grant” = Water Quality Restoration Formula Grant
“Project loss” = Clean Water Project loss
“Reserve” = Clean Water Fund Contingency Reserve
“SFY” = State Fiscal Year

Application of the Reserve's Secondary Purpose

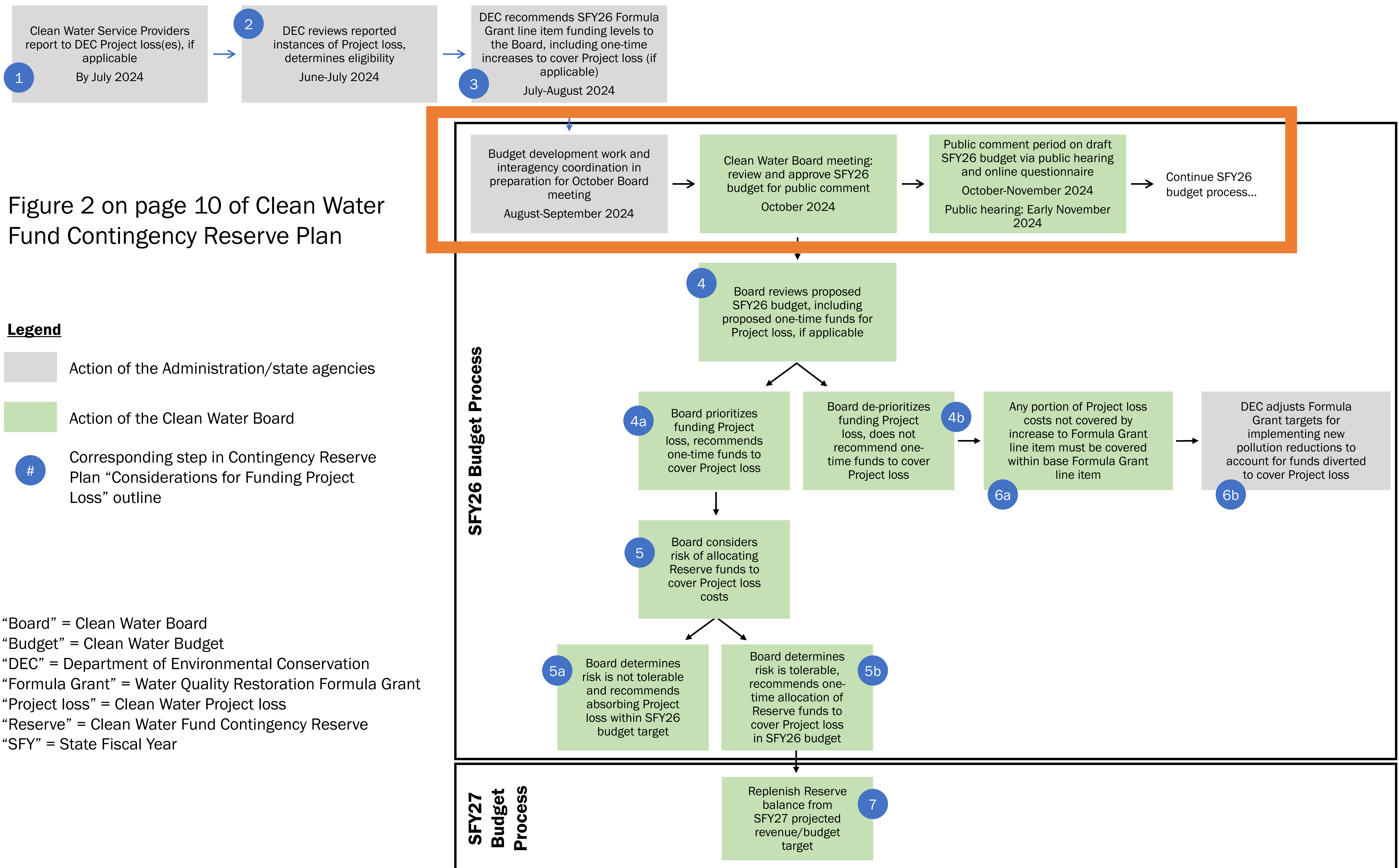

Figure 2 on page 10 of Clean Water Fund Contingency Reserve Plan

Legend

Action of the Administration/state agencies

Action of the Clean Water Board

Corresponding step in Contingency Reserve Plan "Considerations for Funding Project Loss" outline

"Board" = Clean Water Board
"Budget" = Clean Water Budget
"DEC" = Department of Environmental Conservation
"Formula Grant" = Water Quality Restoration Formula Grant
"Project loss" = Clean Water Project loss
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"SFY" = State Fiscal Year

Application of the Reserve’s Secondary Purpose

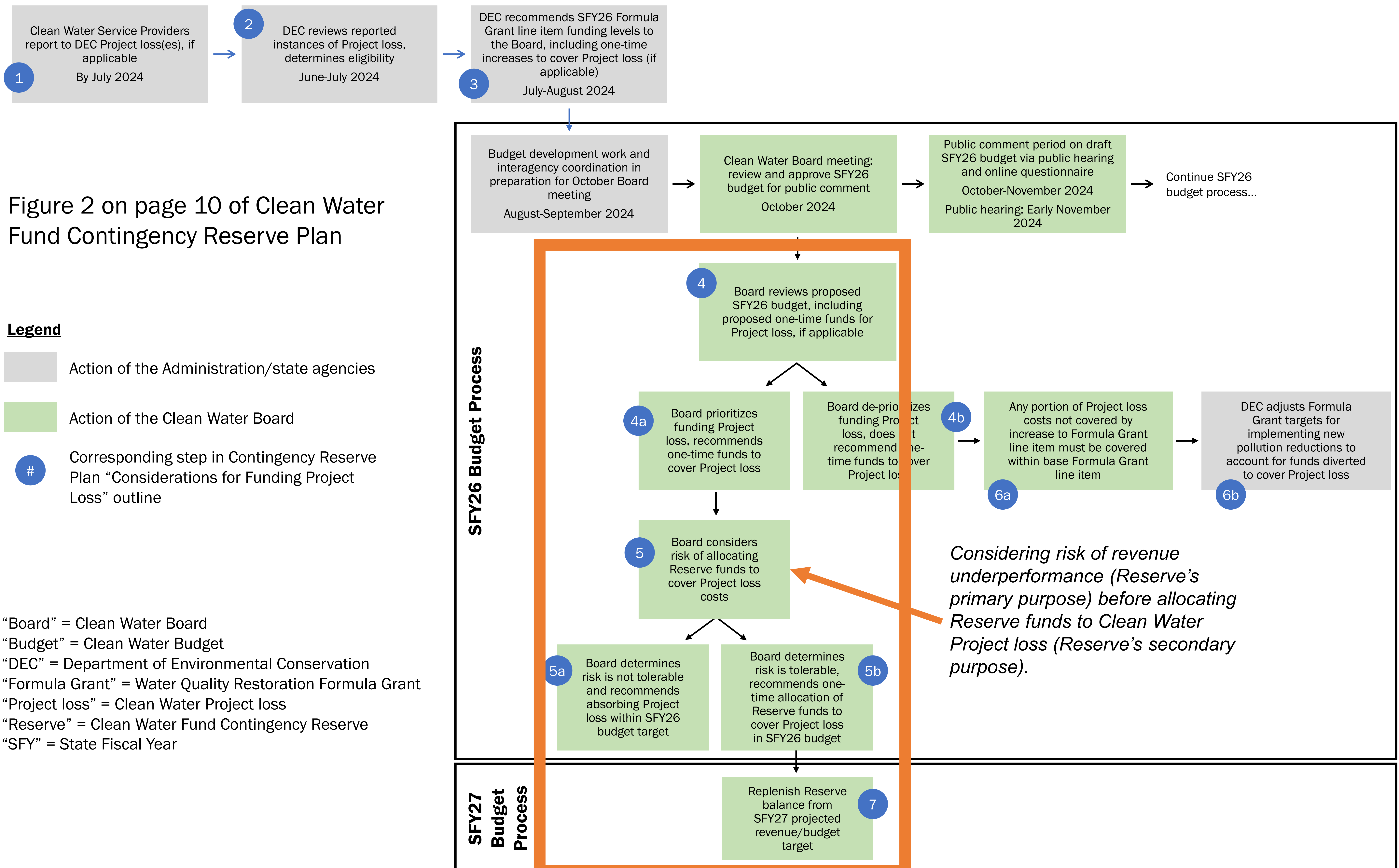

Figure 2 on page 10 of Clean Water Fund Contingency Reserve Plan

Legend

Action of the Administration/state agencies

Action of the Clean Water Board

\# Corresponding step in Contingency Reserve Plan “Considerations for Funding Project Loss” outline

“Board” = Clean Water Board
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“Project loss” = Clean Water Project loss
“Reserve” = Clean Water Fund Contingency Reserve
“SFY” = State Fiscal Year

Application of the Reserve's Secondary Purpose

1 Clean Water Service Providers report to DEC Project loss(es), if applicable
By July 2024

2 DEC reviews reported instances of Project loss, determines eligibility
June-July 2024

3 DEC recommends SFY26 Formula Grant line item funding levels to the Board, including one-time increases to cover Project loss (if applicable)
July-August 2024

SFY26 Budget Process

Budget development work and interagency coordination in preparation for October Board meeting
August-September 2024

Clean Water Board meeting: review and approve SFY26 budget for public comment
October 2024

Public comment period on draft SFY26 budget via public hearing and online questionnaire
October-November 2024
Public hearing: Early November 2024

Continue SFY26 budget process...

4 Board reviews proposed SFY26 budget, including proposed one-time funds for Project loss, if applicable

4a Board prioritizes funding Project loss, recommends one-time funds to cover Project loss

4b Board de-prioritizes funding Project loss, does not recommend one-time funds to cover Project loss

6a Any portion of Project loss costs not covered by increase to Formula Grant line item must be covered within base Formula Grant line item

6b DEC adjusts Formula Grant targets for implementing new pollution reductions to account for funds diverted to cover Project loss

5 Board considers risk of allocating Reserve funds to cover Project loss costs

5a Board determines risk is not tolerable and recommends absorbing Project loss within SFY26 budget target

5b Board determines risk is tolerable, recommends one-time allocation of Reserve funds to cover Project loss in SFY26 budget

SFY27 Budget Process

7 Replenish Reserve balance from SFY27 projected revenue/budget target

Figure 2 on page 10 of Clean Water Fund Contingency Reserve Plan

Legend

Action of the Administration/state agencies

Action of the Clean Water Board

\# Corresponding step in Contingency Reserve Plan "Considerations for Funding Project Loss" outline

"Board" = Clean Water Board
"Budget" = Clean Water Budget
"DEC" = Department of Environmental Conservation
"Formula Grant" = Water Quality Restoration Formula Grant
"Project loss" = Clean Water Project loss
"Reserve" = Clean Water Fund Contingency Reserve
"SFY" = State Fiscal Year

Administrative Approach of Reserve's Secondary Purpose

- Board will recommend Project loss funds within the annual Clean Water Budget process.
- DEC will be responsible for administering and determining eligibility and prioritization for use of Project loss funds.
- DEC will determine how the Project loss funds are allocated across Formula Grants using the Formula Grant Targets and Fund Allocation Methodology.
- DEC will work with Department of Finance and Management to obtain necessary authorizations for expenditures if Project loss funding is needed on an emergency basis that cannot be supported by the standard Clean Water Budget process.

VERMONT

Clean Water Board
Questions & Discussion

State of Vermont
Department of Environmental Conservation
One National Life Drive, Davis 3
Montpelier, VT 05620-3510

Agency of Natural Resources

[phone] 802-828-1550
[fax] 802-828-1552

MEMORANDUM

To: Douglas Farnham, Chief Recovery Officer and Clean Water Board Chair

From: Emily Bird, Clean Water Initiative Program Manager

Through: Julie Moore, Secretary of Natural Resources

Date: February 7, 2024

Subject: Clean Water Fund Contingency Reserve Plan

Cc: The Clean Water Board

Herein is the Clean Water Fund Contingency Reserve Plan (the "Plan") which sets aside a portion of Clean Water Fund ("the Fund") revenues to function as a contingency reserve in the Fund (the "Reserve"). This Plan replaces the Clean Water Fund Expenditure Contingency Plan, put in place in 2018. This updated Plan maintains the primary purpose of the Reserve to manage risk in the event of *revenue underperformance.* Updates to this Plan in 2024 add an additional secondary purpose of the Reserve to manage risk in the event of *Clean Water Project loss*.

The intent of this Plan is to support and provide continuity in the Clean Water Board's (the "Board") decision making by documenting best practices for revenue monitoring and reconciliation already employed by the Board. This Plan also provides transparency for Clean Water Budget stakeholders and the public on the importance of maintaining the Reserve to mitigate risk. The Plan will remain in effect until such time that the Clean Water Board (the "Board") modifies this Plan.

THE CONTINGENCY RESERVE

The Plan requires maintaining a Reserve balance in the Fund. Annually, prior to allocating funds across other line items in the Clean Water Budget, the Board determines the preferred Reserve balance, and replenishes the Reserve to the target balance level (if needed).

Reserve Balance: The Reserve balance is held as a minimum unappropriated balance to maintain a positive cash balance in the Clean Water Fund. The Clean Water Board established a $2.5 million Reserve balance as part of the SFY 2024 Clean Water Budget.[1] Historically, the Board has maintained a Reserve balance equal to roughly 10% of the annual Fund revenue as an appropriately conservative best practice. The most current Board approved Reserve balance will be tracked in the Clean Water Fund Operating Statement.

Reserve Balance Replenishment: In the event Reserve funds are utilized, the Board must first replenish the Reserve balance when recommending the subsequent state fiscal year Clean Water Budget, before allocating projected revenues to Clean Water Budget line items for appropriation to state agencies.

Considerations for Reserve Balance Adjustment: The Board may review and recommend changes to the Reserve balance, if warranted, as part of the annual budget process. The Board should consider the risk of revenue underperformance (Reserve's primary purpose) before reducing the Reserve balance. The Board should consult with the Vermont Department of Taxes and the Department of Finance & Management to assess the risk of requiring use of Reserve funds for revenue underperformance, considering the most current Clean Water Fund Operating Statement's revenue projections and other pertinent data/information on the economic outlook and degree of revenue projection uncertainty.

The Plan requires maintaining a Reserve balance in the Fund to manage risk of revenue underperformance and Clean Water Project loss. These two purposes are described further in the following sections.

PRIMARY PURPOSE: REVENUE UNDERPERFORMANCE

Purpose: The primary purpose of the Reserve is to maintain a positive balance in the Fund to avoid/minimize risk of expending more funds than revenues available in any state fiscal year, in the event revenues underperform and fall short of projections. ***Given the long timelines for project development and year-to-year variability in the funding sources used to support clean water***

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[1] The SFY 2024 Clean Water Budget increased the Contingency Reserve balance from $0.5 million to $2.5 million. The Contingency Reserve was originally established at $0.5 million (10% of the Clean Water Fund's roughly $5 million annual revenue at establishment). The State Fiscal Year 2024 Clean Water Budget proposed to add $2 million in "one-time" funds to increase the total Contingency Reserve to $2.5 million (10% of the current Clean Water Fund's roughly $25 million annual revenue).

work, it is critical to maintain a reserve sufficient to ensure the overall integrity and sustainability of the State of Vermont's Clean Water Budget implementation and associated financial commitments.

Definition of Risk: Revenue projections for the upcoming state fiscal year are the basis of annual Clean Water Budget targets and appropriations. Actual revenues accrue in parallel with implementation of each state fiscal year's Clean Water Budget, as state agencies are executing grants and contracts and encumbering and expending funds against annual appropriations. As such, the Fund would approach a negative cash balance if, in any given state fiscal year, revenues fall short of projections. In this event, without the Contingency Reserve, the Board would be required to reconvene and reprioritize reduced funds, resulting in a budget adjustment to prior and/or current year authorized Clean Water Budget(s). Agencies would be required to reconsider and delay or possibly cancel financial commitments encumbered in grant/contract agreements. The Reserve guards against the following risks tied to revenue instability in the Fund.

- Risk of limited ability to apply the Fund's statutory priorities: The Clean Water Budget funds a diversity of programs across multiple state agencies operating on different timelines based on the partners they serve and field/construction seasons. Without the Reserve, the Board may be limited in its ability to meaningfully prioritize the reduced funds, as state agencies will have already begun encumbering/expending funds in grant/contract agreements. This may result in funds being prioritized based on the timing of agreement execution and not based on the Clean Water Fund statutory priorities.

- Risk of passing burden of revenue underperformance onto individual agencies/funding programs: Without the Reserve, individual agencies/funding programs may be inclined to individually manage revenue underperformance risks by building contingencies into their own appropriations. Some programs may hold more funds in reserve than necessary, while others may hold none in reserve, making them susceptible to running at a deficit. This could present inequities and inconsistencies in management of risk across the Fund. (As such, a reduction in the Reserve amount may not necessarily mean more funds released for implementation on the ground.)

- Risk of costs to agency staff capacity: Without the Reserve, the frequency of prior and/or current year budget adjustments could increase, diverting agency staff capacity away from implementing programs to instead focus on managing budget adjustments.

- Risk of costs to recipient/partner capacity: Without the Reserve, instability in funding programs could present instability for grant and contract recipients who rely on state funds to implement projects. This would present capacity constraints for partner organizations and risk project viability or slow project implementation. Providing stability for partner organizations will help achieve consistent water quality results in the long term.

- Risk of reduced accessibility of public process: The Clean Water Budget is subject to public process to allow opportunity for public comment and transparency around decision making. Without the Reserve, the frequency of prior and/or current year budget adjustments could increase, which would present difficulty/barriers for stakeholders and public to remain engaged in the process, thus reducing participation and accessibility.

The Clean Water Fund is a state "special fund." Many state special funds are set up to manage funds at the revenue, appropriation, and expenditure-level, known as "directly managed special funds." In some cases, this may offer flexibility to manage deficits in real time without a contingency reserve. However, this approach is not feasible for the Clean Water Fund, which is considered "indirectly managed special funds" and cannot be run at a deficit. Due to the interagency nature of the Clean Water Budget, funds are appropriated to and expended by multiple state agencies. Each agency tracks expenditures and financials differently. This makes it infeasible to actively manage the Fund at the expenditure-level, in terms of prioritizing and re-evaluating appropriations if revenues fall short. Due to these challenges, the Board was not given authority to directly manage the special fund. As such, it is required to manage the Fund based on revenues and appropriations (as tracked in the Clean Water Fund Operating Statement) and the Reserve provides a safety net to minimize risk of Fund instability and necessity for budget adjustments.

Mitigation of Risk: ***The State of Vermont is committed to expending only the funds that are available within the Clean Water Fund to maintain the stability and integrity of the Fund.*** The Contingency Reserve guards against downward swings (compared to projections) in Clean Water Fund revenue by maintaining an unappropriated positive cash balance in the Fund. In the event revenues fall short against projections, the Reserve reduces the risk and related program impacts of spending above available amounts by:

- Maintaining alignment of the Clean Water Fund with its statutory priorities;
- Providing a consistent mechanism to mitigate risk across all Clean Water Budget-supported funding programs;
- Minimizing capacity burdens on agency staff and recipients/partners;
- Providing stable/predictable project funding to achieve consistent water quality results long term; and
- Streamlining budget public process to minimize barriers of public participation and accessibility.

Application of the Reserve's Primary Purpose: Clean Water Fund revenue updates are available biannually following the Vermont Emergency Board's adoption of consensus revenue forecasts in January and July. The Vermont Department of Taxes and Vermont Department of Finance and Management use the Emergency Board's forecasts to update actual and projected Clean Water

Fund annual revenue. Revenue updates are presented to the Board in the Clean Water Fund Operating Statement. The Operating Statement includes actual revenues received from the most recently closed state fiscal year and projected revenues for the current and proceeding two fiscal years. The January/February Operating Statement is a mid-state fiscal year monitoring checkpoint and indicates which direction revenues are trending. The July/August Operating Statement confirms final actual revenues for the most recent state fiscal year ending June 30th, which determines one of the three outcomes listed below (also depicted in Figure 1, page 6). Items 1 and 2, listed below, would not require budget adjustment of already appropriated and/or planned budgets. Item 3, listed below, would warrant budget adjustment of already appropriated and/or planned budgets.

July/August Operating Statement determines one of the following outcomes:

1. If the July/August Operating Statement indicates the recently closed state fiscal year actual revenue **overperformed**, generating funds at higher than projected/appropriated levels, the Board shall program these actual "unallocated/unreserved" balances effectively as a "one-time" increase to subsequent state fiscal year(s) Clean Water Budget proposal(s). Actual (for a closed state fiscal year) and projected (for current/future state fiscal year(s)) unallocated/unreserved balances are tracked in the Clean Water Fund Operating Statement by state fiscal year.

2. If the July/August Operating Statement indicates the recently closed state fiscal year ends with **a deficit balance less than the Reserve amount** (e.g., actual revenues underperformed equal to or less than the Reserve amount), the Reserve will be activated to maintain a positive Fund cash balance and maintain existing appropriations for the recently closed and/or current state fiscal year. In other words, the Reserve is applied to make the recently closed state fiscal year's revenue "whole" to avoid impact to state agencies' grants and contracts. In this event, the Board must first replenish the Reserve balance as part of the next state fiscal year's Budget proposal.

3. If the July/August Operating Statement indicates the recently closed state fiscal year ends with **a deficit balance greater than the Reserve amount** (e.g., actual revenues underperformed greater than the Reserve amount), the Reserve will be insufficient to maintain a positive Fund cash balance and maintain existing appropriations for the recently closed and/or current state fiscal year. In this event, the Board would be required to reconvene, determine whether to activate the Reserve to partially cover revenue gaps, and reprioritize reduced funds, resulting in a budget adjustment to the recently closed and/or current state fiscal year authorized Clean Water Budget(s).

Depending on the severity of downward trends in revenue across multiple state fiscal years, the Reserve may be insufficient to guard against revenue underperformance. In this case, the Administration and/or the Board may recommend budget adjustments to recently closed and/or current state fiscal year budgets to align appropriations with actual and/or projected revenue.

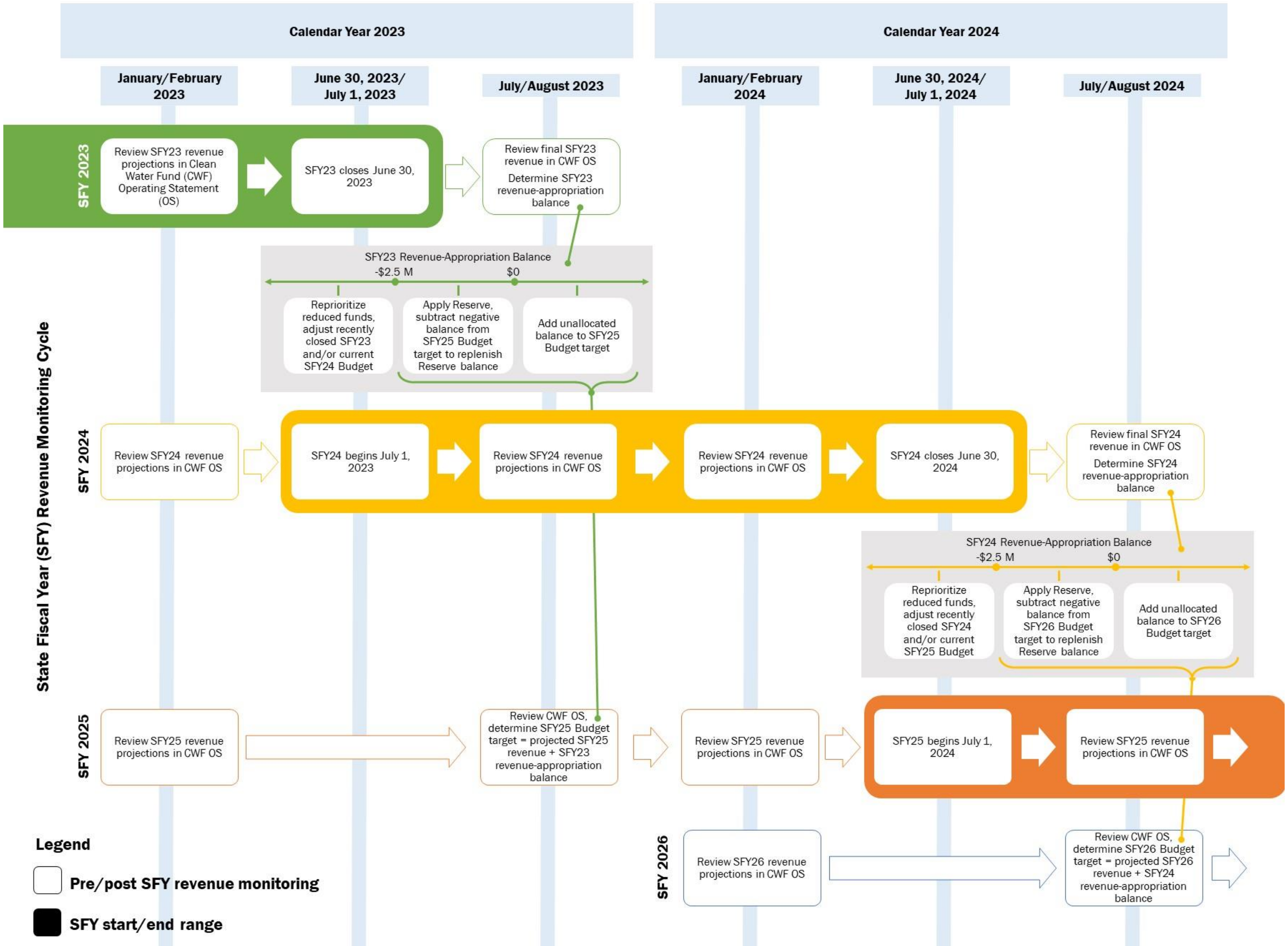

Figure 1. Revenue monitoring and reconciliation milestones, demonstrating outcomes based on July/August Clean Water Fund Operating Statement and end of SFY revenue-appropriation balances. Example based on Calendar Years 2023-2024 and SFYs 2023-2026 with current Contingency Reserve balance of $2.5 million (note: Contingency Reserve balance amount is subject to change per recommendation of the Board).

SECONDARY PURPOSE: CLEAN WATER PROJECT LOSS

Purpose: The secondary purpose of the Reserve is to avoid/minimize risk of losing pollution reduction performance of Clean Water Projects[2] that contribute to Clean Water Service Provider targets, in the event projects are lost/fail ("Clean Water Project loss" or "Project loss") due to eligible circumstances outlined in the Clean Water Service Provider Rule § 39-404.

Clean Water Project loss is the secondary purpose of the Reserve, prioritized below the primary purpose (described above) because Project loss' implications are mainly limited to one Clean Water Budget activity, while revenue underperformance could impact all Clean Water Budget activities.

Definition of Risk: The State of Vermont relies on Water Quality Restoration Formula Grants awarded to Clean Water Service Providers to meet the non-regulatory portion of pollution load reductions required to achieve total maximum daily loads (TMDLs). Clean Water Projects implemented under the Formula Grant program are not compelled by regulation but are necessary in most cases to successfully meet water quality standards.

The State of Vermont provides financial and technical assistance to Clean Water Service Providers and a network of project implementers to support non-regulatory Clean Water Project implementation and long-term operation and maintenance. As such, the state has formalized its reliance and stake in the long-term performance of Clean Water Projects.

A Clean Water Project may be lost or fail in what is anticipated to be unforeseen circumstances, Acts of God, and/or negligence or intentional acts of others and not the Clean Water Service Provider. With the loss of a Clean Water Project, the pollution reduction performance would also be lost, no longer contributing to the state meeting its TMDL targets. In this event, redirecting base Formula Grant funds, intended for new Clean Water Project implementation and forward progress toward pollution reduction targets, to fund restoration of a previously implemented lost/failed project's performance is possible, but could slow forward progress toward meeting TMDL pollution reduction targets.

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[2] Act 76 of 2019 defines "Clean Water Project" as "a best management practice or other program designed to improve water quality to achieve a target established under section 922 of this title [Act 76 of 2019] that: (A) is not subject to a permit under chapter 47 of this title, is not subject to the requirements of 6 V.S.A. chapter 215, exceeds the requirements of a permit issued under chapter 47 of this title, or exceeds the requirements of 6 V.S.A chapter 215; and (B) is within the following activities: (i) developed lands, sub-jurisdictional practices related to developed lands including municipal separate storm sewers, operational stormwater discharges, municipal roads, and other developed lands discharges; (ii) natural resource protection and restoration, including river corridor and floodplain restoration and protection, wetland protection and restoration, riparian and lakeshore corridor protection and restoration, and natural woody buffers associated with riparian, lakeshore, and wetland protection and restoration; (iii) forestry; or (iv) agriculture."

Mitigation of Risk: The Board may recommend the allocation of one-time funds for the restoration of Clean Water Project pollution reduction performance. Clean Water Project pollution reduction performance may be restored by re-implementing the lost project or implementing a new project that restores the pollution reduction performance of the lost project.

Application of the Reserve's Secondary Purpose: Process steps for considering allocation of one-time funds for Clean Water Project loss are as follows. Figure 2, below, summarizes process steps in the context of the annual Clean Water Budget process, using State Fiscal Year 2026 as an example.

1. Clean Water Service Providers report at least annually any Clean Water Project loss to DEC.

2. DEC reviews reported instances of Project loss and determines if they meet the minimum Clean Water Project loss eligibility threshold defined in Clean Water Service Provide Rule.

3. DEC recommends annual Water Quality Restoration Formula Grant line-item funding levels to the Clean Water Board as part of the subsequent annual Clean Water Budget process, including one-time increases to cover Project loss, if applicable.

4. The Board reviews the proposed annual Clean Water Budget, including proposed one-time funds for Project loss, if applicable, and makes one of the following recommendations (4a or 4b). In doing so, the Board considers costs of restoring the lost Clean Water Project's(s') performance in the context of the Clean Water Fund's statutory priorities (10 V.S.A. § 1389(e)). The Board effectively determines if Project loss costs should be spread across all Clean Water Budget-supported activities or if costs should be borne by the Formula Grant program, specifically.

    a. The Board prioritizes funding Project loss and recommends a one-time increase to the Formula Grant line item.

    b. The Board de-prioritizes Project loss and does not recommend a one-time increase to the Formula Grant line item.

5. If the Board deems funding Project loss a priority, the Board may recommend one-time funds to cover Clean Water Project loss by making one of the following recommendations (5a or 5b). In doing so, the Board should consider the risk of revenue underperformance (Reserve's primary purpose) before allocating Reserve funds to Clean Water Project loss (Reserve's secondary purpose). The Board should consult with the Vermont Department of Taxes to assess the risk of requiring use of Reserve funds for revenue underperformance, considering the most current Clean Water Fund Operating Statement's revenue projections and other pertinent data/information on the economic outlook and degree of revenue projection uncertainty. The Board may determine at any point that the risk of allocating

Reserve funds to address Clean Water Project loss is not tolerable, in order to protect Reserve funds to guard against revenue underperformance.

a. Board determines risk of allocating reserve funds is not tolerable and recommends absorbing Project loss costs within the budget target (i.e., projected revenues for the State Fiscal Year), without allocating funds from the Reserve; or

b. Board determines risk of allocating reserve funds is tolerable and recommends one-time allocation of funds from the Reserve (Reserve balance to be replenished from Clean Water Fund revenues in the following State Fiscal Year).

Either approach (5a or 5b), listed above, may partially mitigate the risk of Clean Water Project loss by effectively spreading the costs across all Clean Water Budget activities rather than those costs being borne solely by the Water Quality Restoration Formula Grant budget line item. The distinction between options 5a and 5b, listed above, is the timing of when the costs are applied to the Clean Water Fund: (5a) in the upcoming State Fiscal Year Clean Water Budget development process by allocating funds from projected revenues versus (5b) allocating Reserve funds and replenishing Reserve funds in the subsequent budget year.

6. If the Board does not deem funding Project loss a priority, or elects to partially fund Project loss:

    a. Any portion of Project loss not funded must be covered within the base Formula Grant line item.

    b. In this case, DEC would adjust Water Quality Restoration Formula Grant targets tied to implementing new pollution reductions to account for funds diverted to cover Project loss.

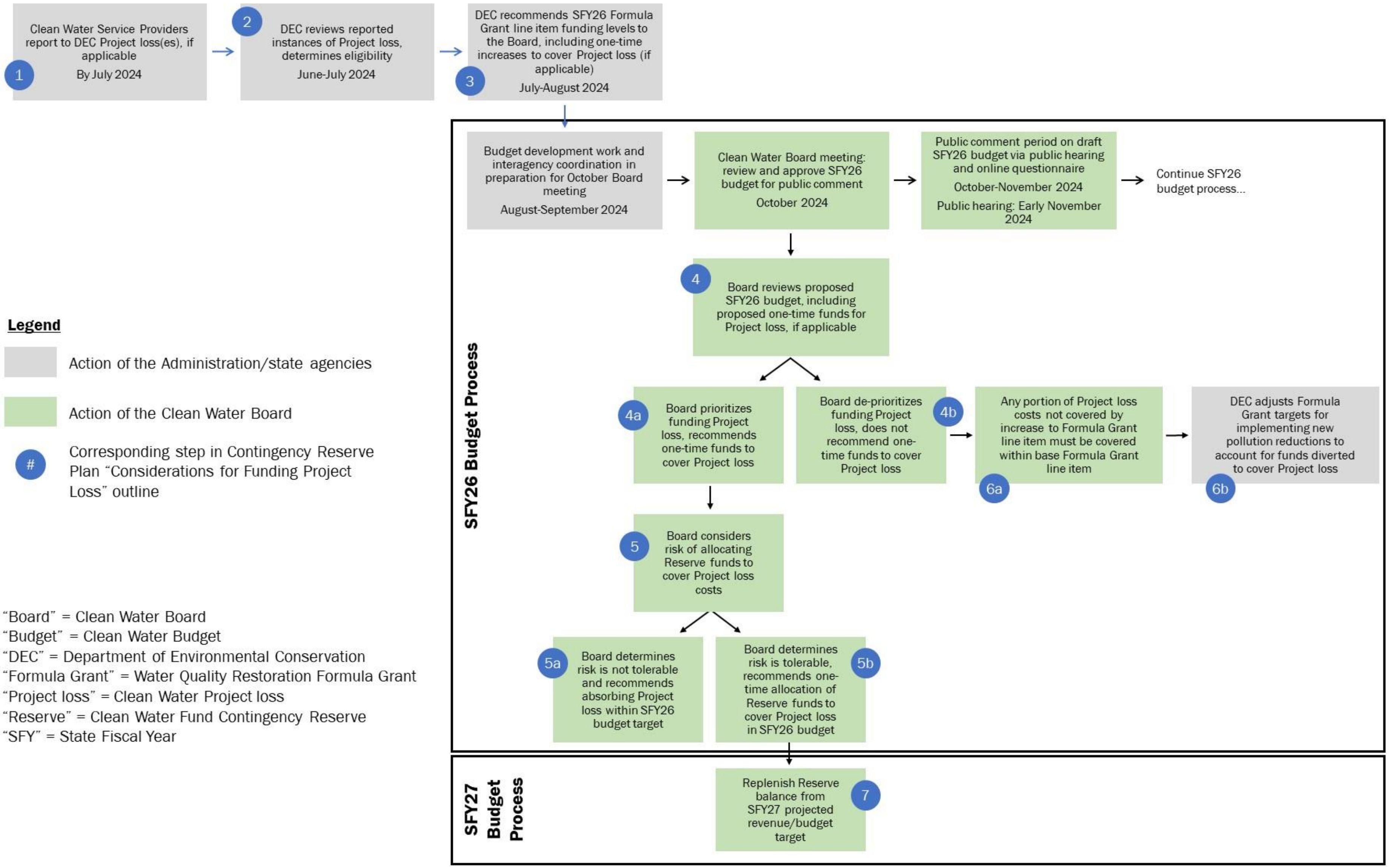

Figure 2. Process steps for considering Clean Water Project loss funding and possible application of the Reserve's secondary purpose in the context of the annual Clean Water Budget process, using State Fiscal Year 2026 Clean Water Budget process as an example.

Administrative Approach: DEC will be responsible for administering and determining eligibility and prioritization for use of Project loss funds. DEC will determine how the Project loss funds are allocated across Formula Grants using the Formula Grant Targets and Fund Allocation Methodology and factoring pollution reduction progress and remaining targets.[3] In the event the Board determines Reserve funds should be allocated to DEC for Project loss and Project loss funding is needed in response to an emergency/time sensitive situation that cannot be supported by the standard Clean Water Budget process, DEC will work with Department of Finance and Management to obtain necessary authorizations for such expenditures.

The Plan is adopted by the Clean Water Board on DATE and authorized by:

Douglas Farnham Date
Chief Recovery Officer
Clean Water Board Chair

[3] Final Water Quality Restoration Formula Grant Targets and Fund Allocation Methodology can be found here: https://dec.vermont.gov/water-investment/statues-rules-policies/act-76/law-rule-guidance

DEPARTMENT OF ENVIRONMENTAL CONSERVATION LEGISLATIVE REPORT

Report on Act 76 Recommendations Regarding Implementation Of A Market-Based Mechanism that Allows the Purchase Of Water Quality Credits by Permittees Under 10 V.S.A. Chapter 47, and other Entities

Year: 2024

Date reported: February 21, 2024

Authorizing statute: 10 V.S.A. Chapter 47

Committees: Senate Committees on Appropriations, on Natural Resources and Energy, and Finance and the House Committees on Appropriations, on Natural Resources, Fish, and Wildlife Environment, and Energy, and on Ways and Means.

Prime contact: Amy Polaczyk, VT DEC Watershed Management Division

Introduction

Act 76 of the 2019 legislature directs the Secretary of the Agency of Natural Resources to develop "*recommendations regarding implementation of a market-based mechanism that allows the purchase of water quality credits by permittees under 10 V.S.A. chapter 47, and other entities*." The Act also specified that "These recommendations shall be developed in consultation with the Clean Water Board and shall be submitted to the legislature." This report, presented to the Clean Water Board on February 14, 2024, fulfills this directive by providing the Agency's current recommendations with regard to further implementation of water quality trading.

Background

10 V.S.A. Chapter 47- Water Pollution Control- empowers the Agency of Natural Resources (ANR) to protect water quality in Vermont's surface waters by regulating discharges. Further, the *Phosphorus Total Maximum Daily Loads (TMDLs) for Vermont Segments of Lake Champlain* (i.e., "Lake Champlain TMDLs") sets forth required reductions across the full range of contributors to nutrient loading to the lake. The contributors are grouped by sector, and include wastewater treatment facilities, stormwater runoff from impervious surfaces, and agricultural runoff. Each of these sectors need to reduce existing loads, and ANR achieves this goal primarily through the use of permits containing conditions that specify the both the nature and quantity of pollutants that can be discharged by a permittee such that surface waters still meet Vermont Water Quality Standards. Such permits exist for so-called 'point-sources', discharges that occur through pipes or other discrete conveyances. These include the discharge of wastewater and stormwater, as well as discharges from certain areas of farms regulated by the ANR. A discharge permit for these types of discharges typically includes either numeric or narrative effluent limits that the permittee must meet to ensure protection of the beneficial uses of a waterbody. Numeric limits are often expressed in pounds

of a pollutant the discharger may release per unit of time, such as over a year. The ease and cost of meeting these effluent limits varies both across sectors, and often within a given sector. As such, the legislature directed ANR to evaluate the feasibility of market-based approaches for the sale and purchase (or "trading") of credits that permittees could use in place of directly meeting effluent limits specified within a permit. This concept was previously assessed as part of an ANR-AAFM-sponsored effort in 2015. The 2015 investigation generally assumed that the agricultural sector would be the "seller" of pollutant credits, and that the developed lands stormwater sector would be the "buyers". The final report from that study concluded that some, but not all, conditions necessary to support trading are already in place. The ANR has now further evaluated both the current landscape of water quality crediting within the State as well as the feasibility of standing up an additional trading program and offers its findings in this report.

Current Water Quality Trading Opportunities

ANR currently has the ability to reallocate or 'trade' nutrient discharges through several existing mechanisms. These include:

• Wasteload Allocation transfer between wastewater treatment facilities as set forth in the DEC's 1987 Wasteload Allocation Rule.

Example: Municipality X is achieving greater than their required removal for Total Phosphorus (TP), and "sells" the excess credits to Municipality Y who is not meeting their current limits, rather than Municipality Y embarking on a facility upgrade to increase TP removal.

Integrated permitting for municipalities with wastewater and municipal stormwater permits;

Example: Burlington Wastewater and Stormwater WLAs for TP are combined in a set of integrated permits that require the group of facilities to meet the total WLA for the city, providing flexibility for project implementation.

• Stormwater offset projects and impact fees;

Example: A developer or property owner exceeds treatment standards for their site, creating offset capacity that may be purchased by property owners that are not able to meet treatment standards.

• Site Balancing to meet stormwater treatment requirements

Example: Development sites may treat existing unregulated impervious surfaces in lieu of new regulated surfaces.

Each of these regulatory options currently exist, and therefore are able to be implemented by the ANR for permittees in Vermont. Waste Load allocation transfer between wastewater treatment facilities involves partnering municipal wastewater treatment facilities discharging to the same watershed or segment of Lake Champlain coming to an agreement on the terms of the waste load/financial exchange and then approaching the ANR with concurrent applications for permit amendment to memorialize the exchange through a change to their respective effluent limits. This differs from integrating permitting, which involves the transfer of waste load allocation between sectors within a municipality. To date this is being preliminarily considered as a transfer of pounds of phosphorus to the developed lands (stormwater) sector from the wastewater treatment facility WLA, which would be memorialized in both stormwater and wastewater permits for the municipality.

Additional opportunities in the developed lands sector include stormwater offset projects, which allow for public and private sector permittees to be pay offset fees when they can't meet required treatment standards or be paid offset fee credits when they exceed standards. Stormwater offset projects are those projects that either treat more stormwater or treat it to a higher level than they are required to. This creates capacity that can be purchased by projects that aren't able to meet treatment standards through the payment of offset fees. Another option available to entities requiring a stormwater permit is known as site balancing, which allows property owners to treat existing un-regulated impervious surfaces in lieu of treating new jurisdictional surfaces under certain circumstances. This added flexibility can have significant cost savings without compromising treatment or water quality.

The ANR currently manages all of these mechanisms through existing legal authority and implements these opportunities through existing permitting programs.

Barriers to Establishing Additional Trading Mechanisms

As described, ANR currently has several robust mechanisms for achieving the goals of water quality trading. These opportunities notwithstanding, there has been interest expressed in pursuing additional opportunities for market-based trading, particularly in the developed lands sector. However, there are several significant impediments to instituting more complex trading processes to address regulated stormwater and wastewater discharges in Vermont.

As described above, there are several existing mechanisms that effectively achieve water quality trading within the developed lands (stormwater) and wastewater sectors. Further, the developed lands sector typically must incur the costs of compliance with existing regulations (achieve baseline regulatory requirements) before any additional trading program credits could be established and implemented. There are also legal and policy questions regarding the quantification of "credits". For example, in wastewater discharges, laboratory analyses are used to determine pollutant concentrations released, while in the stormwater sector Best Management Practices (BMPs) are used to reduce the concentration of pollutant by a prescribed amount based on the practice. There is considerable uncertainty in trading "a pound for a pound" between the two types of discharge, requiring trading formulae to include factors accounting for this uncertainty, that must be derived and applied when reallocating the pollutant loads.

In a similar way, there would also need to be additional analysis to determine which practices in the agricultural sector would be available for trading with the developed lands and wastewater sectors, as well as the formula for trading between those sectors, as it would be different from those for trading between stormwater and wastewater treatment. For example, many agricultural practices are annual in nature, which means that they'd need to be re-established each year. This creates uncertainty and risk for credit purchasers who do not have control over whether the farm they purchase credits from consistently adheres to the practices annually. Additionally, in order to overcome the necessary margin of safety to account for this uncertainty, the buyer must generally purchase more credit than the practices purportedly create due to the variability of these practices as installed. This concept of trade ratios works against the less predictable practices typically available from the agricultural sector. This is further discussed in the 2015 Report, attached.

Further, the investment necessary to create additional water quality credit trading opportunities would need to coincide with the demand from the developed lands and/or wastewater sectors, which the Agency is currently not receiving. Coupled with the significant financial assistance the State is receiving through the federal Infrastructure Investment and Jobs Act (IIJA) and the American Rescue Plan Act (ARPA) ANR does not anticipate such demand to increase in the near future.

Lastly, ANR does not at present have the staff resources necessary to stand up additional trading programs, or to support the complex regulatory interactions required. The implementation of these types of programs would require either additional staff resource or result in an impact to existing services provided by the Agency if additional positions to support the work were not allocated or would require the creation of a new external entity such as a third-party 'trading bank' which would necessitate significant startup investment and ongoing operational costs.

Conclusion and Recommendations

There are several existing mechanisms to achieve the fundamental goals of water quality-based trading already in place at ANR, the addition of new trading concepts is fraught by both logistical and capacity-based concerns, and there is not currently a demonstrable need for these additional mechanisms.

Based on these considerations ANR does not believe development of additional market-based trading mechanisms to address the developed lands or wastewater waste load allocations in the *Phosphorus Total Maximum Daily Loads (TMDLs) for Vermont Segments of Lake Champlain* (i.e., "Lake Champlain TMDLs") is warranted at this time. ANR will continue to monitor both the demand for additional trading opportunities and any regional or national developments in trading concepts or implementation and is open to revisiting our recommendations if conditions change.

Act 76 Water Quality Trading Recommendations

Presented by the Department of Environmental Conservation
Amy Polaczyk

Clean Water Board Meeting
2/14/24

VERMONT

Background

- Act 76 (2019)
  - "These recommendations shall be developed in consultation with the Clean Water Board and shall be submitted to the legislature."
- 10 VSA Ch. 47- Water Pollution Control
  - Mechanism: Permits
- Sectors: Wastewater, Stormwater, Ag
- Variability across sectors: cost and ease
- 2015 Project Report: *Assessing Market-Based Approaches for Phosphorus Reductions in the Vermont portion of the Lake Champlain Basin*

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Current Trading Opportunities

- Wasteload Allocation Transfer
  - Wastewater: muni → muni
- Integrated Permitting
  - Wastewater & Stormwater: across sectors within a muni
- Stormwater Offsets
  - Stormwater: entity to entity- private or public
- Stormwater Site Balancing
  - Stormwater: flexibility within a given project

VERMONT

Barriers to Additional Mechanisms

- Demand
- Timelines
- Inter-Sector Trade Ratios
- Resources

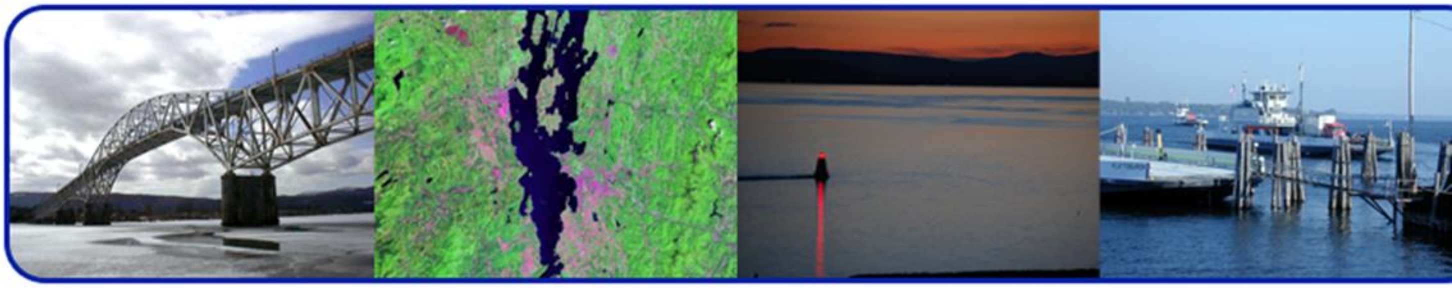
Recommendations

Existing Mechanisms + Uncertainty + Low Demand

=

Development of new market-based trading programs is not recommended at this time

Assessing Market-Based Approaches for Phosphorus Reductions in the Vermont portion of the Lake Champlain Basin



Final Project Report

Prepared for

Vermont Department of Environmental Conservation
Vermont Agency of Agriculture Food and Markets

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September 30, 2015

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Executive Summary

In 2014, the Vermont Department of Environmental Conservation (DEC) and the Vermont Agency of Agriculture Food and Markets (AAFM) initiated a project to analyze and develop market-based approaches for phosphorus reductions in the Lake Champlain Basin. This project, funded through a U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Conservation Innovation Grant (CIG) (CIG #69-3A75-12-256), was intended to help Vermont with the following:

- Achieve the overall phosphorus pollution reduction targets of the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) in a cost-effective manner;
- Reduce costs to the regulated sector in meeting pollutant discharge limits;
- Establish incentives for voluntary phosphorus load reductions above baseline water quality requirements; and
- Accommodate continued growth and economic development.

The expected outcome of the project was to gain an understanding of the potential viability of market-based programs in the Lake Champlain Basin to motivate cost-effective phosphorus reductions based on assessment of existing environmental, economic, regulatory, and social conditions in the Basin. As an initial phase in a market-based approach development process, the findings of this report will help DEC, AAFM, and other key Lake Champlain Basin stakeholders determine if a future investment of time and resources into pursuing market-based tools to aid existing program implementation is warranted. This assessment and final project report provide a high-level snapshot of the opportunities and challenges reflecting the available data and assumptions necessary to conduct this analysis given the project's ambitious schedule ahead of final TMDL issuance and resource constraints.

Description of Project Activities

To help support the feasibility analysis of market-based programs in the Lake Champlain Basin, DEC and AAFM selected the Project Team of Tetra Tech, Inc. (Tt) and Kieser & Associates, LLC based on their current efforts in Lake Champlain Basin to support phosphorus TMDL development and extensive market-based program evaluation and development experience, respectively. In addition to the Project Team, DEC and AAFM coordinated a Watershed Markets Advisory Committee comprised of Basin stakeholders representing interests at the federal, state, and local levels. Input from participating Committee members helped to ground-truth, validate cost assumptions, provide insights on anticipated phosphorus reduction implementation requirements, and gauge interest in various market-based approaches. The Committee also identified numerous issues and considerations that would require additional analysis beyond this initial assessment phase.

DEC, AAFM, Committee members, and the Project Team conducted four primary tasks associated with the market-based feasibility assessment project. These included:

- **Feasibility Study and Market Analysis to Inform Trading Program Strategy Selection.** This focused on the potential viability of market-based approaches for achieving phosphorus reductions in the Lake Champlain Basin. The feasibility study and market analysis provide a snapshot in time of the regulatory drivers, the Basin's geographic conditions influencing phosphorus fate and transport, and variations of estimated phosphorus control costs among sources. Recognizing the evolving regulatory landscape of the Lake Champlain Basin, the analysis is based on existing data, the current status of regulations and regulated sources, and assumptions intended to both streamline the analysis given project resource constraints yet still recognize overall water quality improvement needs in the Basin.

- **Analyze Nutrient Trading Strategies and Recommend an Applicable Strategy for the Vermont Portion of the Lake Champlain Basin.** This task applied the feasibility study and market analysis findings to identify the most promising market-based strategies for the Lake Champlain Basin given the regulatory, environmental, and economic conditions. The goal of this task was to identify one or more market-based strategies that are technically viable as well as socially acceptable to Lake Champlain Basin stakeholders.
- **Develop a Market-Based Framework for a Recommended Trading Program.** These efforts identified framework components of the recommended market-based strategy. Framework components included program rules, public participation, baselines for generating credits, restrictions to avoid hotspots, program infrastructure, verification/certification and tracking/accounting needs, risk assurances, and funding/costs.
- **Stakeholder Involvement and Pilot Project Considerations.** A Watershed Markets Advisory Committee was assembled with the Project Team facilitating four Committee meetings to provide input over the course of the project. Committee feedback identified issues related to data, assumptions, and recommendations. In addition, development of considerations for conducting a pilot project of the recommended market-based strategy revealed critical constraints and opportunities for future market-based programs in the Basin.

Efforts from each task contributed to the overall assessment of the potential viability of market-based approaches and recommendations on the most cost-effective strategy and framework. This required close coordination with DEC, AAFM, and Lake Champlain Basin stakeholders over the course of the nine month project to ensure the Project Team had the most recent information at critical points in the project. Given the fact that the regulatory landscape of the Lake Champlain Basin evolved rapidly over the course of the project, the Project Team could not always incorporate updated or new information into the analysis. However, working with DEC, AAFM, and Watershed Markets Advisory Committee, the Project Team documented where additional analysis in a subsequent phase of the market-based program development process might be necessary.

Project Findings and Additional Analysis Needs

Through the feasibility analysis and market study, including the pilot project analysis, the Project Team determined that not all of the conditions needed to support a viable phosphorus credit market have been met in the Lake Champlain Basin. These principally focused on water quality trading opportunities and to what extent the size of a potential market would dictate more simplified trading exchange strategies (e.g., bilateral trading), or more sophisticated market frameworks (such as a clearinghouse). The developed land sector was considered as the primary market buyer driven by a Waste Load Allocation (WLA) under the Draft Lake Champlain Phosphorus Total Maximum Daily Load (TMDL). Agriculture was considered the seller of credits in the context of required reductions by the Load Allocation (LA) of the TMDL, as well as recent state legislation for agriculture. Beyond trading, analyses also evaluated how select WQT strategies might be applied to effectuate lower implementation costs for the agricultural sector. Table ES-1 provides a summary of where conditions are met, partially met or not met for developing such programs. Remaining issues portend the associated actions and decisions that Lake Champlain Basin stakeholders must address to fully meet the conditions for viable market-based programs.

Table ES-1. Summary of conditions needed to support viable market-based approaches in the Lake Champlain Basin

Conditions Needed to Support Market-Based Approaches in the Lake Champlain Basin	Met	Partial	Not Met	Issues To Be Addressed
Regulatory driver for load reductions		✓		Policy/legal decision on declining trading cap
Substantial demand (buyers and quantities)		✓		Additional analysis to determine public burden
Ample supply (with sellers meeting baselines)			X	Policy/legal decision on interim crediting
Sizeable treatment cost differentials		✓		Additional analysis on costs
Willing public regulators	✓			
Opportunity for innovative (non-water quality trading) funding mechanisms			X	Policy/legal decision on constraints to pool funding

Vermont agency staff and Watershed Markets Advisory Committee members also identified a variety of issues over the course of this project that they believe are key to address in a subsequent phase of the market-based program assessment and development process. These include:

- **Policy/legal decisions on use of a declining trading cap.** The Lake Champlain Basin market-based feasibility analysis used an overarching hypothetical implementation strategy focused on a declining cap which limits the amount phosphorus reduction a buyer could purchase in five year intervals throughout the 20-year TMDL. This mechanism would allow developed land dischargers to spread the economic burden of compliance over a 20-year period while still implementing practices to reach compliance at 5-year milestone intervals. While the Project Team presented this approach to the Watershed Markets Advisory Committee, it is a larger policy issue related to overall TMDL implementation that will require Vermont agency staff deliberation and approval of how the WLA will be applied. Next steps in the process should include detailed discussions about this conceptual TMDL compliance approach and any policy or legal implications that would arise. EPA Region 1 has stated that TMDL implementation is led by Vermont and that this would largely be Vermont's decision to make. Further policy and legal discussions should continue to involve EPA Region 1, as well as a broader group of developed land dischargers that would be affected by this approach to achieving the WLA over time.
- **Policy/legal decisions on the use of interim crediting.** This report presented the concept of using interim baselines as a form of LA phase-in for agriculture that would allow these sources to generate credits while working to achieve their TMDL and state mandated requirements. Widespread credit supply in the Lake Champlain Basin will be extremely limited and likely unable to meet the demands of the growing sources encompassed under the TMDL developed land WLA if all agricultural sources are strictly regulated with a stringent baseline. Contemplated interim baselines, where agricultural reductions associated with achieving baselines are creditable for ten years (then retired), was central to the market feasibility analysis. A similar approach is currently used in Wisconsin water quality trading. This concept is also consistent with USDA's suggested phased baseline approach for agriculture under TMDLs. It is imperative that Vermont agency staff and Lake Champlain Basin stakeholders, including EPA Region 1, analyze the policy and legal barriers to the use of interim crediting for flexibility in meeting the

agriculture LA. Such policy decisions on the use of interim crediting are critical to the future of water quality trading in the Lake Champlain Basin.

- **Policy/legal decisions on constraints to pool funding.** The feasibility analysis raised the potential for significant implementation cost savings by integrating funding for conservation practices and technical services into market-like approaches that could help farmers meet baseline requirements. Analogous to market-based approaches but separate from credit markets under water quality trading, distribution of state and federal funds could be based on performance metrics which optimize fund investments. This is accomplished by competitively distributing funds for the most cost-effective management practices using market-based bidding mechanisms such as a reverse auction. DEC, AAFM, EPA Region 1, and Vermont NRCS would need to engage in policy discussions regarding this type of program to pool agricultural conservation practice funding with competitive award distribution. Focus groups with agricultural operators about this concept are recommended to ensure this approach would be acceptable to producers.
- **Public versus private burden of the aggregated developed lands WLAs.** The analysis discussed the potential for cost savings with water quality tradingbased on multiple scenarios in which the public sector assumed responsibility for varying levels of phosphorus reduction from developed lands. The analysis demonstrated that a higher public burden (e.g., 80 percent) results in higher potential cost savings sufficient to consider water quality trading program development. With moderate (50 percent) to low (20percent) public burden, market-based mechanisms to provide cost savings for phosphorus reductions were quite limited, especially where low cost stormwater controls were likely possible. Therefore, it will be important for Vermont agency staff and Lake Champlain Basin stakeholders to determine more accurately the likely percentage of the developed lands WLA that will be the responsibility of public entities, particularly for pursuing water quality trading program development.
- **Refined agricultural and stormwater phosphorus reduction costs.** The analysis demonstrated that high agricultural phosphorus reduction costs (e.g., \$126 per pound of reduction) and low stormwater control costs (e.g., \$792 per pound) do not result in the significant cost differentials necessary to compel sources to pursue water quality trading. Agricultural costs reflected 20-year life cycle costs for farmers to implement a suite of conservation practices. Urban stormwater control costs reflected well-documented life cycle costs for wet detention basins serving various sized drainage areas (where larger drainages yield economies of scale). Although the Watershed Markets Advisory Committee provided feedback and data on BMP costs throughout the project, the Project Team recommends that sources under the developed lands WLA continue to provide real data and information on phosphorus control costs. For example, only under the highest-cost stormwater BMP scenario examined (\$8,764 per pound) does a more complex water quality trading framework (such as a clearinghouse) appear beneficial, and then only with moderate to high public burden. Select Advisory Committee feedback also suggested that stormwater control costs in highly urbanized settings would be much higher than average stormwater control costs used for the broader basin-wide analysis as requested by DEC. Because the viability of market-based approaches is heavily driven by cost differentials between control practices and agricultural reduction costs, refining this information is crucial to selecting a final market-based approach.
- **Other potential point source buyer considerations not included in the analysis.** At the outset of this project, DEC stated that a WLA reallocation approach for Wastewater Treatment Plants (WWTPs) would adequately address reduction requirements for this source sector. As such, the Project Team to not include them in the market-based analysis. Toward the end of the project, DEC became aware that the reallocation policy would not likely achieve full WWTF compliance

with WLA for select facilities. Therefore, it appears that WWTFs could increase credit demand under a water quality trading framework. As this determination was made late in the project, subsequent analyses should examine these additional trading opportunities. Additionally, new state general permits for stormwater are pending and as a result, the number and type of regulated stormwater sources will likely increase potential demand. Both WWTF and new stormwater control needs will have market implications for the Lake Champlain Basin.

- **Cross-basin trading options.** The Lake Champlain Basin phosphorus TMDL developed for Vermont's portion of the Basin assigns allocations on a lake segment basis. This approach recognizes that Lake Champlain functions as a set of hydrodynamically interconnected segments that extensively influence each other. Discussion during the first Watershed Markets Advisory Committee meeting clearly indicated a desire on the part of EPA Region 1 and DEC to use the assumption that only intra-lake segment market-based activities would take place. This would align with the assumptions of the TMDL, promote consistent TMDL implementation, and prevent hot spots (i.e., unintended shifting of phosphorus load from one lake segment to another). However, some Committee members did express an interest in evaluating the potential for inter-lake segment crediting and offsetting, particularly where there is a strong hydrologic connectivity between lake segments, such as Burlington Bay and the Main Lake. The next phase of analyzing and scoping a market-based program for the Lake Champlain Basin should include further discussion of cross-basin trading options that would promote greater market activity but still meet water quality goals in alignment with the TMDL.
- **Stormwater phosphorus offsets for new growth.** The issue of stormwater offsets became a larger concern for DEC and Watershed Markets Advisory Committee members toward the end of this project. Vermont has existing requirements to meet a "net zero" discharge limit for stormwater-impaired waters as described in Environmental Protection Rules Ch. 22 (Stormwater Management Rule for Stormwater Impaired Waters). Specifically for the Lake Champlain Basin, state law also requires that all projects requiring an operational stormwater permit for discharges within the Basin show no net increase in phosphorus if EPA Region 1 does not issue the final phosphorus TMDL by October 1, 2015. This requirement will apply to all applications for coverage (new and renewal) under GP 3-9010, 3-9015, or individual stormwater permits, which are received after October 1st. While the schedule and resources for this project did not allow for a full discussion of incorporating stormwater offset options into Vermont's existing stormwater offset program, K&A offered stormwater offset program considerations used in other watersheds. A phosphorus offset program framework was developed for Lake Simcoe to offset phosphorus loads resulting from new development in the basin. This "Lake Simcoe Phosphorus Offset Program" (LSPOP) was integrated into existing stormwater management programs providing for a highly accountable and verifiable program that would be ideal for the Lake Champlain Basin if a basin-wide offset program is determined to be applicable. DEC and Lake Champlain Basin stakeholders may wish to compare the LSPOP to Vermont's existing stormwater offset approach to identify opportunities to improve the existing program to meet the Lake Champlain Basin's specific phosphorus offset needs.
- **Water quality trading program integration with existing state mechanisms.** Depending on the additional information gathered in a second phase of market-based program development, it will be important to consider existing state and/or local program infrastructure. Any new trading or market-based program should utilize existing structures, mechanisms and staffing to minimize new costs and additional staffing needs.

Next Steps

The findings from this analysis serve as an initial screening of the conditions and opportunities for market-based approaches in the Lake Champlain Basin to cost-effectively achieve phosphorus reductions. Given the list of additional discussion and analysis considerations presented above, the Project Team recommends that DEC, AAFM, and the Watershed Markets Advisory Committee consider pursuing the next phase of more focused, issue-driven analysis that seeks to resolve critical policy, legal, and technical issues. This next phase of analysis, however, will require broader DEC and AAFM staff participation that includes senior management as well as legal counsel to help dissect and analyze policy ramifications of market-based program assumptions identified in this initial analysis. It will also need to intentionally integrate TMDL implementation plans and strategies. And vice versa, future implementation plans should explicitly recognize adopted market-based program strategies.

Conclusions

Findings from the market-based feasibility study and market assessment conducted for Vermont DEC and AAFM, with input from the Watershed Markets Advisory Committee, indicate that potential phosphorus credit supply and demand exist in the Lake Champlain Basin to support further consideration of a market-based program approach. However, to ensure that conditions in the Basin fully exist to support a viable water quality trading approach, additional policy and technical analyses are necessary.

The current analysis demonstrated that Vermont could achieve substantial cost savings with a market-based approach when stormwater phosphorus reduction costs for developed lands are high, and when a high percentage of total required stormwater reduction burden is assumed by public sources. Cost savings with market-based approaches diminish with a lower public burden for stormwater controls and lower stormwater phosphorus control costs. The volume of potential trades coupled with the projected costs for market-based program development suggests a bilateral water quality trading program for the Lake Champlain Basin may be beneficial. Such trading, however, will be driven by case-by-case circumstances where there are high cost differentials between potential buyers and sellers. Highly urbanized areas will most likely experience such differentials. New state permit requirements may expand the number of state regulated stormwater sources, and thereby increase phosphorus credit demand. In addition, select WWTFs with high costs for WLA compliance may also wish to enter into such a market. In these instances, Lake Champlain Basin stakeholders and sources may be justified to consider developing a more complex trading system such as a clearinghouse. Though as this study demonstrates, additional costs to develop and administer a more complex trading program are not currently justified. And regardless of water quality trading program viability, Lake Champlain Basin stakeholders should also consider the use of a clearinghouse-like reverse auction to help optimize conservation payments to producers and achieve more cost-efficient implementation.

1. Introduction

Reducing the excessive phosphorus loads that cause impairments in Vermont's portion of the Lake Champlain Basin is the focus of the Draft August 2015 phosphorus Total Maximum Daily Load (TMDL) issued by the U.S. Environmental Protection Agency (EPA) Region 1. According to EPA, "long-term implementation of the TMDLs will have the greatest chance of achieving the necessary phosphorus reductions through programs developed and embraced by the State (EPA 2015)." The *Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan* (Phase I Implementation Plan) (State of Vermont 2014) developed by Vermont and submitted to EPA identifies key programs and approaches for achieving phosphorus allocations put forth in the TMDL. The estimated cost for achieving these phosphorus reductions is significant and requires an investment of resources by municipalities, agricultural operators, and other residential and commercial private property owners.

Prior to the completion of the TMDL, the Vermont Department of Environmental Conservation (DEC) and the Vermont Agency of Agriculture Food and Markets (AAFM) sought and received a U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Conservation Innovation Grant (CIG) (CIG 69-3A75-12-256) to assist in evaluating potential cost-effective, market-based approaches for achieving phosphorus reductions. Market-based approaches to nutrient reductions explored herein, involves nutrient sources with high stormwater control costs for achieving load reductions paying sources with lower control costs so as to meet reduction requirements.

Determining the best type of market-based approach for the Lake Champlain Basin requires an understanding of how environmental, economic, regulatory, and social factors interplay to create a potential market supply and demand. Through an understanding of potential market characteristics, different market approaches can be evaluated based on expected viability within a particular setting. Identifying an appropriate market approach allows for the development of program infrastructure that supports the potential market. Program infrastructure includes program rules, protocols, and processing to support program participation, certification, verification, tracking and accounting, and reporting. It is imperative that a market-based approach for the Lake Champlain Basin is developed in a manner that ensures market transactions are, at a minimum, transparent, real, accountable, defensible, and enforceable (EPA 2007).

Under the CIG, the Project Team of Tetra Tech, Inc. (Tt) and Kieser & Associates, LLC (K&A) were retained by DEC and AAFM to complete a market-based feasibility assessment for the Vermont portion of the Lake Champlain Basin. This report describes the findings of the evaluation given the constraints of the TMDL and implementation considerations being in very preliminary draft stages. Recognizing this early timeframe for evaluating market-based implementation considerations, it is relevant to first recognize that certain conditions must be met in order for market-based approaches to facilitate viable, sustainable programs. A market-based feasibility assessment is the process used to collect and analyze technical and economic information to determine if these conditions are present and adequately met. The basic factors needed for a viable market-based approach and applied herein include:

- **Regulatory drivers and incentives.** Without regulatory drivers or alternative incentives, pollutant sources may not be compelled to consider and, ultimately, participate in market-based approaches including water quality trading). Regulatory requirements provide the most compelling drivers for water quality trading. In most cases, these requirements are more stringent permit effluent limits or required load reductions based on stricter water quality standards or related compliance goals (e.g., TMDLs). In other cases, the driver could be a watershed pollutant reduction goal that might not have a regulatory component, but provides other incentives for meeting reduction goals (e.g., avoidance of a TMDL).

- **Sizeable differences in control costs among sources.** Sources with high pollutant control costs will have an economic motivation to seek out reductions from other sources that are able to control pollutants to meet requirements at a lower cost. Typically, agricultural sources are able to control nutrients at a lower cost than urban stormwater sources and wastewater treatment facilities. It is this difference in control costs among sources that will determine which sources might participate as buyers and which sources might have the ability to participate as sellers. Thus, the feasibility of market-based approaches is largely driven by economics, both actual and perceived costs (e.g., transaction costs and risk factors) where there is some driver to creating pressure to achieve water quality improvements. The greater the cost differences between sources' control costs, the greater potential there is for a viable market-based approach.
- **Adequate supply and demand.** Point source and non-point source phosphorus dischargers, who are regulated under the Vermont Lake Champlain TMDL, will be potential buyers and sellers in market-based approaches applied in the basin. Potential market structures assume phosphorus dischargers which can cost-effectively reduce loading will function as suppliers (sellers) in a market while dischargers with higher costs for reduction will represent demand (buyers). For this analysis, agricultural sources are most likely supplying phosphorus load reductions due to lower control costs and regulated point sources, such as stormwater permittees will have a demand for these phosphorus reductions due to higher control costs. A market with incongruent supply and demand will likely prove inadequate for long-term program viability.[1]
- **Stakeholder and regulatory agency willingness.** Viable market-based approaches need broad stakeholder support to move beyond a conceptual phase. Stakeholder support should include potential credit buyers and sellers that will generate the market's actual supply and demand. Regulatory agency staff must also demonstrate support as they are responsible for ensuring attainment of water quality standards, as well as monitoring and enforcing state and federal regulatory requirements. In addition to these two key groups of stakeholders, it is imperative that the general public understand and support selected market-based approaches prior to full-scale implementation.

1.1 Overview of Vermont's Lake Champlain Basin Market-Based Strategy Evaluation Project

In 2014, DEC and AAFM initiated a process to analyze market-based approaches for nutrient reductions in the Lake Champlain Basin. Supported by CIG funding, the goals of the project included helping the State of Vermont to:

- Achieve the overall phosphorus pollution reduction targets of the Lake Champlain TMDL in a cost-effective manner;
- Reduce costs to the regulated sector in meeting pollutant discharge limits;
- Establish incentives for voluntary phosphorus load reductions above baseline water quality requirements; and
- Accommodate continued growth and economic development.

[1] As will be discussed later in this document, consideration of wastewater treatment facilities (WWTFs) as potential buyers was deferred in this analysis as early deliberations by DEC and EPA suggested that reallocation opportunities between and amongst this sector would likely preclude these facilities from market-based program (e.g., water quality trading) participation.

These goals served as the basis for the market-based feasibility assessment described herein.

1.1.1 Project Tasks

Beginning in December 2014, the Project Team of Tt and K&A initiated four primary tasks associated with the CIG project including:

- **Task 1: Prepare a Feasibility Study and Market Analysis to Inform Trading Program Strategy Selection.** The focus of this task was to gauge the potential viability of market-based approaches for achieving phosphorus reductions in the Lake Champlain Basin. The feasibility study and market analysis provides a snapshot in time of the regulatory drivers, the Basin's geographic conditions influencing phosphorus fate and transport, and variations of estimated phosphorus control costs among sources. Despite the evolving regulatory landscape of the Lake Champlain Basin, the analysis conducted under this task was based on existing data, the current status of regulations and regulated sources, and assumptions intended to streamline the analysis given project resource constraints.
- **Task 2. Conduct Analysis of Nutrient Trading Strategies and Recommend Applicable Strategy for the Vermont Portion of Lake Champlain Basin.** This task applied the feasibility study and market analysis findings from Task 1 to identify the most applicable market-based strategies for the Lake Champlain Basin given the regulatory, environmental, and economic conditions. The goal of this task was to identify one or more market-based strategies that are technically viable as well as socially acceptable to Lake Champlain Basin stakeholders.
- **Task 3. Develop Market-Based Framework of the Recommended Trading Program.** The purpose of this task was to identify the framework components of the recommended market-based strategy identified under Task 2. Framework components included program rules, public participation, baselines for generating credits, restrictions to avoid hotspots, program infrastructure, verification/certification and tracking/accounting needs, risk assurances, and funding/costs.
- **Task 4. Conduct Stakeholder Involvement and Identify Pilot Project Considerations.** The objective of this task was to assemble and facilitate a watershed advisory committee to provide the Project Team with input over the course of the project. A Lake Champlain Nutrient Reduction Market-based Watershed Advisory Committee provided feedback on issues related to data, assumptions, and recommendations. In addition, this task included development of considerations for conducting a pilot project of the recommended market-based strategy.

Executing these project tasks required close coordination with DEC, AAFM, and the Advisory Committee over the course of the nine-month project to ensure the Project Team had the most recent information at critical points in the project. However, given the fact that the regulatory landscape of the Lake Champlain Basin evolved rapidly over the course of the project and the project had a constrained schedule, the Project Team could not always incorporate updated or new information into the analysis. The Project Team worked with DEC, AAFM, and the committee to document where additional analysis in a subsequent phase of the market-based program development process might be necessary.

1.1.2 Lake Champlain Market-Based Nutrient Reduction Watershed Advisory Committee

Stakeholder involvement is a key component to the analysis and development of watershed market-based approaches. The viability of such approaches includes public and agency support. Therefore, it is imperative to include representatives from stakeholder groups that might participate in a credit market as a buyer, seller, third-party aggregator/verifier, and regulatory entity.

For this project, DEC and AAFM identified Lake Champlain Basin stakeholders to participate on a Watershed Markets Advisory Committee. Table 1 includes the names and affiliations of individuals who participated in this regard.

Table 1. Vermont Lake Champlain Basin Stakeholders Invited to Participate on the Advisory Committee

Organization	Representative Names
State Agencies	
Vermont Department of Environmental Conservation	Kari Dolan Rick Hopkins David Pasco Jim Pease Eric Smeltzer
Vermont Agency of Agriculture Food & Markets	Laura DiPietro Mike Middleman
State Organizations	
Vermont Association of Conservation Districts	Jill Arace
Vermont Association of Planning & Development Agencies	Charlie Baker
Vermont League of Cities and Towns	Karen Horn
Academia and Non-Governmental Organizations	
University of Vermont Extension	Josh Faulkner
Conservation Law Foundation	Chris Kilian
The Lake Champlain Committee	Mike Winslow
Friends of Northern Lake Champlain	Denise Smith
Source Sectors	
City of Burlington	Megan Moir
City of Essex Junction	Jim Jutras
St. Albans Cooperative Creamery, Inc	Jacques Parent
Vermont Citizens Advisory Committee (former chair)	Buzz Hoerr
Federal Agencies	
U.S. Environmental Protection Agency Region 1	Eric Perkins
Natural Resources Conservation Service	Vicky Drew Kip Potter

Advisory Committee members participated in four meetings throughout the project to provide feedback on the project approach, assumptions, data, and analysis results. Appendix A contains a compilation of the presentations from these meetings. Input from committee members helped to ground-truth and validate cost assumptions, provide insights on anticipated phosphorus reduction implementation requirements, and gauge interest in various market-based approaches. The committee also identified numerous issues and considerations that would require additional analysis beyond this initial assessment phase. The results of the project benefitted substantially from their time and involvement.

1.2 Purpose of this Report

This report represents the culmination of the four CIG project tasks intended to determine the feasibility of market-based approaches in the Lake Champlain Basin to more efficiently and cost-effectively achieve the required phosphorus reductions. Findings from this report are intended to provide a preliminary screening and evaluation of the conditions necessary for potentially viable market-based approaches to reducing phosphorus in Vermont's portion of the Lake Champlain Basin. As an initial phase in a market-based approach development process, the findings of this report will help DEC, AAFM, and other key Lake Champlain Basin stakeholders determine if a future investment of time and resources for pursuing market-based tools to aid existing program implementation is warranted. Consider, however, that this report provides a high-level snapshot of the opportunities and challenges reflecting the available data and the assumptions necessary to conduct this analysis given the project's schedule and resource constraints. The regulatory, legislative, and programmatic landscape of the Lake Champlain Basin is constantly evolving. As a result, it was necessary to establish a certain set of assumptions and best available data at the time of the analysis to allow the project to move forward. The Project Team recognizes that the information contained in this analysis will change. However, the findings of this report–regardless of changes to the data–adequately illustrate the viability of market-based approaches to allow DEC, AAFM, and other Lake Champlain Basin stakeholders to make an informed decision about next steps.

The remainder of this report is organized as follows:

- **Section 2: Feasibility Study and Market Analysis.** This section provides a discussion of the process and findings of the feasibility study and market analysis conducted to estimate the potential viability of market-based approaches in the Lake Champlain Basin resulting from the estimated phosphorus credit supply and demand.
- **Section 3: Market-Based Strategy Options.** This section provides an overview of the various market-based structures and the most appropriate type of market-based structure(s) for the Lake Champlain Basin based on the findings of the Feasibility Study and Market Analysis presented in Section 2.
- **Section 4: Pilot Approach Analysis and Considerations.** This section assesses the most feasible potential market-based strategies recommended in Section 3 and conducts a pilot project analysis for the Main Lake-Winooski lake segment of the Lake Champlain Basin. In addition to looking at potential cost savings with and without market-based strategies, this section also addresses the estimated market-based program development costs and the impact on the estimated overall cost savings.
- **Section 5: Market-Based Framework Recommendations.** This section provides details on the framework elements of the market-based structure recommended due to the assumed viability of the phosphorus credit market in the Lake Champlain Basin.
- **Section 6: Conclusions and Recommended Next Steps.** This section summarizes the findings of all four CIG project tasks that characterize the potential feasibility and cost savings of developing and implementing market-based approaches to achieve phosphorus reductions in the Lake Champlain Basin. In addition, this section identifies data needs and additional analyses for the next phase of assessing and developing market-based programs in the Lake Champlain Basin.
- **Appendix A:** Watershed Advisory Committee presentations
- **Appendix B:** Best Management Practice Cost Analysis
- **Appendix C:** Clearinghouse Structures in Action
- **Appendix D:** Baseline Considerations

2. Feasibility Study and Market Analysis

This section discusses the elements, approach, and findings of the market-based feasibility analysis for the Lake Champlain Basin (Task 1). The purpose of the market feasibility analysis was to conduct a preliminary assessment for the potential of a viable market to help achieve phosphorus reductions. This analysis is an initial assessment which analyzed existing data based on pollutant and economic suitability for a market-based program. The purpose of this analysis was not to collect new data, but to help Lake Champlain Basin stakeholders identify areas where additional data and information might be needed to support future market-based feasibility assessment activities and market-based program development. Where data were not available or where new or updated data became available too late in the project to include in the analysis, the Project Team identified next steps for a Phase II analysis and development process.

A typical market feasibility analysis has two components: 1) pollutant suitability analysis and 2) economic suitability analysis.

- The pollutant suitability analysis includes information on regulatory drivers, pollutant type and form, geographic scope, potential buyers and sellers, potential water quality trading credit supply and demand, potential trade ratios to account for pollutant fate and transport as well as uncertainty, issues related to avoiding localized areas of excessive pollutant loading (i.e., hotspots), and duration of water quality trading credits.
- The economic suitability analysis includes information on potential buyers' willingness-to-pay for water quality credits, potential sellers' price for generating water quality credits, effect of trade ratios on the cost of water quality credits, and the potential costs of involving stakeholders in designing and implementing a market-based program, such as water quality trading.

Information from each of these components provides insight as to where market-based approaches might encounter barriers and what type of market-based structure and framework might be most appropriate based on the sources with the greatest potential for participation and the associated controls with the greatest cost differentials.

The market feasibility analysis is an initial step in the overall market-based program development process. The results of the analysis are not intended to provide definitive answers about how a program should operate in the Lake Champlain Basin, only if the conditions are appropriate to support such an effort. Subsequent market-based program selection, design, and implementation require continued coordination and facilitation with Lake Champlain Basin stakeholders to ensure the program integrates with other State efforts. Findings from the market feasibility analysis can, however, give Lake Champlain Basin stakeholders a starting place and foundation when moving into the program design phase. The analysis can also identify where watershed stakeholders will potentially have to do additional research to obtain detailed, watershed-specific information that could affect market-based program success. Obtaining this information may require holding focus groups with point sources and nonpoint sources to better understand attitudes, perceptions, and concerns as well as holding public meetings with Lake Champlain Basin residents and organizations.

For purposes of discussion and assessment of market-based applicability, water quality trading is primarily targeted in the remainder of this analysis. There are, however, a number of other market-based program approaches integrated in both discussion and analysis in this report.

2.1 Regulatory Drivers for Market-based Approaches

Regulatory drivers for market-based approaches for achieving water quality goals in the Lake Champlain Basin must define both water quality goals as well as mechanisms for implementing practices to achieve these goals. Water quality standards, like those in the Vermont Lake Champlain Basin phosphorus TMDL, and water quality-based effluent limits in federal National Pollutant Discharge Elimination System (NPDES) permits, provide measureable targets that can drive market-based approaches for regulated entities. For agriculture and urban nonpoint sources, the TMDL, state-issued permits, and state regulations establish targets that can create interest in water quality markets.

2.1.1 Vermont's Lake Champlain Basin Phosphorus Total Maximum Daily Load and Phase 1 Implementation Plan

The U.S. Environmental Protection Agency (EPA) is in the process of developing a Lake Champlain Phosphorus TMDL. EPA released a public draft in August 2015 for public review and comment. This was released much later than originally targeted and within about 1.5 months of the endpoint of this analysis. Moreover, potential implementation efforts are only just now evolving creating challenges as to how sources will be regulated and enforced, as well as compliance timelines over the course of the 20-year TMDL implementation period. These constraints greatly limited the Project Team's ability to forecast critical conditions for a potential nutrient reduction market. That said, the TMDL and related source allocations become the quintessential elements for examining potential market-based phosphorus reduction opportunities.

The TMDL identifies the maximum amount of phosphorus allowed to enter each segment of Lake Champlain, and allocates those maximum amounts among the various sources within each major watershed draining to Vermont's portion of the Lake Champlain Basin. The numeric criteria from the water quality standards are used to calculate the loading capacity for the lake segments. The loading capacity is apportioned through waste load allocations (WLAs) for point sources (WWTFs and stormwater from developed lands) and load allocations (LAs) for nonpoint sources (principally agriculture). These WLAs and LAs will are expressed as loads of TP that may be discharged by each source or source category annually.

TMDLs can provide a primary regulatory driver for point sources to participate in market-based approaches in impaired watersheds because the WLAs are typically implemented as: 1) water-quality based effluent limits expressed as numeric limits in NPDES permits, or 2) as technology (BMP)-based requirements in state general stormwater permits under the NPDES program. Generally, the TMDL WLAs for the Lake Champlain Basin will be implemented in NPDES permits or state/municipal permits. For nonpoint sources, the LAs provide targets to be achieved through state permits, standards and guidelines, and incentive programs.

Vermont's Lake Champlain Basin phosphorus TMDL implementation process is divided into two distinct planning phases with regard to EPA's requirements of Vermont. For the first phase, EPA requires Vermont to develop a basin-wide implementation plan that identifies policy commitments that will reduce nonpoint source phosphorus loads (Phase 1 Plan). After EPA finalizes the TMDL, Vermont will have to develop sub-basin implementation plans (Phase 2 Plans) for each lake segment that identify in more detail the specific point source and nonpoint source measures and practices to be implemented by identified dates.

The Phase 1 Plan was published on May 29, 2014 describing state-wide policy commitments that address all major nonpoint sources of phosphorus to the lake. The plan also describes existing regulatory mechanisms, planned regulatory revisions and enhancements to address point sources of phosphorus. Those commitments that are relevant to market-based approaches are summarized in the following sections.

2.1.2 Other Potential Drivers

Beyond regulatory requirements, other factors have the potential to affect the feasibility of market-based approaches in the Lake Champlain Basin. Two notable examples are future development and incentive programs for BMP implementation.

Future Growth

Projections of future growth are not included in the Phase 1 Plan for Lake Champlain. Regardless, any projections for such growth are typically speculative, but will certainly result in additional wastewater and likely stormwater phosphorus loads. The former would fall under the point source strategy contemplated by DEC to allow flexibility amongst WWTFs to meet WLAs. Thus, these were early on considered beyond the bounds of this feasibility assessment. Additional stormwater loads associated with new growth should be a policy consideration for local or state authorities. Existing examples are useful to demonstrate where additional stormwater from growth is being managed to be effectively zero for new development or re-development. Programs such as stormwater offsets being implemented for Lake Simcoe in Ontario will require a net zero load (XCG and K&A 2014). Offsets would be required from retrofits of existing stormwater infrastructure. The District of Columbia's Stormwater Retention Credit program similarly requires minimizing stormwater loads from new development or re-development projects with the purchase of volume reductions elsewhere (DEE 2015). As such, growth in the context of market-based approaches for Lake Champlain will otherwise be discussed in the market framework analysis but not assessed as a driver for supply and demand, especially absent considerations in the TMDL.

Incentive Programs

Incentives, including technical and financial assistance programs, can affect both credit supply and demand for a market-based approach. By making BMP implementation more accessible, incentive programs can influence demand by increasing implementation among sources that might otherwise purchase reductions through a market-based approach. However, because many incentive programs (e.g., Environmental Quality Incentives Program [EQIP], Conservation Reserve Enhancement Program [CREP]) primarily focus on nonpoint agricultural pollutant sources that are more likely to drive supply by increasing BMP implementation among those sources. NRCS's Regional Conservation Partnership Program (RCPP) is an example that illustrates how incentive programs might drive the supply side of the market in the Lake Champlain Basin.

The State of Vermont received $16M in funding from USDA-NRCS's RCPP program to help Vermont landowners reduce nutrient runoff to Lake Champlain. A second RCPP grant of $880,000 will support the Vermont Association of Conservation Districts to address identified gaps in technical services to small livestock farm producers for developing Land Treatment Plans (LTPs), nutrient management plans (NMPs), and Comprehensive Nutrient Management Plans (CNMPs). Collectively, funding for conservation practices and technical services can be integrated into market-based approaches being considered for Lake Champlain. While future restrictions may prevent the use of these funds for the purposes of generating water quality trading credits, monies could be used to help farmers meet baseline requirements of the TMDL. This scenario requires further considerations from DEC and EPA.

For this report, funds available through RCPP will be applied to cost projections for agricultural BMP implementation to determine potential non-point source load reduction resulting from these grant funds. Analogous to market-based approaches, distribution of RCPP funds could be based on performance metrics which would optimize RCPP fund investments by supporting the most cost-effective management practices.

2.2 Suitable Pollutants for Market-based Approaches

Excessive phosphorus loading is considered to be the greatest threat to clean water in Lake Champlain (State of Vermont 2014). Phosphorus concentrations in excess of water quality standards have been documented in most parts of the lake and many lake regions are suffering the effects of eutrophication due to the excessive phosphorus loads. Phosphorus is considered an appropriate pollutant for water quality trading under U.S. EPA's 2003 Water Quality Trading Policy and the U.S. EPA *Water Quality Trading Toolkit for Permit Writers*. While phosphorus occurs in different forms (e.g., soluble vs. particulate) and is cycled through complex pathways in the environment, many water quality monitoring programs – including those conducted for Lake Champlain – focus on total phosphorus (TP). Similarly, many watershed and lake modeling efforts track TP as the principal metric of water quality response to nutrient enrichment. The Lake Champlain Phosphorus TMDL will establish LAs and WLAs for TP. Therefore, TP is the pollutant form on which the market feasibility analysis for Vermont's portion of the Lake Champlain Basin is based.

The use of TP for both the TMDL and as a basis for market-based approaches is, of course, an oversimplification. Phosphorus is contributed to Lake Champlain from both point and nonpoint sources in varying proportions, including WWTF effluent; stormwater from developed lands, roads, construction, and industrial sites; sediment from forested areas, agricultural lands, and streambank erosion; and organic and inorganic fertilizers. These sources discharge different forms of phosphorus that react differently in the aquatic environment. Most of the phosphorus discharged by WWTFs, for example, is in soluble form (MPCA 2007). Commercial fertilizers contain predominantly soluble forms of phosphorus. Phosphorus in manure, while composed mostly of soluble orthophosphate, also includes organic P forms that are significantly less soluble (ASABE 2005). Particulate forms of P in stormwater runoff include both sediment-bound and organic forms. Sediment-bound phosphorus in stormwater arises primarily from erosion of exposed soils such as on construction sites and from impervious surfaces where soil particles may accumulate such as roadways and parking lots. Organic forms come from runoff that contacts pet waste and other organic sources as well as combined sewer overflows that occur during large storm events. Soluble forms of phosphorus in stormwater result from application of fertilizers to residential sites and commercial turf.

Bioavailability—the capacity of a nutrient to readily support biological production—typically varies among phosphorus sources. Phosphorus discharged from WWTFs, for example, tends to be highly bioavailable whereas phosphorus adsorbed to soil particles is generally far less available to support algal growth. Regardless of source, bioavailability of phosphorus in streams tends to vary significantly over the seasons, generally highest in summer and lowest in fall (Hoffmann et al. 1996).

Downstream movement of phosphorus from varied sources is subject to numerous uptake and release mechanisms and is often thought of as a spiraling process, involving varying cycling, redistribution, and detention of soluble and particulate P forms, coupled with continuous downstream flow (Elwood et al. 1983). Hydrology is obviously a major driving force; flow energy and velocity influence sediment transport, rates of channel erosion and deposition, and deposition of sediment in floodplains. Within the stream, phosphorus is stored and cycled among several biotic and abiotic compartments, including suspended and bed sediments, periphyton, aquatic macrophytes, and detritus. The net effects of these phenomena on phosphorus fate and transport are variable and difficult to predict on a watershed or basin scale. Detention of sediment and particulate-bound phosphorus can create a significant lag time in delivery of pollutant loads from watershed to receiving waters (Meals et al. 2010) and some models (e.g., SWAT) consider attenuation of phosphorus loads with transport distance. However, some work in the Lake Champlain Basin has suggested that significant attenuation of annual phosphorus loading from terrestrial sources by in-stream processes cannot be maintained over the long term (Hoffmann et al. 1996). The study concluded that in-stream TP will ultimately be delivered to the lake; the rate of transport from source to lake will vary, but is probably limited within the bounds of one year or less. The authors recommended that upstream distance alone is not an adequate justification for targeting phosphorus load reduction efforts.

Scrutiny of issues surrounding phosphorus form, bioavailability, and transport are important considerations in the context of water quality market-based approaches. Understanding bioavailability from different sources could assist in preventing localized hotspots and ensuring that water quality is protected by avoiding trading control of bioavailable forms for unavailable forms.

2.3 Geographic Scope for Market Analysis

2.3.1 Scale Options for Market-Based Approaches in the Lake Champlain Basin

Vermont's portion of the Lake Champlain Basin is divided into five distinct areas, each with different physical and chemical characteristics and water quality. These lake segments include: the South Lake, the Main Lake (or Broad Lake), Malletts Bay, the Inland Sea (or Northeast Arm), and Missisquoi Bay (Lake Champlain Basin Program, undated). For purposes of phosphorus management, Lake Champlain is further divided into 13 segments, which receive flow from eight drainages, as shown in Figure 1 and Table 2.

Through the TMDL development process, EPA Region 1 has developed phosphorus allocations for the basins draining to 12 of the 13 lake segments. These allocations are based on water quality standards, the Lake's loading capacity, and the varying phosphorus concentrations in the lake segments. As a result, the geographic scope for market-based approaches in the Lake Champlain Basin are likely to follow the boundaries of the basin areas draining to the 12 lake segments delineated for phosphorus management with allocations under the TMDL. The Watershed Markets Advisory Committee discussed the potential opportunities for inter-lake segment market-based approaches where the location of phosphorus sources in adjacent lake segments might be suitable. However, for purposes of this market-based feasibility analysis, the assumption was no inter-lake segment exchanges would exist. The Committee agreed to this approach for purposes of the analysis to ensure consistency with the TMDL and the avoidance of unintentional pollutant hot spots within the Lake Champlain Basin.

Several Committee members expressed an interest in further deliberations on the possibility of water quality trading or other market-based approaches across segments that have phosphorus loads with similar in-lake effects. For example, modeled phosphorus concentrations in the Main Lake are almost equally sensitive to phosphorus loads from the Main Lake Direct Discharge, Burlington Bay, and Shelburne Bay drainage areas. Therefore, a Phase II assessment should evaluate the potential for trading among sources within those segments. Trading among sources in segments with different allocations and different targets in the lake would require additional modeling to evaluate each trade, which likely is not feasible.

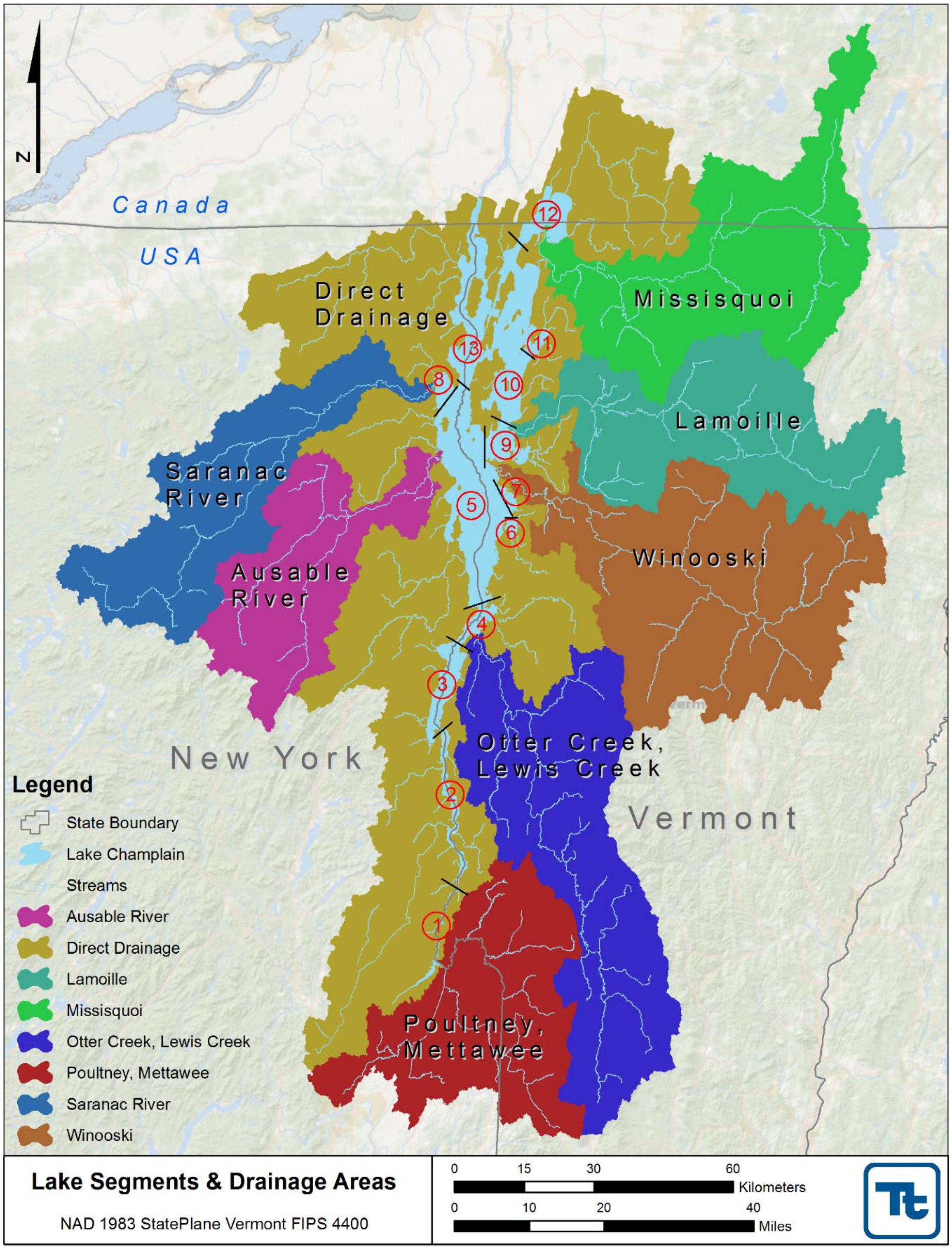

Figure 1. Lake Champlain Basin Lake Segments and Drainage Areas

Table 2. Lake Champlain Basin Lake Segments and Drainage Areas

Lake Segment	Drainage Areas
1-South Lake B	Poultney River
	Mettawee River
	South Lake B Direct Drainage
2-South Lake A	South Lake A Direct Drainage
3-Port Henry	Port Henry Direct Drainage
4-Otter Creek	Otter Creek
	Little Otter Creek
	Lewis Creek
5-Main Lake	Winooski River
	Main Lake Direct Drainage
6-Shelburne Bay	LaPlatte River
7-Burlington Bay	Burlington Bay Direct Drainage
8-Cumberland Bay	Saranac River
	Cumberland Bay Direct Drainage
9-Malletts Bay	Lamoille River
	Malletts Bay Direct Drainage
10-Northeast Arm	Northeast Arm Direct Drainage
11-St. Albans Bay	St. Albans Bay Direct Drainage
12-Missisquoi Bay	Missisquoi River
	Missisquoi Bay Direct Drainage
13-Isle La Motte	Isle La Motte Direct Drainage

Landscape features and erosive processes must be considered when determining the appropriate geographic scope for market-based approaches. For example, a water quality market might exclude phosphorus sources whose discharge is largely intercepted by wetlands or other phosphorus sinks because load reductions at those sources would not result in reduced phosphorus loads to the lake. Ideally, market-based approaches would consider how technologies and BMPs implemented on the land might affect erosive processes in receiving waters when evaluating credit supply and establishing exchange or "trade" ratios that account for such variable conditions as well as associated uncertainties. Realistically, however, data may not be available to support quantification of those relationships.

2.4 Potential Credit Buyers and Sellers

A market for phosphorus reduction credits only exists if a demand for these reductions is present in the potential market. Supply and demand will be established by sources subject to WLAs and LAs under the TMDL. Determining which sources are credit producers and buyers will ultimately depend on the cost of phosphorus reductions for a given entity. Identifying potential buyers and sellers is a crucial step in conducting the feasibility assessment and market analysis.

A potential credit buyer is a phosphorus source that is required to achieve a specific phosphorus reduction or water quality goal, but is unable to do so through optimization of existing or installation of new control technologies in a cost-effective manner. Credit buyers may also include government, non-profit, or private sector entities that desire to invest in actions to improve water quality. A potential credit seller is a phosphorus source that is required to achieve a specific phosphorus reduction, referred to as a baseline, but is also able to cost effectively over-control their source discharge, creating a surplus reduction that is available to sell to other sources that cannot efficiently meet their phosphorus reduction requirements.

The universe of potential buyers and sellers in the Lake Champlain Basin aligns with the regulatory drivers described in Section 3.1. Table 3 identifies the regulatory driver for each type of phosphorus source and summarizes the universe of potential buyers and sellers. Although Table 3 focuses only on pollutant sources in the basin, it is important to note that state and federal agencies are also potential credit buyers.

Table 3. Potential buyers and sellers based on regulatory drivers for phosphorus source types

Phosphorus Source Type	Associated Regulatory Driver	Potential Buyer	Potential Seller
Point Sources			
Wastewater Treatment Facilities (WWTFs)	NPDES numeric WQBEL to implement final approved WLA	X[a]	X[a]
Aquaculture	NPDES numeric WQBEL to implement final approved WLA	X[a]	X[a]
Industrial	NPDES numeric WQBEL to implement final approved WLA	X[a]	X[a]
Municipal Separate Storm Sewer Systems (MS4s)	NPDES BMP-based WQBEL in MS4 General Permit to implement final approved WLA	X	X[b]
Construction storm water	NPDES BMP-based WQBEL in Construction General Permit to implement final approved WLA	X	X[b]
Industrial storm water	NPDES BMP-based WQBEL in MSGP to implement final approved WLA	X	X[b]
RDA-designated stormwater discharger	NPDES BMP-based requirements in general permits, as specified in the Small Sites Guide	X	X[b]
CAFOs	NPDES BMP-based WQBEL in CAFO General Permit to implement final approved WLA	X	X[b]
Nonpoint Sources			
LFOs	BMP requirements in LFO individual permits and AAPs	X	X[b]
MFOs	BMP requirements in MFO general permits and AAPs	X	X[b]
Non-livestock agriculture operations	BMP requirements in AAPs	X	X[b]
Stormwater from impervious surfaces (non-MS4)	BMP requirements in state operational permits, as specified in VSMM	X	X[b]
Logging operations	BMP requirements specified in AMPs	X	X[b]

a. At the outset of this project, DEC stated that a separate process for reallocating the WLA among wastewater treatment facilities would be used; therefore this market-based feasibility assessment did not include WWTFs in the analysis. However, information provided by DEC near the completion of the project illustrated that the reallocation policy among WWTFs would not be sufficient for achieving the WLA. As a result, it is possible that WWTFs would participate as potential credit buyers.
b. Sources subject to BMP-based requirements might participate as credit sellers provided a market-based program or the program that establishes the required BMPs clarifies expectations for baseline BMP implementation.

2.5 Estimating Potential Credit Supply and Demand

A market-based feasibility assessment must address two critical questions, which entities will require credits, and which entities will supply credits. Determining the most appropriate market-based strategy for the Lake Champlain Basin will depend on the size of the potential market and participants as derived from the feasibility assessment.

Impending state stormwater regulations posed a challenge for defining regulated phosphorus sources in the Lake Champlain Basin for purposes of this project. This, coupled with overall project resource and time constraints, resulted in the need for the Project Team to use a streamlined approach for estimating potential credit supply and demand. Under the streamlined approach, the Project Team estimated phosphorus credit supply and demand at the lake segment level using only existing information generated through the TMDL development process, including the most recent TMDL allocations. This provided a broad-scale understanding of the supply and demand in each lake segment basin to make general assumptions about the potential credit market and the most appropriate market-based strategy for Vermont's portion of the Lake Champlain Basin, depending on the assumed robustness of the market. It is important to note that credit supply and demand is best reflected at the field-scale rather than the lake segment basin scale. Therefore, credit supply and demand estimates resulting from this analysis are high-level projections, acknowledging that individual opportunities for credit transactions would likely exist on a case-by-case basis.

2.5.1 Overall Assumptions for Estimating Potential Credit Supply and Demand

Given the rapidly changing regulatory landscape for the Lake Champlain Basin, the market feasibility analysis included a number of assumptions for estimating potential phosphorus credit supply and demand. Prior to the release of the draft TMDL, EPA Region 1 provided Tt estimates of the TMDL's required percent reductions for existing developed land and agricultural sources. These percent reductions are the basis for the potential supply and demand analysis. Due to the timing of analysis for this project and the issuance of the draft TMDL, the Project Team was unable to use the exact percent reductions to urban lands as are called for in the draft TMDL. Comparison of the percent reductions used for this analysis and the draft TMDL indicate however, that the differences are minimal. The market feasibility analysis used the Developed Land WLAs and Agriculture LAs shown in Table 4. The allocations assigned to each source type by lake segment drainage basin shown in Table 4 served as the baseline (for credit sellers) and water quality goals (for credit buyers) for estimating market supply and demand in the Lake Champlain Basin. An overall assumption for the market feasibility analysis is that phosphorus reductions assigned to sources will be required over a 20-year period starting immediately after EPA Region 1 finalizes the TMDL.

Table 4. Percent phosphorus reductions for developed lands and agriculture by lake segment from the draft Vermont Lake Champlain Basin Phosphorus TMDL

Lake Segment	% Developed Land[1] Reduction	% Agriculture reduction
1. South Lake B	23%	59%
2. South Lake A	21%	59%
3. Port Henry	11%	20%
4. Otter Creek	20%	47%
5. Main Lake	20%	47%
6. Shelburne Bay	13%	20%
7. Burlington Bay	11%	0%
8. Malletts Bay	22%	28%
9. Northeast Arm	9%	20%
10. St. Albans Bay	8%	37%
11. Missisquoi Bay	28%	84%
12. Isle LaMotte	10%	20%

[1] Includes reductions needed to offset future growth

2.5.2 Assumptions for Estimating Potential Credit Supply

Fundamental to agriculture representing supply for a market-based program in the Lake Champlain Basin is the assumption that credits may be generated by conservation practices for all agricultural operations other than those associated with farmstead loading. The Project Team assumed that the small fraction of farmstead reductions within the overall agricultural load allocation is associated with manure discharges and therefore considered non-creditable. All other agricultural reductions assume loading occurs via agricultural runoff, a process generally considered to be creditable in most market-based programs. These LA reductions represent potential supply in a possible Lake Champlain Basin credit market.

Baselines

In market-based approaches, particularly water quality trading, potential credit sellers must first implement controls to meet a minimum threshold, or a baseline. Pollutant reductions beyond the baseline are then eligible to be sold as credits. Baseline establishment may have an effect on market viability for a particular watershed. Figure 2 illustrates how more stringent baseline requirements can shrink the supply of nutrient reductions (often referred to as “credits” in water quality trading exchanges) and raise credit costs, thereby suffocating the potential for a market-based approach, particularly water quality trading.

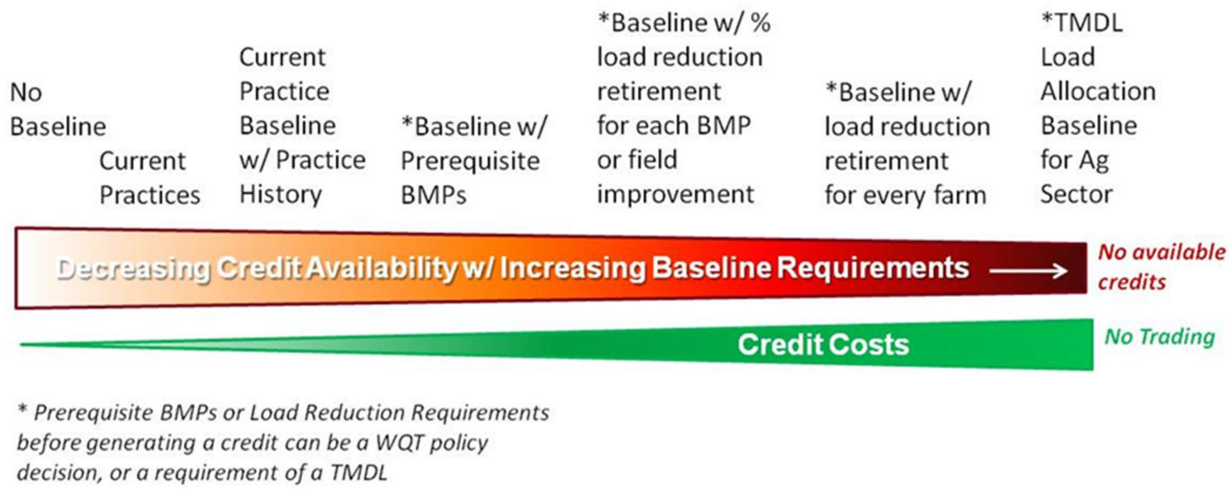

Figure 2. Effects of Various Types of Baseline Requirements on Market-Based Approaches

For agricultural sources in the Lake Champlain Basin, applicable TMDL LAs and the implementation requirements to achieve these LAs serve as the baseline. Therefore, the Project Team evaluated the potential phosphorus reductions from agricultural sources (with the exception of farmsteads) that would go above and beyond the LA to generate possible credits in the Basin.

Early in this analysis, prior to the issuance of the August 2015 public draft TMDL, the Project Team evaluated various combinations of BMPs and the assumed application rates for two of EPA's test scenarios generated as part of the TMDL development process. The Project Team looked at EPA's 'lower range BMP scenario' that included a diverse mix of BMPs applied to agricultural, developed, forested, and stream channel sources to meet loading targets. This scenario, and all other tested scenarios that meet targets, represent an extensive combination of BMPs on agricultural land. Table 5 presents anticipated baseline levels of agricultural BMP implementation required for lands within the Missisquoi and South Lake B basins to meet required targets during TMDL development. Table 6 presents baseline levels of agricultural BMP implementation required in all other basins. The application of low and high range BMP scenarios suggest that aggressive levels of agricultural BMP implementation are needed to achieve LAs. This high level of BMP adoption may limit a farmer's ability to go beyond the baseline for credit generation. As a result, the Project Team considered it reasonable to assume that agricultural credit supply will be insufficient to meet demand from stormwater sources seeking to achieve WLAs implemented through permit requirements.

Table 5. Baseline level of Agricultural BMP application for Areas draining to Missisquoi Bay and South Lake B

Landuse Type	HSG	Slope	BMP Type	Applied Area (%)
Corn-hay rotation on non-clayey soils	A	All	CC, CT, GWW, DB, RB	100%
Corn-hay rotation on non-clayey soils	B	All	CC, CT, GWW, DB, RB	100%
Corn-hay rotation on non-clayey soils	C	All	CC, CT, GWW, DB, RB	100%
Continuous corn on non-clayey soils	A	All	CC, CT, GWW, DB, RB	100%
Continuous corn on non-clayey soils	B	All	CC, CT, GWW, DB, RB	100%
Continuous corn on non-clayey soils	C	All	CC, CT, GWW, DB, RB	100%
Continuous hay	A	M (5%-10%)	RB	80%
Continuous hay	A	H (>10%)	RB	80%
Continuous hay	B	All	RB	80%
Continuous hay	C	All	RB	85%
Pasture	All	All	Fencing/Livestock Exclusion with RB	80%
Corn-hay rotation on clayey soils	D	All	CC, CT, GWW, DB, RB	40%
Continuous corn on clayey soils	D	All	CC, CT, GWW, DB, RB	40%
Corn-hay rotation on clayey soils	D	All	CR, GWW, DB, RB	40%
Continuous corn on clayey soils	D	All	CR, GWW, DB, RB	40%
Continuous hay	D	All	RB	85%
Farmstead_Medium-Large	All	All	Barnyard Management	90%
Farmstead_Small	All	All	Barnyard Management	90%

Table Abbreviations:
CC = cover crops
CT = conservation tillage
MI = manure injection
CR = changes in crop rotation
GWW = grassed waterways
RB = riparian buffer
DB = ditch buffers
CTH = crop to hay (conversion of corn or corn-hay rotation cropland to continuous hay)

Table 6. Baseline level of Agricultural BMP application for Areas draining to other Lake Segments

Main Lake Drainage Area BMPs (Winooski River and Main Lake Direct Drain)

Landuse Type	HSG	Slope	BMP Type	Applied Area (%)
Corn-hay rotation on non-clayey soils	A	All	CC, CT, MI, GWW, RB	80%
Corn-hay rotation on non-clayey soils	B	All	CC, CT, MI, GWW, RB	80%
Corn-hay rotation on non-clayey soils	C	All	CC, CT, MI, GWW, RB	80%
Continuous corn on non-clayey soils	A	All	CC, CT, MI, GWW, RB	80%
Continuous corn on non-clayey soils	B	All	CC, CT, MI, GWW, RB	80%
Continuous corn on non-clayey soils	C	All	CC, CT, MI, GWW, RB	80%
Continuous hay	A	M (5%-10%)	RB	80%
Continuous hay	A	H (>10%)	RB	80%
Continuous hay	B	All	RB	80%
Continuous hay	C	All	RB	80%

Landuse Type	HSG	Slope	BMP Type	Applied Area (%)
Pasture	All	All	Fencing/Livestock Exclusion with RB	80%
Corn-hay rotation on clayey soils	D	All	CC, CT, GWW, DB, RB	40%
Continuous corn on clayey soils	D	All	CC, CT, GWW, DB, RB	40%
Corn-hay rotation on clayey soils	D	All	CR, GWW, DB, RB	40%
Continuous corn on clayey soils	D	All	CR, GWW, DB, RB	40%
Continuous hay	D	All	RB	80%
Farmstead_Medium-Large	All	All	Barnyard Management	90%
Farmstead_Small	All	All	Barnyard Management	90%
Corn-hay rotation on clayey soils	D	M (5%-10%)	Crop to Hay	20%
Corn-hay rotation on clayey soils	D	H (>10%)	Crop to Hay	20%
Continuous corn on clayey soils	D	M (5%-10%)	Crop to Hay	20%
Continuous corn on clayey soils	D	H (>10%)	Crop to Hay	20%

Representative of levels for basins other than those draining to Missisquoi and South Lake B

Baseline constraints on agricultural credit generation can limit broader interest by this sector to engage in any load reduction activities, even for the TMDL, absent a clear regulatory mechanism to otherwise compel them. Payment incentives through a market-based approach could provide motivation for farmer participation if there is real and immediate opportunity to generate credits prior to achieving the baseline (e.g., TMDL LA), even if such credits had a limited credit life. Therefore, one option is for DEC and EPA to consider is the use of interim agricultural baselines that motivate early BMP implementation and achieve phosphorus load reduction progress. Interim baselines would allow farmers to generate interim credits. For example, a farmer could implement BMPs to achieve a TMDL threshold established by the TMDL through a water quality trade but only use reductions that achieve a baseline as interim credits for a period of ten years. After ten years, reduction practices would need to be maintained per the TMDL as well as new state agricultural regulations, but actual reductions could no longer be used as trading credits. These “short-term trading credits”, in essence, would be retired to the benefit of Lake Champlain water quality. If a farmer generated phosphorus reductions beyond their baseline, such “long-term credits” might be tradable for as long as practices were maintained.

Short-term and long-term credits, if cost-effective, would give regulated developed land entities facing potentially expensive stormwater BMPs under their WLAs flexibility to meet begin to address infrastructure retrofits. Thus, a farmer would be paid to implement a minimum suite of BMPs necessary to meet their load allocation goal. After ten years, these credits would no longer be available (i.e., these would be retired) and the farmer would then have to implement additional BMPs (while also maintaining his original BMPs) above the load allocation baseline to generate new credits. The ten year credit window could be initiated by a fixed date/window of opportunity, or could start from whatever date the farmer agreed to initiate BMPs for trading credits.

Interim crediting is how trading operates in Wisconsin and is similar to USDA’s suggested phased baselines for agriculture under TMDLs. Without the use of interim credits or some form of a phase-in, widespread credit supply in the Lake Champlain Basin will be extremely limited and likely unable to meet the demands of the growing sources encompassed under the TMDL’s developed lands WLA.

The assumption here is that interim credits would be calculated from pre-conservation practice implementation loads minus reduced loads following post-practice implementation. The consideration here would also be that phosphorus reductions could be used for credits even if the farmer was not already achieving baseline requirements under state regulations and/or the LA.

In summary, if interim credits were to become part of a market-based program, it could be stipulated by program rules or conditions that such interim credit-generating practices would be required to meet a baseline. Any practices implemented that exceeded baseline conditions would be eligible for longer-term, permanent credits though still falling under practical considerations such as the standard life of the conservation practice. Absent interim crediting, agriculture will not likely have much of a role in water quality trading as TMDL and state requirements are currently quite onerous.

Trade Ratios

For purposes of this market feasibility analysis, the Project Team applied an uncertainty ratio of 2:1 whereby the buyer much purchase two pounds of phosphorus reduction for every one pound of required reduction being traded. The 2:1 ratio is common in trading programs and thus, is used here for the purposes of estimating credit supply and demand. Other trade ratios could have applicability in the Lake Champlain Basin to account for fate and transport between sources engaged in a market transaction. Altering the 2:1 trade ratio to account for fate and transport would be of particular value if Lake Champlain Basin stakeholders wanted to consider cross-lake segment trading on a case-by-case basis. However, increasing the trade ratio does impact cost-effectiveness of trading and therefore should ultimately be evaluated in the context of protecting/improving water quality while also providing a reasonable margin of cost effectiveness for buyers.

BMP Costs

There were several assumptions applied regarding costs for the market assessment. The Project Team derived agriculture conservation practice costs from information provided by Mr. Kip Potter of Vermont NRCS, a participating member of the Watershed Markets Advisory Committee. Appendix B provides a detailed overview of the BMP cost analysis. The Project Team then applied the NRCS BMP costs to potential field areas of implementation to determine a 20-year life cycle cost per pound of phosphorus reduction resulting from a BMP. This analysis was done for a single and a multiple BMP scenario. Results are presented in Table 7 and Table 8, respectively.

Table 7. Life cycle costs for multiple agricultural practices.

Multiple Ag Conservation Practices:			
Crop is either corn-hay rotation or continuous corn on non-clayey soils Conservation practices applied on total area of 23,203 acres			
Riparian Buffer	$	109,434	
Cover Crop	$	2,697,481	
Conservation Tillage	$	1,156,063	
Grassed Waterway	$	202,635	
Total	$	4,165,614	
Total Phosphorus Reduced		33,089	lbs/yr reduced
Cost Per Pound Reduced	$	126	per lb P reduction/yr

Table 8. Life cycle costs for a single agricultural practice.

Single Ag Conservation Practice:			
Riparian buffers for continuous corn fileds on all soil types			
Conservation practice applied on total area of 30,862 acres			
Riparian Buffer	$	145,557	
Total Phosphorus Reduced		11,821	lbs/yr reduced
Cost per Pound Reduced	$	12	per lb P reduction/yr

These analyses established the cost per pound of phosphorus per year from agricultural conservation practices of $126 per pound of phosphorus reduction per year for a suite of four practices (riparian buffer, cover crop, conservation tillage, grassed waterway) and $12 per pound of phosphorus reduction per year for a single practice (riparian buffers for continuous corn fields). For purposes of cost comparisons later in this report, $126 per pound is considered the default value.

2.5.3 Demand Assumptions

Demand for the Lake Champlain Basin market focuses on stormwater sources to which EPA assigned the WLA under a 'Developed Lands' classification. According to the TMDL, the developed land WLA includes stormwater runoff from sources such as municipal and residential areas, construction sites, state highways and back roads. These sources have a range of requirements to meet the WLA, including state NPDES permits and non-NPDES state permits. Some stormwater sources under this WLA are not subject to either types of permit, such as stormwater from small land areas below the State's permitting threshold (EPA 2015). The exception to this overall demand is the proportion of loading which results from back roads (i.e., unpaved roads). Loading from backroads is excluded from this analysis since the cost to address these loads is relatively low and does not present a sizable cost differential compared to agricultural practices, a requirement for market-based approaches.

Although wastewater treatment plants also have a separate WLA, these sources are not explicitly included in the demand analysis for this project. According to the draft TMDL, WWTFs are not the dominant source of phosphorus to Lake Champlain as a whole, nor to any of the individual impaired lake segments (EPA 2015). At the outset of this project, prior to the issuance of the public review draft of the TMDL, DEC stated that WWTPs should not be included in the market feasibility analysis because a separate WLA reallocation policy would be used to address WWTF phosphorus reductions. The Project Team assumed that this reallocation process would result in little to no demand from the WWTF sector. Based on this understanding, the Project Team did not include WWTFs in the analysis to estimate potential credit supply and demand as agreed to by DEC.

BMP Selection for Estimating Credit Demand

With a focus on the Developed Lands sector, the Project Team analyzed the mix of BMPs used in EPA's BMP Scenario Tool for the lower and upper range BMP scenarios. Table 9 presents the mix of Developed Land BMPs used in the lower range scenario. The upper range BMP scenario intensified the related BMP applications for the Developed Lands sector beyond the applications presented in Table 5 and Table 6.

BMPs in Table 21 present challenges for identifying potential demand. Ideally, demand assessments in a market feasibility analysis can be limited to be just one or a few BMPs that represent substantial external, non-budgeted municipal costs that would be borne by regulated entities. Market demand for private property owners is unlikely with on-site source control requirements. Select developed land BMPs in Table 9 either cannot be realistically calculated or quantified (i.e., fertilizer bans), nor easily incorporated over time (i.e., on-site controls) in TMDL compliance milestones. Certainly, a TMDL implementation challenge may exist for enforcement of on-site/source reduction BMPs, and for achieving expected TMDL goals when all of these are on private property.

Table 9. MS4 and Developed Land Baseline BMPs in 'Lower Range' Scenario

MS4-Baseline BMPs	Developed Land Baseline BMPs
Ban on P fertilizer applies to all residential and commercial/industrial turf (pervious) lands – 100%	Ban on P fertilizer applies to all residential and commercial/industrial turf (pervious) lands – 100%
Surface infiltration practices to treat 0.9" runoff depth on all residential and commercial/industrial impervious lands (a and b soils) – 25%	Surface infiltration practices to treat 0.9" runoff depth on all residential and commercial/industrial impervious lands (a and b soils) – 25%
Wet ponds and constructed wetlands on all residential and commercial/industrial impervious lands (c soils) – 25%	Wet ponds and constructed wetlands on all residential and commercial/industrial impervious lands (c soils) – 25%
Surface infiltration practices along paved roads (a and b soils) – 25%	Surface infiltration practices along paved roads (a soils) – 25% Surface infiltration practices along paved roads (b soils) – 50%
Roadside erosion control on unpaved roads (all soils) – 100%	Roadside erosion control on unpaved roads (all soils) – 100%
Mechanical broom sweeper to paved roads twice yearly – 70%	
Catch Basin Cleaning – 70%	

For the purposes of this analysis, the Project Team evaluated only wet detention ponds to determine potential demand. Wet detention ponds are more ubiquitous in their design and application than other BMPs, are more amenable to calculating load reductions at scale, and generally more consistent in terms of their cost per reduction. Other practices, particularly low impact development, are difficult to quantify due to ambiguity on where practices can be feasibly implemented, scale of practice implementation to achieve overall reduction goals, and highly variable site-specific costs.

An important condition for water quality trading market development is the existence of sizable cost differentials between agricultural conservation practices and developed land BMPs applied in water quality trades.[2] As such, cost determination for phosphorus treatment by agriculture and stormwater are necessary for LCB market analysis. These, in turn, are used with supply and demand estimates to recommend a particular market framework.

[2] Kieser & Associates. 2015. Recommended cost analysis strategy for agricultural and urban BMPs in the Lake Champlain Basin. Prepared for Tetra Tech.

Cost Assumptions

The costs assumptions for stormwater phosphorus reductions using wet detention are based on previous research, as well as Vermont estimates and costs used by EPA during the TMDL development process. K&A of the Project Team has previously calculated costs for stormwater phosphorus reduction using wet detention for the Lower Fox River Basin Water Quality Trading Economic Feasibility Assessment (K&A 2015). The Project Team used annual capital and operation and maintenance costs for wet detention facilities generated for the Lower Fox River Basin feasibility assessment, as well as Lake Champlain Basin developed land load reductions by various catchment area sizes, to estimate a cost per pound of phosphorus reduction for this analysis. Findings from these analyses indicate wet detention for medium (86 acres) and large (561 acres) catchments areas to cost $1,907 per pound of phosphorus removed and $742 per pound of phosphorus removed, respectively. These costs are comparable with those provided by a 2014 VT study (~$1,000/lb), EPA draft costs from the Scenario Tool ($436 to $3,393/lb) and VT DEC estimates ($902 to $4,067).[3,4,5,6]

During the Watershed Markets Advisory Committee meeting in August 2015, MS4 representatives stated that some of the actual and anticipated stormwater control costs were significantly higher than the high-end range of $1,907 per pound of phosphorus removed used in the analysis. Therefore, if the credit supply and demand estimate is favorable with these conservative cost assumptions in place, it is likely that the actual higher cost per pound of phosphorus removed would result in greater demand and a more robust market in the Lake Champlain Basin.

BMPs to address unpaved road loading, which equals 19,272 pounds of phosphorus, were determined to be relatively cost-effective ($250-500 per pound of phosphorus reduced).[6] Unpaved road BMP costs are close to agricultural credit costs ($126 per pound of phosphorus reduced), once the 2:1 trade ratio is applied. As a result, the analysis does not include demand generated by required reductions on unpaved back roads.

2.5.4 Comparison of Lake Champlain Basin Potential Credit Supply and Demand

With an understanding of the analysis assumptions and the control costs, it is possible to examine the phosphorus reductions required of agriculture and the developed lands sectors and associated control cost differences to estimate potential credit supply and demand. A viable market-based program, specifically water quality trading, must have ample credit supply and demand. Table 10 illustrates reductions required under the TMDL for each lake segment in the Lake Champlain Basin for developed lands (demand) and agriculture (supply).

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[3] Vermont Department of Environmental Conservation. 2014. Vermont Lake Champlain phosphorus TMDL Phase I Implementation Plan. Prepared for Governor presentation

[4] Pease, J. August 2015. VTDEC- Watershed Management Division. Personal communication.

[5] EPA Scenario Tool. 2015

[6] Environmental Protection Agency, Region 1. February, 2014. Methodology for developing cost efficiencies for Lake Champlain TMDL phosphorus control measures: Stormwater BMP component.

Table 10. Developed land and agricultural load reductions required under the TMDL for each lake segment in the LCB (minus back roads for developed lands and farmstead loads for agriculture).

Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years for Developed Lands* (Demand)	Required Reductions (lbs/yr) over 20 Years for Agricultural Lands** (Supply)
South Lake B	Poultney	2,532	15,501
South Lake B	Mettawee	1,012	10,194
South Lake B	SLB DD	127	3,210
South Lake A	SLA DD	641	29,371
Port Henry	Port Henry DD	135	2,756
Otter	Otter	8,335	86,776
Otter	Little Otter Creek	729	12,031
Otter	Lewis Creek	587	5,061
Otter	Otter DD	169	3,965
Main Lake	Winooski	11,710	29,896
Main Lake	ML DD	345	6,432
Shelburne Bay	La Platte	972	2,996
Burlington Bay	BB CSO	205	-
Burlington Bay	BB DD	210	-
Malletts Bay	Lamoille River	6,117	16,103
Malletts Bay	Malletts Bay DD	727	1,106
Northeast Arm	Northeast Arm DD	658	4,992
St. Albans Bay	St. Albans Bay DD	478	7,584
Missisquoi Bay	Missisquoi	7,201	83,070
Missisquoi Bay	Missisquoi Bay DD	1,422	28,538
Isle LaMotte	Isel La Motte DD	151	1,284
Totals		44,464	350,865
**Excluding backroads at 19,272 lbs/yr*			
***Excluding required reductions from farmsteads*			

While select lake segments have notably less overall demand than others, current demand expressed in Table 10 suggests trading could be viable. Similarly, credit supply appears to be sufficient given overall demand.

3. Market-Based Strategy Options

The findings of the market feasibility analysis in Section 2 indicates that there is sufficient phosphorus credit supply from agricultural sources—although the use of interim baselines to allow for interim credits would be key to ensuring adequate supply—and apparent ample demand from the Developed Lands sector, with anticipated demand from WWTFs even with implementation of a WLA reallocation policy.

This section therefore presents an overview of market-based structures for Lake Champlain Basin stakeholders to consider based on these supply and demand findings. It also provides considerations and recommendations for appropriate market-based structures and associated framework considerations based on the findings of the feasibility analysis.

3.1 Overview of Potential Market-Based Strategies

The following provides an overview of potential market-based strategies that could potentially be used in the Lake Champlain Basin. The most viable market-based strategy depends on the characteristics of the market, as discussed in Section 2. Market-based programs may focus on one or integrate several market-based strategies: bilateral trading, brokerage, clearinghouse and watershed-based segment plans. Relative advantages of each potential market-based strategy applied to the Lake Champlain Basin will depend on overall credit supply and demand. The rationale for examining this for the Vermont portion of the Lake Champlain Basin is that Vermont DEC should consider one overarching market-based framework under which all potential participants would need to conform. It is possible, as will be discussed with the pilot example in Section 4, that individual lake segments might have greater market participation and therefore desire more sophisticated market-based structures. However, as will also be discussed, creating an expensive and complex underlying basin program used by few would not be advisable.

In these regards, an overview of each possible market-based strategy that could be considered for the Lake Champlain Basin is provided below.

- **Bilateral trading.** As the name implies, water quality trading under a bilateral market results from one-on-one negotiations. In this type of market, the price of the unit of trade may be determined through a process of bargaining or by using a market price. High transaction costs are associated with this type of market, due to the time and effort needed to negotiate trades. In a market with limited buyers and sellers, building a prescriptive bilateral trading framework within the existing trading policy will not necessarily provide great cost savings and/or facilitate more trades. Rather, bilateral trades become a safe default trading option in limited credit markets. Under this framework buyers will negotiate directly with sellers following trading conditions stipulated by Vermont DEC. The basis for trading would remain within individual Vermont permits with reporting requirements and other trading policy elements remaining as the responsibility of the point source (M&A et al. 2014)
- **Brokerage/aggregator models.** In markets with significant credit demand, there may be opportunities for brokers and aggregators to assist buyers find credits. Local knowledge of farming operations and landowners would likely be a key element to the success of third party brokers and/or aggregators. As subsequent sections will discuss, Soil & Water Conservation District (SWCD) brokers in the Great Miami trading have been crucial to program success (Kieser and McCarthy 2015). The basis for trading contracts would remain a bilateral in a brokered trade, but for aggregator participation would instead be between a buyer and the third party aggregator with the permit still representing the trading instrument.

- **Clearinghouse structure.** A clearinghouse is an entity authorized by an oversight or regulatory agency to pay for pollution reduction credits and then sell such credits to sources seeking cost-effective reductions to meet compliance requirements. The clearinghouse converts a commodity that may have a variable price (i.e., a pollutant credit) into a uniform commodity. A clearinghouse creates a simplified market in which transaction costs are lower than for bilateral trades. This is because the clearinghouse locates (either directly, or via brokers and aggregators) and purchases the credits, and certifies the credits saving buyers and sellers the time and effort (and hence the cost) of locating and negotiating credits. Pennsylvania's PENNVEST provides an excellent example of a state-run credit clearinghouse. This type of market structure works more efficiently where there are high volumes of regulated dischargers, and economies of scale can be achieved. Appendix C contains examples of clearinghouse frameworks in action.
- **Watershed-based program plans.** This approach in the Lake Champlain Basin would allow individual lake segments of Lake Champlain Basin to more specifically manage trades with some local flexibility operating under one over-arching water quality trading framework for the Lake Champlain Basin. Local flexibility could require additional approval from DEC. Watershed plans, in theory, allow for increased participation with stakeholders familiar with the geographic area that individual lake segment water quality trading plans might encompass. Assuming adequate credit supply and demand exists in a lake segment drainage to warrant trading, this approach could accommodate locally-driven partnerships, but also create some potentially additional burdens for DEC to manage. As each segment might have specific needs or considerations, potential nuances between segments could make monitoring and verification more difficult for DEC. This could, however, be accommodated with a Lake Champlain Basin clearinghouse with a credit registry and other mechanisms that accommodate localized approaches using the same core principles of the overarching trading program.

3.2 Possible Market-Based Strategies for the Lake Champlain Basin

A variety of market-based strategies were considered for potential applicability in the Lake Champlain Basin. Ultimately, the market-based strategies with the greatest potential for viability depend on credit supply and demand within each lake segment as noted above. At the outset of this project, Vermont DEC and AAFM expressed an interest in exploring the use of a clearinghouse approach as one market-based strategy in the Lake Champlain Basin.

An important element of the proposed market-based strategy for the Lake Champlain Basin is the proportion of required reductions that can be accomplished through a market-based approach versus onsite stormwater practice implementation. The Project Team used an overarching hypothetical implementation strategy of a declining cap on the quantity of pounds of phosphorus reduction eligible for purchase throughout the 20-year TMDL to help assess different market-based strategies in the Lake Champlain Basin. Table 11 illustrates these proportions.

The hypothetical implementation strategy makes the simplifying assumption that total required Developed Land reductions will be accomplished evenly, in 5-year intervals, over the 20-year TMDL period. Participants who enter the market early by purchasing credits from agriculture are able to offset a greater percentage of their required reductions than in later years of the TMDL compliance timeline. Participants will earn ten years of interim credits when entering the market in years 0 to 10 and fewer than ten years of interim credits when entering the market in years 11 to 15. The remaining reductions, not offset through trading, will be achieved with onsite stormwater practices. Stormwater practices are assumed to be 'permanent' reductions towards the TMDL goal. The notion of still requiring a portion of stormwater practices to be implemented ensures that local water quality conditions (where stormwater may be creating localized impairments) are still being addressed.

Table 11. Proposed declining water quality trading cap for phosphorus sources under the Developed Lands WLA.

Years (Developed Land Reduction Cycle)	Reductions Eligible for WQT (per 5-year cycle)	Reductions to be met through stormwater BMPs (per 5-year cycle)
0-5	80%	20%
6-10	60%	40%
11-15	40%	60%
16-20	20%	80%

The ability to meet compliance goals with water quality trading does not allow participants to avoid the TMDL, but rather provides a mechanism to achieve compliance using credits to meet interim milestones. This mechanism would allow developed land dischargers to spread the economic burden of compliance over a 20-year period while still implementing practices to reach compliance. Figure 3 illustrates a hypothetical example of how credits would be accounted for under this declining cap by a stormwater entity. Five-year compliance milestones are denoted as horizontal dashed lines. The numbers shaded yellow represent the pounds of new, 'permanent' reductions that must occur in each 5-year interval via stormwater BMPs. A buyer may choose to implement additional stormwater practices in a given time interval. In those instances, the number of 'permanent' reductions required the following interval would vary.

Ultimately, 80 percent of developed lands under this hypothetical scenario illustrated in Figure 3 would be managed by stormwater BMPs, while no more than 20 percent of the overall required load reduction would be covered by water quality trading credits at a 2:1 trade ratio, at the end of year 20. As illustrated in Figure 3, numbers above the interim milestones in each 5-year period represent the additional agricultural reductions associated with the 2:1 trade ratio requirement.

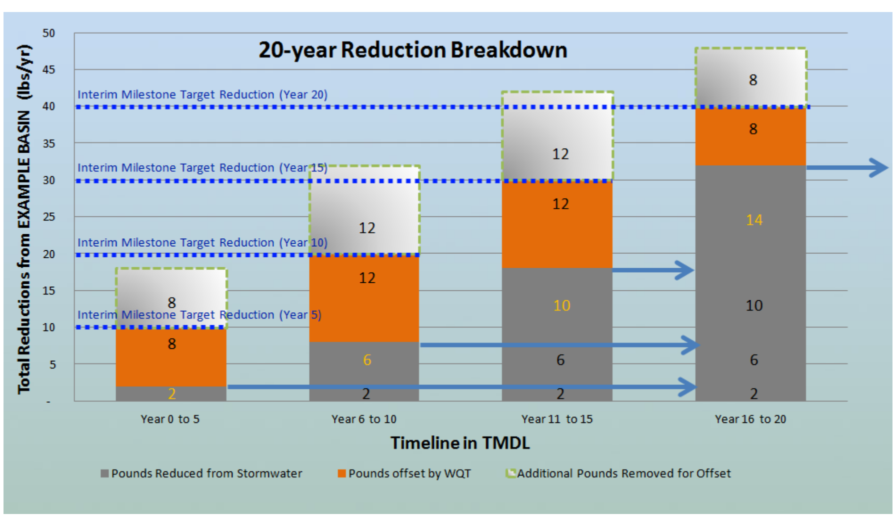

Figure 3. Hypothetical example illustration of a declining water quality trading cap.

3.2.1 Program Structure Options

The size of the potential trading market will justify which type of program structure is most applicable for the Lake Champlain Basin. Bilateral trading tends to have low administrative costs for the state but higher transactions costs for individual actors. Conversely, a clearinghouse structure generally requires significant capital investment for development and long-term administrative costs to the operating entity, but offers lower transaction costs for buyers and sellers. The economic feasibility analysis also considered multiple scenarios in which the public sector assumed different levels of required reductions (80%, 50% or 20%) under the developed lands WLA. Table 12 illustrates costs with and without trading and cost savings for three scenarios of varying public burden.

Table 12. Projected stormwater compliance costs with and without trading as well as potential savings with water quality trading for the Vermont portion of the Lake Champlain Basin.

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Year	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $742/lb	Total Savings of Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Savings of Trading if Ag Reductions at $126/lb and Stormwater at $742/lb
80%	35,571	$84,792,490	$32,922,149	$63,231,098	$30,078,880	$21,561,392	$2,913,269
50%	22,232	$42,396,245	$16,496,074	$39,519,436	$18,799,300	$2,876,809	($2,303,225)
20%	8,893	$16,958,498	$6,598,430	$15,807,775	$7,519,720	$1,150,723	($921,290)

Analysis of public cost with and without trading indicates that the use of a robust program like a clearinghouse would not likely be economically viable from a whole-basin perspective if stormwater costs are $742. A clearinghouse might be justified if stormwater costs are $1,907 or higher. Cost savings under the proposed framework are directly correlated with market participation and in the case of Table 12, assume all entities would trade under the context of the declining cap illustrated in Figure 3.

When public burden is high (80 percent), the potential cost savings are also higher. When most of these required reductions are assumed to be the responsibility of private entities and not a direct cost to public entities, potential savings are absent and there would be limited trading at the basin-wide level.

Based on these findings, the development of a basin-wide clearinghouse is not recommended if public burden is low and cost of stormwater reduction is also low ($742 per pound of phosphorus reduction) due to the absence of savings. A bilateral trading framework, possibly using third party brokers and aggregators to facilitate trades between buyers and sellers, is therefore recommended given that there is sufficient demand and likely supply, but on average, the market may not be robust.

Important to recognize here is that all trades are locally-driven by site constraints and associated costs. Therefore, it is likely that most trades will occur where there are the highest cost differentials. And conversely, where there are limited cost differentials, there will likely be few trades. Such contrasting circumstances are likely to be found in highly urbanized areas where stormwater control costs are often high, compared to lower density development where control costs may be much cheaper.

That said, the use of a more complex program may be warranted for individual lake segments with significant supply and demand. Programmatic elements of both a clearinghouse and bilateral agreements could be used to formulate a trading program for individual segments or even regions within a particular segment where there was a high level of demand and available supply. This option may be well suited economically for segments with an existing MS4 loads such as Main Lake, Shelburne Bay, Malletts Bay, and St. Albans Bay.

4. Market-Based Pilot Project Analysis and Considerations

As discussed in Section 3, implementing a robust, complex basin-wide trading program for the Lake Champlain Basin would likely be unnecessary given the relatively limited potential savings to be gained from its implementation. Alternatively, bilateral trading within individual lake segments appears to be the most reasonable approach for potential trading participants associated with developed lands to utilize cost-effective compliance options to meet their Lake Champlain TMDL reduction goals. This section applies these broader findings in the context of a potential market-based pilot case for the Lake Champlain Basin.

4.1 Pilot Project Area Selection

The market-based pilot project analysis explores the applicability of implementing recommended trading program considerations in the Main Lake-Winooski (Winooski) lake segment of the Lake Champlain Basin. The Winooski lake segment was selected for this pilot project analysis in large part due to the substantial supply and demand for phosphorus credits identified in previous analyses for trading between developed land (excepting rural road) buyers and agricultural (not including farmsteads) sellers. Table 13 summarizes both of these quantities as derived from previously reported works.

Table 13. Supply and Demand in the Winooski.

Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years for Developed Lands* (Demand)	Required Reductions (lbs/yr) over 20 Years for Agricultural Lands** (Supply)
Main Lake	Winooski	11,710	29,896
**Excluding required reductions from backroads*			
***Excluding required reductions from farmsteads*			

Given this possible demand and supply, the Winooski lake segment represents a lake segment that could be expected to experience potentially substantial cost savings under a market-based program. The cost associated with the proposed water quality trading program and the potential cost savings are summarized herein. For this pilot project analysis, required reductions under the Developed Lands WLA are assumed to represent potential demand in the Winooski lake segment, with agricultural reductions under the LA representing potential supply.

4.2 Market-Based Pilot Project Analysis

The analysis assumes interim agricultural reductions traded at 2:1 for stormwater reduction milestones. These methods applied here, and in Task 3, assume the use of a declining cap on the quantity of developed land reductions that can be offset with water quality trading over the 20-year TMDL implementation period. Also notable is the examination of demand in the context of public burden costs assuming 80, 50 or 20 percent of developed land reductions become public expenses such that the entire reduction requirement from developed lands is never 100 percent. This latter consideration is reflected in Figure 4, Figure 5 and Figure 6, respectively to illustrate how the declining cap and public burden will dictate the eligible quantity of market-based offsets of stormwater practices over the 20-year TMDL for this lake segment.

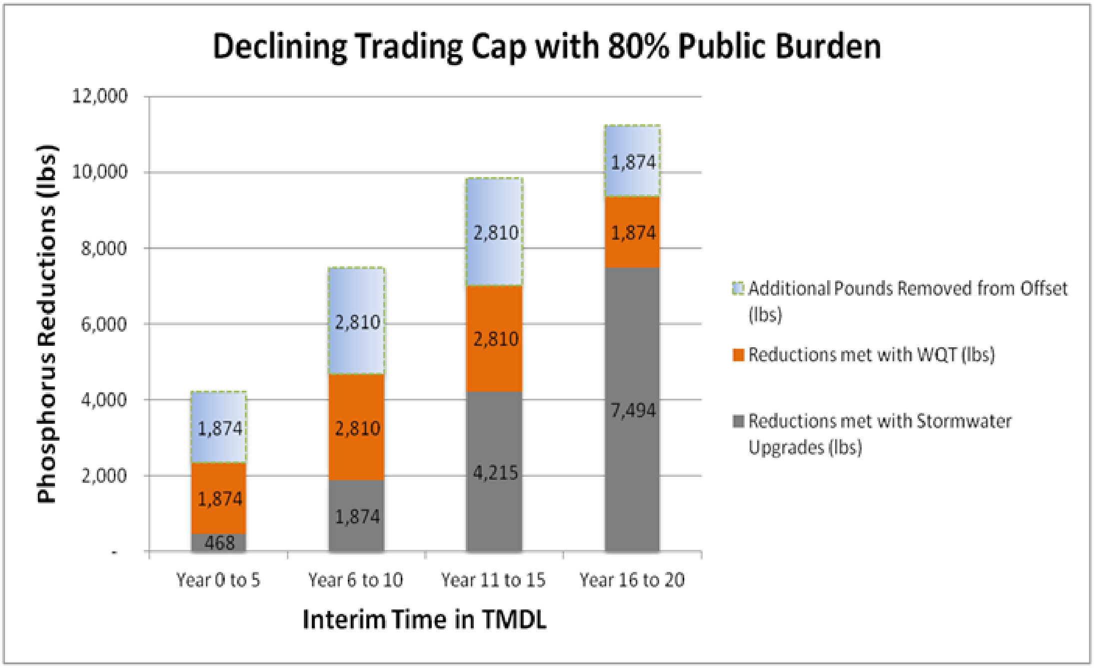

Figure 4. Declining Trading Cap with 80% Public Burden

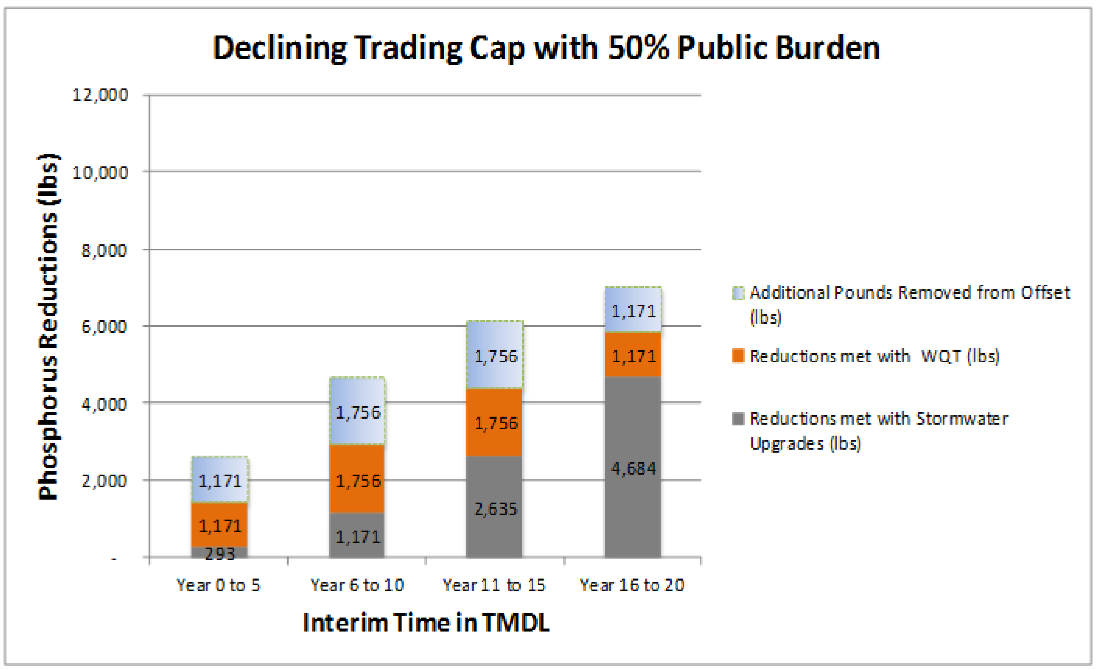

Figure 5. Declining Trading Cap with 50% Public Burden

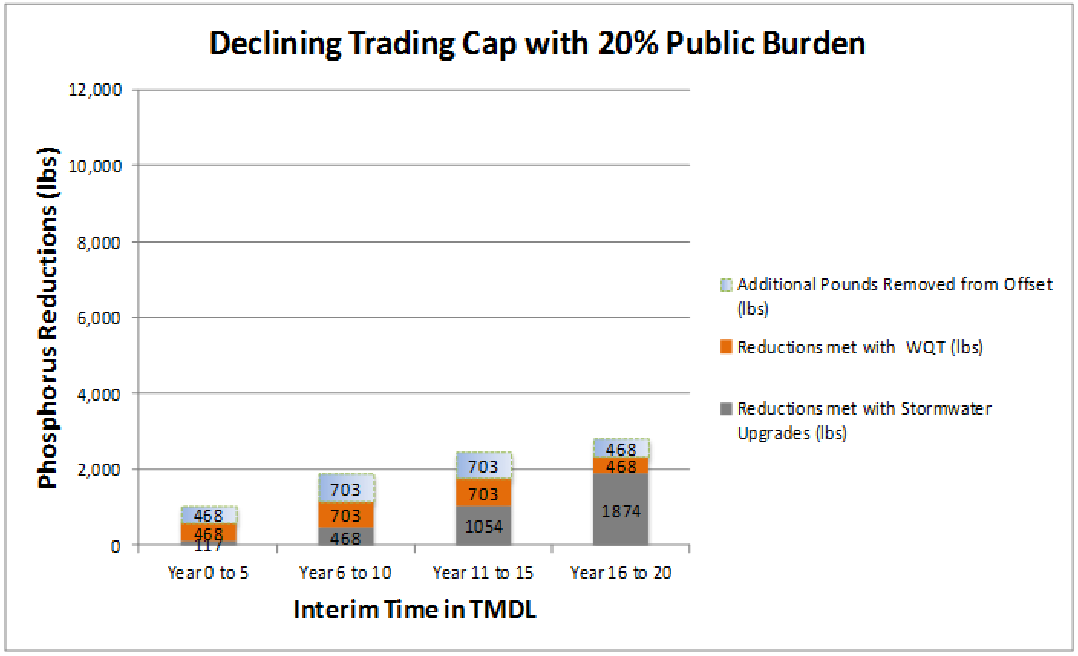

Figure 6. Declining Trading Cap with 20% Public Burden

Table 14 summarizes the costs for each of these scenarios from Figures 4-6.

Table 14. Associated Costs and Savings from Bilateral Water Quality Trading in the Winooski Lake Segment

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $742/lb	Total Savings of Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Savings of Trading if Ag Reductions at $126/lb and Stormwater at $742/lb
80%	9,368	$17,864,179	$ 6,950,824	$ 16,652,000	$ 7,921,316	$ 1,212,179	$ (970,492)
50%	5,855	$11,165,112	$ 4,344,265	$ 10,407,500	$ 4,950,822	$ 757,612	$ (606,558)
20%	2,342	$ 4,466,045	$ 1,737,706	$ 4,163,000	$ 1,980,329	$ 303,045	$ (242,623)

Cost savings shown in final two columns of Table 14 are considered representative of those associated with bilateral trading in the Winooski lake segment. This assumes local participants bear none of the Lake Champlain Basin market-based program development costs. Evident are the minimal to no cost-saving conditions when stormwater BMP costs are low and/or there is a low public burden to meet developed land reductions under the TMDL. These are discussed further in following sections on trading framework applications in the Winooski lake segment as a pilot consideration.

4.3 Market-Based Pilot Options and Cost Considerations

As a result of the feasibility analysis, this project explored more seriously the use of two different market-based strategies in the Lake Champlain Basin: water quality trading through bilateral transactions and a clearinghouse model. The Project Team recommends developing a bilateral water quality trading framework and associated rules for the entire basin to ensure that water quality trades are consistently conducted within lake segments. The Project Team also suggested an optional consideration for a clearinghouse model for individual lake segments if the potential volume of demand warranted a more robust but localized trading framework. Therefore, the potentially high demand and apparent ample supply of phosphorus credits in the Winooski lake segment (both greater here than in any other Lake Champlain Basin lake segment) led the Project Team to consider program development costs for both bilateral water quality trading and the clearinghouse model as part of the pilot analysis. The assessment also considers potential credit cost reduction mechanisms such as a reverse auction.

4.3.1 Pilot Analysis of Bilateral Water Quality Trades

A bilateral trading framework proposed for the Lake Champlain Basin in the context of this project would include options for broker and aggregator participation. As such, this pilot analysis assumes that the state would bear the costs for establishing this type of framework. The costs associated with a bilateral trading framework in the Winooski lake segment would therefore not be borne exclusively by Winooski lake segment entities. Instead, the costs associated with developing standardized tools and processes would be assumed by the State of Vermont. It could be expected that buyers and sellers might bear some additional costs for the use of a third-party negotiator. However, such costs will vary depending on who would fill such roles (e.g., existing entities such as conservation districts or private parties). Existing agencies traditionally supporting agriculture might require no charges for assisting buyers to connect with farmers. Private third-parties would likely have fees for such assistance, but these might add little to the price of a credit considering there will ultimately be cost negotiations between buyers and sellers regarding credits prices. As such, the Project Team assumed no additional costs when estimating the cost savings associated with bilateral water quality trading in the Winooski lake segment as presented above in Table 14.

Bilateral water quality trades are commonly executed through brokers and/or aggregators in water quality trading programs. These third-party entities can simplify buyer needs for finding disaggregated agricultural credits and facilitate a number of contractual and regulatory requirements for trading. Brokers may negotiate with credit generating landowners, verify BMP implementation and operation and help establish contracts between buyers and sellers. Brokers primarily provide logistical support for buyers and sellers but do not typically retain contractual obligations with credit generation or maintenance of credits.

Aggregators in water quality trading programs function to reduce risk, program costs, and ease the access to trading for both buyers and sellers. Aggregators in bilateral transactions can accomplish many of the same basic functions of a clearinghouse (reduce participant risk, lower transaction costs, encourage market participation) without the associated program development costs, oversight and implementation requirements.

Based on Table 14 costs, it could be expected that bilateral water quality trading in the Winooski lake segment might be most utilized when stormwater costs for BMPs range into the upper of the two prices at $1,907 per pound of phosphorus, and where public will bear more than half of the stormwater reduction burden. At $742 per pound of phosphorus, there will not likely be broad scale trading across the Winooski lake segment at any level of public burden. Since actual trades are driven by local conditions, it is likely that urban areas with higher cost per pound reductions may utilize trading. In those settings where stormwater BMPs provide lower opportunity costs, bilateral water quality trading is unlikely. Therefore, even considering the Winooski lake segment as potentially the most likely lake segment to trade given the highest volume of potential demand, bilateral trading may be limited. This affirms that a basin-wide trading program should be developed to more aptly accommodate bilateral water quality trading to offer select opportunities for cost savings in individual settings where stormwater BMP costs are quite high, rather than investing in a more complex water quality trading program with a clearinghouse model.

4.3.2 Clearinghouse

Clearinghouses offer the opportunity to use bidding and costing mechanisms that can potentially drive down the costs of project implementation. Reverse auctions, which have been of specific interest to VT DEC staff, could potentially achieve lower agricultural credit prices in the Winooski lake segment where there is high demand and high supply. This might provide greater cost savings for buyers than previously illustrated in Table 14. To examine the potential results of a Winooski lake segment-specific clearinghouse, Tables 15 and 16 present hypothetical scenarios in which reverse auctions reduce agricultural phosphorus credit prices by 50 percent and approximately 75 percent, respectively over the default value of $126 per pound of phosphorus. These new costs of $63 and $31 per pound were applied to the cost methodologies discussed in Section 3 to determine the cost and subsequent savings resulting from potential clearinghouse trades. Table 15 and Table 16 summarize these results, though it should be noted that these do not include development costs for an in-segment clearinghouse.

These summary tables suggest that reverse auctions have the potential to generate some additional cost savings in the Winooski lake segment, especially with higher stormwater costs compared to Table 14 costs of bilateral water quality trading. To further illustrate these potential savings, the information contained in Tables 15 and 16 above is represented graphically in Figure 7.

For illustrative purposes only, stormwater costs of $8,764 per pound of phosphorus reduction are also represented in Figure 7. This cost was identified for wet detention ponds with small drainage areas (See Appendix B). This cost is also within potential high-end stormwater costs provided by EPA.[7] The cost savings in Figure 7 are divided into three categories, separated by dashed lines, based on varying degrees of public burden assumed by stormwater entities. In each of these categories, cost savings for three different agricultural costs, ($126, $63, and $31) and three different stormwater costs ($8,764, $1,907 and $742) are illustrated.

A clearinghouse is an entity authorized by an oversight agency, to pay for pollution reductions and then sell credits to entities needing compliance flexibility for otherwise high costs. The clearinghouse creates a simplified market operation for participants in which transaction costs can be lower than for bilateral trades, though up front clearinghouse development costs are much higher.

Of particular note for clearinghouse considerations are the unique mechanisms for soliciting lower priced trading credits compared to bilateral transactions. One such mechanism is the use of reverse auctions. Reverse auctions are a bidding mechanism that allows agricultural producers to submit proposals or bids for providing phosphorus reductions through implementation of conservation practices. Contracts are awarded to the lowest bidder who can deliver phosphorous reductions and may lead to decline in credit cost. Initially, agricultural producers may have concerns with equity if their installation costs appear to not be fully reimbursed, the regulatory obligation to now meet both state and TMDL reductions may dispel such concerns with water quality trading participation.

[7] EPA Region 1. 2014. Methodology for developing cost efficiencies for Lake Champlain TMDL phosphorus control measures: Stormwater BMP component. Provided by Eric Perkins.

Table 15. Potential Trading in the Winooski Lake Segment with Reverse Auctions Reducing Agriculture Phosphorus Reductions by 50 percent

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $63/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $63/lb and Stormwater at $742/lb	Total Savings of Trading if Ag Reductions at $63/lb and Stormwater at $1,907/lb	Total Savings of Trading if Ag Reductions at $63/lb and Stormwater at $742/lb
80%	9,368	$17,864,179	$ 6,950,824	$ 15,471,672	$ 6,740,987	$ 2,392,507	$ 209,836
50%	5,855	$11,165,112	$ 4,344,265	$ 9,669,795	$ 4,213,117	$ 1,495,317	$ 131,148
20%	2,342	$ 4,466,045	$ 1,737,706	$ 3,867,918	$ 1,685,247	$ 598,127	$ 52,459

Table 16. Potential Trading in the Winooski Lake Segment with Reverse Auctions Reducing Agriculture Phosphorus Reductions by 75 percent

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $31/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $31/lb and Stormwater at $742/lb	Total Savings of Trading if Ag Reductions at $31/lb and Stormwater at $1,907/lb	Total Savings of Trading if Ag Reductions at $31/lb and Stormwater at $742/lb
80%	9,368	$17,864,179	$ 6,950,824	$ 14,872,140	$ 6,141,455	$ 2,992,039	$ 809,368
50%	5,855	$11,165,112	$ 4,344,265	$ 9,295,087	$ 3,838,410	$ 1,870,024	$ 505,855
20%	2,342	$ 4,466,045	$ 1,737,706	$ 3,718,035	$ 1,535,364	$ 748,010	$ 202,342

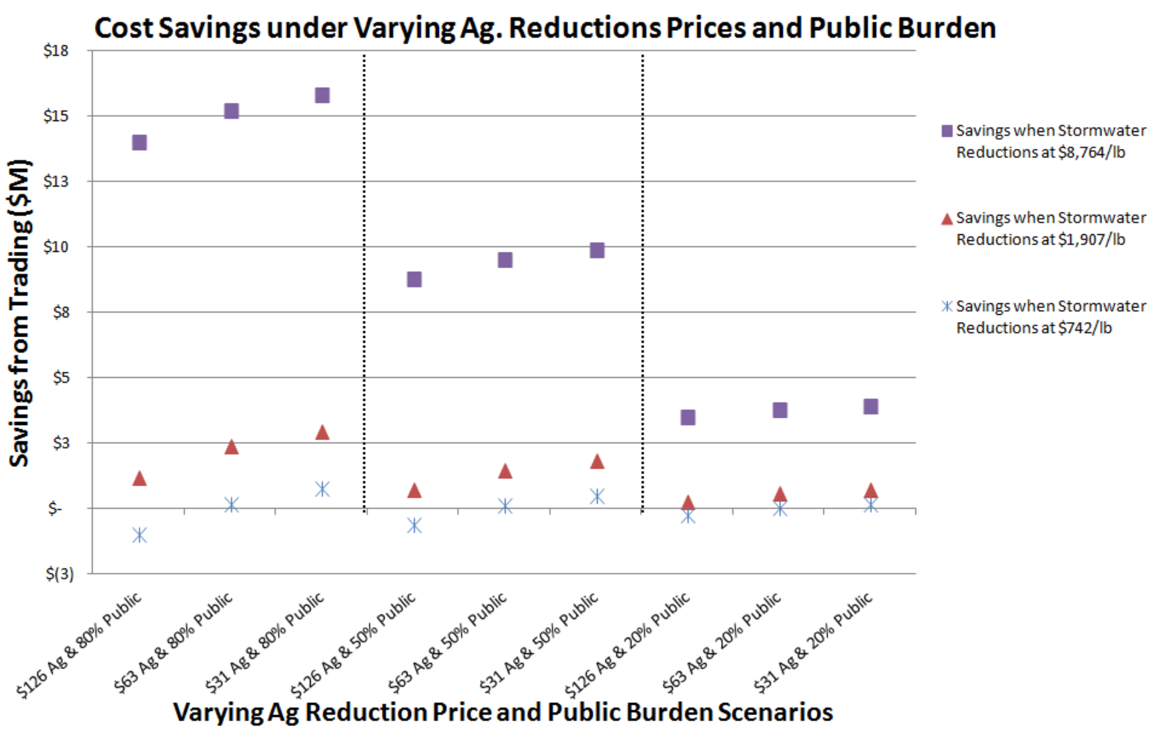

Figure 7. Potential Cost savings with Varying Agricultural Reductions Prices and Public Burden

Two primary conclusions can be drawn regarding the value of a water quality trading clearinghouse model using a reverse auction mechanism in the Winooski considering trading over the 20-year TMDL implementation timeframe. These include:

1. The difference in cost savings between agricultural credit costs within each category of public burden is relatively low.

2. Overall cost savings across all categories of public burden are relatively minimal even as agriculture phosphorus credit prices are lowered through reverse auctions.

The cost of agriculture reductions therefore does not appear to be driving savings. This may be expected recognizing that reduction costs double with the application of a 2:1 trade ratio (such that trading credit prices are twice the agricultural reduction costs in these applications). Rather, stormwater BMP costs and portion of public burden have the greatest influence on cost savings.

Of note is that costs to develop a localized, robust clearinghouse program for use just within the Winooski lake segment are not included in costs from Table 15 and Table 16. The following section considers these additional program development costs in the Winooski lake segment.

4.4 Comparing Pilot Cost Savings with Program Framework Development Costs

Each type of potential market-based program has an associated program development cost to establish the necessary program infrastructure and to operate the program. This section examines program development costs and compares these to the forecasted cost savings for the Winooski lake segment pilot project analysis. Programmatic costs associated with bilateral trading and clearinghouses are derived from the Project Team's experience in conducting other feasibility assessments and market studies, as well as professional experience in designing market-based programs for other watersheds.

4.4.1 Estimated Costs for Developing Bilateral Water Quality Trading Program

The Project Team assumed that the state would cover the costs for developing a Lake Champlain Basin trading program focused on bilateral trades. This would include Vermont regulatory policy to authorize trading. Such policy would need to include standard water quality trading elements addressing baselines, eligibility, credit purchase caps, and trade ratios as well as possibly defining roles for credit verifiers and third-party trading facilitation (i.e., aggregators and brokers). Accomplishing these tasks would provide consistent protocols across the basin for both buyers and sellers.

In a 2014 trading feasibility study for Montana (K&A, 2014), additional costs for standardizing tracking and reporting, contracts and credit estimation methods were estimated to minimally range from $150,000 to $220,000. Montana's policy was already in place so these costs were in addition to original policy development. Such policy development costs can be expected to range from $250,000 to $1M depending on the complexity of the program. Costs from the lower end of this range could be expected for developing a Lake Champlain Basin bilateral trading policy.

For bilateral trading in the Winooski lake segment, or any other lake segment in the Lake Champlain Basin, such program development or trading tool costs would not necessarily be borne by credit buyers or sellers. Typically, these are covered by existing state program allocations, set-asides and/or grants. Any segment-specific program therefore that goes beyond the scope of a state bilateral water quality trading program would, however, likely necessitate local stakeholders to secure the funds to develop, for example, a more robust clearinghouse model for their local applications. These funds could come through state or federal grants, or from participants.

4.4.2 Estimated Costs for Developing a Clearinghouse Program

Based on the development costs associated with other active trading programs in Ohio and Pennsylvania, clearinghouse program development is estimated herein for a Winooski application at $500,000 (which would necessarily include a locally applicable trading registry). Annual clearinghouse operation over the 20-year TMDL implementation period would likely require a 0.5 full-time employee (FTE). Assuming one FTE is $80,000 per year, the cost over 20 years for the 0.5 FTE to operate the clearinghouse would be another $800,000. This scenario therefore assumes an additional $1.3M in costs to the lake segment stakeholders, but that the State of Vermont has already developed the enabling policy or regulation to allow for water quality trading within the larger Lake Champlain Basin.

These additional clearinghouse costs of $1.3M will diminish water quality trading cost savings for the Winooski lake segment over just bilateral trading presented in Tables 15 and 16. As such, Tables 17, 18 and 19 summarize revised cost savings assuming these aforementioned clearinghouse costs at varying agricultural reduction prices.

Table 17. Adjusted Savings with a Clearinghouse model with Ag Reductions at $126 per pound in the Winooski

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $126/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $126/lb and Stormwater at $1,907/lb	Total Savings from Trading if Ag Reductions at $126/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $126/lb, Stormwater at $1,907/lb and Administration	Total Savings from Trading if Ag Reductions at $126/lb, Stormwater at $742/lb and Administration
80%	9,368	$17,864,179	$ 6,950,824	$ 16,652,000	$ 7,921,316	$ 1,212,179	$ (970,492)	$ (87,821)	$ (2,270,492)
50%	5,855	$11,165,112	$ 4,344,265	$ 10,407,500	$ 4,950,822	$ 757,612	$ (606,558)	$ (542,388)	$ (1,906,558)
20%	2,342	$ 4,466,045	$ 1,737,706	$ 4,163,000	$ 1,980,329	$ 303,045	$ (242,623)	$ (996,955)	$ (1,542,623)

Table 18. Adjusted Savings with a Clearinghouse Model and Reverse Auction Yielding Ag Reductions at $63 per pound in Winooski

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $63/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $63/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $63/lb and Stormwater at $1,907/lb	Total Savings from Trading if Ag Reductions at $63/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $63/lb, Stormwater at $1,907/lb and Administration	Total Savings from Trading if Ag Reductions at $63/lb, Stormwater at $742/lb and Administration
80%	9,368	$17,864,179	$ 6,950,824	$ 15,471,672	$ 6,740,987	$ 2,392,507	$ 209,836	$ 1,092,507	$ (1,090,164)
50%	5,855	$11,165,112	$ 4,344,265	$ 9,669,795	$ 4,213,117	$ 1,495,317	$ 131,148	$ 195,317	$ (1,168,852)
20%	2,342	$ 4,466,045	$ 1,737,706	$ 3,867,918	$ 1,685,247	$ 598,127	$ 52,459	$ (701,873)	$ (1,247,541)

Table 19. Adjusted Savings with a Clearinghouse Model and Reverse Auction Yielding Ag Reductions at $31 per pound in Winooski

Percent of Total Required Reductions Assumed by Public Costs	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag Reductions at $31/lb and Stormwater at $1,907/lb	Total Cost of Trading if Ag Reductions at $31/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $31/lb and Stormwater at $1,907/lb	Total Savings from Trading if Ag Reductions at $31/lb and Stormwater at $742/lb	Total Savings from Trading if Ag Reductions at $31/lb, Stormwater at $1,907/lb and Administration	Total Savings from Trading if Ag Reductions at $31/lb, Stormwater at $742/lb and Administration
80%	9,368	$17,864,179	$ 6,950,824	$ 14,872,140	$ 6,141,455	$ 2,992,039	$ 809,368	$ 1,692,039	$ (490,632)
50%	5,855	$11,165,112	$ 4,344,265	$ 9,295,087	$ 3,838,410	$ 1,870,024	$ 505,855	$ 570,024	$ (794,145)
20%	2,342	$ 4,466,045	$ 1,737,706	$ 3,718,035	$ 1,535,364	$ 748,010	$ 202,342	$ (551,990)	$ (1,097,658)

These clearinghouse costs are illustrated in Figure 8. The non-shaded symbols in figure were previously presented in Figure 7; corresponding shaded symbols represent new costs that include development and operation of a clearinghouse using reverse auctions.

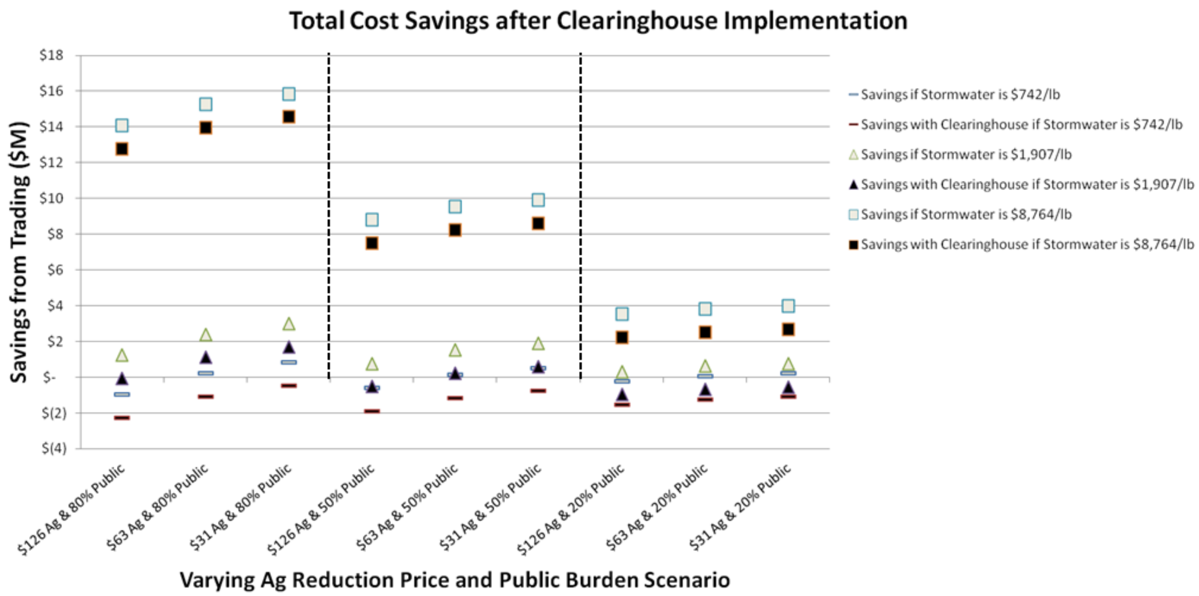

Figure 8. Potential Cost Savings with Varying Ag Price, Public Burden and Clearinghouse Implementation

For lower cost stormwater BMP scenarios ($742 per pound), the cost of clearinghouse program development and operation exceeds that of potential savings in all cases of varying public burden. For intermediate-cost stormwater BMP scenarios ($1,907 per pound), the cost of the clearinghouse program is roughly equal to the savings achieved through bilateral trading. This essentially halves any bilateral trading cost savings and/or eliminates potential cost-saving benefits of a clearinghouse for conditions where the public burden for stormwater BMPs is less than 50 percent. Only with the highest-cost BMP scenario ($8,764 per pound) does a clearinghouse option appear beneficial under the three different public burden scenarios. This latter clearinghouse scenario also only provides benefits over bilateral trading (at $126 per pound), if the reverse auction could achieve agricultural reduction costs of $31 per pound of phosphorus.

4.5 Summary of Pilot Analysis Findings for the Winooski Lake Segment

The Main Lake-Winooski lake segment has the highest developed land stormwater BMP demand as well as the highest potential agricultural credit supply of all lake segments in the Lake Champlain Basin. Due to the potential credit supply and demand characteristics, the Project Team selected the Winooksi lake segment to examine more detailed opportunities for bilateral water quality trading, and potential utilization of a local, more robust clearinghouse model trading framework. The clearinghouse model also allowed for examination of additional cost-saving mechanisms such as reverse auctions. The Project Team conducted these analyses using the trading conditions examined for the overall Lake Champlain Basin with agricultural reductions traded at 2:1, costs of $126 per pound of phosphorus reduction, a declining trading cap for stormwater with 5-year interim milestones, and varying public burdens for addressing the stormwater WLA of the TMDL for developed lands (excluding rural back roads due to low BMP cost differentials that would not result in demand).

Under simple bilateral water quality trading program conditions, the Project Team assumed the State of Vermont would establish legal and operational trading conditions to prevent Winooski lake segment trading participants from bearing program development costs. Using this approach, the pilot analysis demonstrated some, but likely limited cost savings in the Winooski lake segment through bilateral water quality trading. These cost savings, however, are only realized when the analysis includes higher stormwater costs of $1,907 per pound of phosphorus reduction. Such cost savings, ranging from about $300K to $1.2M (20 percent public burden to 80 percent public burden) represent only about 6-7 percent overall savings versus the no trading scenario. This suggests that even for the Winooski lake segment, where there could be high demand, trading will likely only occur where site-specific conditions result in high stormwater BMP costs (e.g., highly urbanized areas).

Limited opportunities exist to justify a more robust clearinghouse trading framework in the Winooski lake segment. The only condition observed for this is under the assumption of 80 percent public burden for stormwater with associated costs at almost $9,000 per pound, and a reverse auction driving agricultural reductions to $31 per pound. Therefore, even in the most likely of segments such as the Winooski lake segment, there is little justification for a clearinghouse water quality trading framework. All potential cost savings with trading in this segment appear to be driven by stormwater BMP costs and the proportion of public burden, not as a result of lower agricultural phosphorus reduction costs. For this reason, bilateral water quality trading still remains the only viable market-based framework option for the Winooski lake segment, consistent with observations the entire Lake Champlain Basin. This also will likely only draw interest for site-specific water quality trading where there are high urban stormwater BMP costs.

4.6 Reverse Auctions as a Funding Distribution Mechanism for the Lake Champlain Basin

Utilizing reverse auctions with water quality trading to reduce credit prices does not necessarily present an economically viable trading alternative for the Winooski lake segment or wider trading interests across the Lake Champlain Basin. Reverse auctions, separate from specific use in a water quality trading framework, however, may be an appropriate method to effectively distribute funding for agricultural BMP implementation. This section examines a “clearinghouse-like” program notion using a reverse auction mechanism in the Lake Champlain Basin solely as a means to accomplish additional cost savings absent trading.

Previous discussions with Vermont AAFM staff and the Watershed Markets Advisory Committee indicated the intended use of various grants and/or Farm Bill funding to implement agricultural conservation practices throughout the basin to help meet state requirements and the TMDL load allocation. For the purposes of this analysis, these federal funds are referred to as USDA-NRCS funds. As such, the analysis presented here assumes five possible funding levels available to the Lake Champlain Basin over 20 years: $4, $10, $20, $30, and $40 million. The analysis also assumes the per pound of phosphorus reduction costs of $126 as a base price, and then reverse auction costs of $63, $31, and $12. Further, the analysis assumes that funds would be distributed in some fashion by a clearinghouse-like framework (which may or may not be possible with USDA-NRCS funds). These costs per pound of phosphorus reduction are applied to potential levels of funding in Table 20 to forecast the potential quantity of reductions which may be generated under each scenario.

Table 20. Phosphorus Reductions (lbs) Achieved with Varying USDA-NRCS Funds

Cost Scenario	Cost/lb P reduced	Lbs P Reduced per USDA-NRCS Level of Funding				
		$4M	$10M	$20M	$30M	$40M
No Reverse Auction	$126	31,746	79,365	158,730	238,095	317,460
Reverse Auction Scenario #1	$63	63,492	158,730	317,460	476,190	634,921
Reverse Auction Scenario #2	$31	129,032	322,581	645,161	680,470	680,470
Reverse Auction Scenario #3	$12	333,333	680,470	680,470	680,470	680,470

Of note here is that the total agricultural phosphorus loading for the Lake Champlain Basin is 680,470 pounds per pre-draft TMDL release by EPA. Mathematically, lower BMP costs and larger funding amounts can achieve greater agricultural reductions but cannot achieve a zero sum discharge in reality. Therefore, cells in Table 20 are shaded for where there are hypothetical situations when there is more than ample funding to achieve discharges beyond the current load. This is further depicted in Figure 9.

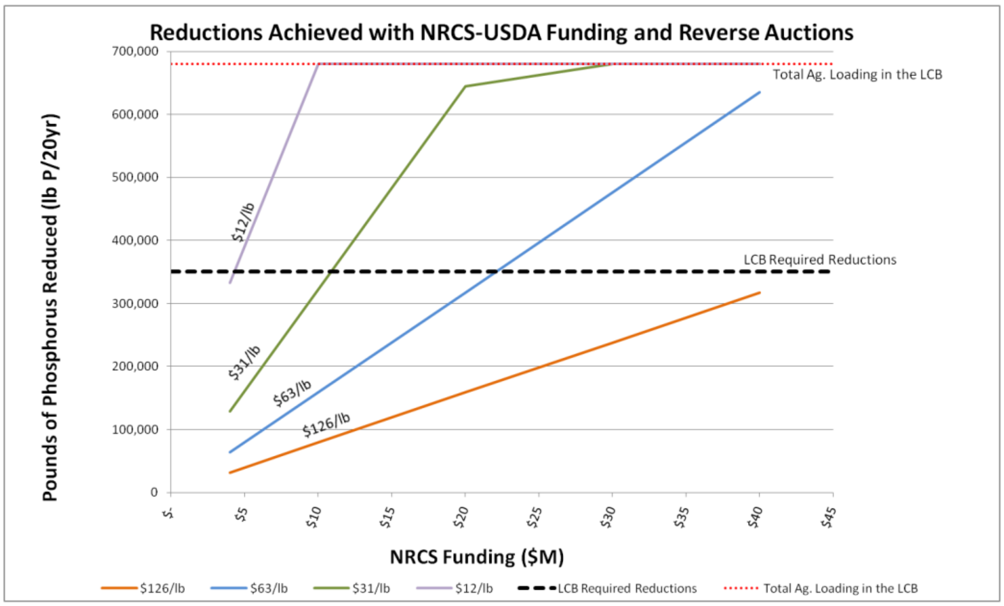

Figure 9. Reductions (lbs) Achieved with Varying NRCS-USDA Grant Funds

The dashed black line in Figure 6 represents the total required agricultural load reductions (excluding farmsteads) in the Lake Champlain Basin, which total 350,865 pounds of phosphorus over 20 years. The red-dotted line is the maximum estimated agriculture load in the basin. As Figure 9 illustrates, the required reductions could be achieved with $20 million or less when Ag prices are $63, $31 or $12 per pound. This simply suggests the potential value of using clearinghouse-like functions such as a reverse auction for more cost-effectively meeting the load allocation. Obviously, there will also be a range of costs encountered with a reverse auction mechanism, therefore these forecasts are very simplistic illustrations of potentially avoided costs to meet the LA.

4.6.1 Potential Cost Savings with an Agricultural Reverse Auction Mechanism in the Lake Champlain Basin

Lower cost agricultural phosphorus reductions than the default value of $126 per pound used in this market-based feasibility analysis suggest substantial efficiencies. To realize such savings requires the development and administration of a clearinghouse-like reverse auction program over 20 years. Based on Project Team experience, an assumed program cost of $4.2 million accounts for a $1million set up and $3.2 million over 20 years to cover two FTEs (at a salary of $80,000/yr) for management. With these costs, Table 21 illustrates the potential utility of reverse auctions comparing conservation practices implementation costs with and without a reverse auction.

Table 21: Avoided costs (i.e., cost savings) with and without Reverse Auctions to meet the agricultural Load Allocation

Cost Scenario	Cost/lb P reduced	Minimum Needed to Achieve Ag Load Allocation ($M)	Reverse Auction Cost ($M)	Funding Needed with Reverse Auction ($M)	Avoided Costs Using Reverse Auction ($M)
No Reverse Auction	$126	44.10	--	44.10	--
Reverse Auction Scenario #1	$63	22.05	4.20	26.25	17.85
Reverse Auction Scenario #2	$31	10.85	4.20	15.05	29.05
Reverse Auction Scenario #3	$12	4.20	4.20	8.40	35.70

When agricultural phosphorus reduction costs are $126 per pound, $44.1 million will be needed to meet the Lake Champlain TMDL WLA. This is considered the base case condition (i.e., no reverse auction) that may be currently contemplated based on default reduction costs. In the three subsequent scenarios, the minimum cost to achieve total Lake Champlain Bain reductions via reverse auction scenarios are similarly calculated, except with the cost of program development and operation. Avoided costs (i.e., savings) are determined by comparing the base case cost with a reverse auction costs. All reverse auction scenarios result in lower total costs than the base case absent an auction mechanism, and all generate substantial avoided costs (savings). For scenarios 2 and 3, avoided costs greatly exceed total conservation practice cost investments compared to the base case.

4.6.2 Conclusions & Recommendations for Reverse Auctions in the Lake Champlain Basin

Reverse auctions through a clearinghouse-like framework may serve as a highly efficient market-based means to distribute conservation practice funds for the Lake Champlain Basin. The potential exists for relatively high cost savings/avoided costs with practice implementation pricing at 50 percent or lower than a base case cost of $126 per pound of phosphorus reduction. Such savings do, however, assume that reverse auctions would be considered an acceptable means of competitive fund distribution to producers, that such lower prices could actually be realized, and that any federal funds could be managed in a clearinghouse-like fashion. An actual reverse auction pilot would address these key issues. Vermont agency staff and Lake Champlain Basin stakeholders may therefore wish to explore opportunities in these regards.

Given the previous pilot project analysis for the Winooski lake segment and the entire Lake Champlain Basin, a clearinghouse just for water quality trading is not economically viable. However, if a clearinghouse-like program with a reverse auction mechanism was developed for agricultural fund distribution, this new program would be highly transferable to water quality trading applications. It could therefore offer potential water quality trading credit buyers an efficient mechanism for trading otherwise not available with just a bilateral trading policy for the basin.

5. Market-Based Framework Recommendations

The feasibility assessment findings presented in Sections 2 and 3, as well as the pilot analysis findings presented in Section 4, indicate that a bilateral water quality trading approach currently appears to be the most viable market-based approach in the Lake Champlain Basin. This section presents an overview of the market-based framework considerations and recommendations that would be needed to support bilateral water quality trading in the Lake Champlain Basin.

5.1 Overview of Bilateral Water Quality Trading Operational Structure

For bilateral transactions, Figure 10 illustrates a proposed operational construct for trading in the Lake Champlain Basin under this framework.

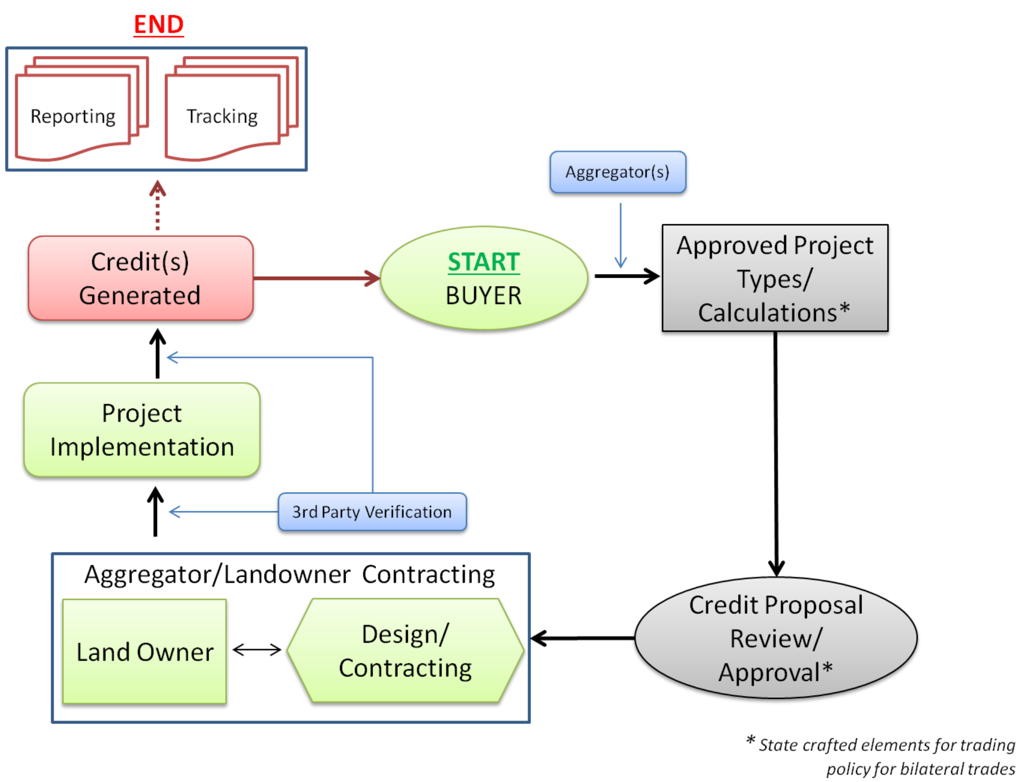

Figure 10. Proposed bilateral water quality trading construct for the Lake Champlain Basin.

The buyer, or credit aggregators, would pursue potential crediting project opportunities. State regulatory authorities would approve all proposed crediting opportunities (projects) to ensure each project results in anticipated load reductions and that the quantification methods used to calculate these reductions are based on best available science. After the State reviews a proposal, the aggregator would work with land owners to design and implement the conservation practices. Post-implementation, each project would be verified by a third-party to confirm the project complies with the State-approved design and is constructed as designed. The aggregator would then coordinate the transaction of generated credits between the agricultural producer (seller) and the developed entity (buyer). Ultimately, transaction information would be reported to the regulatory agency for tracking.

Though generically defined here, this structure is common amongst market-based programs that facilitate bilateral trading.

5.2 Framework Considerations for Lake Champlain Basin Stakeholders

This section introduces some of the key components of a bilateral market-based structure. Many of these components will require Vermont agency staff and other Lake Champlain Basin stakeholders to address associated policy issues.

5.2.1 Program participation

In the context of bilateral trading, there are several participatory roles (Willamette Partnership et al. 2015) to consider including:

- The *buyer* is any entity with a discharge approved or pending approval under state-or federally-issued permit (e.g., TMDL requirements). This document focuses on entities that have a developed land WLA. Others may include any entities regulated under the new TMDL.
- The *seller* is any entity that generates credits, whether that entity is the permittee, a contractor of the permittee that develops or aggregates credits, or a landowner developing credits on a buyer's behalf.
- An *aggregator* is a project developer that facilitates pollutant reduction practices to generate credits from several producers to sell in bulk to permitted buyers.
- *Verifiers* are often independent, third-party entities that are trained in the relevant conservation practice designs used to generate credits. These entities provide objective options, reviews and inspections of crediting projects to ensure these are constructed and functioning as designed.
- Finally, a *program administrator* is an organization responsible for the operation and maintenance of a water quality trading program. Responsibilities of a program administrator may include: defining credit calculation methodologies, protocols, and quality standards; project review; and credit registration. Program administrators may include third parties or state, federal, or local agencies.

5.2.2 Baselines

Trading baselines establish a minimum level of effort or level of implementation that must be achieved before the project or landowner is eligible to generate credits. It will be important for Lake Champlain Basin stakeholders to consider the implications of the baseline on the viability of the bilateral water quality trading market. This is a significant policy decision in the overall program framework and as has been assessed herein, some form of interim crediting for agriculture will be needed for this sector to participate effectively in a trading program. Appendix D provides a more generalized discussion of baselines as well as provides examples from other state programs with how they might apply to the Lake Champlain Basin.

5.2.3 Credit Certification/Verification

Implementation and operation of credit generating projects are usually inspected in water quality trading programs once installed to ensure that these are completed and operating as designed. This is often done by third parties. Inspections in subsequent years throughout the life of each project further ensure that credit generation is occurring. Each stage of review is typically followed by a final approval, or certification, of the project. Project reviews, both initial and ongoing, can be divided into three main components: 1) administrative review for completeness and correctness; 2) technical review to determine quantification is complete and accurate; 3) confirmation of project implementation and performance.

Credit generating projects must be reviewed for both proper implementation and to ensure quantification methods confirm anticipated water quality improvements are achieved. In a rigorous review process, BMP projects might be inspected by DEC personal, or approved third-party verifiers, to ensure each practice was installed using approved protocols. Quantification methods for each of these projects would then require an additional review, once project has been fully implemented, to confirm load reductions are accomplished. A more elaborate review and certification process may result in higher degree of market participant and public confidence that water quality improvements occur as a result of trading. That said, a more intensive project review will require additional time and resources both of which may be an expenditure for the state and/or the buyers or sellers. Such costs can diminish savings associated with trading and potentially preclude trading opportunities if the process is too burdensome.

5.2.4 Credit Tracking and Accounting

Tracking credits from generation to sale to retirement will be crucial for the long term viability of a Lake Champlain Basin trading program. Multiple options exist for DEC to complete this process. Common recommendations for tracking typically suggest that credits be serialized and entered into a ledger or registry (Willamette Partnership et al. 2015). This approach may better track credits by assigning a unique identifier to each pound of phosphorus reduction, however similar to an intensive review process, this approach may present additional costs to DEC depending on the specific nature of the tracking program within the Lake Champlain Basin program.

Tracking and reporting are essential for every trading program to ensure transparency and accountability for market participants, regulators and the public. Every trading program must determine what specific information is relevant for tracking and reporting, as it may vary between programs. That said, the following list provides topics of information commonly tracked and reported in trading programs. While there is no single list of information to track in trading, the following provides guidelines for DEC to consider when developing tracking protocols:

1. *Credit generation*
    a. Practice type
    b. Types of implemented crediting practices
    c. Acres treated by each practice
    d. Nutrient reductions generated by each practice
    e. Cost of practice implementation
    f. Location of each practice
    g. Landowner contact information
    h. Unit cost of reductions
2. *Trade transaction*
    a. Buyer contact information
    b. Seller contact information
    c. Credit sale price
    d. Number of credits associated with trade agreement

3. *Practice verification information*
    a. Verifier's identification
    b. Practice inspection dates
    c. Status of implemented practices
    d. Identification of practice deficiencies

5.2.5 Risk Assurances

There are inherent risks associated with trading for buyers, sellers, agencies and the public. These include financial risk for market participants, and methods to mitigate this risk through the use of aggregators, brokers and other program elements to ensure fair transactions and expected water quality outcomes. Water quality outcomes are often addressed by trade ratios (see next section). While these ratios are crucial to a trading program, there are numerous other risks for market participants outside of credit price determination. The following summarizes some of these additional risks, approaches to address these, and related cost ramifications:

- Scientific or Physical Site Conditions
    - Direct measurement or monitoring
        - High potential costs particularly depending on the site, receiving waters and duration of monitoring necessary to establish significantly statistical results
    - Use of conservative BMP effectiveness estimates
        - Low-moderate costs, but this approach may reduce the number of credits from a practice
    - Scientifically-vetted estimation methods
        - Low cost if methods are readily available
    - Uncertainty or retirement ratios to provide a margin of safety
        - Low-moderate costs, but this approach may also reduce the number of credits from a practice
- Extreme events
    - Credit reserve pools to ensure extra credits are available to fulfill contracts with stormwater permittees in the event of a failed practice
        - Costs depend on credit-generating practices, though low cost options are commonly sought
- Regulatory risk
    - Grandfathering of recently implemented practices may promote early action and adoption of trading to adequate buyers and sellers exist in the market
        - Low costs as often these were already paid-for practices
    - Certainty programs where third parties, even state agencies certify projects providing market certainty
        - Moderate costs to pay for additional inspections and certifications
    - Water quality trading design standards and best practices guidance and standards for applicable projects under the program
        - Low transaction costs but potentially higher upfront program development costs to get practices programmatically approved
- Market Risk
    - Pre-implementation certification which initiates the planning process before expenditures are actually made

    - Moderate costs as there are financial investments made before these are purchased
  - Credit banks which centralize risk by housing trading within one entities as opposed to bilateral transactions
    - Low buyer-seller transaction costs buy high upfront program development costs
  - Government guarantee to assure that credits are bought in advance
    - High cost for holder of credits in no transactions materialize
- Buyer Risk
  - Aggregators transfer crediting liability and risk away from individual market participants
    - Higher upfront risk for aggregators but recouped in sale price of credits with much lower administrative costs on the part of the ultimate credit user
  - On-going project review by a third party provides assurances to the buyer and public regarding credit validity.
    - Costs associated with reviews vary based on intensity of review
  - Shared liability between buyer and seller which transfers some contractual risk for performance to seller
    - Low costs if financial assurances and fail-safe contractual arrangements are made between buyer and seller but only if the water quality trading program has a “true-up” for failures to be remedied in a reasonable timeframe

Additional details on these risks and approaches to further address them can be found in Willamette Partnership et al. (2015) and K&A (2009).

Trade Ratios

Trade ratios are used as assurance that water quality benefits are being achieved under a trading program. A trade ratio is a numeric value used to adjust available credits for a seller or credit obligation of a buyer based on various forms of risk and uncertainty. Ratios can be used to ensure that the environmental benefit of a credit-generating project is equivalent to or greater than the reduction that would occur if the buyer installed treatment technology on site. Trading ratios are often expressed as a number of credits needed per unit of discharge (e.g., a 2:1 ratio means that two units of reduction are needed per one unit of impact), or as a discount factor (e.g., a 10 percent reduction factor applied to the estimated credits).

Water quality trading programs generally develop one or more types of trading ratios that are applied (either individually or as a lumped factor) to estimated pollutant reductions and/or credits. Trading ratios are frequently used to mitigate risk and uncertainty associated with the quantification of nonpoint source load. They can also be used to set aside credits for purposes like net water quality benefit or insurance against project failure.

When developing trading ratios, one should also consider the water quality trading program’s policy objectives, watershed goals, economic feasibility, and acceptable levels of risk or uncertainty. The assumptions underlying the chosen ratios should be carefully documented in a transparent manner. Moreover, increasing trade ratios based on many different factors can sometimes drive up trade ratios to the point where there is double-counting of uncertainty factors with ultimately diminish the economics of potential trades (K&A 2009). Higher or lower trade ratios may ultimately be instituted for specific projects, or types of projects, if quantification methods suggest the need for such variation. Assigning trade ratios can also largely be driven by policy decisions or stakeholder preferences.

A trade ratio of 2:1 was introduced into the Lake Champlain Basin analysis to account for potential risk of any unknown fate and transport aspects of phosphorus between buyer and seller locations in the basin. This is a common ratio found in other programs where typical ratios may range from 1:1 up to 3:1. The assignment of a 2:1 trade ratio in this report assumes this is sufficient to ensure that the water quality benefit from an agricultural BMP is equivalent or greater than the reduction that would have occurred if stormwater practices had been implemented on site. Trade ratios certainly can be adjusted as new information and science becomes available on the Lake Champlain Basin.

Credit Insurance Pools

Credit buyers often must assume the risk of seller default in bilateral water quality trading transactions absent an aggregator. If a seller fails to deliver the agreed upon credits, the buyer is still obligated to obtain additional credits or make other potentially costly onsite reductions. The State should consider developing an insurance bank of credits to guard against this type of situation. One option for the development of this insurance pool could be to mandate that a percentage of each transaction be allotted to an insurance pool.

5.2.6 Program Funding

Federal, state and local match funding are typically needed to develop water quality trading programs and associated infrastructure. Multiple funding sources can therefore be critical to implementing larger programs and broader watershed improvement strategies. Depending on the trading framework, the state or other administering agency may elect to apply fees to each trade (for both buyers and/or sellers) in order to recover the costs associated with long-term administrative costs. This approach is used for example, by PENNVEST, which applies a 2.5 cents per credits traded to recoup administrative costs. Administration costs will ultimately depend on the type of market-based framework selected. Potential program development and administrative costs were introduced in Section 4.

6. Next Steps and Conclusions

The focus of this project was to assess the current environmental, economic, regulatory, and social factors in the Lake Champlain Basin to determine if the conditions necessary to support market-based phosphorus reduction programs exist. To make this determination, the Project Team evaluated if the following conditions are present:

- Regulatory driver for water quality improvements (i.e., load reductions)
- Substantial potential demand, both in number and type of potential buyers and associated phosphorus reduction quantities
- Ample potential supply, specifically from sellers able to meet baseline requirements
- Sizable treatment cost differentials among phosphorus control costs
- Willing public/willing regulators

This section summarizes the findings of Vermont's assessment of the feasibility of market-based approaches in the Lake Champlain Basin for each of these key conditions. This section also provides a discussion of the issues that Lake Champlain Basin stakeholders should address if there is a continued interest in moving beyond this initial feasibility assessment phase.

6.1 Summary of Findings: Conditions to Support Market-Based Approaches in the Lake Champlain Basin

Through the feasibility analysis and market study, including the pilot project analysis, the Project Team determined that not all of the five conditions needed to support a viable phosphorus credit market have been met in the Lake Champlain Basin. Table 22 provides a summary of these conditions and, where conditions are not met or partially met, indicates the associated issue actions and decisions that Lake Champlain Basin stakeholders should address to fully meet the condition. Of the five conditions, the Project Team considers only one to be met at the present time. Of the remaining conditions, three are partially met and one is not met. A sixth condition regarding the opportunity for innovative, non-water quality trading funding mechanisms to address the use of a clearinghouse-like reverse auction to distribute funding was added as a condition. The Project Team considers this latter condition not met.

Table 22. Summary of conditions needed to support viable market-based approaches in the Lake Champlain Basin

Conditions Needed to Support Market-Based Approaches in the Lake Champlain Basin	Met	Partial	Not Met	Issues To Be Addressed
Regulatory driver for load reductions		✓		Policy/legal decision on declining trading cap
Substantial demand (buyers and quantities)		✓		Additional analysis to determine public burden
Ample supply (with sellers meeting baselines)			X	Policy/legal decision on interim crediting for agriculture
Sizeable treatment cost differentials		✓		Additional analysis on costs
Willing public/regulators	✓			Appear to be present
Opportunity for innovative (non-water quality trading) funding mechanisms			X	Policy/legal decision on constraints to pool funding

6.2 Additional Issues for Further Analysis

As shown in Table 24, Vermont state agency staff and other key Lake Champlain Basin stakeholders have additional issues to resolve and analyses to conduct to better determine if conditions are truly amenable to support a viable market-based program for reducing phosphorus. Previous sections of this report address these additional issues and analyses. A brief summary of each issue is presented again here. In addition, Vermont agency staff and Watershed Markets Advisory Committee members identified a variety of issues over the course of this project that they believe are key to address in a subsequent phase of the market-based program assessment and development process. An overview of these is also presented as follows.

6.2.1 Necessary Conditions Analyses

The issues associated with the partial or not met conditions are key for Lake Champlain Basin stakeholders to address and resolve as part of a subsequent project phase. These include:

- **Policy/legal decisions on use of a declining trading cap.** As discussed in Section 3.2, the analysis developed and applied an overarching hypothetical implementation strategy focused on a declining cap limiting the amount phosphorus reduction a buyer could purchase in five year intervals throughout the 20-year TMDL. This mechanism would allow developed land dischargers to spread the economic burden of compliance over a 20-year period while still implementing practices to reach compliance. While the Project Team presented this approach to the Watershed Markets Advisory Committee, it is a larger policy issue related to overall TMDL implementation that will require Vermont agency staff deliberation and approval. Next steps in the process should include detailed discussions about this conceptual TMDL compliance approach and any policy or legal implications that would arise. EPA Region 1 has stated that TMDL implementation is led by Vermont and that this would largely be Vermont's decision to make. Further policy and legal discussions should continue to involve EPA Region 1, as well as a broader group of developed land dischargers that would be affected by this approach to achieving the WLA over time.
- **Policy/legal decisions on use of interim crediting.** Section 2.5.2 presented the concept of using interim credits or some form of LA phase-in for agricultural sources that would allow these sources to generate credits while working to achieve their baseline (i.e., the agriculture LA and/or new state regulations for this sector). Absent baseline flexibility for agricultural participation, widespread credit supply in the Lake Champlain Basin will be extremely limited. It will also likely be unable to meet the demands of the growing sources encompassed under the TMDL developed lands WLA if all agricultural sources must first meet their lake segment LA baseline or state regulations before generating eligible credits. With either baseline condition, it must be determined whether these will be performed-based outcomes or technology-based requirements. The former is more amenable to trading as it can be readily expressed as mass phosphorus loading per time. The latter complicates baseline considerations which need to express trading credits in units of mass/time.

  Importantly, the hypothetical use of interim credits was central to the Lake Champlain market feasibility analysis. Such is not unprecedented as a similar construct is currently used in Wisconsin water quality trading, while USDA has also suggested phased baselines for agriculture under TMDLs. It is thus, imperative that Vermont agency staff and Lake Champlain Basin stakeholders, including EPA Region 1, analyze the policy and legal barriers to the use of interim crediting and flexibility in the timing of meeting the agriculture LA as the baseline for credit generation. The policy decision on the use of interim crediting for agricultural sources is critical to the viability of a water quality trading program in the Lake Champlain Basin.

- **Policy/legal decisions on constraints to pool funding.** Section 2.1.2 raised the potential for integrating funding for conservation practices and technical services into market-based approaches in a way that could help farmers meet LA requirements or state regulations. Analogous to market-based approaches, distribution of RCPP funds could be based on performance metrics which would optimize RCPP fund investments by supporting the most cost-effective management practices. DEC, AAFM, EPA Region 1, and Vermont NRCS would need to engage in policy discussions about using a clearinghouse-like approach to distributing these funds. Focus groups with agricultural operators about this concept are recommended to ensure this approach would be acceptable to producers.
- **Public versus private burden of the aggregated developed lands WLAs.** Section 3.2.1 discussed the cost assessment for multiple scenarios in which the public sector assumed different quantities of required load reduction. The analysis demonstrated that higher public burden (80 percent) results in higher potential cost savings since public burden represents demand. Therefore, it is necessary for Vermont agency staff and Lake Champlain Basin stakeholders to determine more accurately the percentage of the developed lands WLA that will be the responsibility of public entities to achieve. If the public burden is less than 80 percent and stormwater control costs are low, these factors indicate that development of a basin-wide clearinghouse is not recommended, though bilateral trading would likely be desired, particularly in highly developed urban areas with high stormwater control costs.
- **Refined agriculture and stormwater phosphorus reduction costs.** As discussed throughout the report, if agriculture phosphorus reduction costs are high and stormwater control costs are low, there will not likely be sufficient cost-differentials to compel sources to pursue water quality trading. Although the Watershed Markets Advisory Committee provided feedback and data on BMP costs throughout the project, the Project Team recommends that sources under the developed lands WLA continue to provide real data and information on phosphorus control costs. Because the viability of market-based approaches is so heavily driven by cost-differentials, this information is crucial to refining prior to selecting a final market-based approach. For example, only with the highest-cost stormwater BMP scenario ($8,764 per pound) does a clearinghouse option appear beneficial under the three different public burden scenarios presented in the analysis.

6.2.2 Additional Stakeholder Identified Analyses

Throughout the project, Vermont agency staff and Watershed Markets Advisory Committee members raised some additional issues that they felt warranted further analysis. These additional issues include the following.

- **Potential point source buyer considerations, specifically WWTFs not included in this analysis.** At the outset of this project, DEC stated that a WLA reallocation approach for WWTTs would adequately address this source sector and directed the Project Team to not include them in the market-based analysis. Toward the end of the project, DEC became aware of the fact that the reallocation policy wouldn't allow WWTFs to fully meet their respective WLA. Therefore, it appeared that there would be increased demand from WWTFs. However, this determination was made too late for inclusion in the project. As a result, this is an issue that would require additional analyses in a subsequent analysis and program development phase. There are also new state general permits for stormwater on the horizon. Thus, the number and type of regulated stormwater sources will increase and their potential demand and phosphorus control costs have implications for market viability.

- **Cross-basin trading options.** The Lake Champlain Basin phosphorus TMDL developed for Vermont's portion of the Basin assigns allocations on a lake segment basis. This approach recognizes that Lake Champlain functions as a set of hydrodynamically interconnected segments that extensively influence each other (EPA 2015). Discussion during the first Watershed Markets Advisory Committee meeting clearly indicated a desire on the part of EPA Region 1 and DEC use the assumption that only intra-lake segment market-based activities would take place. This would align with the assumptions of the TMDL, promote consistent TMDL implementation, and prevent hot spots (i.e., unintended shifting of phosphorus load from one lake segment to another). However, some Committee members did express an interest in evaluating the potential for inter-lake segment crediting and offsetting, particularly where there is a strong hydrologic connectivity between lake segments, such as Burlington Bay and the Main Lake. The next phase of analyzing and scoping a market-based program for the Lake Champlain Basin should include further discussion of cross-basin trading options that would promote greater market activity and still meet water quality goals that align with the TMDL.
- **Stormwater phosphorus offsets for new growth.** The issue of stormwater offsets became a larger concern for DEC and Watershed Markets Advisory Committee members toward the end of this project. Vermont has existing requirements to meet "net zero" sediment discharges in stormwater-impaired waters as described in Environmental Protection Rules Ch. 22 (Stormwater Management Rule for Stormwater Impaired Waters). Specifically for the Lake Champlain Basin, state law also requires that all projects requiring an operational stormwater permit for discharges within the Basin show no net increase in phosphorus if EPA Region 1 does not issue a final phosphorus TMDL by October 1, 2015. This requirement will apply to all applications for coverage (new and renewal) under GP 3-9010, 3-9015, or individual stormwater permits, which are received after October 1st. While the schedule and resources for this project did not allow for a full discussion of stormwater offset options to build off of Vermont's existing stormwater offset program, K&A of the Project Team did share stormwater offset program considerations from other watersheds. A phosphorus offset program framework was developed for Lake Simcoe to offset phosphorus loads resulting from new development in the basin (XCG & K&A, 2014). Offsets are accomplished through the implementation of stormwater best management practice retrofits of existing infrastructure that are within the same localized areas of new development. The program offers a highly accountable system in which the transaction of offsets is efficiently tracked between buyers and sellers building on existing program infrastructure. This "Lake Simcoe Phosphorus Offset Program" (LSPOP) was integrated into existing stormwater management programs providing for a highly accountable and verifiable program that would be ideal for the Lake Champlain Basin if a basin-wide offset program is determined to be applicable. The LSPOP is just now beginning to be implemented within the Lake Simcoe watershed. It is expected to produce net load reductions compared to previous stormwater treatment requirements for new development. Incorporating offsets into phosphorus management will generate a net load reduction of nearly 7 T/year from urban development in this basin with expected buildout. DEC and Lake Champlain Basin stakeholders can conduct a comparison of the LSPOP to Vermont's existing stormwater offset approach to identify opportunities to improve the existing program to meet the Lake Champlain Basin's specific phosphorus offset needs.

- **Water quality trading program integration with existing state mechanisms.** Depending on the additional information gathered in a second phase of market-based program development in the basin, it will be important to consider existing state and/or local program infrastructure. Any new trading or market-based program should utilize existing structures, mechanisms and staffing to minimize new costs and additional staffing needs.

6.3 Next Steps

The findings from this CIG project serve as an initial screening of the conditions and opportunities for market-based approaches in the Lake Champlain Basin. Given the list of additional discussion and analysis issues presented above, the Project Team recommends that DEC, AAFM, and the Watershed Markets Advisory Committee consider pursuing the next phase of more focused, issue-driven analysis that seeks to resolve critical policy, legal, and technical issues. This next phase of analysis, however, will require broader DEC and AAFM staff participation that includes senior management as well as legal counsel to help dissect and analyze policy ramifications of market-based program assumptions identified in this initial analysis. It will also be critical to more clearly define TMDL implementation pathways to optimize integration trading with existing programs, avoid duplication or conflicting strategies and more formally recognize new market-based approaches in overall implementation planning.

6.4 Conclusions

Findings from the market-based feasibility study and market assessment conducted for Vermont DEC and AAFM, with input from the Watershed Markets Advisory Committee, indicate that potential phosphorus credit supply and demand exist in the Lake Champlain Basin to support further consideration of market-based approaches. However, to ensure that conditions in the Basin fully exist to support a viable water quality trading approach, additional policy and technical analyses are necessary.

The analysis demonstrated that Vermont could achieve substantial cost savings with a market-based approach when stormwater phosphorus reduction costs are high and when there is a high percentage (e.g., 80 percent) of total required stormwater reductions assumed by public sources. Cost savings with market-based approaches diminish with a lower public burden for stormwater controls and lower stormwater phosphorus control costs. The volume of potential trades coupled with the projected costs for market-based program development suggests bilateral water quality trading on case-by-case basis is the most cost-effective water quality trading option in the Lake Champlain Basin. If new state permit requirements expand the universe of state regulated stormwater sources, and thereby increase the volume of phosphorus reduction credit demand, it could make sense for Lake Champlain Basin stakeholders and sources to consider developing a clearinghouse. This too, would be bolstered by participation of WWTFs in trading.

Regardless of water quality trading program viability, Lake Champlain Basin stakeholders should consider the use of a clearinghouse-like reverse auction mechanism to help optimize conservation payments to producers and achieve more cost-efficient implementation.

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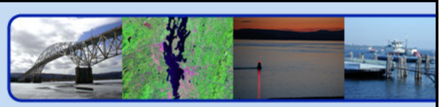


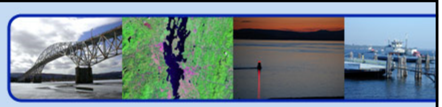
WELCOME AND INTRODUCTIONS

Kari Dolan, Vermont Department of Environmental Conservation
Laura DiPietro, Vermont Agency of Agriculture, Food, and Markets

MEETING PURPOSE & COMMITTEE'S ROLE

Kellie DuBay and Don Meals, Tetra Tech

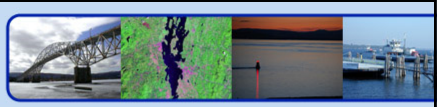
Meeting Purpose



- Engage the Watershed Markets Advisory Committee in the Lake Champlain market-based approach feasibility analysis and framework project
  - Review the project history
  - Review the project process/schedule
  - Obtain input on technical issues

Committee's Role and Expectations

- Group selected to serve advisory role for 10 month project
  - Small number of representatives now due to time constraints and technical focus
  - Next phase would include broader public involvement
- Would like committee to provide:
  - Perspectives of phosphorus sources
  - Feedback on team's proposed assumptions/options to consider in the analysis
  - Reactions to findings and recommendations



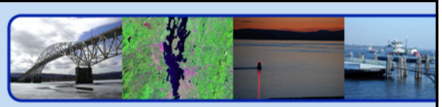
OVERVIEW OF MARKET-BASED APPROACHES TO IMPROVE WATER QUALITY

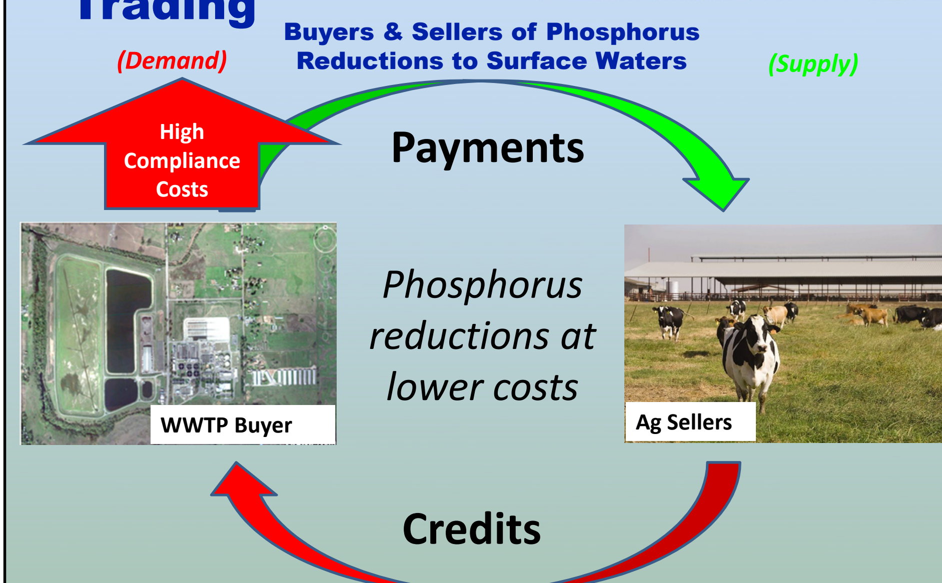
Mark Kieser, Kieser & Associates

Market-based Approaches

- Water quality trading (WQT)
- Water quality offsets
- Corporate sustainability
- Payment for Watershed Services programs
- Water funds
- Water footprinting
- Ag certification/supply chain certification
- Voluntary markets (e.g., pollinator habitat)

Water Quality Trading

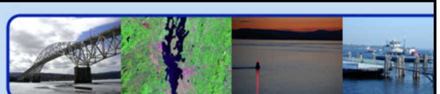




WQT Program Rules

- Legal Basis (How – rule, policy, TMDL, etc.)
- Restrictions (Where)
- Eligibility (Who)
- Pollutants traded (What)
- Baselines
- Uniformly defined credits
- Discounts/Trading ratios
- Tracking (registry)
- Program evaluations (monitor)
- Compliance/ Enforcement
- Public info access
- Certification/verification
- Risk assurances
- Adaptive management

Notable Programs



State	Description (Program, Permits, Rules, etc.)	PS/ PS	PS/ NPS	NPS/ NPS	Activity (Relative)
Minnesota	Permits, Draft Rules	✓	✓	✓	Moderate
North Carolina	Bubble Permits, WQ banks	✓	✓	✓	High
Maryland	Guidelines (some draft)	✓	✓		None
Montana	Policy		✓		None
Colorado	Rules, watershed programs		✓		Low
Virginia	Rules	✓	✓	✓	High
Connecticut	Legislation	✓			High
Oregon	Guidance	✓	✓		Low
Pennsylvania	Rules	✓	✓	✓	High
California	Permit		✓	✓	Low
Idaho	Internal Guidance Doc.	✓	✓		None
Michigan	Rule (Rescinded)	✓	✓	✓	None
Wisconsin	P rule/guidance		✓		Low
Ohio	Rule, watershed programs	✓	✓	✓	High

Guiding Principles for WQT

Ohio WQT

- Watershed-based
- Water quality improvement at reduced costs
- Incentives for voluntary actions
- Net WQ benefit

MN WQT

- Economical (voluntary)
- Accountable (traceable, enforceable)
- Equivalent (same problem, time , location)
- Additional (new; >existing)

USEPA

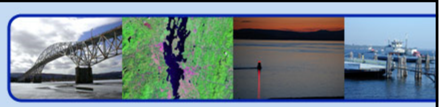
- Transparent
- Real
- Accountable
- Defensible
- Enforceable

(T.R.A.D.E.)

Lake Simcoe

- Accountable
- Beneficial
- Defensible
- Economical
- Enforceable
- Equitable
- Flexible
- Transparent

Participant Considerations

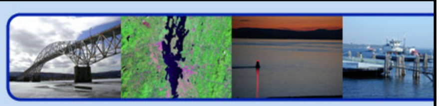


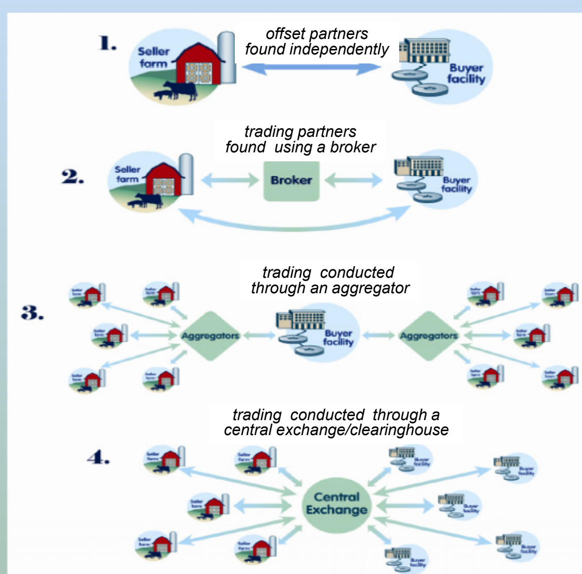
- Effective driver (REQUIRED reductions)
- Cost differentials for treatment
- Availability of trading partners (geographic scope, eligibility, baselines, etc.)
- Program complexity
- Program risk and assurances
- Support and recognition from regulators

Potential Program Structures

- Depends on trading volumes & sectors
  - **Sole source** (single offset without WQT rules)
  - **Bilateral trades** (rules but limited trades)
  - **Brokerage/Aggregator** (rules with 3rd party facilitation)
  - **Clearinghouse** (rules and a central administrator)

Potential Program Structures





Medford, OR

Ohio

Limited trading

Robust trading

Virginia

Pennsylvania
Great Miami River
CT Long Island Sound (PS/PS)

Broker Model

- Comparable role as a "real-estate agent"
- Connect landowners (credit sellers) with buyers
- Help identify conservation practice options for credits
  - Nutrient reduction calculations, final credit proposals, bitateral contracts usually remain buyer responsibilities
- Assist with contracting between buyer/seller
- Coordinate technical services for landowners

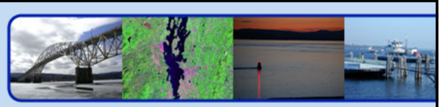
Aggregator Model

- Manage projects & credits (generation/sale)
  - Find sellers
  - Identify and design practices
  - Contract with landowner
  - Oversee all aspects of project installation
- Assure quantity (and quality) of credits to individual buyers
  - Conduct standardized credit quantification methods
  - Document project outcomes/credits
  - Sell credits
- Maintain backup (reserve) pool of credits
- Reporting to buyers
  - Annual credits contracted
  - Volume of credits in back-up pool

Clearinghouse Model

- Contractual role with buyers/sellers and recognized role with regulators to manage Credit Clearinghouse
  - New or existing entity
  - Buyers/state/others pay to fund Clearinghouse operations
  - Buyers additionally pay Clearinghouse for credits
- Credit management (generation/sale)
- Innovative solicitations (“reverse auctions”)
- Assure quantity (and quality) credits for buyers
  - Maintain credit quantification methods/protocols
  - Identify and engage third party project verifiers
- Maintain backup (reserve) pool of credits
- Tracking and reporting for buyers/sellers, VT DEC, public
  - Credit inventory
  - Trading activities

Program Roles to Fill



- Administrator
- Program marketing (e.g., aggregators, brokers)
- Technical (crediting, implementation)
- Regulatory reviews
- Project verification
- Project credit registration and tracking

Early Considerations

- Trading should not directly conflict with existing watershed management programs
- Conflicts must be mitigated
- Trading provisions can enhance or augment other programs
- Focus on trades that address multiple goals through ancillary benefits of practices

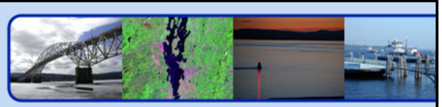
Setting Goals and Outcomes

- Cost-effective compliance for buyers
- Broader goal of restoration
- Outcome in terms of “net water quality benefit” (e.g., 10% net TP reduction)
- Target incentives in priority areas (e.g., impaired or sensitive waters)
- Qualitatively defined benefits (e.g., improved habitat, wetland restoration, floodplain enhancements, etc.)

Trade Offs

- Too many goals makes system unwieldy or ineffective
- Increasing desired outcomes increases costs
- Complex program increases technical, logistical, and administrative challenges
- Fewer participants engage in the marketplace

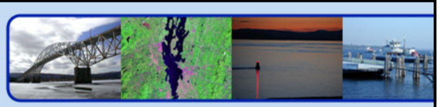
Optimization



- Define WQT program goals
- Test alignment of trading goals with other program goals
- Use evaluation criteria to compare trading benefits with implementation approaches for other programs (“feasibility analysis”)

HISTORY AND GOALS OF THE LAKE CHAMPLAIN NUTRIENT MARKET-BASED APPROACHES PROJECT

Kari Dolan, Vermont Department of Environmental Conservation



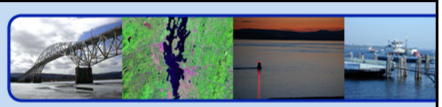
Vermont's Experience with Market Approaches

- "Act 51": 1997 Vermont Laws 51, Section 5
- Stormwater offsets in stormwater-impaired waters before TMDLs are developed (10 VSA Section 1264a, 2004)

Vermont's Experience with Market Approaches

- "Act 51": 1997 Vermont Laws 51, Section 5
  - Pilot Project involving implementation of cost-effective off-site mitigation of P discharges from ≤ 2 small municipally-owned treatment plants
  - Net reduction in P loading from mitigation ≥ monthly average P concentration limit of 0.8 mg/l
  - Shoreham Pilot that allowed implementation of nonpoint source (NPS) plan in lieu of P removal at WWTF (35,000 gpd)

Vermont's Experience with Market Approaches

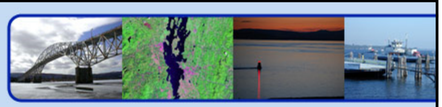


- "Act 51": 1997 Vermont Laws 51, Section 5
  - Policy Issues
    - How to determine compliance with the plan
    - How to quantify P reductions from practices
    - How to determine whether program is cost-effective
    - Plan represented restrictions on use of private land
    - Costs to implement the NPS program shifts costs from sewer users in village to town residents

Vermont's Experience with Market Approaches

- "Act 51": 1997 Vermont Laws 51, Section 5
  - Practices
    - Town road maintenance
    - Conservation of town-owned property
    - Impervious surface minimization on town-owned land including roads
    - Stormwater management, using town by-laws
    - Erosion control at construction sites, using bylaws
    - Educational outreach
  - Schedule: Complete implementation by June 30, 2004; consequence: require WWTF upgrade

Vermont's Experience with Market Approaches

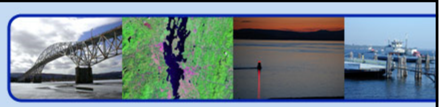


- "Act 51": 1997 Vermont Laws 51, Section 5
  - Contested
    - Plan did not comply with Act 51 because Plan was vague and unenforceable
    - Phosphorus reductions from plan implementation were not quantified
  - Policy debate between Legislature and Water Resources Board
    - 2001 Capital Construction Act (Act 61, Section 47a)
    - Water Resources Board (Docket No. WQ-00-11, 11/30/2001) approved plan, with changes to implementation and reporting schedule, baseline study, and annual reporting on quantified P reductions attributable to each practice, cost, and future actions

Vermont's Experience with Market Approaches

- Summary of 2002 report
  - Roads: some progress with road inventory but no prioritization or capital budget
  - No land conservation easements on town-owned property
  - No actions to minimize impervious surfaces on town-owned land
  - Postponed bylaw updates
  - Developing outreach materials
  - No quantitative estimates of P reductions for each practice and only limited cost information
  - Lack of scientific data for use in quantifying P reductions
  - NPS measures selected in Shoreham have very limited data to help quantify P reductions
- State recommended not to pursue similar P mitigation projects in the future

Vermont's Experience with Market Approaches

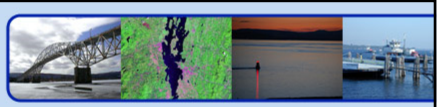


- Lessons Learned from Shoreham
  - Local process was difficult and controversial
  - High administrative costs
    - Inability to quantify P reduction credits created uncertainty and vulnerability to an appeal
    - Difficult to monitor
    - Did not address uncertainty (e.g., no trading ratio required)
    - Difficult to enforce
  - Question whether PS-NPS offsets can work for LC
    - Under TMDL, there may be nothing to trade: Scope of NPS controls to meet TMDL targets is so extensive that nearly every feasible NPS control practice is needed to achieve required reductions

Vermont's Experience with Market Approaches

- Lessons Learned from Shoreham (continued)
  - Vermont Wasteload Allocation Process Rule allows for a reallocation of P loads among discharge in a watershed; may be the preferred first option if a WWTF needs to expand before a point/NPS trading option.
  - Piloting projects are informative
  - TMDL implementation plan is a good framework
  - Difficult to quantify NPS P reduction effectiveness

Vermont's Experience – Stormwater Offsets

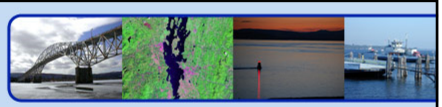


- Zero discharge standard for new(re) development before TMDL
- Projects include: stormwater BMPs, culvert replacement, streambank stabilization, riparian corridor protection projects
- Establishment of an offset bank for 10 municipalities in 2003 with a $1.2 million state and ~$4 million in federal earmarks
- Outcome: 29 projects, 100K lbs of TSS, $300K in fees
- Lessons learned
  - Problems with land title changes
    - Stormwater permits do not run with the land
  - Scope could be limiting (limited to 30 sq mi)
  - Positive benefits
    - Low transaction costs
    - Low administration costs

Where we are Today - LC P Trading Initiative

- Conservation Innovation Grant (CIG) from USDA NRCS
- Partnership between VAAFM and VDEC
- Goals
  - Evaluate market-based strategies to help achieve P pollution reduction targets of the TMDL in a cost-effective way
  - Reduce the cost of the regulated sector in meeting pollutant discharge limits
  - Establish incentives for voluntary P reductions above baseline requirements
  - Accommodate continued growth and economic development

LC P Trading Initiative

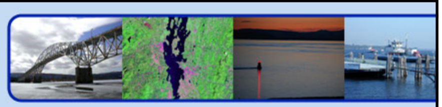


- Deliverables
  - Conduct a feasibility study and market analysis
  - Conduct a pollutant suitability assessment
    - Geographic scope, determine buyers and sellers, estimate of supply and demand, define trading ratio considerations
  - Conduct an Economic Suitability Analysis, looking at control costs and potential cost savings
  - Analyze trading and offset strategies
  - Develop market-based framework
  - Support stakeholder participation
  - Develop a pilot project
  - Final report

OVERVIEW OF THE PROJECT PROCESS

Kellie DuBay, Tetra Tech
Mark Kieser, Kieser & Associates

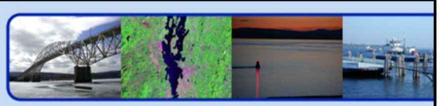
Project Overview



- Timeframe: December 2014 – September 2015
- Four tasks:
  - Conduct Feasibility Assessment and Market Analysis
  - Analyze and Recommend Market-Based Nutrient Strategy for Lake Champlain Basin
  - Develop Market-Based Framework
  - Conduct Stakeholder Participation and Pilot
- Four committee meetings
  - March/April 2015
  - June 2015
  - August 2015

Task 1 Overview: Feasibility Assessment

- Gauge the potential for a phosphorus market based on existing factors
  - Regulatory drivers to implement TMDL
  - Type & geographic location of P sources
  - Control costs
  - Watershed factors (e.g., attenuation)
- Snapshot in time
  - Existing data only
  - Limited discussion of future conditions (e.g., new permits)
- Must make assumptions for purposes of the analysis
  - Will need committee input
  - Focus of today's facilitated discussion

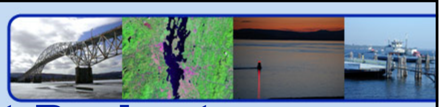


Task 2 Overview: Market-Based Strategy

- Based on characteristics of Lake Champlain Basin and feasibility analysis findings
- Analyze only applicable potential strategies that could work with existing conditions or anticipated changes (e.g., new permits, expanded sources)
- Recommended strategy would have to be both technically-sound and socially acceptable
  - Will need Committee input on potential strategies
  - Focus of second Committee meeting

Task 3 Overview: Market-Based Framework

- Based on recommended strategy
- Will include options for framework components:
  - Rules
  - Public participation
  - Baselines for generating credits
  - Restrictions to avoid hotspots
  - Infrastructure
  - Verification/certification
  - Tracking/accounting
  - Risk assurances
  - Funding/costs
- Focus for Committee's second and third meetings



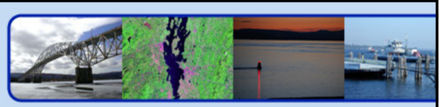
Task 4 Overview: Committee and Pilot Project

- Four committee meetings over 10 months
- Pilot to test elements of recommended framework
- Will work with Committee during second and third meeting to conceptualize pilot project
- Will report to Committee on pilot project progress during fourth meeting

Project Milestones

• Feasibility Assessment	• Draft 2/15/15
• Market-based Strategy	• Draft 3/15/15
• Committee Mtg #2	• By 4/15/15
• Market-based Framework	• Draft 6/15/15
• Committee Mtg #3	• By 7/1/15
• Committee Mtg #4	• By 8/15/15
• Pilot Project	• Draft 9/7/15
• Final Project Report (all tasks)	• Due 9/30/15

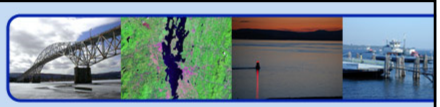
Project Outcomes



- Recommendations for Phase II of market-based efforts
- List of data gaps and additional research needs
- Direction for legal/policy analysis

FACTORS INFLUENCING MARKETABLE PHOSPHORUS REDUCTIONS IN THE LAKE CHAMPLAIN BASIN

Technical Working Session



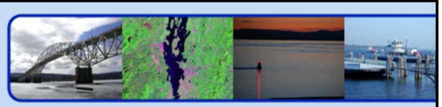
Goal of this Session

- Identify and discuss factors that will influence the estimate of phosphorus credit supply and demand in the Lake Champlain Basin
- Obtain Advisory Committee input on assumptions to use in the feasibility assessment to guide credit supply/demand estimate analysis

Factor: Regulatory Drivers

- Control costs to achieve point/NPS requirements to implement the TMDL affect credit supply and demand
- Documented existing requirements (from Phase I Implementation Plan)
- Using assumptions about TMDL allocations (from EPA Region 1)
- Will attempt to factor in additional information as it becomes available
  - RDA analysis
  - New permit requirements

Allocation

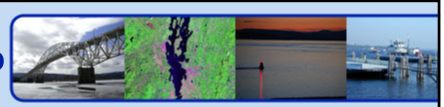


Segment	WLA - WWTP	WLA - Developed	LA	MOS	TMDL
1. South Lake B	0.8	6.8	18.4	1.4	27.3
2. South Lake A	0.2	1.7	10.6	0.7	13.3
3. Port Henry	0.0	0.6	5.1	0.3	6.0
4. Otter Creek	12.0	14.5	82.5	5.7	114.7
5. Main Lake	9.8	25.5	80.8	6.1	122.2
6. Shelburne Bay	0.7	3.0	5.0	0.5	9.2
7. Burlington Bay	1.5	1.0	0.4	0.2	3.0
9. Malletts Bay	3.2	12.9	26.9	2.3	45.3
10. Northeast Arm	0.0	3.4	11.3	0.8	15.5
11. St. Albans Bay	1.1	2.3	6.6	0.5	10.6
12. Missisquoi Bay	1.9	9.7	30.7	2.2	44.5
13. Isle LaMotte	0.1	0.7	2.7	0.2	3.7
Total	31.4	82.1	281.0	20.8	415.3

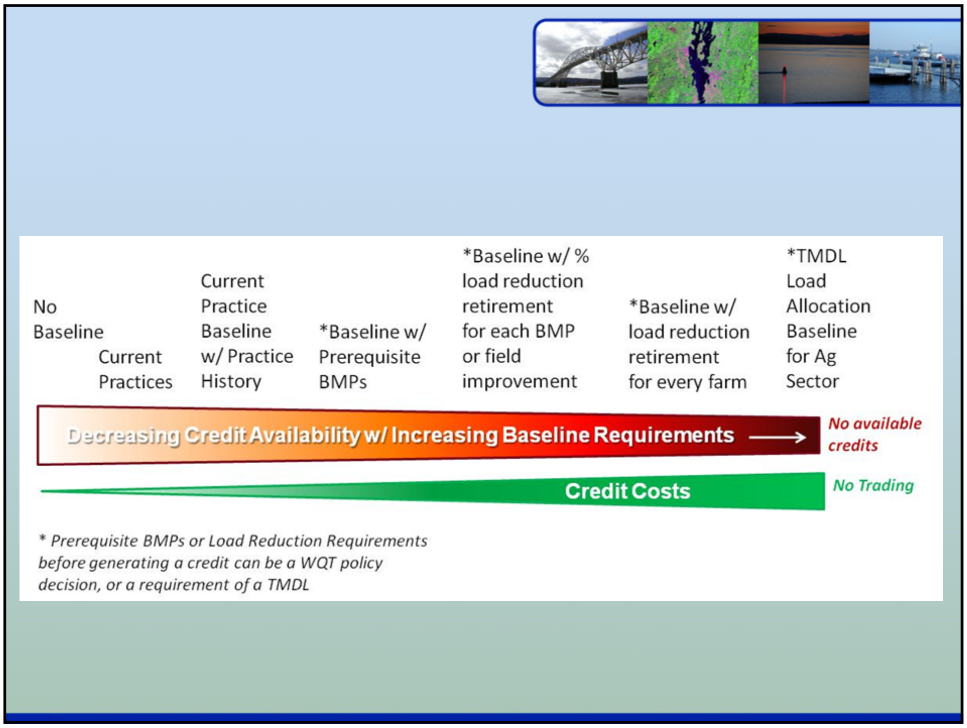
% Requirements

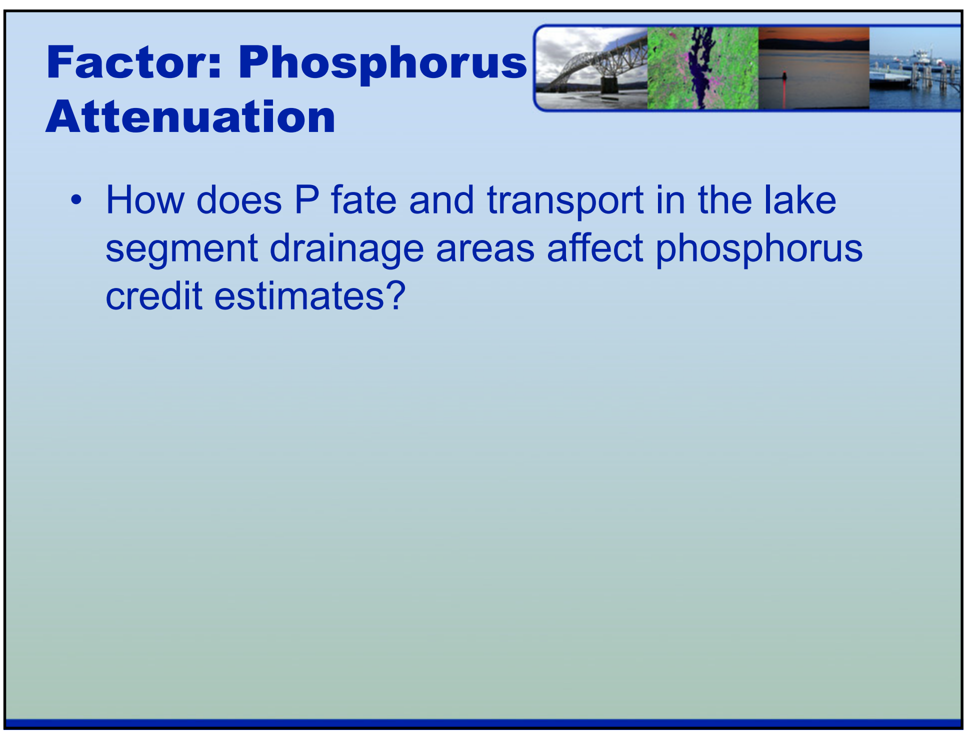
Segment	WWTP	SW	NPS	Overall
1. South Lake B	0.2/0.8/Current	23%	56%*	47%
2. South Lake A	Current Permit	21%	56%*	50%
3. Port Henry	Current Permit	11%	20%	15%
4. Otter Creek	Current Permit	20%	30%	18%
5. Main Lake	0.2/0.8/Current	24%	31%	25%
6. Shelburne Bay	0.2/0.8/Current	19%	20%	13%
7. Burlington Bay	0.2/0.8/Current	25%	0%	34%
9. Malletts Bay	Current Permit	26%	28%	20%
10. Northeast Arm	Current Permit	9%	20%	13%
11. St. Albans Bay	0.2/0.8/Current	13%	36%	24%
12. Missisquoi Bay	0.2/0.8/Current	19%	75%*	67%
13. Isle LaMotte	Current Permit	14%	20%	12%

Factor: Enhanced P Control Activities



- P credit supply affected by establishment of market baselines
  - What requirements do sources have to meet to implement TMDL?
  - Controls above and beyond should be eligible to generate P credits for the market
- Baseline options can expand or contract the market
- Need input on which phosphorus control activities could be eligible for generating


No Baseline
Current Practices
Current Practice Baseline w/ Practice History
*Baseline w/ Prerequisite BMPs
*Baseline w/ % load reduction retirement for each BMP or field improvement
*Baseline w/ load reduction retirement for every farm
*TMDL Load Allocation Baseline for Ag Sector
Decreasing Credit Availability w/ Increasing Baseline Requirements
No available credits
Credit Costs
No Trading
* Prerequisite BMPs or Load Reduction Requirements before generating a credit can be a WQT policy decision, or a requirement of a TMDL


Factor: Phosphorus Attenuation
• How does P fate and transport in the lake segment drainage areas affect phosphorus credit estimates?

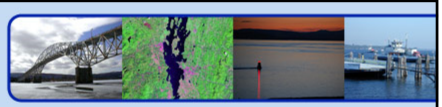
NEXT STEPS AND ACTION ITEMS


Trading Feasibility Assessment
for the Lake Champlain Basin
Watershed Markets Advisory Committee Meeting
June 4, 2015
VERMONT
AGENCY OF NATURAL RESOURCES
TETRA TECH
KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING


WELCOME AND
INTRODUCTIONS
Kari Dolan, Vermont Department of Environmental Conservation
Laura DiPietro, Vermont Agency of Agriculture, Food, and Markets

PROJECT STATUS UPDATE & MEETING PURPOSE

Kellie DuBay, Tetra Tech



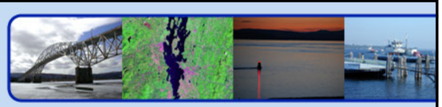
Project Review

- Timeframe: December 2014 – September 2015
- Tasks:
  1. Conduct Feasibility Assessment and Market Analysis
  2. Analyze and Recommend Market-Based Nutrient Strategy for Lake Champlain Basin
  3. Develop Market-Based Framework
  4. Conduct Stakeholder Participation and Pilot
- Committee meetings
  1. January 2015
  2. March/April 2015 (pushed to June due to technical work)
  3. June 2015
  4. August 2015

Project Status Update

- Conduct Feasibility Assessment and Market Analysis
  - Submitted draft on February 17, 2015
  - Included detailed approach for estimating supply and demand from each source sector
  - Revised approach on May 7, 2015
- Analyze and Recommend Market-Based Nutrient Strategy for Lake Champlain Basin
  - Developed early draft, but needs supply/demand estimate to characterize market

Meeting Purpose

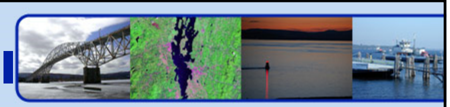


- Discuss preliminary supply/demand findings
  - Initial feasibility of trading in LCB
- Discuss ramifications for trading program design
  - Possible trading scenarios for agriculture and MS4s
  - Interim milestone considerations for trading
  - Tracking of RCPP funding within the framework
  - Potential cost savings with trading

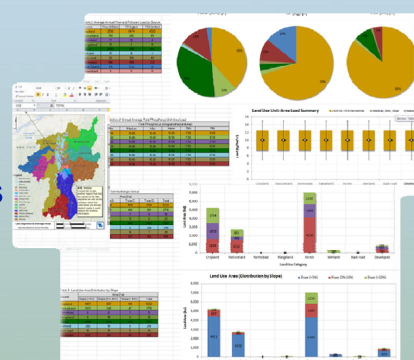
OVERVIEW OF FEASIBILITY ASSESSMENT & PRELIMINARY SUPPLY/ DEMAND ESTIMATES

Kellie DuBay, Tetra Tech and Mark Kieser, Kieser & Associates

Estimating Potential Supply/Demand



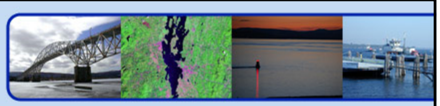
- Looked at a variety of options for estimating supply/demand
- Identified a broad approach that uses existing data from EPA's Scenario Tool to be consistent with TMDL
- Uses identified load reductions and average implementation costs per pound P reduced



Overview of EPA's Scenario Tool

- Provides
  - Calibrated SWAT results
  - Existing Source Loads
  - BMP efficiencies
- Allows user to create BMP scenarios to compare to loading targets
- Using 'Lower Range Scenario' as TMDL allocation surrogate
- Lower Range Scenario
  - 25% reduction to MS4 loads
  - 50-75% reductions to Agricultural loads (depending on lake segment)

WQT Feasibility



1. Is there sufficient P demand in the basin to justify development of a WQT program…
   - Near-term from MS4 stormwater reduction requirements?
     - Other future demand?
2. Is there sufficient Ag P credit supply to meet demand?
3. As there sufficient cost differentials between MS4 reductions and Ag reductions?
4. Will TMDL LA (baseline) requirements for Ag preclude sufficient credit-generating opportunities?
   - Are there other programmatic opportunities benefitted by a WQT program?

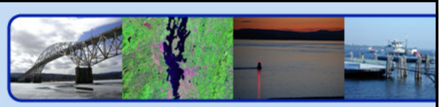
MS4 Demand

Lake Segment	Drainage Area	Total Area Developed Lands (ha)	Existing Load (lb/yr)	% Reduction Required	Required Reductions (lb)
Main Lake	Winooski	5,181	5,816	25	1,454
Main Lake	ML Direct Drainage	47	176	25	44
Burlington Bay	BB Direct Drainage	719	1,698	25	424
Burlington Bay	BB CSO	448	1,914	25	478
Shelburne Bay	La Platte	2,258	4,874	25	1,219
Otter	Otter	652	1,777	25	444
Malletts Bay	Lamoille River	640	1,036	25	259
Malletts Bay	Malletts Bay Direct Drainage	1,514	1,911	25	478
St. Albans Bay	St. Albans Bay Direct Drainage	679	1,658	25	414
Missisquoi Bay	Missisquoi	1	3	25	1
Total MS4		**12,139**	**20,863**		**5,216**

Trading is likely not feasible in Main Lake Direct Drainage and Missisquoi due to relatively low demand. Trading for Burlington Bay CSO is also excluded from analyses.

Burlington Bay will have demand, but very limited Ag supply.

Ag Supply



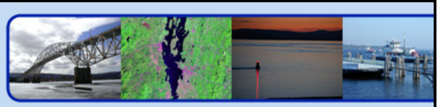
Lake Segment	Drainage Area	Total Area Ag Lands (ha)	Existing Load (lb/yr)	% Reduction Required	Required Reductions (lb)
Main Lake	Winooski	19,776	68,753	57	39,189
Main Lake	ML Direct Drainage	2,949	14,008	57	7,985
Burlington Bay	BB Direct Drainage	4	9	53	5
Burlington Bay	BB CSO	-	-	-	-
Shelburne Bay	La Platte	6,170	15,540	61	9,480
Otter	Otter	49,620	190,001	51	96,672
Otter	Little Otter Creek	8,860	26,524	51	13,495
Otter	Lewis Creek	4,493	11,385	51	5,793
Otter	Otter Direct Drainage	1,171	8,574	51	4,362
Malletts Bay	Lamoille River	18,103	61,560	56	34,227
Malletts Bay	Malletts Bay Direct Drainage	17,000	4,279	56	2,379
St. Albans Bay	St. Albans Bay Direct Drainage	5,747	20,984	75	15,708
Missisquoi Bay	Missisquoi River	27,073	106,007	68	72,085
Missisquoi Bay	Missisquoi Direct Drainage	7,320	34,712	68	23,604
Total Ag		**168,286**	**562,335**		**324,985**

Low demand in Main Lake Direct Drainage and Missisquoi. Burlington Bay is CSO-driven and excluded from analyses. Burlington Bay will have demand, but very limited Ag supply.

Cost scenarios for MS4/Ag Trading

- MS4 P reduction costs considered:
  - $5,000/lb
  - $15,000/lb
  - $30,000/lb
    - $15,000 is likely a reasonal average cost per pound of reduction. Costs up to $30,000 can be expected in some settings
- Ag P reduction costs considered:
  - $10/lb
  - $50/lb
  - $125/lb
    - Likely costs for Ag would be lower (e.g., $10-25/lb)
- nalysis assessed program costs based on select combinations of Ag and MS4 costs

MS4 WLA costs



Lake Segment	Drainage Area	Total Area Developed Lands (ha)	Required Reductions (lb)	Total Cost at $5,000/lb Reduction	Total Cost at $15,000/lb Reduction	Total Cost at $30,000/lb Reduction
Main Lake	Winooski	5,181	1,454	$ 7,269,734	$ 21,809,203	$ 43,618,407
Main Lake	ML Direct Drainage	47	44	$ 220,462	$ 661,386	$ 1,322,772
Burlington Bay	BB Direct Drainage	719	424	$ 2,121,947	$ 6,365,840	$ 12,731,681
Burlington Bay	BB CSO	448	478	$ 2,392,013	$ 7,176,038	$ 14,352,076
Shelburne Bay	La Platte	2,258	1,219	$ 6,093,019	$ 18,279,056	$ 36,558,111
Otter	Otter	652	444	$ 2,221,155	$ 6,663,464	$ 13,326,928
Malletts Bay	Lamoille River	640	259	$ 1,295,214	$ 3,885,643	$ 7,771,286
Malletts Bay	Malletts Bay Direct Drainage	1,514	478	$ 2,389,257	$ 7,167,771	$ 14,335,542
St. Albans Bay	St. Albans Bay Direct Drainage	679	414	$ 2,072,343	$ 6,217,028	$ 12,434,057
Missisquoi Bay	Missisquoi	1	1	$ [illegible]	$ 12,401	$ [illegible]
Total MS4		12,139	5,216	$ 26,079,277	$ 78,237,830	$156,475,660

MS4 Capital Costs in WQT-applicable lake segments:

- At $5,000/lb = $23.6M
- At $15,000/lb = $70.4M
- At $30,000/lb = $140.7M

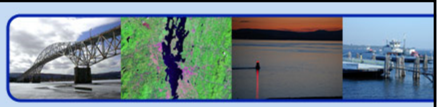
Ag LA costs

Lake Segment	Drainage Area	Total Area Ag Lands (ha)	Required Reductions (lb)	Total Cost at $10/lb Reduction	Total Cost at $50/lb Reduction	Total Cost at $125/lb Reduction
Main Lake	Winooski	19,776	39,189	$ 391,894	$ 1,959,468	$ 4,898,671
Main Lake	ML Direct Drainage	2,949	7,985	$ 79,846	$ 399,232	$ 998,081
Burlington Bay	BB Direct Drainage	4	5	$ 50	$ 251	$ 628
Burlington Bay	BB CSO	-	-	$ -	$ -	$ -
Shelburne Bay	La Platte	6,170	9,480	$ 94,796	$ 473,981	$ 1,184,953
Otter	Otter	49,620	96,672	$ 966,724	$ 4,833,619	$ 12,084,049
Otter	Little Otter Creek	8,860	13,495	$ 134,953	$ 674,765	$ 1,686,913
Otter	Lewis Creek	4,493	5,793	$ 57,925	$ 289,626	$ 724,064
Otter	Otter Direct Drainage	1,171	4,362	$ 43,623	$ 218,117	$ 545,292
Malletts Bay	Lamoille River	18,103	34,227	$ 342,271	$ 1,711,357	$ 4,278,392
Malletts Bay	Malletts Bay Direct Drainage	17,000	2,379	$ 23,792	$ 118,961	$ 297,402
St. Albans Bay	St. Albans Bay Direct Drainage	5,747	15,708	$ 157,083	$ 785,415	$ 1,963,538
Missisquoi Bay	Missisquoi River	27,073	72,085	$ 720,847	$ 3,604,236	$ 9,010,591
Missisquoi Bay	Missisquoi Direct Drainage	7,320	23,60[illegible]	[illegible] 236,040	$ 1,180,199	$ [illegible]
Total Ag		**168,286**	**324,[illegible]85**	**$ 3,249,846**	**$ 16,249,229**	**$ 40,623,071**

Ag Costs in LCB:

- At $10/lb = $3.3M
- At $50/lb = $16.23M
- At $125/lb = $40.6M

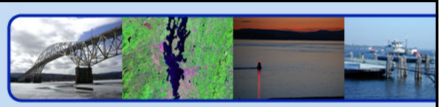
In Summary…



- Reasonable volume of demand for P credits from MS4s exists in LCB
  - Exception in some lake segments
  - Will likely increase over time as regulated universe expands
- Sufficient supply of P credits from agriculture likely exists in LCB despite high TMDL LA for Ag
  - Exception in some lake segments with limited Ag
  - Volume of credit demand <2% of Ag LA
    - LA is 58% or ~325,000 lbs; WLA demand is 5,216 lbs
- Sufficient cost differentials exist under most scenarios suggesting WQT is economical

Discussion and Break

- Questions on supply/demand estimates and cost assumptions for analysis?
- Break 15 minutes

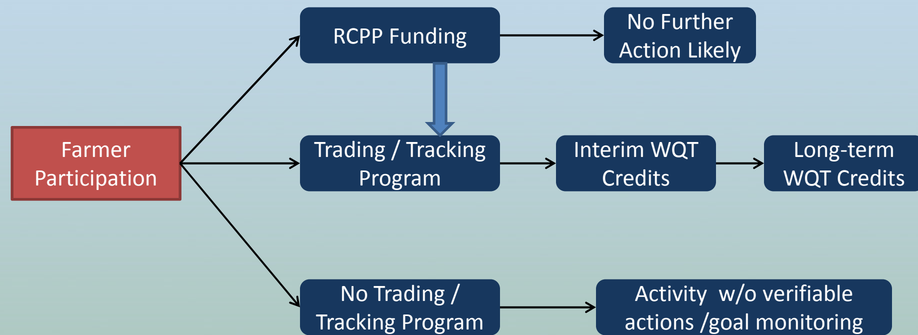


TRADING CONSIDERATIONS, OPTIONS & IMPLICATIONS FOR MARKET-BASED APPROACHES

Mark Kieser, Kieser & Associates

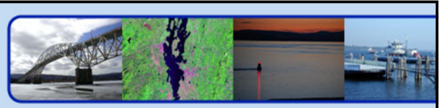
LA Scenario: Ag WQT/tracking

- What are the possible options to meet TMDL over 20 years?



Interim Credits: Reductions used to meet LA baseline; good only for 10 years
Long-term Credits: Reductions beyond the LA baseline; good for life of practice

LA Scenario: Ag Credit Generation Timeline



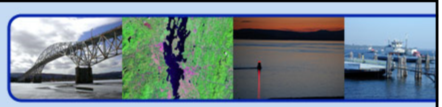
WQT	Years: 0-5	Years: 6-10	Years: 11-15	Years: 16-20	Years: 20+
Implement: 0-5yrs		Interim credits	Interim credits	Long-term credits	Long –term credits
Implement: 6-10 yrs			Interim credits	Interim credits	Long-term credits
Implement: 11-15 yrs				Interim credits	Long-term credits
Implement: 16-20 yrs					Long-term credits
RCPP Funding	Not Eligible for Trading →	→	→	→	
Non-Program Option	Uncertain Outcomes →	→	→	→	

WLA Scenario: WQT for MS4s

- Analysis assumes MS4 WLA reductions in 20 yrs
- Cost analysis was divided into 4 unique periods
  - 0-5 yrs, 6-10 yrs, 11-15 yrs and 16-20 yrs
- Each period assigned a different ratio of reductions to be met through WQT/SW BMPs

Time Period	0-5 Years	6-10 Years	11-15 Years	16-20 Years
Target reductions	**25%**	**50%**	**75%**	**100%**
Reductions through WQT	*80%*	*60%*	*40%*	*20%*
Reductions through SW BMPs	*20%*	*40%*	*60%*	*80%*

WLA Scenario Cost Calculation



- Establish costs to MS4s absent trading

Lake Segment	Drainage Area	Total Area Developed Lands (ha)	Required Reductions (lbs)	Costs at $15,000/lb	Costs at $30,000/lb
Main Lake	Winooski	5,181	1,454	$ 21,809,250	$ 43,618,500
Burlington Bay	BB Direct Drainage	719	424	$ 6,365,850	$ 12,731,700
Shelburn Bay	La Platte	2,258	1,219	$ 18,279,000	$ 36,558,000
Otter	Otter	652	444	$ 6,663,450	$ 13,326,900
Mallett's Bay	Lamoille River	640	259	$ 3,885,600	$ 7,771,200
Mallett's Bay	Mallett's Bay Direct Drainage	1,514	478	$ 7,167,750	$ 14,335,500
St. Alban's Bay	St. Alban's Bay Direct Drainage	679	414	$ 6,217,050	$ 12,434,100
	Total	11,643	4,693	$ 70,387,950	$ 140,775,900

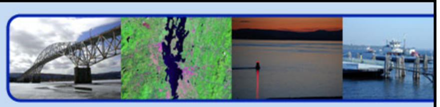
- Averaging these ‘total costs’ across the 4 ‘periods’ established for these analyses:
  – At $15,000/lb: Cost per period = $17,596,988
  – At $30,000/lb: Cost per period = $35,193,975

WQT Scenario Cost Calculation

- Four <u>unit</u> cost scenarios ($/lb P) initially examined:
  - $50 Ag BMPs and $15,000 Stormwater controls
  - $50 Ag BMPs and $30,000 Stormwater controls
  - $125 Ag BMPs and $15,000 Stormwater controls
  - $125 Ag BMPs and $30,000 Stormwater controls
- Costs for each of four scenarios aggregated over the 4 periods

Example WQT Scenario Costs for all Trading Areas

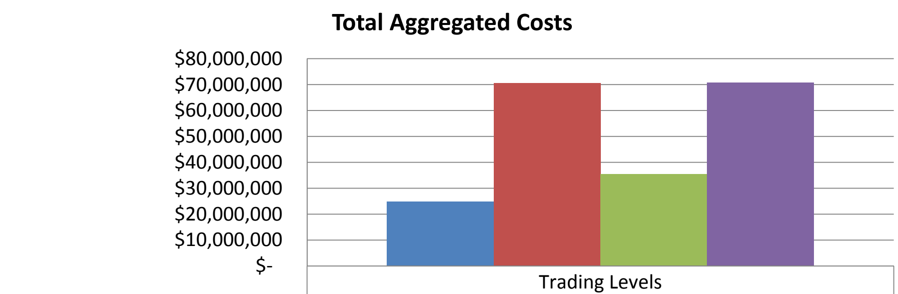
(0-5 yrs)



Year 0-5									
Drainage Area	Required Reductions (lb)	75% of WLA remaining (lbs)	Reduced by (lbs)	80% with WQT	Cost with Trading at $50/lb	Cost with Trading at $125/lb	20% with Upgrades	Remaining cost through upgrades at $15,000/lb	Remaining cost through upgrades at $30,000/lb
Winooski	1,454	1,090	363	291	$ 14,539	$ 36,349	73	$ 1,090,460	$ 2,180,920
BB Direct Drainage	424	318	106	85	$ 4,244	$ 10,610	21	$ 318,292	$ 636,584
La Platte	1,219	914	305	244	$ 12,186	$ 30,465	61	$ 913,953	$ 1,827,906
Otter	444	333	111	89	$ 4,442	$ 11,106	22	$ 333,173	$ 666,346
Lamoille River	259	194	65	52	$ 2,590	$ 6,476	13	$ 194,282	$ 388,564
Mallett's Bay Direct Drainage	478	358	119	96	$ 4,779	$ 11,946	24	$ 358,389	$ 716,777
St. Alban's Bay Direct Drainage	414	311	104	83	$ 4,145	$ 10,362	21	$ 310,851	$ 621,703
Total	4,693	3,519	1,173	939	$ 46,925	$ 117,313	235	$ 3,519,400	$ 7,038,801

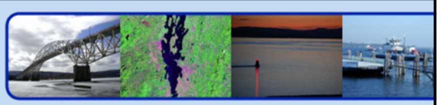
- Calculations run for each of 4 periods with proportion of WQT to facility upgrades changing as illustrated previously.

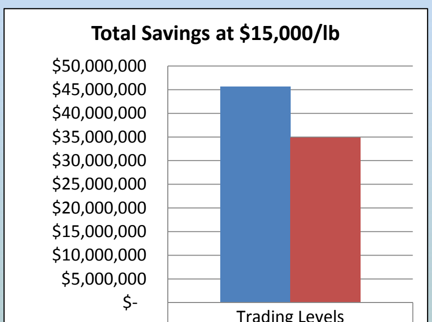
Aggregated Costs - All Trading Areas



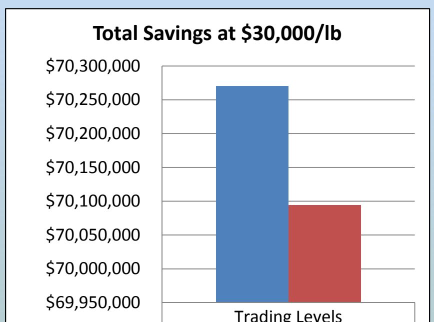
	Trading Levels
Trading at $50 Ag and 15k/lb Upgrade	$24,729,652
Trading at $50 Ag and 30k/lb Upgrade	$70,505,318
Trading at $125 Ag and 15k/lb Upgrade	$35,487,286
Trading at $125 Ag and 30k/lb Upgrades	$70,681,288

Program Savings - All Trading Areas





	Trading Levels
Trading at $50 Ag and 15k/lb Upgrades	$45,658,298
Savings at $125 Ag and 15k/lb Upgrades	$34,900,664



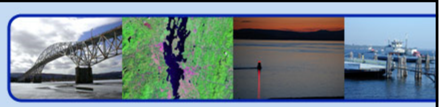
	Trading Levels
Trading at $50 Ag and 30k/lb Upgrade	$70,270,582
Traing at $125 Ag and 30k/lb Upgrade	$70,094,612

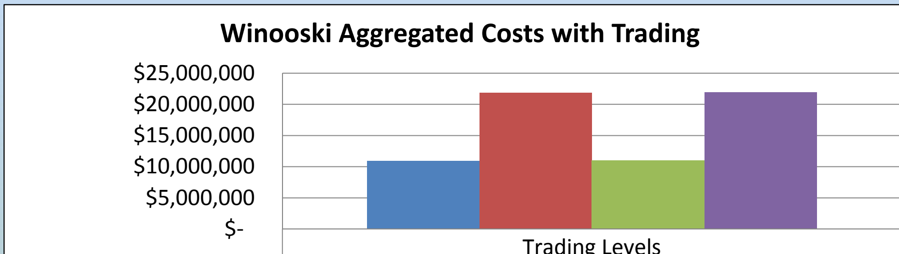
Savings were determined by comparing costs for each of the scenarios compared to the average cost per period absent trading

Specific Drainage Area Analysis: Winooski Example

- Program cost and savings calculated specifically for Winooski
- Methodology identical to previous drainage area evaluation

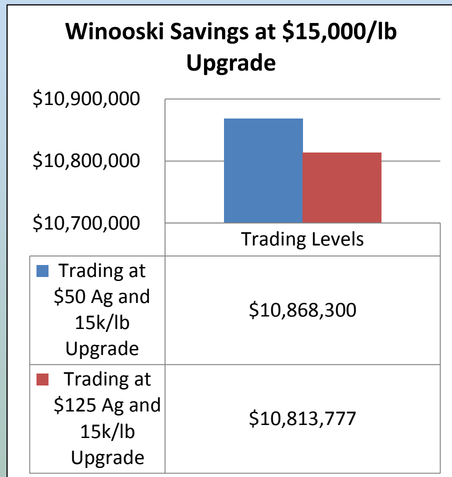
WQT Costs in Winooski

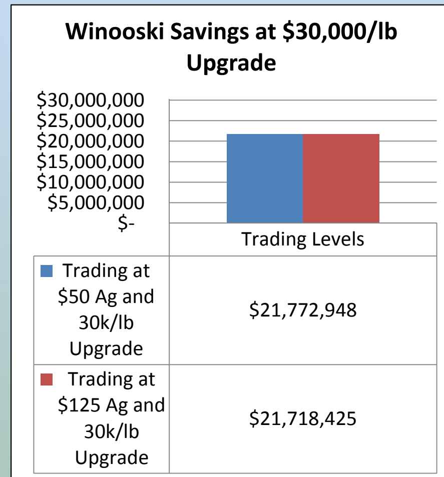




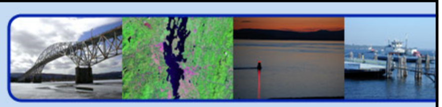
	Trading Levels
Trading at $50 Ag and 15k/lb Upgrade	$10,940,950
Trading at $50 Ag and 30k/lb Upgrade	$21,845,552
Trading at $125 Ag and 15k/lb Upgrade	$10,995,473
Trading at $125 Ag and 30k/lb Upgrade	$21,900,075

Program Savings for Winooski





Trading/tracking Implications

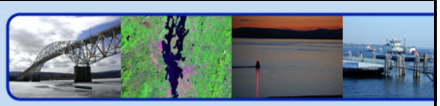


- Where where supply and demand do not align…
  - Low Demand with Ag: Target with RCPP funding
  - High Demand (or future demand) without Ag: Target other BMPs
- RCPP as mechanism to meet LA
  - Track within WQT program
  - No credit generation

In Summary…

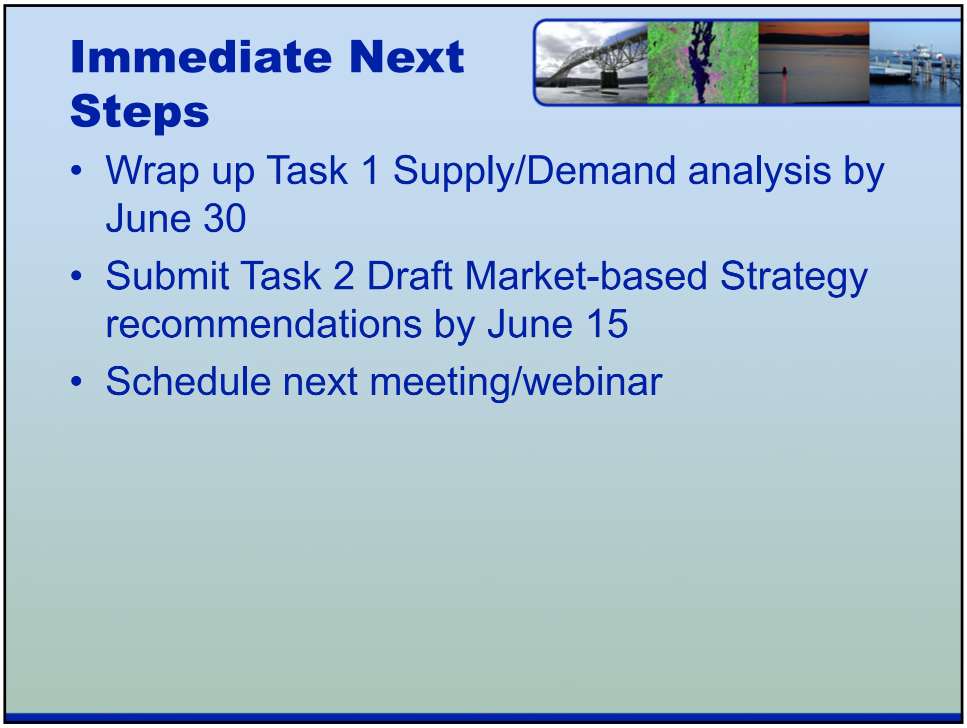
- There are substantial cost savings for MS4s using some level of trading
- Cost savings will vary and some segments will not likely have MS4/Ag trading
- Interim milestones allow for accountable cost-effective progress towards TMDL goals
- Ag LA/baseline issues can likely addressed with interim credits and RCPP funds

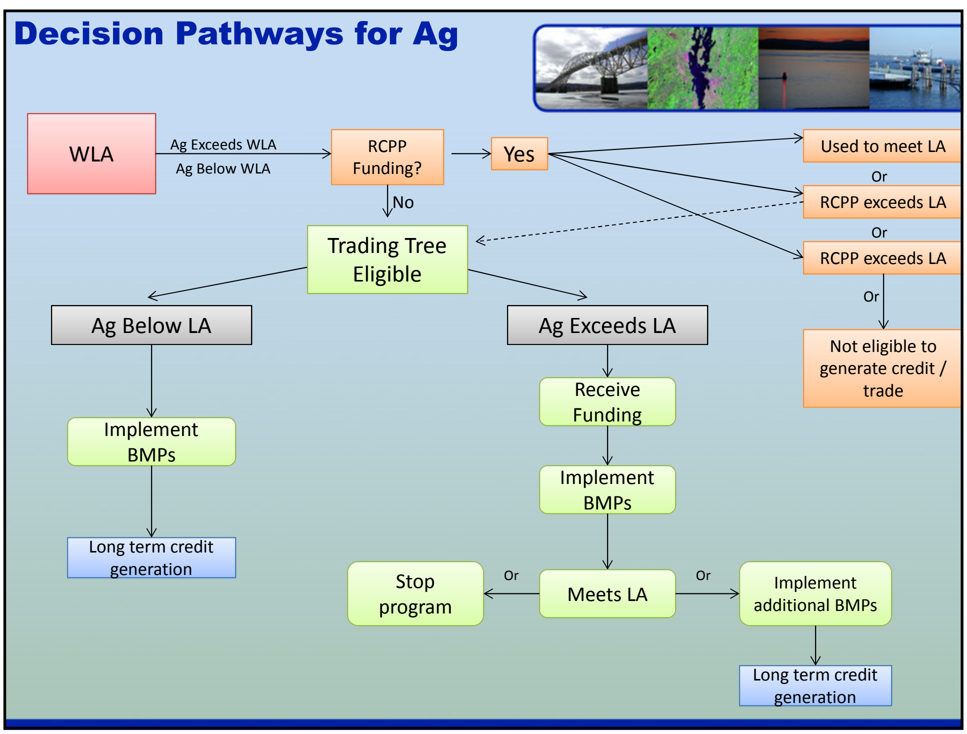
Key Questions for Discussion



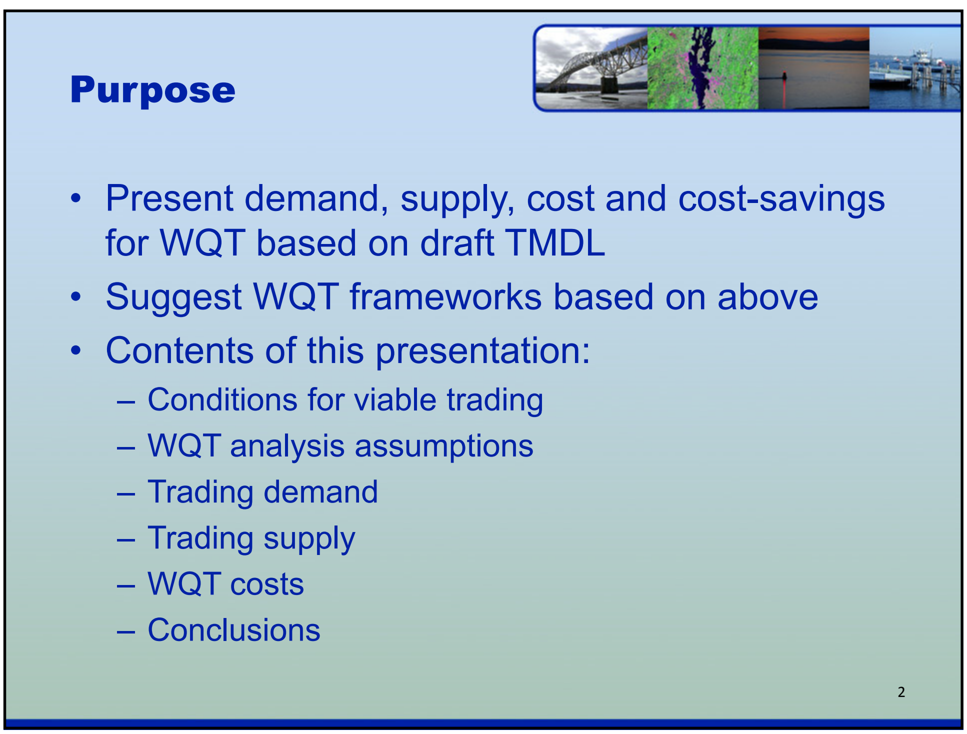
Project Team needs Committee decisions on the following issues for completing the analysis:

- Use of interim milestones/crediting?
- Technology Baselines v. Performance Baselines for agriculture?
- Farm field or farm operation baselines?
- Use of RCPP or other funds to generate credits?


Immediate Next Steps
• Wrap up Task 1 Supply/Demand analysis by June 30
• Submit Task 2 Draft Market-based Strategy recommendations by June 15
• Schedule next meeting/webinar


Decision Pathways for Ag
WLA
Ag Exceeds WLA
Ag Below WLA
RCPP Funding?
Yes
No
Used to meet LA
Or
RCPP exceeds LA
Or
RCPP exceeds LA
Or
Not eligible to generate credit / trade
Trading Tree Eligible
Ag Below LA
Ag Exceeds LA
Implement BMPs
Long term credit generation
Receive Funding
Implement BMPs
Stop program
Or
Meets LA
Or
Implement additional BMPs
Long term credit generation

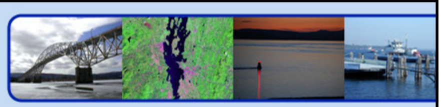

Watershed Advisory Committee
Meeting Presentation
WQT Supply and Demand in the LCB
With Ramifications for Trading Program Design
August 20, 2015
TETRA TECH
KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING


Purpose
• Present demand, supply, cost and cost-savings for WQT based on draft TMDL
• Suggest WQT frameworks based on above
• Contents of this presentation:
– Conditions for viable trading
– WQT analysis assumptions
– Trading demand
– Trading supply
– WQT costs
– Conclusions
2

Conditions for a Viable WQT Program

- Regulatory driver for water quality improvements (i.e., load reductions)
- Substantial demand (buyers and quantities)
- Ample supply (credit sellers able to meet baseline requirements)
- Sizable treatment cost differentials ("rule of thumb"…order of magnitude)
- Willing public/willing regulators

3



ANALYSIS ASSUMPTIONS

4

Important Caveat!

Cost information provided in this presentation is strictly for purposes of helping to analyze and scope a potential water quality trading program for VT's portion of the LCB and are intended for Watershed Advisory Committee discussion purposes only in the context of this NRCS Conservation Innovation Grant project.

Further analysis and discussion beyond the scope of this project phase will be necessary.

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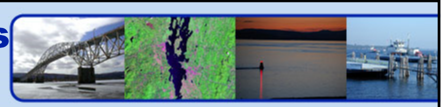
Background Assumptions for LCB Trading Program Analysis



- All required reductions (lbs P/yr) come from TMDL
- TMDL reductions achieved over a 20-year period
- LA reductions for Agriculture = SUPPLY
  - Except farmstead loads
  - Interim credits with a limited 10-year life allowed for achieving state regs and/or LA trading baseline
- WLA reductions for All Developed Land = DEMAND
  - Basically…stormwater (SW)
  - Except backroads
  - Can't all be traded away ("declining cap")
- Trade ratio of 2:1

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Supply Cost Assumptions

- 20-year life-cycle costs for Ag conservation practices
- Derived from costs provided by Kip Potter (VT NRCS)
  - $126/lb for multiple BMPs
  - $12/lb for single BMP

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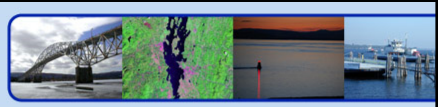
Trading Demand Assumptions



- Assumes 25% of WLA SW reductions will be equally met in each of four separate 5-year periods
- SW Load reduction requirement for entire basin = 44,464 lbs/yr
  - Excludes “Backroads” (i.e., unpaved roads)
    - Unpaved load reduction requirement is 19,272/lbs/yr
    - Unpaved BMP costs range from $250-500/lb (per VT DEC)
    - Insufficient cost differential with Ag reductions at $126/lb ($252/credit at 2:1) to include unpaved roads in WQT demand
  - For the 44,464 lb/yr demand:
    - Assumes private load reduction NOT tradable
    - Public-burden load reduction IS tradable
    - Examined range of public/private percent split of the load as:
      - 20/80
      - 50/50
      - 80/20

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Stormwater Cost Assumptions

- 20-year life-cycle costs for stormwater BMPs
- Derived from other recent WQT feasibility studies (Green Bay, WI; Lake Simcoe, Ontairo)(range = $742, $1,907 and $8,764/lb)
  - Similar to VT study data (~$1,000/lb per Jim Pease)
  - Similar to EPA draft costs used in the scenario tool ($436-3,393/lb) (Eric Perkins document)
  - Largely within the range of the DEC summary costs for urban stormwater ($902-4,067/lb) (DEC presentation)

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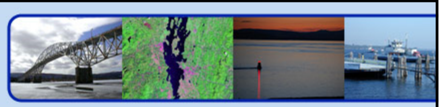
5-year Stormwater Reduction Period Assumptions



- Proposed interim milestones:
  - Years 0-5: 25% of required reductions*
  - Years 6-10: 50% of required reductions
  - Years 11-15: 75% of required reductions
  - Years 16-20: 100% of required reductions
- For each interim milestone, portion of reductions to be met with stormwater controls and remainder with a “declining WQT cap”

* *Assumes stormwater load reductions for all developed land except backroads*

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Declining WQT Cap Assumptions for SW

Years (Developed Land Reduction Cycle)	Reductions Eligible for WQT (per 5-year cycle)	Reductions to be met through stormwater BMPs (per 5-year cycle)
0-5	80%	20%
6-10	60%	40%
11-15	40%	60%
16-20	20%	80%

Benefits to this approach:

- Rewards early market participation by allowing greater percentage to be offset with WQT
- Requires urban developed land investments in SW controls (i.e., cannot trade your way out)
- Ag entities reaching compliance later in the 20-year period provide credits in the market for later permit cycles
- If all of Ag meets LA in years 1 to 2, Ag credits will not exist for urban entities in years 13-20

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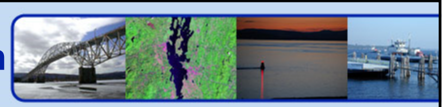
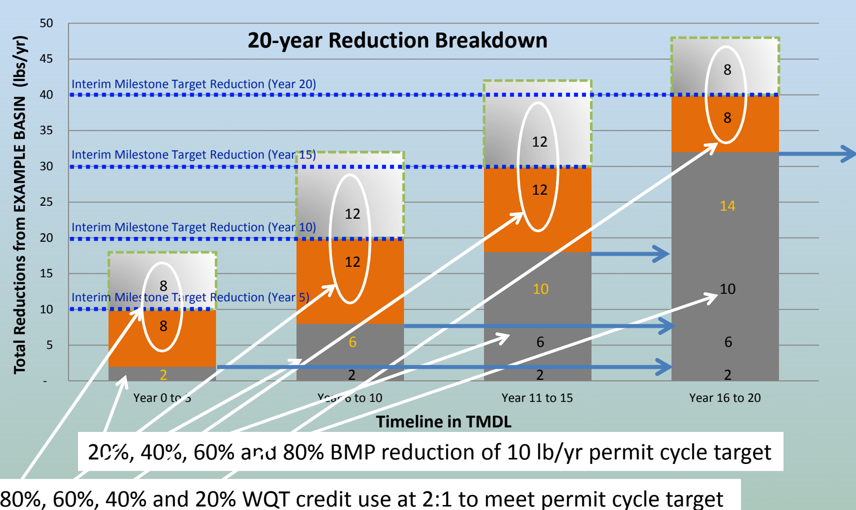
EXAMPLE: 40 lb/yr Basin Reduction Requirement





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WQT DEMAND

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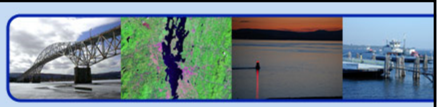
Required Developed Land SW Reductions by Segment*



Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years
South Lake B	Poultney	2,532
South Lake B	Mettawee	1,012
South Lake B	SLB DD	127
South Lake A	SLA DD	641
Port Henry	Port Henry DD	135
Otter	Otter	8,335
Otter	Little Otter Creek	729
Otter	Lewis Creek	587
Otter	Otter DD	169
Main Lake	Winooski	11,710
Main Lake	ML DD	345
Shelburne Bay	La Platte	972
Burlington Bay	BB CSO	205
Burlington Bay	BB DD	210
Malletts Bay	Lamoille River	6,117
Malletts Bay	Malletts Bay DD	727
Northeast Arm	Northeast Arm DD	658
St. Albans Bay	St. Albans Bay DD	478
Missisquoi Bay	Missisquoi	7,201
Missisquoi Bay	Missisquoi Bay DD	1,422
Isle LaMotte	Isel La Motte DD	151
Total		44,464

** Excluding backroads at 19,272 lbs/yr*

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WQT Demand: (example)
Public Burden = 80% of Required SW Load Reductions

Year 0 to 5

Lake Segment	Drainage Area	Total Required Reductions over 20 Years for Entire Segment (lbs/yr)	80% Total Public Burden for Reductions (lbs/yr)	25% 5-year Interim Milestone of Total Public Burden (lbs/yr)	80% of Reduction Eligible for WQT in Years 0-5 (lb/yr)	Ag Reductions Needed for WQT at 2:1 trade ratio (lbs/yr)	20% of Interim Milestone met with Stormwater BMPs (lbs/yr)
South Lake B	Poultney	2,532	2,026	506	405	810	101
South Lake B	Mettawee	1,012	810	202	162	324	40
South Lake B	SLB DD	127	102	25	20	41	5
South Lake A	SLA DD	641	513	128	103	205	26
Port Henry	Port Henry DD	135	108	27	22	43	5
Otter	Otter	8,335	6,668	1,667	1,334	2,667	333
Otter	Little Otter Creek	729	583	146	117	233	29
Otter	Lewis Creek	587	470	117	94	188	23
Otter	Otter DD	169	135	34	27	54	7
Main Lake	Winooski	11,710	9,368	2,342	1,874	3,747	468
Main Lake	ML DD	345	276	69	55	110	14
Shelburne Bay	La Platte	972	778	194	156	311	39
Burlington Bay	BB CSO	205	164	41	33	66	8
Burlington Bay	BB DD	210	168	42	34	67	8
Malletts Bay	Lamoille River	6,117	4,894	1,223	979	1,958	245
Malletts Bay	Malletts Bay DD	727	581	145	116	232	29
Northeast Arm	Northeast Arm DD	658	527	132	105	211	26
St. Albans Bay	St. Albans Bay DD	478	382	96	76	153	19
Missisquoi Bay	Missisquoi	7,201	5,761	1,440	1,152	2,304	288
Missisquoi Bay	Missisquoi Bay DD	1,422	1,138	284	228	455	57
Isle LaMotte	Isel La Motte DD	151	121	30	24	48	6
	SUBTOTALS	44,464	35,571	8,893	7,114	14,228	1,779

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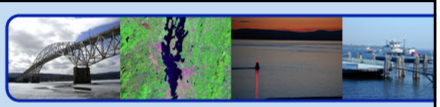

WQT SUPPLY

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Ag Supply

DEMAND

Drainage Area	Total Required Reductions for Ag (lbs/yr)	Required Reductions (lbs) over 20 Years
Poultney	15,501	2,532
Mettawee	10,194	1,012
SLB Direct Drainage	3,210	127
SLA Direct Drainage	29,371	641
Port Henry Direct Drainage	2,756	135
Otter	86,776	8,335
Little Otter Creek	12,031	729
Lewis Creek	5,061	587
Otter Direct Drainage	3,965	169
Winooski	29,896	11,710
ML Direct Drainage	6,432	345
La Platte	2,996	972
BB CSO	-	205
BB Direct Drainage	-	210
Lamoille River	16,103	6,117
Malletts Bay Direct Drainage	1,106	727
Northeast Arm Direct Drainage	4,992	658
St. Albans Bay Direct Drainage	7,584	478
Missisquoi	83,070	7,201
Missisquoi Bay Direct Drainage	28,538	1,422
Isel La Motte Direct Drainage	1,284	151

Ample Ag Supply in each Lake Segment

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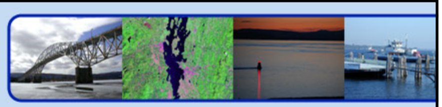

COSTS

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Ag Conservation Practice and Stormwater BMP costs

Multiple Ag Conservation Practices:

Crop is either corn-hay rotation or continuous corn on non-clayey soils
Conservation practices applied on total area of 23,203 acres

Riparian Buffer	$	109,434	
Cover Crop	$	2,697,481	
Conservation Tillage	$	1,156,063	
Grassed Waterway	$	202,635	
Total	$	4,165,614	
Total Phosphorus Reduced		33,089	lbs/yr reduced
Cost Per Pound Reduced	$	126	per lb P reduction/yr

Single Ag Conservation Practice:

Riparian buffers for continuous corn fileds on all soil types
Conservation practice applied on total area of 30,862 acres

Riparian Buffer	$	145,557	
Total Phosphorus Reduced		11,821	lbs/yr reduced
Cost per Pound Reduced	$	12	per lb P reduction/yr

Stormwater BMP:

Wet detention ponds
Conservation practice applied on total area of 21,690 acres

Small catchment area (6 acres)	$	8,764	per lb P reduction/yr
Medium catchment area (86 acre)	$	1,907	per lb P reduction/yr
Large catchment area (561 acre)	$	742	per lb P reduction/yr

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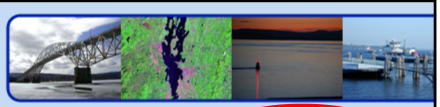
SW Costs w/o Trading*



Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,900/lb	Stormwater Cost of $742/lb
South Lake B	Poultney	2,532	$ 4,811,644	$ 1,879,074
South Lake B	Mettawee	1,012	$ 1,922,617	$ 750,833
South Lake B	SLB DD	127	$ 242,211	$ 94,590
South Lake A	SLA DD	641	$ 1,217,890	$ 475,618
Port Henry	Port Henry DD	135	$ 256,331	$ 100,104
Otter	Otter	8,335	$ 15,836,212	$ 6,184,457
Otter	Little Otter Creek	729	$ 1,384,327	$ 540,616
Otter	Lewis Creek	587	$ 1,116,179	$ 435,897
Otter	Otter DD	169	$ 321,360	$ 125,499
Main Lake	Winooski	11,710	$ 22,248,256	$ 8,688,530
Main Lake	ML DD	345	$ 654,646	$ 255,657
Shelburne Bay	La Platte	972	$ 1,846,663	$ 721,170
Burlington Bay	BB CSO	205	$ 389,610	$ 152,153
Burlington Bay	BB DD	210	$ 399,945	$ 156,189
Malletts Bay	Lamoille River	6,117	$ 11,623,179	$ 4,539,157
Malletts Bay	Malletts Bay DD	727	$ 1,380,365	$ 539,069
Northeast Arm	Northeast Arm DD	658	$ 1,250,844	$ 488,487
St. Albans Bay	St. Albans Bay DD	478	$ 908,071	$ 354,626
Missisquoi Bay	Missisquoi	7,201	$ 13,681,776	$ 5,343,094
Missisquoi Bay	Missisquoi Bay DD	1,422	$ 2,701,617	$ 1,055,053
Isle LaMotte	Isel La Motte DD	151	$ 287,503	$ 112,277
Total		44,464	$ 84,481,243	$ 32,992,149

** Excluding backroads at $4.8 - $9.6M*

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WQT Costs: (example)

Public Burden = 80% of Required SW Load Reductions Years 0-5

Year 0 to 5

Lake Segment	Drainage Area	Total Required Reductions over 20 Years for Entire Segment (lbs/yr)	80% Total Public Burden for Reductions (lbs/yr)	25% 5-year Interim Milestone of Total Public Burden (lbs/yr)	80% of Reduction Eligible for WQT in Years 0-5 (lb/yr)	Ag Reductions Needed for WQT at 2:1 trade ratio (lbs/yr)	Cost of WQT when Ag Credits at $126/lb	20% of Interim Milestone met with Stormwater BMPs (lbs/yr)	Cost of Stormwater if $1,907/lb	Cost of Stormwater if $742/lb	Total Cost of Trading if Ag Credits are $126/lb and Stormwater Treatment is $1,907	Total Cost of Trading if Ag Credits are $126/lb and Stormwater Treatment is $742
South Lake B	Poultney	2,532	2,026	506	405	810	102,108	101	$ 193,175	$ 75,163	$ 295,283	$ 177,271
South Lake B	Mettawee	1,012	810	202	162	324	40,800	40	$ 77,188	$ 30,033	$ 117,988	$ 70,833
South Lake B	SLB DD	127	102	25	20	41	5,140	5	$ 9,724	$ 3,784	$ 14,864	$ 8,924
South Lake A	SLA DD	641	513	128	103	205	25,845	26	$ 48,895	$ 19,025	$ 74,740	$ 44,870
Port Henry	Port Henry DD	135	108	27	22	43	5,440	5	$ 10,291	$ 4,004	$ 15,731	$ 9,444
Otter	Otter	8,335	6,668	1,667	1,334	2,667	336,061	333	$ 635,782	$ 247,378	$ 971,843	$ 583,439
Otter	Little Otter Creek	729	583	146	117	233	29,377	29	$ 55,577	$ 21,625	$ 84,954	$ 51,002
Otter	Lewis Creek	587	470	117	94	188	23,686	23	$ 44,812	$ 17,436	$ 68,498	$ 41,122
Otter	Otter DD	169	135	34	27	54	6,820	7	$ 12,902	$ 5,020	$ 19,721	$ 11,840
Main Lake	Winooski	11,710	9,368	2,342	1,874	3,747	472,131	468	$ 893,209	$ 347,541	$ 1,365,340	$ 819,673
Main Lake	ML DD	345	276	69	55	110	13,892	14	$ 26,282	$ 10,226	$ 40,175	$ 24,119
Shelburne Bay	La Platte	972	778	194	156	311	39,188	39	$ 74,139	$ 28,847	$ 113,327	$ 68,035
Burlington Bay	BB CSO	205	164	41	33	66	8,268	8	$ 15,642	$ 6,086	$ 23,910	$ 14,354
Burlington Bay	BB DD	210	168	42	34	67	8,487	8	$ 16,057	$ 6,248	$ 24,544	$ 14,735
Malletts Bay	Lamoille River	6,117	4,894	1,223	979	1,958	246,656	245	$ 466,640	$ 181,566	$ 713,296	$ 428,222
Malletts Bay	Malletts Bay DD	727	581	145	116	232	29,293	29	$ 55,418	$ 21,563	$ 84,711	$ 50,856
Northeast Arm	Northeast Arm DD	658	527	132	105	211	26,544	26	$ 50,218	$ 19,539	$ 76,762	$ 46,084
St. Albans Bay	St. Albans Bay DD	478	382	96	76	153	19,270	19	$ 36,457	$ 14,185	$ 55,727	$ 33,455
Missisquoi Bay	Missisquoi	7,201	5,761	1,440	1,152	2,304	290,342	288	$ 549,287	$ 213,724	$ 839,629	$ 504,065
Missisquoi Bay	Missisquoi Bay DD	1,422	1,138	284	228	455	57,331	57	$ 108,463	$ 42,202	$ 165,794	$ 99,533
Isle LaMotte	Isel La Motte DD	151	121	30	24	48	6,101	6	$ 11,542	$ 4,491	$ 17,644	$ 10,592
	SUBTOTALS	44,464	35,571	8,893	7,114	14,228	1,792,781	1,779	$ 3,391,700	$ 1,319,686	$ 5,184,481	$ 3,112,467

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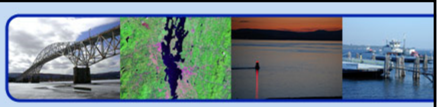
Cost Comparisons:

80% public burden



Cost Summary and Comparison

Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag at $126/lb and Stormwater at $1,907	Total Cost of Trading if Ag at $126/lb and Stormwater at $742	Total Savings of Trading if Ag at $126/lb and Stormwater at $1,907	Total Savings of Trading if Ag at $126/lb and Stormwater at $742
South Lake B	Poultney	2,532	$ 4,829,371	$ 1,879,074	$ 3,601,338	$ 1,713,148	$ 1,228,033	$ 165,926
South Lake B	Mettawee	1,012	$ 1,929,700	$ 750,833	$ 1,439,008	$ 684,533	$ 490,692	$ 66,300
South Lake B	SLB DD	127	$ 243,103	$ 94,590	$ 181,286	$ 86,237	$ 61,817	$ 8,352
South Lake A	SLA DD	641	$ 1,222,377	$ 475,618	$ 911,546	$ 433,620	$ 310,831	$ 41,998
Port Henry	Port Henry DD	135	$ 257,275	$ 100,104	$ 191,854	$ 91,264	$ 65,421	$ 8,839
Otter	Otter	8,335	$ 15,894,556	$ 6,184,457	$ 11,852,821	$ 5,638,358	$ 4,041,735	$ 546,099
Otter	Little Otter Creek	729	$ 1,389,427	$ 540,616	$ 1,036,117	$ 492,879	$ 353,309	$ 47,737
Otter	Lewis Creek	587	$ 1,120,291	$ 435,897	$ 835,419	$ 397,407	$ 284,872	$ 38,491
Otter	Otter DD	169	$ 322,544	$ 125,499	$ 240,526	$ 114,418	$ 82,018	$ 11,082
Main Lake	Winooski	11,710	$ 22,330,223	$ 8,688,530	$ 16,652,000	$ 7,921,316	$ 5,678,223	$ 767,214
Main Lake	ML DD	345	$ 657,058	$ 255,657	$ 489,979	$ 233,082	$ 167,079	$ 22,575
Shelburne Bay	La Platte	972	$ 1,853,466	$ 721,170	$ 1,382,159	$ 657,490	$ 471,307	$ 63,681
Burlington Bay	BB CSO	205	$ 391,045	$ 152,153	$ 291,609	$ 138,718	$ 99,437	$ 13,435
Burlington Bay	BB DD	210	$ 401,418	$ 156,189	$ 299,344	$ 142,397	$ 102,074	$ 13,792
Malletts Bay	Lamoille River	6,117	$ 11,666,001	$ 4,539,157	$ 8,699,521	$ 4,138,341	$ 2,966,480	$ 400,816
Malletts Bay	Malletts Bay DD	727	$ 1,385,450	$ 539,069	$ 1,033,152	$ 491,468	$ 352,298	$ 47,601
Northeast Arm	Northeast Arm DD	658	$ 1,255,452	$ 488,487	$ 936,210	$ 445,353	$ 319,242	$ 43,134
St. Albans Bay	St. Albans Bay DD	478	$ 911,417	$ 354,626	$ 679,658	$ 323,312	$ 231,759	$ 31,314
Missisquoi Bay	Missisquoi	7,201	$ 13,732,182	$ 5,343,094	$ 10,240,305	$ 4,871,288	$ 3,491,877	$ 471,805
Missisquoi Bay	Missisquoi Bay DD	1,422	$ 2,711,571	$ 1,055,053	$ 2,022,061	$ 961,890	$ 689,510	$ 93,163
Isle LaMotte	Isel La Motte DD	151	$ 288,562	$ 112,277	$ 215,185	$ 102,363	$ 73,377	$ 9,914
Total		44,464	$ 84,792,490	$ 32,992,149	$ 63,231,098	$ 30,078,880	$ 21,561,392	$ 2,913,269

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Summary of WQT Cost Savings

Cost Summary and Comparison (80% Public Burden)

All Lake Segments	All Drainage Areas	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag at $126/lb and Stormwater at $1,907	Total Cost of Trading if Ag at $126/lb and Stormwater at $742	Total Savings of Trading if Ag at $126/lb and Stormwater at $1,907	Total Savings of Trading if Ag at $126/lb and Stormwater at $742
Total		44,464	$ 84,792,490	$ 32,992,149	$ 63,231,098	$ 30,078,880	$ 21,561,392	$ 2,913,269

Cost Summary and Comparison (50% Public Burden)

All Lake Segments	All Drainage Areas	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag at $126/lb and Stormwater at $1,907	Total Cost of Trading if Ag at $126/lb and Stormwater at $742	Total Savings of Trading if Ag at $126/lb and Stormwater at $1,907	Total Savings of Trading if Ag at $126/lb and Stormwater at $742
Total		22,232	$ 42,396,245	$ 16,496,074	$ 39,519,436	$ 18,799,300	$ 2,876,809	$ (2,303,225)

Cost Summary and Comparison (20% Public Burden)

All Lake Segments	All Drainage Areas	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,907/lb (No Trading)	Stormwater Cost of $742/lb (No Trading)	Total Cost of Trading if Ag at $126/lb and Stormwater at $1,907	Total Cost of Trading if Ag at $126/lb and Stormwater at $742	Total Savings of Trading if Ag at $126/lb and Stormwater at $1,907	Total Savings of Trading if Ag at $126/lb and Stormwater at $742
Total		8,893	$ 16,958,498	$ 6,598,430	$ 15,807,775	$ 7,519,720	$ 1,150,723	$ (921,290)

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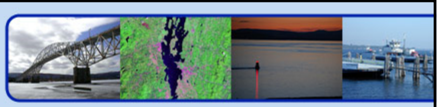
Conclusions



- Cost-savings are expected with WQT when SW costs are at $1,907 or higher
- Many lake segments have higher demand (>500 lbs/yr)
- Supply is adequate to meet anticipated demand in any lake segment
- Interim Ag crediting opportunities are critical to ensure adequate supply
- Numerous trading scenarios are possible, but those presented are demonstrative of some benefits with high Ag supply costs and low to moderate SW costs
- Volume of potential trades suggests bilateral trading in most cases
- Clearinghouse suitable under higher SW costs and high public burden for reductions
  - One strategic program framework but trading only within lake segments
  - One registry to track trading by lake segment if a clearinghouse is developed

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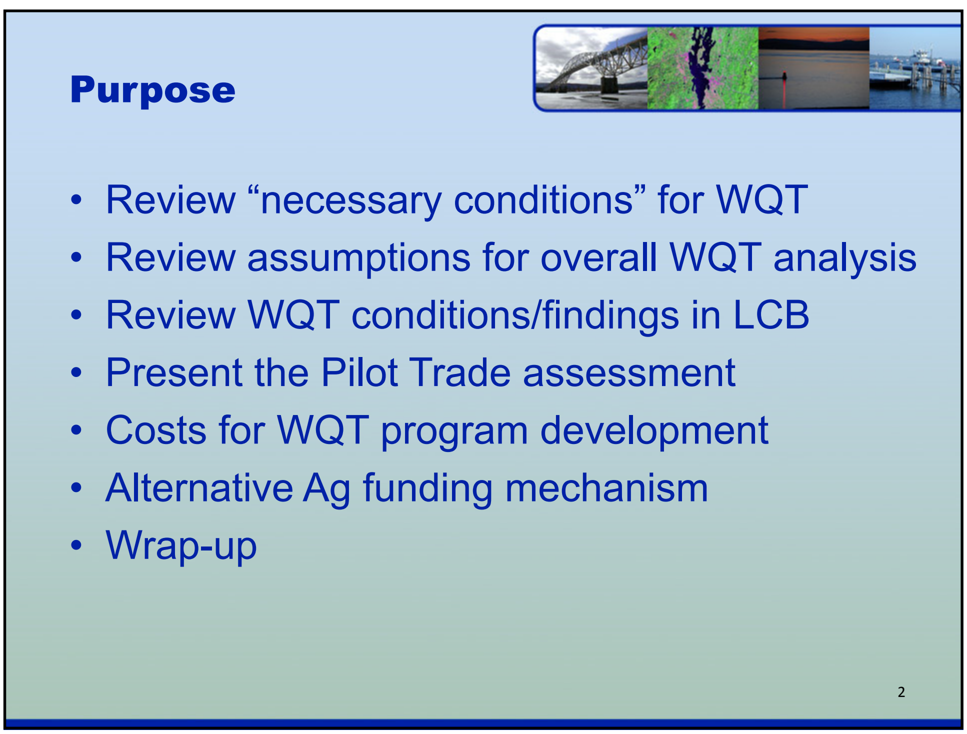
Watershed Advisory Committee Meeting Presentation
WQT Pilot Trading in the Winooski Lake Segment of the LCB
September 24, 2015
TETRA TECH
KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING

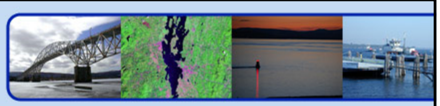

Purpose
• Review “necessary conditions” for WQT
• Review assumptions for overall WQT analysis
• Review WQT conditions/findings in LCB
• Present the Pilot Trade assessment
• Costs for WQT program development
• Alternative Ag funding mechanism
• Wrap-up
2

Conditions for a Viable WQT Program…a Reminder

- Regulatory driver for water quality improvements (i.e., load reductions)
- Substantial demand (buyers and quantities)
- Ample supply (credit sellers able to meet baseline requirements)
- Sizable treatment cost differentials ("rule of thumb"…order of magnitude)
- Willing public/willing regulators

3

WQT Assessment Assumptions for 20 years



Demand – Developed Land Waste Load Allocation **(except backroads)**

- 5-year interim milestones with incremental 25% reduction goals
- Declining trading cap (%credits/ %BMPs)
  - 80/20, 60/40, 40/60, 20/80
- Trade Ratio of 2:1
- Varying public burden
  - 80%, 50%, 20%
- Wet Detention Pond SW costs at:
  - $742/lb
  - $1,907/lb
- *Trading only within same lake segment*

Supply – Ag Conservation Practices **(except farmsteads)**

- Interim 10-year credits for new practices
- Farm baselines apply after 10 years of crediting
  - State Ag rules
  - TMDL LA
- Sub-baseline reductions retired to load allocation
- Default Ag costs at:
  - $126/lb (four practices)
  - $12/lb (single practice)
- *Trading only within same lake segment*

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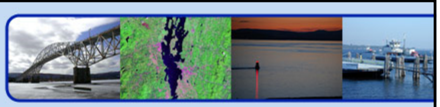
Overall Projected SW Costs (absent Trading)*

Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years	Stormwater Cost of $1,900/lb	Stormwater Cost of $742/lb
South Lake B	Poultney	2,532	$ 4,811,644	$ 1,879,074
South Lake B	Mettawee	1,012	$ 1,922,617	$ 750,833
South Lake B	SLB DD	127	$ 242,211	$ 94,590
South Lake A	SLA DD	641	$ 1,217,890	$ 475,618
Port Henry	Port Henry DD	135	$ 256,331	$ 100,104
Otter	Otter	8,335	$ 15,836,212	$ 6,184,457
Otter	Little Otter Creek	729	$ 1,384,327	$ 540,616
Otter	Lewis Creek	587	$ 1,116,179	$ 435,897
Otter	Otter DD	169	$ 321,360	$ 125,499
Main Lake	Winooski	11,710	$ 22,248,256	$ 8,688,530
Main Lake	ML DD	345	$ 654,646	$ 255,657
Shelburne Bay	La Platte	972	$ 1,846,663	$ 721,170
Burlington Bay	BB CSO	205	$ 389,610	$ 152,153
Burlington Bay	BB DD	210	$ 399,945	$ 156,189
Malletts Bay	Lamoille River	6,117	$ 11,623,179	$ 4,539,157
Malletts Bay	Malletts Bay DD	727	$ 1,380,365	$ 539,069
Northeast Arm	Northeast Arm DD	658	$ 1,250,844	$ 488,487
St. Albans Bay	St. Albans Bay DD	478	$ 908,071	$ 354,626
Missisquoi Bay	Missisquoi	7,201	$ 13,681,776	$ 5,343,094
Missisquoi Bay	Missisquoi Bay DD	1,422	$ 2,701,617	$ 1,055,053
Isle LaMotte	Isel La Motte DD	151	$ 287,503	$ 112,277
Total		44,464	$ 84,481,243	$ 32,992,149

** Excluding backroads at $4.8 - $9.6M*

5

Summary of LCB Basin-wide WQT Cost Savings



Percent of Total Required Stormwater Reductions Assumed by Public	Required Stormwater Reductions (lbs/yr) over 20 Years	Stormwater Costs at $1,907/lb (No Trading)	Stormwater Costs at $742/lb (No Trading)	Total Public Cost of Trading if Ag Credits at $126/lb and Stormwater at $1,907/lb	Total Public Cost of Trading if Ag Credits at $126/lb and Stormwater at $742/lb	Total Savings with Trading if Ag Credits at $126/lb and Stormwater at $1,907/lb	Total Savings with Trading if Ag Credits at $126/lb and Stormwater at $742/lb
80%	35,571	$84,792,490	$32,922,149	$63,231,098	$30,078,880	$21,561,392	$2,913,269
50%	22,232	$42,396,245	$16,496,074	$39,519,436	$18,799,300	$2,876,809	-$2,303,225
20%	8,893	$16,958,498	$6,598,430	$15,807,775	$7,519,720	$1,150,723	-$921,290

- Substantial cost savings with default Ag credit cost of $126/lb, high SW costs ($1,907/lb) but only at 80% public burden for SW controls
- Some, but limited cost savings at either SW cost and moderate to high (50-80%) public burden for SW demand
- No savings at moderate to low public burden (50-20%) and lower SW costs
- Volume of potential trades suggests bilateral trading on case-by-case basis is most likely WQT option in LCB

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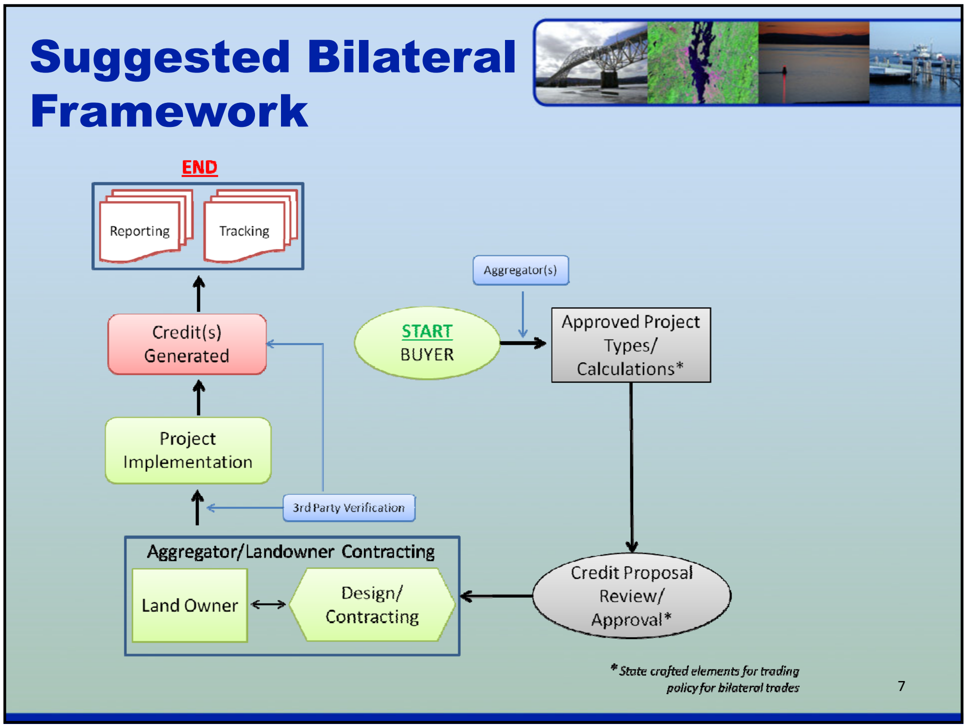
Suggested Bilateral Framework
END
Reporting
Tracking
Aggregator(s)
Credit(s) Generated
START BUYER
Approved Project Types/ Calculations*
Project Implementation
3rd Party Verification
Aggregator/Landowner Contracting
Land Owner
Design/ Contracting
Credit Proposal Review/ Approval*
*State crafted elements for trading policy for bilateral trades
7


PILOT TRADING ASSESSMENT
8

Purpose of Pilot Analysis

- Provide specific assessment of trading feasibility where it is most likely needed in a single LCB lake segment
  - *High demand*
  - *Sufficient supply*
- Apply previously suggested trading program framework conditions for bilateral trading
- Also assess total cost savings under a central clearinghouse model using reverse auction mechanism

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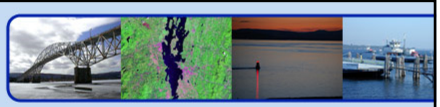
Selection: Main Lake/Winooski

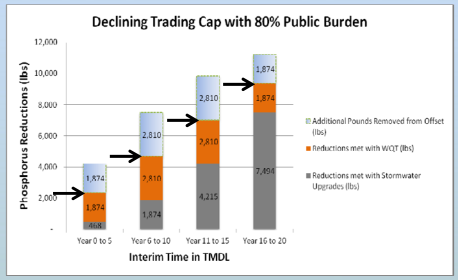


- Highest potential demand and supply of all LCB segments
- If trading not economically viable in Winooski, then not likely viable in other segments particularly using a reverse auction/clearinghouse mechanism

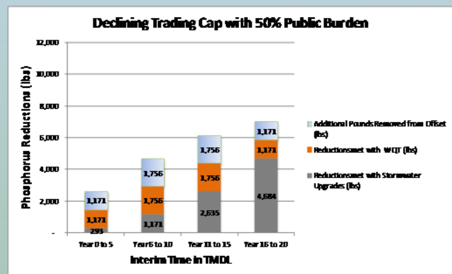
Lake Segment	Drainage Area	Required Reductions (lbs/yr) over 20 Years for Developed Lands* (Demand)	Required Reductions (lbs/yr) over 20 Years for Agricultural Lands** (Supply)
Main Lake	Winooski	11,710	29,896
**Excluding required reductions from backroads*			
***Excluding required reductions from farmsteads*			

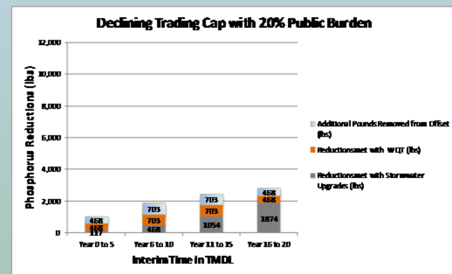
10

Declining Cap with Varying Public Burden in Winooski



5-year interim milestone goals





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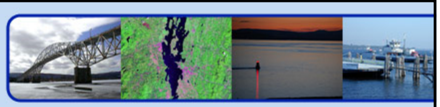
Cost Savings with Bilateral WQT in Winooski



Percent of Total Required Stormwater Reductions Assumed by Public	Required Stormwater Reductions (lbs/yr) over 20 Years	Stormwater Cost at \$1,907/lb (No Trading)	Stormwater Cost at \$742/lb (No Trading)	Total Cost of Trading if Ag Reductions at \$126/lb and Stormwater at \$1,907/lb	Total Cost of Trading if Ag Reductions at \$126/lb and Stormwater at \$742/lb	Total Savings of Trading if Ag Reductions at \$126/lb and Stormwater at \$1,907/lb	Total Savings of Trading if Ag Reductions at \$126/lb and Stormwater at \$742/lb
80%	9,368	$17,864,179	$6,950,824	$16,652,000	$7,921,316	$1,212,179	-$970,492
50%	5,855	$11,165,112	$4,344,265	$10,407,500	$4,950,822	$757,612	-$606,558
20%	2,342	$4,466,045	$1,737,706	$4,163,000	$1,980,329	$303,045	-$242,623

- No cost savings with bilateral trades under any low cost SW scenario at $742/lb
- ~7% Cost savings under each public burden scenario with higher SW costs at $1,907/lb
- ***QUESTION*: Could there be greater savings with lower Ag reduction costs and/or higher SW costs?**

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WQT Clearinghouse pros/cons

- Pros
  - Reduced transaction costs where there is a high volume of demand and supply
  - Reverse auctions or other credit “bidding” mechanisms can potentially lower credit costs
  - Easier to track overall program activities/transacations
- Cons
  - Higher program development costs
  - Higher administrative management costs
  - Requires greater agency participation to administer

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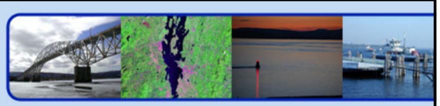
Credit Cost Reduction Options…the Reverse Auction



- Pilot analysis focused on utility of reverse auctions to potentially increase cost savings in the Winooski
  - *Assumed* lower Ag P reduction pricing was possible over default cost of $126/lb by:
    - 50% ($63/lb)
    - 75% ($31/lb)
  - *Assumed* SW P reduction costs of:
    - $742/lb
    - $1,907/lb
    - $8,764/lb

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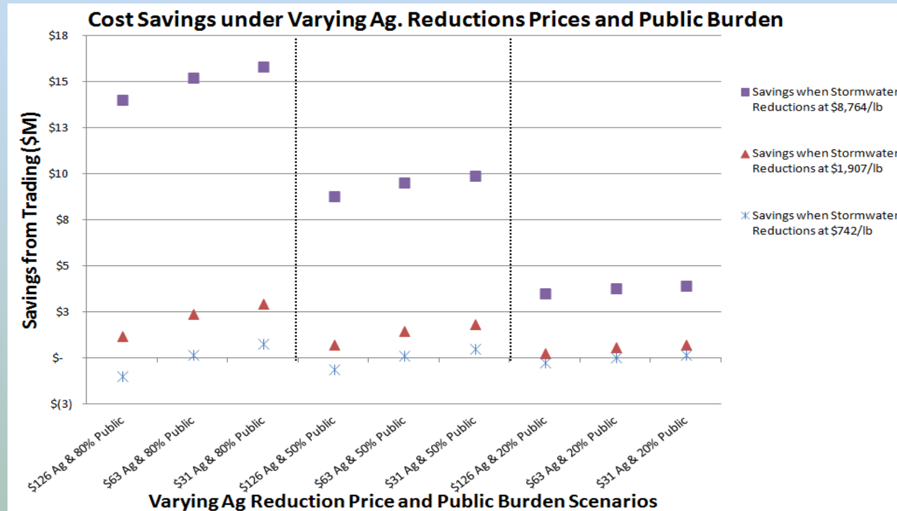
Reverse Auction Savings Summary



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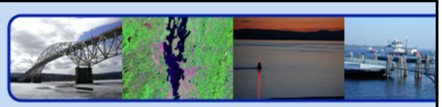
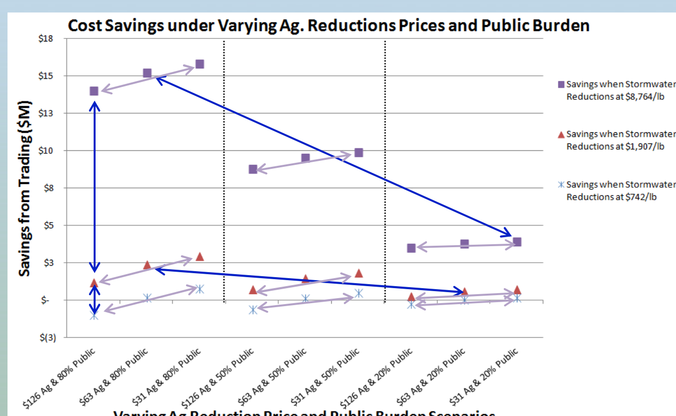
Reverse Auction Takeaways



- SW costs and public burden principally drive savings
- Difference in cost savings between Ag reduction costs within each category of public burden is relatively low



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COST OF WQT PROGRAM DEVELOPMENT

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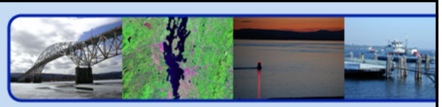

Bilateral Transactions

- Would require VT regulatory policy for WQT:
  - Standardized information for tracking, reporting and credit estimation
  - Define roles for credit verifiers and third-party trading facilitation (e.g., aggregators and brokers)
  - Likely \$250,000 - \$500,000 to develop
- Development costs for bilateral trading instruments
  - Likely \$150,000 to \$220,000 *(from K&A MT feasibility analysis)*
- K&A conservatively assumed upper-end costs for bilateral transactions in VT
- These costs would typically be borne by the State and not specifically a burden to Main Lake-Winooski stakeholders

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Clearinghouse

- Requires greater investment compared to bilateral transactions
- Still requires regulatory policy (like for bilateral trades)
- If Winooski (or another segment) desired a more complex clearinghouse program for their stakeholders, add:
  - Registry and local trading instruments: ~$500,000
  - ~½ FTE ($40,000) annually for 20 years: $800,000
- Total additional costs borne by segment stakeholders = ~$1.3M

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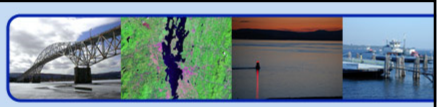
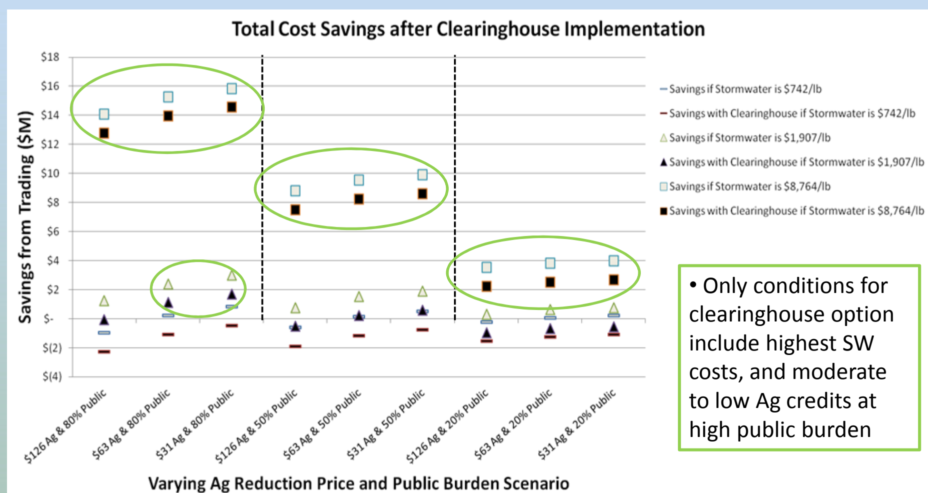
Cost Savings with Clearinghouse/ Reverse Auction





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Summary on Potential Trading in Winooski

- **Bilateral trading:** Some cost saving potential
  - Only observed with higher stormwater costs ($1,907/lb)
  - Ranges from $300,000 to $1.2M (20% to 80% public burden) representing ~7% overall savings vs. no trading scenarios
- **Clearinghouse/Reverse Auction**: Cost savings limited to:
  - High public burden (80%) and high stormwater costs ($8,000+/lb)
  - Cost of program development generally outweighs potential savings
  - Clearinghouse does not appear to be a viable option in Winooski

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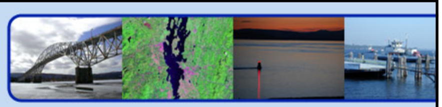

HOPE MAY NOT BE LOST…

22

Hypothetical LCB Innovative Funding Scenario…Rationale

- Previous discussions indicated need for various grants and/or Farm Bill funding to implement agricultural conservation practices throughout the LCB to help meet state requirements and the TMDL load allocation
- "Clearinghouse-like" program with reverse auction mechanism could optimize payments to producers for cost savings

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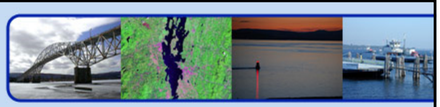
Analysis Assumptions



- Assume per pound reduction costs of $126/lb (default price), and $63, $31 or $12/lb achieved through reverse auctions
- Costs per pound of reduction are extrapolated to assess the overall funding level necessary to meet to meet the TMDL load allocation, recognizing potential surplus reductions beyond this level
- Cost savings with a reverse auction funding mechanism calculated from base case of default Ag reduction cost of $126/lb
- Savings are adjusted for $4.2M LCB-wide clearinghouse/reversion auction program development and administrative cost
  - $1M for program development
  - $3.2M over 20 years to cover two FTEs (at a salary of $80,000/yr)

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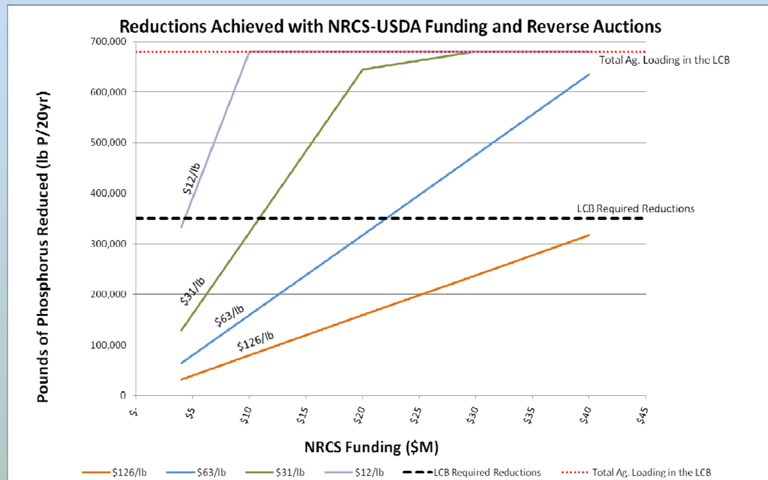
Results



Total Ag loading for the LCB is 680,470 lbs

Mathematically, lower BMP costs could exceed this total load, but in reality cannot achieve a zero sum discharge

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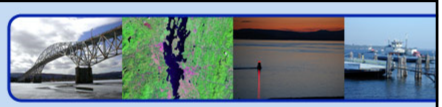
Avoided Cost Potential



Cost Scenario	Cost/lb P reduced	Minimum Needed to Achieve Ag Load Allocation ($M)	Reverse Auction Cost ($M)	Funding Needed with Reverse Auction ($M)	Avoided Costs Using Reverse Auction ($M)
No Reverse Auction	$126	44.10	--	44.10	--
Reverse Auction Scenario #1	$63	22.05	4.20	26.25	17.85
Reverse Auction Scenario #2	$31	10.85	4.20	15.05	29.05
Reverse Auction Scenario #3	$12	4.20	4.20	8.40	35.70

- Reverse auctions through clearinghouse-like framework may be a highly efficient method to distribute funds
- Development of this mechanism for “funding” would also serve WQT needs
- Key issues for considering such a scheme include:
    - Must be acceptable to producers
    - Lower implementation pricing could actually be realized
    - Federal funds could be managed/distributed by a “clearinghouse”

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WRAP-UP

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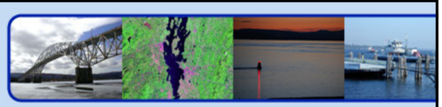

Are Conditions Met for a Viable WQT Program in the LCB?

Necessary Conditions for LCB Trading	Met	Partial	Not Met	
Regulatory driver for load reductions		✓		Policy/legal decision on declining trading cap
Substantial demand (buyers and quantities)		✓		Additional analysis to determine public burden
Ample supply (with sellers meeting baselines)			×	Policy/legal decision on interim crediting
Sizable treatment cost differentials (order of magnitude)		✓		Additional analysis on costs (high Ag/low SW = no WQT)
Willing Public/Regulators	✓			
Opportunity for Innovative (non-WQT) funding mechanisms			×	Policy/legal decision on constraints to pool funding

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Considerations/ Next Steps

- Watershed Advisory Committee feedback:
  - Are suggested WQT program conditions reasonable for first cut analysis to examine trading feasibility in this phase given assumptions and current unknowns with TMDL implementation and State Ag rule enforcement?
  - Are Ag costs at \$126/lb a reasonable default value?
  - Are SW costs at \$742-\$1,907 similarly reasonable?
  - Is pilot analysis reflective of WQT program assumptions?
- Next Steps:
  - Compilation of a Final Report from Draft Memoranda/Presentations
    - Will include Phase II considerations:
      - Policy/legal basis for WQT and assumptions
      - Refined Ag and stormwater costs
      - Potential point source buyer considerations
      - Cross-basin trading options (e.g., Burlington Bay/Main Lake)
      - Offsets for new growth
      - WQT program integration with existing state mechanisms
  - Draft on 9/25; Final on 9/30

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KIESER & ASSOCIATES, LLC
Environmental Science and Engineering

MEMORANDUM

To: Tetra Tech Project Team **Date:** July 16, 2015

From: Mark Kieser
James Klang, PE
Kieser & Associates, LLC

RE: Recommended Cost Analysis Strategy for Agricultural and Urban BMPs in the Lake Champlain Basin

A preliminary evaluation strategy for computing agricultural phosphorus reduction costs was constructed for the Lake Champlain Basin (LCB). This cost information will be vital to assess credit supply opportunities for Water Quality Trading (WQT) applications where phosphorus credits are supplied by agriculture for credit demand associated with urban stormwater control costs.

Computed agricultural conservation practice costs will ultimately be compared with those for urban stormwater Best Management Practices (BMPs) for the purposes of assessing cost-effectiveness trading supply and demand. We envision such comparisons will be presented in a separate supply/demand report. The evaluation therefore more concisely expands on previous, preliminary cost calculation assumptions used by K&A in a recent presentation to the WQT committee in June. New estimates incorporate additional lake segment-specific information based on EPA Scenario Tool runs provided by Tetra Tech (addressing reduction practice efficiency), and agricultural conservation practice costs determined by Kip Potter, water quality specialist, at Vermont NRCS. Thus, such calculations represent what we believe to be the best available information for agriculture that are applicable for estimating supply costs in the LCB based on information from both VT NRCS and EPA Scenario Tool results.

All methodological assumptions used for cost computations are discussed herein. Agricultural cost estimates could likely be refined with farm-specific data, but such data would only likely be useful for evaluating a specific trade and not necessarily the broader analysis of WQT supply and demand. Urban stormwater costs presented herein are derived from previous WQT feasibility studies conducted by K&A as well as from EPA estimates. The site dependent nature of urban stormwater controls results in cost uncertainty. As such, cost ranges are presented in this summary for computing demand costs.

Agricultural Conservation Practices

Phosphorus removal efficiency associated with the installation of conservation practices was estimated based on required management practices outlined by EPA's Scenario Tool (Tool). These are expressed as pounds of phosphorus reduced per year within a lake segment drainage area. For each lake segment, the Tool defines the combination of conservation practices (or treatment train) needed to achieve a certain level of reduction. Analysis by K&A in this regard focused on two treatment trains: 1) a combination of cover crops, conservation tillage, grassed waterways, ditch buffers and riparian buffers; and, 2) riparian buffers only. The Tool prescribes numerous other practice scenarios, however for this analyses these were not evaluated due in large part to information gaps defined below.

The Tool estimates the total reduction of phosphorus resulting from the implementation of these practices. The analysis example presented here focuses on the Mississquoi River drainage area. General characteristics of the Mississquoi agriculture drainage area as provided by Tetra Tech are as follows:

- Total Area of Agriculture Drainage: 71,680 acres
- Phosphorus Loading Associated with Agriculture: 124,563 lbs/yr
- TMDL Required Agricultural Phosphorus Loading Reduction Target: 74,340 lbs/yr

For trading cost-effectives, phosphorus reductions are coupled with practice installation costs and expressed as ‘cost per pound of reduction per year’ (or “treatment efficiency” as referred to herein). Conservation practice costs were obtained from Kip Potter at Vermont NRCS. Attachment 1 of this memo provides total practice costs as currently prescribed by Vermont NRCS. The ‘total practice cost’ presented in Attachment 1 is assumed to account for the entire cost, which includes an additional 25% to meet the cost share requirement. Total costs were then applied to the Tool results in order to determine an annual cost per pound of reduction. Conservation practice costs for each treatment train are determined on a lifecycle basis to account for practice lifetime, capital costs, operation and maintenance, and inflation. When information needed for cost determination was not available, best professional judgment was used accordingly. The following section will highlight these assumptions as well as provide a narrative for calculation methodologies.

Agricultural Conservation Practice Assumptions and Cost Methodology

Several assumptions were made when calculating conservation practice costs in this analysis. These include:

1. **Total area requiring practice applications**: The Tool identifies target implementation acreage for each treatment scenario by lake segment drainage. However, not all practices will be implemented on the entirety of this area. The cost analysis assumes 100 percent of the acreage in the Tool will require cover crops and conservation tillage, 30 percent will require ditch or stream buffers, and 10 percent will require grassed waterways. Furthermore, for ditch buffers and grassed waterways, the analysis assumes a ratio between conservation practice area and field area that the practice is treating. For example, one acre of stream or ditch buffer treats ten acres of agricultural land and one acre of grassed waterways serves twelve acres of Ag land. These ratios (1:10 and 1:12) were determined

based on approximations using aerial images in LCB. Refinements to these percentages and ratios can be readily incorporated into computations.

2. **Drainage Area for Analysis**: Costs were applied to Scenario Tool findings for the Mississquoi River drainage area. Mississquoi Direct Drainage was not included in the analysis since trading between agriculture and MS4s was deemed unlikely in preliminary considerations for supply and demand.

3. **Conservation practice scenarios in the Tool vs. NRCS cost considerations**: As Attachment 1 illustrates, NRCS has a defined cost for 'change in crop rotation, grassed waterway, ditch buffer, and riparian buffer' but does not include conservation tillage, an additional practice in the Tool. For this reason, reduction efficiency in Treatment Train 1 was determined by identifying the costs for each practice in the treatment train and summing these costs rather than using a lumped value from NRCS.

4. **Transferability of costs**: Costs obtained from NRCS are based on costs in the Rock River. These values are expected to be generally applicable throughout all drainage areas as per a personal communication with Kip Potter at VT NRCS. That said, differences may exist between segments leading to higher or lower costs.

5. **Life-cycle Cost Analysis (LCA):** Agricultural costs are calculated based on the lifecycle costs of each practice, as suggested by the Department of Energy (DOE).[1] LCA accounts for project lifetime, operation and maintenance costs, inflation and discount rates over time. The components of LCA for these analyses are:
   a. Capital cost: As determined by Vermont NRCS (Attachment 1)
   b. Operation and Maintenance: 4% (as per Indiana NRCS)[2]
   c. Project lifetime: 1 to 10 years (varies based on conservation practice)
   d. Inflation rate: 0.1% (current)
   e. Nominal discount rate: 3.1% (current)
   f. Real discount rate: 3.0% (difference between nominal discount rate and inflation)
6. **Additional treatment trains:** Additional conservation practice scenarios were not evaluated during this analysis for two primary reasons. First, NRCS nomenclature did not align with the Tool. This could result in improperly associating a practice cost with a certain acreage or load reduction. Another reason is that for certain a treatment train, the Tool indicates zero pounds of reduction occurring as a result of the practice. K&A is unclear if this is a result of the Tool lacking input data or if the treatment is truly ineffective. In either case, additional scenarios were not evaluated.

[1] Rushing, A, J. Kneifel and P. Lavappa. National Institute of Standards and Technology. 2014. Energy price indices and discount factors for life-cycle cost analysis. http://dx.doi.org/10.6028/NIST.IR.85-3273-29
[2] Operation and maintenance costs will likely vary between conservation practices. Site-specific estimates for O&M could be used to refine calculations in this analysis. Indiana NRCS is used here since it is one of a few states that identifies a 'base' O&M cost.

Following these methodological assumptions, cost efficiency for TP load reductions were determined for two different Tool scenarios. Tables 1 and 2 summarize the findings of this analysis, respectively for the single buffer application and then for the combined suite of conservation practices.

Table 1: Annual Riparian Buffer Costs per Pound TP Removed.

Conservation Practice: Riparian buffers for continuous corn fileds on all soil types Conservation practice applied on total area of 30,862 acres			
Riparian Buffer	$	145,557	
Total Phosphorus Reduced		11,821	lbs/yr reduced
Cost per Pound Reduced	$	12	per lb P reduction/yr

Table 2: Annual Riparian Buffer-Cover Crop-Conservation Tillage-Grassed Waterway Cost per Pound TP Removed.

Conservation Practice: Crop is either corn-hay rotation or continuous corn on non-clayey soils Conservation practices applied on total area of 23,203 acres			
Riparian Buffer	$	109,434	
Cover Crop	$	2,697,481	
Conservation Tillage	$	1,156,063	
Grassed Waterway	$	202,635	
Total	$	4,165,614	
Total Phosphorus Reduced		33,089	lbs/yr reduced
Cost Per Pound Reduced	$	126	per lb P reduction/yr

Cost calculations for both of these agricultural conservation scenarios, as well as others not quantified in this analysis, could be largely refined with more specific information regarding potential acreage coverage for the practice and confirmation of project capital costs.

Urban Stormwater BMPs

In order to appropriately compare cost of agricultural conservation practices to urban stormwater BMPs, a similar cost calculation method was applied for wet detention basins in LCB. Obtaining a cost per pound of reduction via detention basins allows for a reasonably analysis for potential economic efficiency comparisons for WQT supply and demand.

Similar to agricultural conservation practices, implementation of urban stormwater BMPs focuses on the Mississquoi River (excluding direct drainage) to allow for direct cost comparisons for supply and demand. The characteristics of the drainage area, according to the scenario tool, are as follows:

- Total area of developed land: 21,690 acres
- Area of pervious surface: 17,546 acres (80% of total area)
- Phosphorus Loading Associated with Urban Stormwater Runoff from MS4s: 28,523 lbs/yr
- TMDL Required MS4 Phosphorus Loading Reduction Target: 10,042 lbs/yr

Costs for phosphorus reduction using wet detention have been previously calculated by K&A in the Lower Fox River of Green Bay for a similar trading feasibility analysis.[3] For the purposes of this analysis in the LCB, only wet detention ponds will be evaluated as they are more ubiquitous in their design and application than other BMPs, are more amenable to calculating load reductions at scale, and generally more consistent in terms of their cost per reduction. Other practices, particularly low impact development, are difficult to quantify due to ambiguity on where practices can be feasibly implemented, scale of practice implementation to achieve overall reduction goals, and highly variable site-specific costs. Using annual capital and operation and maintenance costs for wet detention facilities as in the Lower Fox example, as well as considering LCB-specific load reduction by various catchment area sizes, a cost per pound of phosphorus reduction was estimated.

Urban Stormwater BMP Assumptions and Considerations

Similar to Ag BMP cost calculations, assumptions were necessary for determining efficiency of TP removal in wet detention basins. The following assumptions were made when calculating stormwater BMP costs in this analysis.

1. **Urban BMP treatment trains**: The Scenario Tool prescribes numerous BMPs for implementation in the Mississquoi, however the analysis performed here focuses only on the use of wet detention basins to treat urban stormwater. This was done for various reasons including:

    a. Wet detention basins are generally a more cost-effective urban stormwater BMP and can be assumed to better address retrofit needs than other smaller, source location-specific BMPs (such as LID measures). The purpose of this demand calculation was to assess a reasonable option for meeting TMDL WLA lake segment goals for MS4s. It is not designed to optimize any stormwater BMP solutions for the TMDL. In addition, calculations for load reductions and cost per pound reduced are more confidently estimated for wet detention basins compared to other practices.

    b. Surface infiltration practices and biofiltration, both of which are required by the Tool, are typically implemented in conjunction with other practices. Parsing out the load reduction between different low-impact development

[3] Kieser & Associates, XCG Consultants and Troutman Sanders. 2015. Lower Fox River Basin Water Quality Trading Economic Feasibility Assessment. Prepared for Great Lakes Commission, Ann Arbor, MI.

or green infrastructure projects would be ineffective and unreliable given the current level of information for stormwater in LCB. Even if these LID and GI practices could be partitioned out in a BMP treatment train, the costs to achieve one pound of reduction are substantial. For example [4]:

- Bioswales: $2,642 per pound
- Impervious surfaces: $7,322 per pound
- Infiltration Basins: $3,200 per pound
- Porous pavement: $12,000 to $70,000 per pound

2. **Use of Green Bay cost data**: Current inflation and discount rates were applied to capital costs and operation and maintenance from the Green Bay report. This analysis assumes the costs used in Green Bay are applicable to LCB.

3. **Life Cycle Cost Analysis**: Similar to determination of project costs for agriculture conservation practices, LCA was used to determine annual costs associated with wet detention basins. These cost analyses were based on:
   a. Capital cost: Fixed value as determined in Green Bay cost analysis[2]
      - Small catchment (6 acres): $162,500
      - Medium catchment (86 acres): $697,521
      - Large catchment (561acres): $2,310,406
   b. Operation and Maintenance costs: Fixed value as determined in Green Bay cost analysis
      - Small catchment (6 acres): $13,425
      - Medium catchment (86 acres): $29,050
      - Large catchment (561 acres): $37,455
   c. Project lifetime: 20 years
   d. Inflation rate: 0.1% (current)
   e. Nominal discount rate: 3.1% (current)
   f. Real discount rate: 3% (difference between nominal discount rate and inflation rate)

Following this proposed methodology and assumptions, cost efficiency for TP load reductions was determined for wet detention basins. Table (3) summarizes the findings of this analysis.

[4] Environmental Protection Agency. 2015. A compilation of cost data associated with the impacts and control of nutrient pollution. EPA 820-F-15-096

Table 3: Wet Detention Basin: Cost per Pound TP Removed.

Conservation Practice: Stormwater wet detention ponds Conservation practice applied on total area of 21,690 acres			
Small catchment area (6 acres)	$	8,764	per lb P reduction/yr
Medium catchment area (86 acre)	$	1,907	per lb P reduction/yr
Large catchment area (561 acre)	$	742	per lb P reduction/yr

The costs for urban stormwater treatment do not account for land acquisition prices which will increase capital costs for wet detention basins. Moreover, if a basin is needed in close proximity to the Lake, land prices will likely be relatively higher thus increasing annual costs. Furthermore, the costs presented here do not reflect relative treatment efficiencies that may occur between different size catchment basins or important site conditions (such as sandy versus clay soils). Refinement of cost per lb of TP reduction could be accomplished using Vermont-specific capital and O&M costs for wet detention basins. Additionally, a better understanding and definition of what the Tool defines as "surface infiltration practices" may allow for a more complete analysis in the future using other stormwater BMPs.

SUMMARY

The cost estimation methodology recommended herein as applied for the Mississquoi River basin example provides reasonable estimates for comparing supply and demand costs between agriculture and urban stormwater, respectively. This approach is recommended for advancing final supply and demand costs in other appropriate LCB lake segments to complete the overall WQT feasibility analysis.

The final analysis will need to consider credit-generating baselines associated with recent Vermont legislation requiring technology implementation for agriculture, as well as the pending LCB TMDL load allocations. The latter may be expressed as performance-based requirements, or may be similarly expressed as technology requirements. Such will only be determined when the TMDL is issued.

Regardless, credit supply estimates will need to assume that select farmers will be able to achieve both regulatory thresholds (state and TMDL), and go beyond these to produce credits. As the demand for credits is only a small fraction of the overall agricultural load in most lake segments where trading may be applicable, it is not unreasonable to assume that some producers will therefore be able to generate credits to meet demand. Costs for such credits over the life of the conservation practice (or contract to produce credits) are generally within the range of earlier cost estimates provided by K&A. Notably, however, the next round of supply and demand cost comparisons will also need to integrate a trading ratio.

Attachment 1[5]

Agricultural Conservation Practice Efficiency in Cost Per Pound of Phosphorus Reduced per year Averaged Over a Five-year Period			
Conservation Practice	**NRCS Payment**	**Total Practice Cost**	**Practice Cost Efficiency ($/lb P reduction)***
1. Change in crop rotation	$16	$21	$35
2. Change in crop rotation and conservation tillage	$51	$68	NA
3. Change in crop rotation, grassed waterway, ditch buffer and riparian buffer**	$50	$67	NA
4. Change in crop rotation, grassed waterway riparian buffer	$5,766	$7,688	NA
5. Change in crop rotation and riparian buffer	$769	$1,025	NA
6. Conservation tillage	$34	$45	NA
7. Cover crop	$79	$105	$147
8. Manure injection	$51	$68	NA
9. Cover crop, conservation tillage, grassed waterway, ditch buffer and riparian buffer	$6,413	$8,550	NA
10. Cover crop, conservation tillage and manure injection	$164	$219	$181
11. Cover crop and manure injection	$110	$147	NA
12. Annual crop to permanent hay	$209	$279	NA
13. Ditch buffer	$550	$733	$2**
14. Grassed waterway	$5,000	$6,666	$140
15. Grassed waterway and riparian buffer	$5,750	$7,666	NA
16. Manure injection and reduced manure P applied	$70	$93	NA***
17. Reduced manure P applied	$19	$25	$320
18. Reduced manure P applied and grassed waterway	$5,019	$6,692	NA
19. Riparian buffer	$750	$1,000	$52
20. Livestock Exclusion /Grazing system (estimated average)	$50,000	$66,666	$297
21. Farmstead practices (estimated average)	$200,000	$266,666	$5,540
NA – Not Available: practice was not included in Scenario Tool example			
**Based on the total NRCS cost*			
***Ditch buffer efficiency currently set very high*			
****Error in Model*			

[5] Attachment 1 is taken directly from Kip Potter (VT NRCS). No alterations have been made.

C. Clearinghouse Frameworks in Action

A clearinghouse framework can be advantageous for water quality trading depending on local supply and demand of credits. Presented below are two examples of clearinghouse frameworks in action: 1) Ohio's Greater Miami River and 2) Pennsylvania's PENNVEST. Trading within the Great Miami relies on reverse auction strategies to solicit competitive bids from producers. Reverse auctions were found to lower transaction and administrative costs for the program and promoted cost effective credit price determination. Pennsylvania's PENNVEST program is a robust clearinghouse system for waters draining to Chesapeake Bay. While PENNVEST may lack some of the cost-effectiveness of the Greater Miami program because of the multiple basins it must cover in the Bay, an array of contract types and pricing in Pennsylvania's water quality trading program may allow for greater flexibility to buyers and sellers in the Lake Champlain Basin.

Greater Miami River Water Quality Trading Program

This program involves voluntary point source/nonpoint source trading of phosphorus and nitrogen credits. A credit represents one pound of phosphorus or nitrogen prevented from discharging into surface water in the watershed on an annual average basis (MCD, 2005). Landowners work with trusted agricultural agents from soil & water conservation districts (SWCDs) to develop BMP proposals for credits. The Miami Conservancy District (MCD), acting as a third party credit clearinghouse, selects proposals using a reverse auction process where contracts are awarded to proposals for agricultural BMPs with the lowest cost credits first (Kieser & Associates, 2012). Roles for both credit buyers (WWTFs) and sellers (producers) are reversed compared to a traditional auction. Proposals are awarded successively with the next highest credit cost until the target credit quantity is obtained or available funding for credits is expended. Reverse auctions theoretically reveal the true value or cost to farmers, thus promoting a cost-effective approach to credit price determination. Table C-1 presents a brief summary of advantages and disadvantages for using reverse auctions in the Great Miami River. Selected points presented in Table C-1, as well as other aspects of the Great Miami River not presented in Table C-1, will be discussed further as they may be relevant to Lake Champlain Basin trading.

Table C-1: Great Miami River Reverse Auction Characteristics.

Advantages	Drawbacks
Coordination between public agencies: **MCD serves as clearinghouse; SWCD promotes trading among local farmers which lowers administrative Program costs (K&A, 2012).**	After multiple rounds of bidding a reverse auction may function as a fixed price system since price maximum and minimum are revealed over time. Effective reverse auctions require a level of uncertainty on threshold prices (Newburn and Woodward, 2011).
Lower transaction costs: Clearinghouse structure lowered transaction costs since no contractual agreements exist between WWTPs and farmers (Kieser & Associates et al., 2010).	Short contracts are not favorable for BMPs requiring high capital investments. May discourage certain BMPs that have significant ecosystem benefits (Newburn and Woodward, 2011).
Favorable trade ratios for early Program entry: Participants entering before finalized regulations had lower trade ratios than those who entered post-regulations (Newburn and Woodward, 2011).	Small farms may be at a competitive disadvantage since BMPs may affect a larger percentage of overall crop land.
Cost effective trading: Reverse auctions promote a 'buyers market' in which credits are sold at the lowest market price, a farmer's true value.	Farmers who continually lose bids may be disincentivized to implement additional BMPs.

Transaction Costs

Reverse auctions in the Great Miami River lowered transaction costs to program participants. Both Kieser & Associates (2012) and Newburn and Woodward (2011) explain that a third party clearinghouse lowers bargaining costs between buyer and seller since no contract exists. In contract negotiations, a buyer is incentivized to negotiate the lowest price possible to both spend less and protect themselves against seller default. A seller's objective is to sell credits for the highest price over their cost of BMP implementation. The result of negotiations almost certainly forces the buyer and seller to accept a higher price and lower credit price, respectively, than preferred. Under a clearinghouse structure, a neutral third party assumes the role of trade negotiator resulting in buyers and sellers trading at a more preferred price than under bilateral trading.

Agency Coordination: Lower Administrative Costs

The clearinghouse model may also lower administrative costs through public agency coordination. In Ohio, MCD which provides the role of the clearinghouse, enrolled local SWCDs as recruiters for producer credits. Newburn and Woodward (2011) note that SWCDs already provided technical services for producers under larger federal programs and therefore their duties were not significantly expanded under a trading program. Initial fund allotment to local SWCD offices under the Great Miami River trading program amounted to $52,700, 3.9% of the over $1.3 million in total expenditures. A complete breakdown of SWCD assistance and total funding is illustrated in Table C-2.

Table C-2: Great Miami River Program Administrative Costs.

County	Funded Projects	SWCD Initial Assistance Cost (USD)	SWCD Monitoring Cost (USD)	Farmer Payments (USD)	Number of SWCD Staff[1]
Butler	1	350	0	18,000	3
Clark	2	400	1,000	15,909	4.5
Darke	37	46,475	11,128	790,149	7
Logan	4	1,650	150	20,833	4.5
Mercer	10	0	0	23,927	5.5
Miami	6	1,125	625	57,085	5
Montgomery	2	1,900	100	15,855	6.5
Preble	8	800	1,000	20,329	5
Shelby	29	0	0	262,164	7
Warren	1	0	0	45,260	3
Total	100	52,700	14,003	1,269,511	51

Utilizing SWCD officers proved to be an effective strategy for the Great Miami River program. While not essential for the Lake Champlain Basin, state personal should consider possible incorporation of existing departments in order to lower administrative costs and improve efficiency similar to the Great Miami River.

Cost of Implementation: WQT vs. EQIP

If possible, understanding how BMP implementation cost under reverse auction trading compared to 'more traditional' EQIP implementation could help inform states on trading applicability. Kieser & Associates (2008) conducted an economic comparison between credit supplier payments under EQIP versus credit trading in the Great Miami. When analyzing costs for high residue, hayfield, grass, pasture and alfalfa establishment, grazing management, and grassed waterway BMP implementation, nutrient credit trading was indicated to be extremely successful. Cost comparison results of EQIP and water quality trading by Kieser & Associates (2008) are illustrated in Table C-3.

Table C-3: BMP Cost- EQIP vs. WQT (source: Kieser & Associates, 2008).

BMP Type	EQIP	GMR WQCT Program
High Residue	$8 per acre	$5 per acre
Hayfield and Grass Establishment	$137 to $191 per acre	$183.25 per acre
Pasture Establishment/Grazing Management	$137 to $191 per acre $15 per acre per year	$92.10 per acre $8.12 per acre per year
Alfalfa Establishment	$95 per acre	$37 per acre
Grassed Waterways	$2.80 per linear foot Base payment Items such as tile intakes, filter fabric and stone outfalls are additional	$3671.62 per acre or $5.06 per linear foot

While these findings may not be universally applicable, they do indicate the potential cost savings of water quality trading over EQIP funding. Kieser & Associates (2008) concluded that credit trading successfully provided:

- Alternatives to producers which do not wish to participate in Farm Bill programs
- Flexible mechanisms for permitting cost-effective nutrient load reductions
- Watershed managers a tool to cost-effectively manage nutrient reductions.

Program Cost-effectiveness

In theory, reverse auctions achieve cost savings since producers are incentivized to develop low-cost BMP implementation. Cost-effectiveness, as defined by Newburn and Woodward (2011), are savings achieved under a reverse auction compared to a fixed price system. Naturally a farmer is inclined to submit a bid at a higher price than actual implementation costs. Since a reverse auction rewards farmers who can generate credits for the lowest cost, a farmer who bids significantly higher than his costs decreases his chances winning. For this reason, reverse auctions are believed to reveal the 'true cost' to a farmer. While these savings may hold true for one time auctions, Newburn and Woodward (2011) note that the efficacy of reverse auctions may decrease with multiple rounds of bidding. Table C-4 provides a brief summary of auction results for the Great Miami River trading program.

Table C-4: Cost-effectiveness for Multiple Auctions.

Round Number	Bid Applications	% Accepted	Cost Savings (% savings)
1	19	63	32
2	62	24	24
3	9	89	28
4	18	78	19
5	2	50	1
6	50	100	14
Total	160	63	19

Source: Adapted from Newburn and Woodward (2011)

In general, as bidding rounds multiply the percentage of accepted bids increased while the cost savings to MCD decreased. Newburn and Woodward (2011) suggest this occurs from a county or producer's ability to learn how to push the bid and still remain competitive. Ultimately, this results in MCD paying relatively higher prices in later rounds. Effectiveness of reverse auctions may rely on uncertainty of threshold prices in order to create incentives for producers to submit lower bids (Newburn and Woodward, 2011).

Reverse auctions are not required to operate a clearinghouse trading framework. The following section will overview Pennsylvania's PENNVEST program. This clearinghouse does not use a reverse auction, but rather a suite of auction and contract types in order to accommodate diverse supply and demand needs.

PENNVEST

The Pennsylvania Infrastructure Investment Authority, PENNVEST, is a public agency providing low cost financial assistance for sewer, storm, drinking water, and nonpoint source infrastructure needs. PENNVEST oversees Pennsylvania SRF funding. PENNVEST also administers the nutrient credit trading program, in conjunction with the Department of Environmental Protection, for Susquenhanna and Potomac watersheds. PENNVEST serves as a clearinghouse for buyers and sellers thus reducing transaction costs and risk to participants, similar to MCD under the Great Miami River program in Ohio. Unlike the Great Miami River, PENNVEST relies on a suite of contracts, forward, single-year, spot and strip, in order to solicit credit bids. Requirements of each of these contract types are outlined in Table C-5. Auction type variety may allow for an increased ability to meet credit supply and demand in a given year.

Table C-5: Contract Types under PENNVEST

Contract Type[1]	Requirements
Forward	Seller agrees to deliver a defined quantity of credits to PENNVEST at a specified date for a predetermined price. The same type of contract and requirements can also be applied to buyers.
Single- year	Participants agree to the purchase or sale of credits for a one-year period for at a predetermined date and price.
Spot	Single, one-time trades for immediate delivery
Strip	A variation on forward contracts. Participants agree to the sale and purchase of similar credits over a three year period; N-'11, N-'12, N-'13 would be part of a 'strip'.

Source: Adapted from PENNVEST Nutrient Credit Clearinghouse Rulebook: Version 7 (2014), p.2-5

[1] Definitions contained in Table C-5 are taken from PENNVEST (2014).

PENNVEST also affords flexibility in credit allocation and price determination in transactions where credit demand and supply are not equal. Tables C-6 & C-7 are illustrative examples adapted from the 2014 PENNVEST Rulebook. Auctions prioritize matching the largest set of bids with the largest offer and will only contain bids and offers that cross, i.e., the price of the lowest bid should be greater than the price of the highest offer. The result of Example 1 (Table C-6) would be the largest set of bids (27,000) is matched using AO1, AO2 and AO4 at a final price of $8.00.

Table C-6: Example 1- PENNVEST Auction Results.

Demand for Credits				Supply of Credits			
Acc#	*Price (per lb)*	*Bid Quantity*	*"All or None" or "Partial"*	*Offer #*	*Price (per lb)*	*Offer Quantity*	*"All or None" or "Partial"*
AB1	$ 10.00	6000	Partial	AO1	$ 5.00	6000	Partial
AB2	$ 9.00	11000	All / None	AO2	$ 6.00	10000	All / None
AB3	$ 8.00	5000	All / None	AO3	$ 7.00	5000	All / None
AB4	$ 8.00	5000	All / None	AO4	$ 8.00	11000	All / None

Source: Adapted from PENNVEST Nutrient Credit Clearinghouse Rulebook: Version 7 (2014), p. 49.

For Example 2 (Table C-7), AO1 will only fill 3,000 credits while AO2 and AO3 will each fill 10,000 credits. Since AO2 and AO3 are "All or None", a priority for the auction is to fill those bids or lose out on 20,000 credits. A 'partial' requirement from AO1 allows PENNVEST to only fill a portion. The result from the auction fulfills all requirements. The Auction Settlement price will be $5.00, using the lowest bid and highest offer.

Table C-7: Example 2- PENNVEST Auction Results

Demand for Credits				Supply of Credits			
Acc#	*Price (per lb)*	*Bid Quantity*	*"All or None" or "Partial"*	*Offer #*	*Price (per lb)*	*Offer Quantity*	*"All or None" or "Partial"*
AB1	$ 7.00	15000	Partial	AO1	$ 3.00	5000	Partial
AB2	$ 6.00	4000	Partial	AO2	$ 4.00	10000	All / None
AB3	$ 5.00	4000	Partial	AO3	$ 5.00	10000	All / None

Source: Adapted from PENNVEST Nutrient Credit Clearinghouse Rulebook: Version 7 (2014), p. 50.

While PENNVEST may not deliver the most cost-effective credit pricing, a theoretical benefit of reverse auctions (the flexibility afforded by different auction types and credit fulfillment) may be potentially beneficial for Lake Champlain Basin applications. PENNVEST still offers a clearinghouse structure which lowers transactions costs for buyers and sellers while utilizing other public agencies to reduce administrative costs, as seen in Great Miami River.

References

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D. Summary of Baseline Considerations

The following is a summary of typical considerations for setting WQT baselines (derived from: Willamette Partnership et al. 2015)[1]

- *Regulatory requirements* generally form the foundation of any trading baseline. Because a trading program is most often applied on top of an existing regulatory framework, those existing regulatory requirements must be typically met in order for credits to be generated. The trading baseline ensures that projects provide water quality benefits beyond any relevant requirements stemming from federal, state, tribal, and local regulation in place at the time of implementation. For example, if state law requires riparian pastures to exclude animals from surface waters, then having streamside fencing in place might necessarily be required to meet regulatory requirements and would not be a BMP eligible to generate credits. Such regulatory requirements, however, may include provisions for generating interim credits as is the case in Wisconsin.
- *TMDL or other water quality obligations*. Where there is a TMDL in place, the 2003 EPA Trading Policy states that nonpoint source "pollutant reductions [should be] greater than those required by a regulatory requirement or established under a TMDL." EPA's 2007 *Water Quality Trading Toolkit for NPDES Permit Writers* further interprets this to mean that "each nonpoint source participating in trading under a TMDL make reductions consistent with the LA before they can generate credits (additional reductions) for sale." This approach ensures that progress is made toward water quality standards with each trade. Establishing a trading baseline that adequately accounts for required nonpoint source obligations under a TMDL is intended to ensure that credits generated from nonpoint sources exceed those that are expected under the TMDL at the time of the proposed trade. A trading program should consider whether TMDL nonpoint source load allocations (LAs), as converted into enforceable site-specific requirements at a particular point in time, are stringent enough to help achieve those LAs in the long term, and whether the trading baseline for a program is consistent with U.S. EPA reasonable assurance determinations for a TMDL. Utilizing LAs as part of the trading baseline is made difficult in practice by U.S. EPA not having TMDL implementation authority, and because state agencies have varying approaches and authority related to TMDL implementation. That said, TMDL Implementation Plans do provide the opportunity to institute phased or interim baseline options.

  Translating TMDL LA requirements to individual nonpoint sources or projects can also be challenging. TMDLs are not typically written with trading, or nonpoint source implementation necessary to achieve those LAs, in mind. For example, the EPA's 2007 *Water Quality Trading Toolkit for NPDES Permit Writers* notes that a nonpoint source's baseline "would be derived from the nonpoint source's LA" but it does not specify how to derive baseline for particular sites from the LA. For instance, TMDLs may not link LAs to particular BMPs, specify timelines for achieving LA or provide the information needed to interpret load reduction expectations at the site level—all of which would make it more feasible for trading programs to derive trading baselines from TMDLs. If TMDLs are unclear about how LAs apply to individual nonpoint sources,

[1] *Willamette Partnership, World Resources Institute, and the National Network on Water Quality Trading, 2015. Building a Water Quality Trading Program: Options and Considerations. http://willamettepartnership.org/wp-content/uploads/2015/06/BuildingaWQTProgram-NWQT.pdf.

* *"Building a Water Quality Trading Program: Options and Considerations" was created in part through the adaptation of publications developed by the National Network on Water Quality Trading (the Network), but is not the responsibility or property of the Network.*

states and TMDL-implementing agencies will need to determine the site-specific requirements derived from the TMDL that may inform and/or set a trading baseline.

- *Trading program obligations*. In some instances, such as where TMDL LAs prove difficult to translate into site-specific requirements, a trading program may set forth its own set of requirements as part of the trading baseline. These requirements may reflect trading program stakeholder views on the role of nonpoint source sectors in reducing pollutant loading, or seek to avoid penalizing early adopters of conservation practices. Similarly, if other water quality goals or obligations are in place (e.g., the Minnesota River Basin Plan was used to inform the MN Rahr Malting permit) and set affirmative water quality obligations for nonpoint source performance, the trading baseline may consider translating those obligations into eligibility requirements for participation in the WQT program. Other trading programs such as Ohio's, simply establish higher trade ratios (3:1) for agriculture to generate credits regardless of where their operational status is in relation to a LA. Where there are no TMDLs, non-point sources generate credits for 2:1 trades also based on reductions over current operations. Trading programs where there are no TMDL obligations or existing regulatory requirements might consider establishing minimum standards as part of the trading baseline.

Trading baseline can affect the trading program's viability. If the baseline is set too high, it will be difficult for projects to achieve creditable load reductions at a reasonable cost and may limit the potential supply of credits. Alternately, if a trading program sets baseline levels too low, it may raise concerns that the program is not helping to achieve overall water quality goals. Setting a trading baseline too low may also penalize agricultural producers that have done the right thing by implementing BMPs early and voluntarily. Ultimately, improving water quality is the goal and must inform baseline decisions.