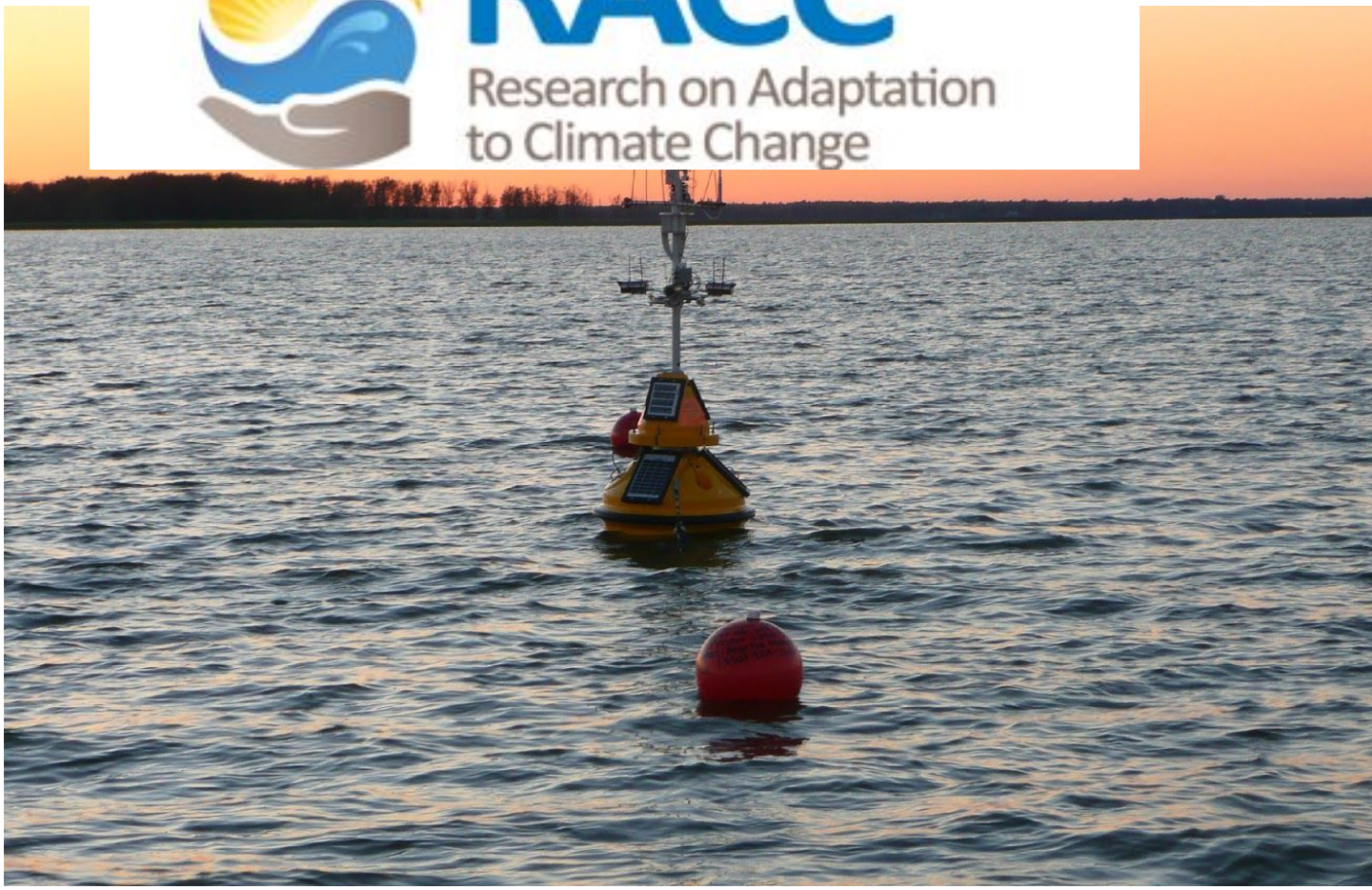
RACC

Research on Adaptation to Climate Change



ABSTRACT

A recent report by the Vermont Agency of Natural Resources has indicated that approximately $156 million is needed annually for the next ten years for the State of Vermont to meet its obligations under the Clean Water Act. Recent public opinion polling indicates that the most publicly-acceptable means for raising funds are through one-time development fees and annual stormwater fees. Further polling indicates that the median willingness to pay among Vermont households is $40 per year, when raised through water utility and vehicle registration fees. The polling also suggests that willingness to pay could be increased through outreach and education.

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Executive Summary

In the first report of Vermonters' perception of water quality, released in January of 2014 by the Research on Adaptation to Climate Chance (RACC) team,[1] several main findings were ascertained:

1. Vermonters are deeply concerned about water quality, more so than any other surveyed policy issue.

2. Vermonters believe that water is a public good, and that we ought to focus on the maintenance of recreational opportunities, high quality of life, and economic health as the primary impacts of water quality policy.

3. Vermonters show a strong preference for state-level responsibility for water quality, and also believe that responsibility ought to be clearly designated.

4. Vermonters are convinced that adequate funding ought to be dedicated to water quality in Vermont.

5. Vermonters' recreational habits are significantly impacted by water quality.

6. Socioeconomic, cultural, and life stage factors influence Vermonters' perception of water quality-related legal and economic issues.

7. Vermonters have a fairly high level of confidence in experts on climate change.[2]

This initial report highlighted Vermonters' hesitance to want to pay fees or taxes for improved water quality. However, additional polling data commissioned by RACC researchers shed new light on Vermonters' willingness to pay (WTP) for water quality. These results gave cause to revisit the conclusions we drew from the first survey and seek to develop a more comprehensive picture of Vermonter's willingness to pay for clean water. This report examines the data from these two public opinion surveys in greater depth. An overview of the methods employed in this research may be found in the Appendix A.

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[1] Chris Koliba, Asim Zia, Steve Scheinert, and Katherine Logan, 2014, "2013 Water Quality Survey," Burlington, VT.

[2] Koliba *et al*, 2014, 2.

MAJOR CONCLUSIONS TO BE DRAWN FROM THIS RESEARCH:

Two broad-based surveys provide data for conclusions on Vermonters' willingness to pay for water quality: RACC's 2013 Water Quality Public Opinion Survey and the 2014 annual Vermonter Poll, which included questions from RACC researchers on Vermonter's willingness to pay for water quality protections in the Lake Champlain Basin.

According to Vermonter Poll Results:

While approximately 35% of Vermonters polled reported an unwillingness to pay additional fees, the remaining 65% have strong willingness to pay to conserve water quality (See Figure 2).

Vermonters in most of the counties are willing to pay $40 or more as additional water utility and vehicle registration fees per year. The exceptions are the following counties: Caledonia, Essex, Franklin, Lamoille and Orange (See Figure 3).

Additionally, Vermonters with shorter residency time (e.g. more recent transplants to the area) have higher willingness to pay for water quality.

Older and college educated respondents were more likely to be willing to pay $80 or more annually for clean water than the general population.

Democrats were more likely to be willing to pay over $40 a year for clean water.

The distances that respondents lived from Lake Champlain appeared to not be a significant determinant of their willingness to pay (See Table 3).

We estimate that 189,552 households in Vermont would be assessed the additional water utility fee. If $20 per year in additional fees is added on to the water utility bills of these households, we estimate that $3,791,000 per year could be collected through increased fees in water utility bills. Further, if a $20 per year additional fee is levied on vehicle registrations for estimated 605,000 motorized vehicles registered in VT (VT DMV), we estimate that an additional $12,100,000 could be raised through vehicle registration fees. Both water utility and vehicle registration fees could add combined total of $15.89 million per year.

According to the RACC Water Quality Survey[3]:

Upon closer examination, the results from the first survey appear to be in line with these findings (See Table 1).

- 58.7% of respondents find one-time development fees acceptable.

[3] Koliba et al., 2014,

- 41.3% of respondents find annual development fees acceptable.
- 58.9% of respondents find stormwater fees acceptable.
- 34.2% of respondents find broad-based taxes acceptable.
- 46.1% of respondents find excise taxes acceptable.

Self reported democrats and progressives are more likely to support one-time development fees, stormwater fees, broad-based taxes, and excise taxes for water quality improvement.

Age, income and education play a limited, but statistically significant role in determining respondent's willingness to pay.

The distance that respondents lived from Lake Champlain did not play a meaningful role in influencing respondents' willingness to pay (See Table 2).

Summary Conclusion:

These datasets indicate that political identity and education are the most consistent predictors of increased acceptability of payment mechanisms and increased willingness to pay. This provides two suggestions about how policy can promote willingness to pay. The first suggestion derives solely from these observations of the data. Vermont, with its high proportion of registered Democrats and Progressives can rely on their political beliefs to support policies that raise money to pay for water quality programs. Additionally, greater education generally and outreach about the problem is likely to increase voter support for water quality programs.

The second suggestion arises when the observations about political identity, education, and sense of place are looked at together. In interviews, representatives of the state agencies involved in water quality report hearing complaints from Vermont residents who live outside of the Lake Champlain Basin (LCB) that too much attention is paid to the LCB to the exclusion of other watersheds. With a lack of results related to the distance of a residence from the shores of Lake Champlain, but with water quality problems around Vermont, this data can be interpreted to suggest that efforts to raise awareness about and address water quality concerns should highlight the state-wide nature of water quality challenges. Willingness to pay for water quality is *not* an exclusive characteristic of LCB residents. Greater support for water quality programs across the state might be found by increasing the attention paid to other watersheds as well as increasing the awareness of that greater attention among voters; while programs for other water bodies, including the Connecticut River and Lake Memphremagog certainly exist, they should feature more prominently in state-wide materials, discussions, and programs.

Background Context:

The On-Going Efforts to Improve Water Quality the Lake Champlain Basin and Control Harmful Algal Blooms

In 2012, responding to both the on-going process for writing a new Total Maximum Daily Load (TMDL) implementation plan and recent experience with Tropical Storm Irene, the Vermont Legislature passed Act 138. Section 19 of Act 138 tasked the Vermont Agency of Natural Resources (VTANR) to report on the costs necessary for Vermont to meet its obligations under the Clean Water Act in the Lake Champlain Basin and what policy options were available for raising the revenue to meet these costs. The report estimated that it would require approximately $156 million annually, for ten years to meet these requirements, based on current state programs. This includes $1.8 million for river, floodplain and shoreland management, $8.7 million for agricultural and forestry non-point source reduction, $63.9 million for municipal infrastructure and regulated stormwater programs, and $81.3 million for municipal non-point source reduction.[4] It then identified 16 different financial tools that could be used to raise the necessary funds. The report estimates that eight of these tools would, together, generate approximately $25.85 million, annually, while the remaining eight options would generate only small amounts each.[5] This would require five years to cover current needs, and likely place significant, and politically unpopular, costs on the population of Vermont.

In light of this funding gap, the Vermont Department of Environmental Conservation (VTDEC) continues to pursue efforts to find funding sources, with the need for funding continuing to grow as that need goes unmet and the underlying causes continue to worsen. The Clean Water Act compels Vermont to meet clean water standards. In an effort to meet these standards, Vermont had submitted a TMDL to the Environmental Protection Agency (EPA), which first accepted the standards, but then withdrew that acceptance once the standards were challenged in court. Representatives of VTDEC and the Vermont Agency of Agriculture, Farms, and Markets, have been working diligently to propose a new TMDL implementation plan. In a letter to VTDEC, dated May 8th, 2014, the EPA expressed concerns that the then-current draft of the plan lacked sufficient identification of funds and staff to implement the plan. Negotiations to define the details of this plan continue between VTDEC and the EPA. In August, 2014, the Shumlin Administration was forced to submit a revised budget that cuts $30 million from the state budget.

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[4] Vermont Agency of Natural Resources, 2013, "Water Quality Remediation, Implementation, and Funding Report," Montpelier, VT (January), 29.
[5] ANR, 2013, 8.

[6] These events have heightened the need to review possible funding mechanisms for both their revenue raising potential and political acceptability.

Research Questions

This report reviews recent survey results that speak to the potential for raising funds and political acceptability of a range of potential funding mechanisms. Some of these mechanisms, including the deployment of fees on development and construction, raising fees for storm water management through vehicle registration fees, and the implementation of new excise taxes on certain goods whose disposal impact water quality, are included in the Act 138 report. Others represent mechanisms not included in the report. The surveys asked about the acceptability of these options, including questions designed to elicit how much individuals were willing to pay through these mechanisms to support water quality.

This report examines these responses to determine how acceptable these mechanisms are, including how acceptability varies in relation to how far the respondent lives from Lake Champlain. Control variables also allow for assessments of how the acceptability varies with a range of demographic data, including education, age, income level, and political affiliation. This will provide a picture of how willing Vermonters are to support spending on water quality and how that varies across the state and how different demographic characteristics influence the acceptability of different funding mechanisms and the level of willingness to pay (WTP) to support water quality programs. Questions that ask about how much individuals are willing to pay through specific mechanisms allow for an analysis of the amount of funds that the listed mechanism could raise. This report concludes with an analysis that shows that embedding additional fees in the cost of a vehicle registration and in water utility bills could raise $15,891,000 per year to fund water quality policy and programs.

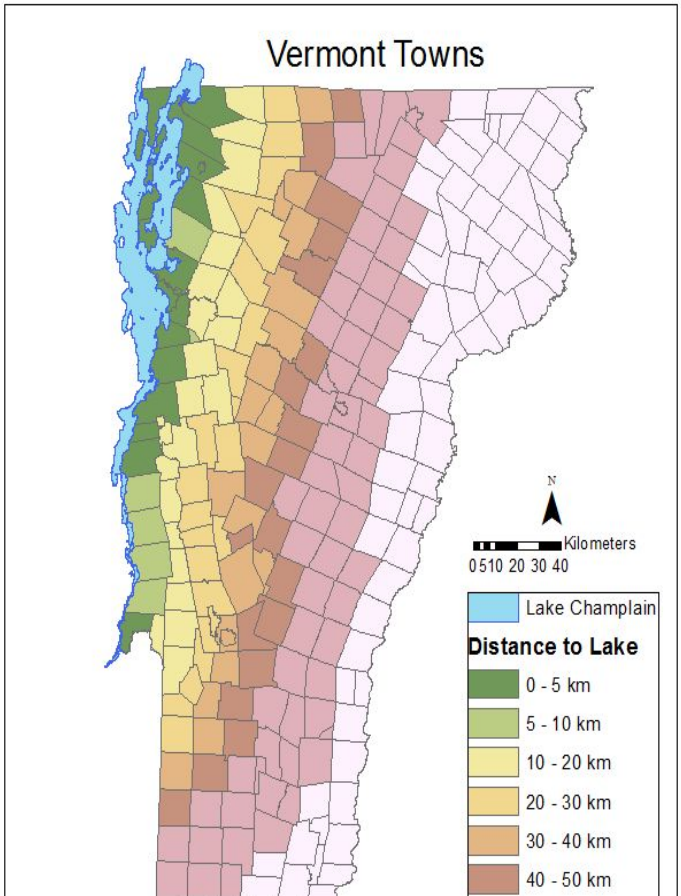
Data and Methods

This report addresses two research questions to draw an overall picture of Vermonters' willingness to pay for water quality projects and programs. First, identifying the population's willingness to pay requires carefully crafted questions that will promote careful and accurate assessments of individuals' willingness to pay. Since all the relevant methods for doing this have shortcomings[7] this report will rely on triangulation through multiple questions and question

[6] Stuart Ledbetter, 2014, "Vt. lawmakers agree to revised list of budget cuts," WPTZ News, 13 Aug.
[7] P.A. Diamond, and J.A. Hausman, 1994, "Contingent Valuation: Is Some Number better than No Number?" *The Journal of Economic Perspectives*, 8(4); R.T. Carson, J.J. Louviere, and N. Wasi, 1999, "A Cautionary Note on

types, gathered through multiple data sources. Specifically, two broad-based surveys will provide data. One source is a public opinion poll performed during summer, 2013 for the University of Vermont's Research on Adaptation to Climate Change (RACC) project. The other source is the annual Vermonter Poll, which the University of Vermont's Center for Rural Studies performs annually. RACC researchers arranged for the 2014 poll to include a question that addressed Vermonter's willingness to pay for water quality protections in the Lake Champlain Basin.

Designing Discrete Choice Experiments: A Comment on Lusk and Norwood's 'Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates,'" *American Journal of Agricultural Economics*, 91(4).


Vermont Towns
N
Kilometers
0 5 10 20 30 40
Lake Champlain
Distance to Lake
0 - 5 km
5 - 10 km
10 - 20 km
20 - 30 km
30 - 40 km
40 - 50 km

willingness to pay vary by their relative distance to an impaired water body? It is logical to assume that those who live closer to water bodies will be willing to pay more since they are more directly affected.[8] It is unlikely that this effect exists for an Vermonter's distance from Lake Champlain. However, persistent efforts in Vermont focusing on the Lake Champlain Basin are likely to connect water quality promotion efforts to this basin. This can be expected to leave public opinion focused around the distance this body of water rather than other bodies of water. Indeed, various conversations with stakeholders through Vermont have given some indications that this might be the case. Figure 1 shows the distances across Vermont to Lake Champlain from town centroids. The answers to both of these questions provide a picture Vermonters' willingness to pay by showing how that willingness varies with individual Vermonters' demographic characteristics and geographic location.

Results

The analyses reveal a range of results, many of which are inconsistent across demographic characteristics and fund raising mechanisms. The differences in how the questions in each survey are framed allow them to support different conclusions. The questions for the Public Opinion Survey were primarily designed to elicit public opinion about the trade-offs between the different fundraising mechanisms, combined with an effort to gauge levels of willingness to pay. Conversely, the question included in the Vermonter Poll was expressly designed to gauge respondents' willingness to pay. This report draws its conclusions following these specializations; the Public Opinion Survey's data assesses preferences regarding the method of raising funds while the Vermonter Poll's data determines the fundraising capacity for embedding fees in either respondent's water bills or vehicle registration fees.

[8] B. Hannon, 1994, "Sense of place: Geographic discounting by people, animals, and plants," *Ecological Economics*, 10(2); B.P. Kaltenborn, 1998, "Effects of sense of place on responses to environmental impacts: A study among residents of Svalbard in the Norwegian high Arctic," *Applied Geography*, 18; B.W. Eisenhauer, R.S. Krannich, and D.J. Blahna, 2000, "Attachments to special places on public lands: An analysis of activities, reason for attachments, and community connections," *Society and Natural Resources*, 13(5); M. Vorkinn and H. Riese, 2001, "Environmental concern in a local context: The significance of place attachment," *Environment and Behavior*, 33(2); B.S. Jorgensen and R.C. Stedman, 2003, "A comparative analysis of predictors of sense of place dimensions: Attachment to, dependence on, and identification with lakeshore properties," *Journal of Environmental Management*, 79; A. Zia, B. Norton, S. Metcalf, P. Hirsch, and B. Hannon, 2014, "Spatial Discounting, Place Attachment and Environmental Concern: Toward an Ambit-Based Theory of Sense of Place," *Journal of Environmental Psychology*, 40.

How to Raise Funds

For each tool, Table 1 presents a general level of acceptance. Initial analysis compared respondents' acceptability of differing levels of taxes or fees, either, high, moderate, or low. This analysis indicated that the acceptance levels for each fee level were highly correlated, making analysis using differing fee levels largely redundant. As a result, only one level is reported here, for which the moderate level was chosen as a mid-point between high and low levels. To gauge general acceptance, Table 1 reports the percentage of respondents that answered in each category in the Public Opinion Poll data. These basic results form a baseline for interpreting the results in Table 1, since the results in Table 2 are measured as changes from the results in Table 1.

Table 1. General Acceptance of Fundraising Mechanisms

Fundraising Mechanism	Unacceptable	Unsure	Undesired but Acceptable	Desired	Strongly Desired
One-Time Development Fees	21.4%	20.0%	20.9%	21.4%	16.4%
Annual Development Fees	35.9%	22.9%	18.4%	12.6%	10.3%
Stormwater Fees	34.5%	6.6%	25.7%	20.4%	12.8%
Broad-based Taxes	59.3%	6.5%	18.5%	12.0%	3.7%
Excise Taxes	42.8%	11.2%	20.5%	18.6%	7.0%

The results in Table 1 indicate that stormwater fees are the most popular option.

- 58.9% of respondents find stormwater fees acceptable.
- 58.7% of respondents find one-time development fees acceptable.
- 46.1% of respondents find excise taxes acceptable.
- 41.3% of respondents find annual development fees acceptable.
- 34.2% of respondents find broad-based taxes acceptable.

These numbers indicate the percentage of respondents that identified each policy tool as either Undesired but Acceptable, Desired, or Strongly Desired. Viewed this way, stormwater fees have the highest overall acceptability, with one-time development fees being almost as acceptable. Table 2 indicates which demographic characteristics change the likelihood of a respondent answering something other than "Unacceptable." The results in Table 2 for each tool will be discussed separately below.

Development Fees

The Public Opinion Survey considered two types of development fees. As described in the Act 138 Report, these fees would be assessed on developers either once, likely at the time of construction, or annually on the buildings that they own and operate. The goal would be to offset costs associated with runoff from impervious surfaces. Table 2 indicates that the most powerful predictor that a respondent will find these acceptable is if they are a registered Democrat or registered Progressive. Increasing distance from a water body increases the chances that a respondent will be unsure of the mechanism's acceptability, which is still a greater tolerance than being certain that they are unacceptable. For these, increases in income have a possible effect in increasing the chances that the mechanism will be desired, but these results were not sufficiently significant to be fully certain that there were observed.

Stormwater Fees

Under Act 138, these would be assessed in a broad-based way, by being added to the cost of annual vehicle registration fees, thereby increasing these fees. These fees are used to offset water quality losses that result from stormwater runoff from roadways and other impervious surfaces. Table 2 shows Democrats and Progressives are much more likely to be in favor of these than other political identifications. Also, those who describe their religious identity as liberal and those who have attended college show signs of an increased chance of finding these fees acceptable, though, the results are largely of borderline statistical significance.

Key for Table 2	
+	increased probability
-	decreased probability
(b)	Borderline statistical significance ($0.05 < p < 0.1$)
Double (++/--)	strong stat. sig. ($p < 0.01$)
Blank Cell	No statistically significant relationship
X	Insufficient observations to estimate

Table 2. Acceptability of Different Fundraising Mechanisms (Reference Answer is "Unacceptable")

	Distance from Lake Champlain	Income	Age	Female	Democrat/ Progressive	Reside in LCB	Religious Conservative	Religious Liberal	Attended College

One-Time Development Fees	Acceptable but Undesired											
	Unsure	+					+			-(b)		
	Desired			+(b)			++					
	Strongly Desired						+					
Annual Development Fees	A/U								-(b)	--		
	Unsure	+			+	++				--		
	Desired			+(b)			+					
	S. Desired											
Stormwater Fees	A/U						+				+	+(b)
	Unsure						+			X	+(b)	
	Desired				+(b)		++					+(b)
	S. Desired					+(b)	++				+	
Broad-Based Taxes	A/U			++		+	+				+(b)	
	Unsure					+(b)	+					-(b)
	Desired						+					+(b)
	S. Desired				+							
Excise Taxes	A/U			++	+	+						
	Unsure			+			++			X	+(b)	
	Desired						++					+
	S. Desired			+		+(b)						

Table 3. Willingness to Pay Estimation Using Vermonter Poll Data

WTP	**Model 3** N=450			**Model 4** N=450		
	$1-$40	$41-$80	>$80	$1-$40	$41-$80	>$80
Euclidian Distance	0.995 *[0.989, 1.002]*	1.000 *[0.991, 1.008]*	0.991* *[0.982, 1.001]*	0.996 *[0.989, 1.003]*	1.000 *[0.991, 1.009]*	0.992 *[0.982, 1.002]*
Residency Time	0.986* *[0.972, 1.001]*	0.986 *[0.969, 1.004]*	0.969*** *[0.950, 0.988]*	0.987* *[0.972, 1.001]*	0.987 *[0.970, 1.006]*	0.970*** *[0.951, 0.989]*
Age	1.011 *[0.992, 1.031]*	1.004 *[0.979, 1.029]*	1.028** *[1.001, 1.055]*	1.012 *[0.992, 1.032]*	1.004 *[0.979, 1.029]*	1.028** *[1.001, 1.056]*
College	1.132 *[0.681, 1.881]*	1.156 *[0.604, 2.213]*	2.283** *[1.065, 4.891]*	1.137 *[0.679, 1.902]*	1.192 *[0.622, 2.286]*	2.313** *[1.077, 4.968]*
Female	1.173	1.154	1.341 *[0.697, 2.578]*	1.931** *[1.074, 3.472]*	1.243 *[0.562, 2.749]*	1.810 *[0.724, 4.528]*

	[0.734, 1.875]	*[0.641, 2.076]*				
Homeowner	1.194 *[0.504, 2.829]*	0.792 *[0.265, 2.368]*	0.317* *[0.096, 1.043]*	1.226 *[0.511, 2.942]*	0.803 *[0.266, 2.422]*	0.321* *[0.097, 1.062]*
Single Family	1.029 *[0.514, 2.060]*	0.827 *[0.344, 1.987]*	1.532 *[0.525, 4.472]*	1.018 *[0.505, 2.053]*	0.848 *[0.350, 2.053]*	1.537 *[0.526, 4.494]*
White	1.923 *[0.415, 8.909]*	0.409 *[0.098, 1.704]*	†	1.877 *[0.398, 8.862]*	0.392 *[0.094, 1.636]*	†
Democrat	0.906 *[0.500, 1.641]*	2.276** *[1.153, 4.494]*	2.240** *[1.073, 4.674]*	2.390* *[0.890, 6.419]*	3.839** *[1.294, 11.388]*	4.457** *[1.372, 14.472]*
Republican	0.861 *[0.441, 1.682]*	0.904 *[0.360, 2.269]*	1.393 *[0.504, 3.844]*	1.975 *[0.725, 5.383]*	0.677 *[0.129, 3.548]*	1.769 *[0.382, 8.193]*
Progressive	1.714 *[0.316, 9.282]*	3.771 *[0.631, 22.534]*	3.514 *[0.516, 23.928]*	1.113 *[0.147, 8.397]*	1.990 *[0.238, 16.661]*	2.352 *[0.178, 31.067]*
Income	0.870 *[0.712, 1.063]*	1.230 *[0.954, 1.586]*	1.292* *[0.972, 1.719]*	0.870 *[0.710, 1.065]*	1.231 *[0.955, 1.586]*	1.295* *[0.974, 1.723]*
Female Democrat				0.198** *[0.057, 0.685]*	0.441 *[0.109, 1.789]*	0.320 *[0.071, 1.455]*
Female Republican				0.215** *[0.056, 0.829]*	1.463 *[0.198, 10.816]*	0.632 *[0.085, 4.703]*
Female Progressive				†	†	†
Pseudo R-Square	Cox and Snell: 0.165 Nagelkerke: 0.178 McFadden: 0.069			Cox and Snell: 0.190 Nagelkerke: 0.205 McFadden: 0.081		

Reference category WTP=0
† Insufficient observations generated outlier values that could not be interpreted.
Significance is represented by *p<0.10, **p<0.05, ***p<0.01
Bracketed range is the 95% confidence interval;

Broad-Based Taxes

Broad-based taxes, in this context, is a catch-all term for using increases in sales and property tax and a surtax on existing income tax liability to generate a very broad base of supporters, allowing for potentially more funds to be raised while minimizing the burden on any individual or any one group. This is in contrast to development fees, which would be paid primarily by developers, though it is likely that those costs would be passed on to residential and business tenants in the form of greater rental costs. These are clearly the least popular options, with few demographic factors indicating a greater likelihood for acceptance. Only higher incomes clearly increase acceptance, and then only in the category of 'Acceptable but undesired.' Only respondents

politically identifying as a Democrat or Progressive indicate increased likelihoods in more than one acceptability category.

Excise Taxes

Following from Act 138, excise taxes include specific taxes on a number of specific products, including motor fuels, flushable consumer products, pesticides, and bottled beverages. While more popular than broad-based taxes, this mechanism is still quite unpopular. The strongest results indicate that, again, Democrats and Progressives have a greater likelihood of finding this mechanism acceptable, as do those with greater incomes.

Estimated Fundraising Capacity

The Vermonter Poll posed a differently framed question and collected different demographic data, though its data bears on the same questions about how willingness to pay varies across Vermont. Posed with clearly defined dollar values, these data allow for an estimate of how much funding can be raised from a single funding mechanism, the imposition of additional annual fees for water utility usage and motor vehicle registration. These data concerned themselves primarily with the influence of distance to the lakeshore and length of residency in determining how much a respondent is willing to pay through fees embedded in water utility bills and vehicle registration. Representative results are presented in Table 3. These results presented the clearest connections between willingness to pay and the various demographic data. This data, which explicitly asked about willingness to pay for water quality problems designed to aid the Lake Champlain Basin, show that a respondent's distance from their residence to the nearest point on the lakeshore did not influence the level of their willingness to pay. Instead, they show that newer residents have a greater willingness to pay, particularly for the highest dollar amounts. They show that women and Democrats are willing to pay to support water quality programs, but that female Democrats are actually less likely than either women or Democrats, in general. These results corroborate the story from the Public Opinion Survey data that distance to the lake is not a primary determinant of willingness to pay.

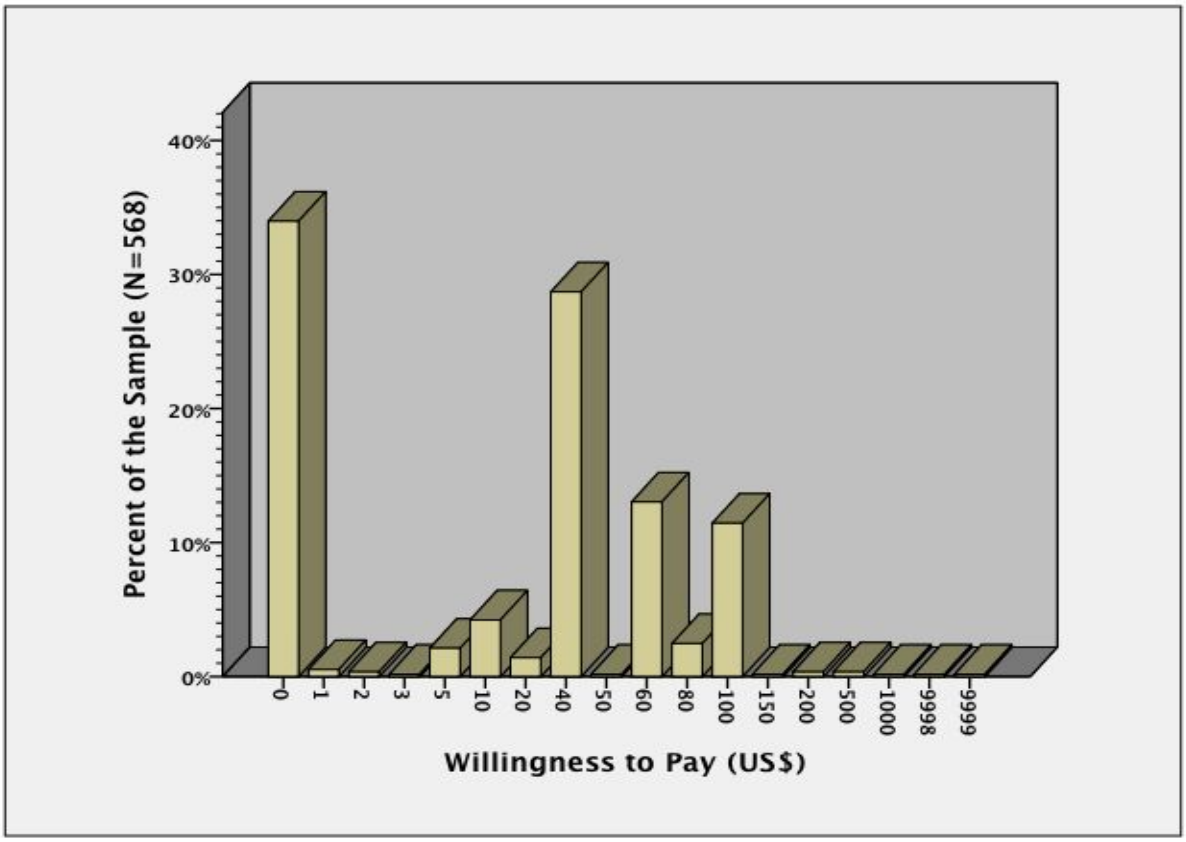


Figure 2.Vermonter's Willingness to Pay from Spring 2014 Vermonter Poll

The results from Table 3 provide the basis for estimating revenue raising capacity. Figure 2 shows the distribution of Vermonter's annual WTP through additional water utility bills and vehicle registration fees that underlies the results in Table 3. While approximately 35% of respondents are unwilling to pay additional fees, the remaining 65% have a strong willingness to pay to protect water quality in the Lake Champlain Basin in the face of climate change. Based on this distribution, we estimate a median willingness to pay of $40 per year, evenly split into a $20 flat fee that is as onto current water utility bills and a $20 flat fee added onto current vehicle registrations rates.

Figure 3 shows that respondents in most of the counties are willing to pay $40 or more as additional water utility and vehicle registration fees per year. The exceptions are the following counties: Caledonia, Essex, Franklin, Lamoille and Orange.[9] Boxes represent the middle quartiles of the distribution for willingness to pay in each county. The whiskers extending

[9] Too few observations were made in Grand Isle to support a statistical distribution.

beyond the boxes primarily represent minimum and maximum values, as appropriate. Black bars represent the median value of the distribution. Outliers are indicated individually where appropriate.

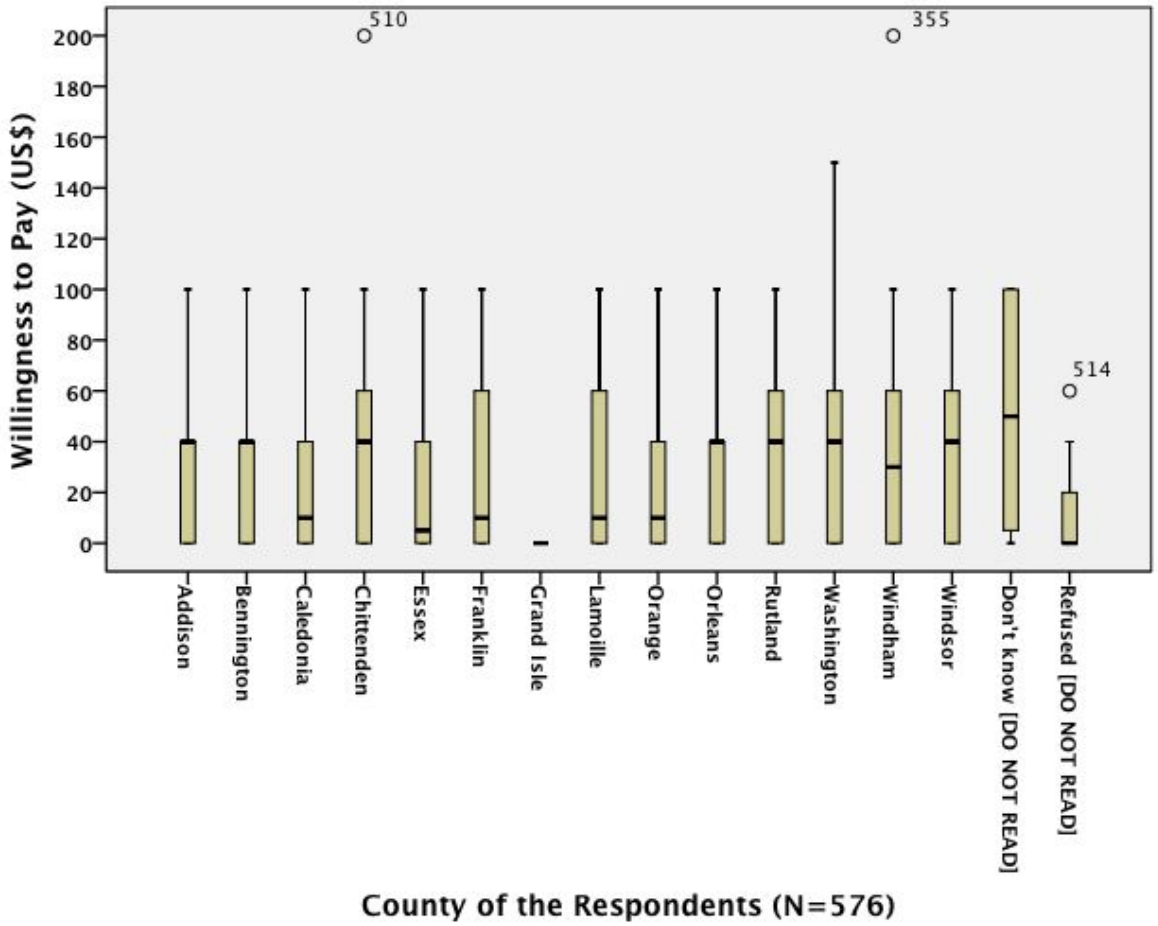


Figure 3. Boxplot of Vermonter's WTP distributed by county of their residence

We estimate that 189,552 households in Vermont would be assessed the additional water utility fee.[10] If $20 per year in additional fees are added on to the water utility bills of these households,

[10] Data from a 2013 Government Performance Results Act (GPRA) report, stored the Environmental Protection Agency's Safe Drinking Water Information System (SDWIS) database indicates that public water utilities serve 450,054 residents in Vermont. The US Census's 2013 American Community Survey (ACS) indicates that the households occupied by owners represent 71.0% of Vermont households and include an average of 2.47 individuals. The ACS also indicates that renter-occupied households make up the remaining 29.0% and include an average of 2.14 individuals. A weighted average of these values indicates that, on average, Vermont households include 2.3743 individuals. Using the number of residents served by public utilities and the average number of residents per

we estimate that $3,791,000 per year could be collected through increased fees in water utility bills. Further, if a $20 per year additional fee is levied on vehicle registrations for estimated 605,000 motorized vehicles registered in Vermont,[11] we estimate that an additional $12,100,000 could be raised through vehicle registration fees. Both water utility and vehicle registration fees could add combined total of $15.89 million per year.

Conclusions

Vermonters have demonstrated that they have a strong interest in seeing improvements in water quality statewide and that the state government should play an important role in supporting and providing that improvement.[12] The Act 138 Report[13] indicates that nearly $156 million is needed annually over the next ten years for Vermont to meet its obligations under the Clean Water Act. Analysis of polling data confirms another conclusion of the report, that the ability to raise funds falls vastly short of the amount of funds needed.[14] This analysis indicates that publicly supported fundraising is estimated at only $15.89 million per year, well short of the required $156 million needed annually for ten years, though it would represent a meaningful step towards raising the necessary funds.

It is important to note that it would be necessary to ensure that the funds raised would be applied to cleaning up Vermont's water bodies. The mechanisms discussed above that would be able to raise these funds would place the collection burden on the Department of Motor Vehicles, providing this department with the revenue. One option to ensure that the revenue is spent on water quality projects would be to place it in a fund like a "Save Lake Champlain Fund." Another option would be to transfer the revenue within the Agency of Transportation and to other agencies, which operate programs to support water quality.

These data do provide some confirmation of existing conclusions on the relationship between sense of place and willingness to pay, though the confirming evidence is limited. There are some potential explanations for this discrepancy between the results found here and the predictions from theory. More than one body of water in Vermont is failing to meet its CWA requirements. Pollution problems, such as harmful algal blooms, persist in both Lake Carmi and Lake Memphremagog, and in the Connecticut River. The Environmental Protection Agency currently

household indicates that approximately 189,552.29 households are served by public water utilities. This figure is rounded to 189,552 households. See Appendix B for full details.

[11] Data from Vermont Department of Motor Vehicles.

[12] Koliba *et al*, 2014.

[13] ANR, 2013.

[14] ANR, 2013.

lists 24 approved TMDLs in Vermont[15] that, while concentrated in and around relatively-densely populated Chittenden County, cover a considerable portion of the state. The oldest approved TMDLs have been in place since 2001. As depicted in Figure 1, the distances in this study are measured only in relation to Lake Champlain. This means that additional water bodies, closer to respondents may be driving acceptance levels and willingness to pay, but are not accounted for in the measurement of distance.

These datasets indicate that political identity and education are the most consistent predictors of increased acceptability of payment mechanisms and increased willingness to pay. This provides two suggestions about how policy can promote willingness to pay. The first derives solely from these observations of the data. Vermont, with its high proportion of registered Democrats and Progressives can rely on their political beliefs to support policies that raise money to pay for water quality programs. Additionally, greater education generally and outreach about the problem is likely to increase voter support for water quality programs.

The second suggestion arises when the observations about political identity, education, and sense of place are looked at together. In interviews, representatives of the state agencies involved in water quality report hearing complaints from Vermont residents who live outside of the LCB that too much attention is paid to the LCB to the exclusion of other watersheds. This confirms that Vermonters have begun to feel that governmental efforts to improve water quality are focused on the LCB, to the exclusion of Vermont's other impaired waters. With a lack of results related to the distance of a residence from the shores of Lake Champlain, but with water quality problems around Vermont, this data can be interpreted to suggest that efforts to raise awareness about and address water quality concerns should highlight the state-wide nature of water quality challenges. Willingness to pay for water quality is *not* an exclusive characteristic of LCB residents. Greater support for water quality programs across the state might be found by increasing the attention paid to other watersheds as well as increasing the awareness of that greater attention among voters; while programs for other water bodies, including the Connecticut River and Lake Memphremagog certainly exist, they should feature more prominently in state-wide materials, discussions, and programs. This will respond to popular misconceptions regarding the focus of water quality policy in Vermont and so could lead to an increase in Vermonters' willingness to pay.

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[15] The full list, maintained by the EPA is available here: <<http://www.epa.gov/region1/eco/tmdl/approved.html#vt>>. There is also a 25th approved TMDL that applies to the New England region, generally, including Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

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Appendix A: Data Sources and Methods of Analysis

2013 Public Opinion Survey

During summer, 2013, RACC researchers, at the University of Vermont, and as part of the Vermont Experimental Program to Stimulate Competitive Research (Vermont EPSCoR), collected data using a mail survey. The survey attempted to reach 5,000 randomly selected individuals across Vermont. Researchers received 422 responses, giving a response rate of 8.44%, as a base 95% confidence interval of ±4.77%.[16] The questions, sample and primary outputs have been previously released (Koliba, Zia, Scheinert, and Logan, 2014), and so will not be reviewed in full here.

The key questions for this analysis will be the survey's set of questions that address willingness to pay. This survey posed four questions that asked about the willingness to pay for five different policy tolls:

- One-time development fees
- Annual development fees
- Stormwater fees embedded in vehicle registration fees
- Broad-based taxes
- Excise taxes for certain disposable and polluting products

Each question asked respondents to rank high, moderate, and low increases in these fees using a Likert-type scale, numbered from 1 to 5, but offering the choices of "Unacceptable," "Acceptable but Undesired," "Unsure," "Desired," or "Strongly Desired."[17] The questions did not specific dollar amounts that were tied to the "high," "moderate," and "low" values, as these values vary heavily in each context.

2014 Vermonter Poll

RACC team added specific questions about Vermonter's WTP in the 2014 Vermonter Poll, a computer-aided telephone-interviewing (CATI) poll conducted by the Center for Rural Studies at the University of Vermont. The survey was conducted between the hours of 9:00 a.m. and 9:00 p.m. beginning on March 10, 2014 and ending on March 25, 2014. A random sample for the poll

[16] Base confidence intervals assume a 50% proportion value when calculating the confidence interval. Confidence intervals for individual questions will decrease as the observed proportions move further away from 50%.
[17] Likert scales are a specific type of ordinal scale that rank an item from -2 to 2, with opposing assessments placed on opposite sides of the 0-value. While scaled from 1 to 5, the questions here could be recoded as a Likert scale simply by subtracting 3 from the coded values.

was drawn from a list of Vermont telephone numbers, which is updated quarterly and included listed and unlisted telephone numbers. Cellular phone numbers were not included in the sampling frame. Only Vermont residents over the age of eighteen were interviewed. The poll included questions on a variety of issues related to public policy in the state of Vermont. In total, 2,013 households were successfully contacted, yielding 576 complete responses; therefore, 28.6 percent of these calls resulted in a completed survey. Based on a group of this size, the results have a margin of error of plus or minus 4.5 percent with a confidence interval of 95 percent.

The question in the poll regarding willingness to pay to protect Lake Champlain water quality was prefaced with an overview on how phosphorus, nitrogen, and more intense and frequent storms will degrade water quality in the lake if no proactive measures are taken. The preface also mentioned that the Vermont government didn't have adequate money to fund these protective measures. Participants were then asked if they were willing to pay an annual fee of (a) $20, (b) $30, (c) $40, or (d) $50 as part of their water bills and the same amounts as part of their vehicle registration fees to protect Lake Champlain water quality in the medium to long run (10-50 years). If respondents answered no for (a), they were asked what the minimum amount they were willing to pay was. If respondents answered yes for (d), they were asked what the maximum amount they were willing to pay was.

Analysis: Multinomial Logistic Regression

The acceptability of policy tools and willingness to pay are recorded in the appropriate variables in the Public Opinion Survey and Vermonter Poll, respectively. The influence on the acceptability and willingness to pay can then be estimated using regression analysis. However, their scaling methods prevent estimation by Ordinary Least Squares (OLS). In the Public Opinion Poll, these variables are coded using ordinal scales (Kennedy, 2003). In the Vermonter Poll, they are recorded as the labeled values of multinomial variables. This requires the use of models designed to address limited dependent variables. Analysis follows the more restrictive assumptions required to use a multinomial variable as a dependent variable (Kennedy, 2003), allowing for parallel analyses of each dataset.

Previous research demonstrates that proximity to water affects individual's willingness to pay to keep that water clean (Hannon, 1994; Kaltenborn, 1998; Eisenhauer, Krannich, and Blahna, 2000; Vorkinn and Riese, 2001; Jorgensen and Stedman, 2005; Zia *et al*, 2014). Therefore, a measurement of how far respondents are from Lake Champlain is necessary for an accurate assessment of the acceptability of fundraising mechanisms and overall willingness to pay. Both

surveys record a certain amount of geographic data about the respondents. In the case of the public opinion survey, respondents identified their residential zip codes and the initial sample includes full addresses. The Vermonter Poll, as well, includes some full addresses. Both datasets record the town in which respondents reside. Researchers used geo-referencing to identify the specific locations of respondents. When specific addresses were unavailable but town information was available, one of two procedures is followed. For the Vermonter Poll respondents, respondents are placed at the post office that serviced their general area. For Public Opinion Poll respondents, respondents are assigned the centroid of their town. Once placed, the distances to Lake Champlain are calculated and recorded for each response.[18] Distances are calculated using both Euclidian distance, which record the straight-line distance from the address to the shoreline, and roadway distance, which records the distance from the respondent's location to the shore by following the shortest path along the road network. Nevertheless, only a portion of the data could be linked to a geographic location. This includes 220 observations of the Public Opinion Poll data and 450 observations of the Vermonter Poll data. The following models are then estimated. For the Public Opinion Survey data:

$$Acceptability = f(Distance, Income\ Level, Age, Gender, Political\ Affiliation, Lake\ Champlain\ Basin\ Residenc$$

For the Vermonter Poll data:

$$Willingness\ to\ Pay = f(Distance, Residency\ Time, Age, College\ Attendance, Gender, Homeowner\ Status, Sing$$

Each model is estimated using different subsets of the independent variables as a sensitivity analysis. The clearest results are included in this report.[19] This includes testing for different impacts from either directly measured distances or the natural logarithm of distance.[20] Results were clearer using the natural logarithm, and so these results are reported here.

[18] Geo-referencing and distance calculations were performed using ArcGIS. Map layers for Lake Champlain from the Vermont Center for Geographic Information (VCGI).
[19] Regressions were performed using IBM *Statistical Package for Social Science* (SPSS).
[20] That is, distance transformed by taking: ln(distance).

Appendix B: Calculation of Funds Raised through Water Utility Fee

Housing statistics from Census (Am. Community Survey, 2013):

Average household size, Owner occupied: 2.47 individuals

Average household size, Renter occupied: 2.14 individuals

% of occupied housing that is homeowner: 71.0%

% of occupied housing that is rental: 29.0%

Weighted averaging:

$$0.71(2.47) + 0.29(2.14) = 1.7537 + 0.6206 = 2.3743$$

Weighted average of residents per household: 2.3743 individuals per household

Number of households in Vermont to be assessed the fee:

Individuals served by public utilities (EPA, 2013): 450,054 individuals

Number of Community Water Systems (CWS): 426 water systems

Number of Households served:

$$\frac{450{,}054\ individuals}{2.3743\ individuals\ per\ household} = 189{,}552.289\ households$$

Funds raised from these households through a $20 fee:

$$189{,}552\ households(\frac{\$20}{household}) = \$3{,}791{,}040$$