Chapter VII

Analysis of Results

7.1 Introduction

In this section we discuss the analysis of the data from the survey. This analysis is primarily comprised of regression analysis of the Willingness to pay for the complete groundwater cleanup program under the hypothetical scenario presented in the survey. Regression analysis is usefull both for analyzing errors in bidding (i.e., the problem of large bids discussed previously), which might bias the value estimates, and for developing predictive models for use in benefit-cost analysis. The predicted values from this base regression are then used along with each individual's adjustments for the alternative scenarios to discuss the valuations for the alternative Scenarios.

Two sources of error exist in predicting contingent values with a regression model. These sources of error are measurement error and model error. Measurement error in the dependent variable, WTP, may be present due to the hypothetical nature of the CVM. If all error in the estimated equation is measurement error, the predicted mean bid using the Box-Cox analysis may approximate the true mean WTP if there is skew in the distribution of errors. The raw mean will provide an estimate of the

willingness to payif all error is model error. Model error can arise because of errors in functional form or because of excluded explanatory variables and can produce skewed residuals.

It is impossible to know *a priori* how much of the error is model error and how much is measurement error. From laboratory experiments from the effect of context and information, and from the logical inconsistency of some very large bids we know that skewed measurement error is likely to be present, which implies that the raw mean of the CVM bids will likely overestimate true values. In summary, an upper bound estimate of value can be obtained from the raw mean which implicitly assumes that all error in an econometric equation predicting such values is model error. If all error is measurement error, an appropriate estimate of values can be obtained by employing the Box-Cox transformation thereby eliminating skewness in the distribution of residuals in a predictive equation of values. The mean of the predicted values from such an equation will likely be substantially lower than the raw mean and if used for policy purposes assumes that all error in the estimated equation is measurement error in the dependent variable. See Chapter III for a discussion of this issue.

The BOX-COX transformation used in the regression analysis is:

$$WTP' = \begin{cases} \dfrac{WTP^{\alpha-1}}{\alpha\, e^{(1/n)\,\Sigma \log WTP}} & \text{for } a \neq 0 \\ \log WTP & \text{for } a = 0 \end{cases}$$

where a is chosen to normalize the error distribution in regression analysis (Box and Cox, 1964). $e^{(1/n)\Sigma \log WTP}$ is the geometric mean of the WTP value

being estimated. Predicted bids from the regression analysis can be used for policy analysis if all error is assumed to be measurement error.

As discussed below, substantial skew is present in the residuals of the linear regression and the BOX-COX procedure produces an essentially normal distribution of residuals. Thus, the procedure developed above can be defended on purely econometric grounds as an appropriate method for dealing with large outliers which would otherwise bias CVM studies.

7.2 Variables and Summary of Results

The surveys in the Appendix D provide full explanations and context for the variables used in the data analysis. Chapter VI provides the raw data results for the variables below. The independent variables used in the regression are listed in Table 7.1.

Regional dummy variables are defined according to Table 7.2. These were coded from the mailing addresses.

The initial value question in each version of the survey is the individual's willingness to pay for complete cleanup a hypothetical groundwater contamination problem. 'Ibis hypothetical situation involves groundwater contamination from a leaking landfill leading to a potential 40% shortage in domestic water supply. The willingness to pay for complete groundwater cleanup is stated as how much an individual is willing to have his or her monthly water bill increased every month for the next ten years. The dollar values stated are these monthly dollar values. For all versions of the questionnaire this question (Q 11) was identical. The individuals circled a dollar value between $0 and $500 or circled "MORE

TABLE 7.1: INDEPENDENT VARIABLES

INDEPENDENT VARIABLES	EXPLANATION	QUESTION
INCOMEVD	Income in $1000's - taken as median of category	H10
KIDS	1 if respondent has children, 0 if not	H4
AGE	age of survey respondent	H3
WHITE	1 if Caucasian, 0 if not	H8
EDUC	Educational level 1 to 10 (1 =no formal, 10 = advanced)	H5
GENDER	1 for female, 2 for male	H2
REGION	regional dummy variables explained in Table 7.2	coded from address
LANDFILL	Is respondent aware of a community landfill contaminating groundwater 1 = yes aware 0 = no,not aware	Q1
EXPOSED	Dummy variable for surveys sent to zip codes in which groundwater contamination exists 1 if contamination present -1 if not	Version B
USE	1 if respondent uses groundwater, 0 if not	Q3
SOURCES	Number of sources of groundwater contamination	Q1
RECYCLES	Number of items recycled	H6
OTHENV	Mean attitude toward non-groundwater environmental issues	92
GRNDWTR	Attitude toward groundwater contamination	Q2
COMPLETE	How much respondent is satisfied with complete groundwater cleanup program	Q6
MEANNCOM	Mean of how much respondent is satisfied with cleanup programs other than complete cleanup	Q6-Q10
RESPONS	How responsible respondent feels for helping to pay to cleanup groundwater contamination in his community	Q15

TABLE 7.2 REG1ONAL DUMMY VARIABLES

REGION	
NORTHEAS	1 for live in ME, NH, VT, RI, CT, MA
NEWYORK	1 for live in NY, NJ
MIDATLAN	1 for live in PA, VA, MD, DE, DC, WV
SOUTH	1 for live in KY, TN, NC, SC, GA, AL, FL, MS
LAKES	1 for live in MI, IL, IN, MN, OH, WI
SOUTHWES	1 for live in NM, TX, OK, AR, LA
MOUNTAIN	1 for live in CO, UT, WY, ND, SD, MT
WEST	1 for live in CA,AZ, NV, HI
NORTHWES	1 for live in AK, ID, OR, WA
MIDWEST	1for live in IA, KS, MO, NE region excluded for regression analysis

THAN $500". For the purposes of data analysis answers of "MORE THAN $500" were set equal to $501. Of the 2546 individuals who answered the WTP question only 5, or less than 2/10 of 1%, answered "MORE THAN $500". More than 93% of the respondents stated a WTP of $30 or less per month.

The reduced willingness to pay for complete groundwater cleanup is the dependent variable in the linear and the Box-Cox regression. To account for potential embedding problems, question Q 12 asked if the bid was entirely just for the described groundwater cleanup or if the bid included values for other environmental or public goods as well. Reduced WTP simply equals the answer for Q 11 if the respondent answered that the total stated value was just for the stated groundwater cleanup program. If the stated value was also for other environmental or public goods the stated WTP was multiplied by the percent indicated in Q 13 to be just for the complete groundwater cleanup to derive the reduced Willingness to pay. (See Chapter VI: Results, Table 6.4). 71% of the respondents stated that their value was entirely just for the program described. For the 29% of the respondents

who self-reported embedding the mean stated percent for just the groundwater cleanup program described was 42.5% of their WTP. For the individuals for whom REDWTP could be calculated, accounting for the effects of the self-reported embedding lowered the mean WTP from $14.70 to the reduced WTP of $11.58: a 21.2% adjustment due to embedding (see Table 3.1 for a comparison to other studies using this approach).

The willingness to pay variables are listed in Table 7.3. These are derived by multiplying the reduced WTP (REDWTP) or predicted REDWTP from the regression using the Box-Cox transformation on REDWTP for complete groundwater cleanup by the percent adjustment stated for the each of the alternative scenarios presented.

The REDWTP (willingness to pay for complete groundwater cleanup when facing a 40% shortage) was decomposed into component values by the percent assigned by the individuals to these components. Q 14 asked the respondents to assign percentage splits according to the four components.

TABLE 7.3: WILLINGNESS TO PAY VARIABLES

WTP	EXPLANATION
REDWTP	reduced WTP for complete groundwater cleanup
CONTWTP	WTP for containment program
NATWTP	WTP for national cleanup
PUBWTP	WTP for public treatment program
TENWTP	WTF for complete cleanup with 10% water shortage
SEVENWTP	WTP for complete cleanup With 70% water shortage

When respondents did not enter a value in one or more of the four components, but did answer at least one, their percentage splits were normalized to sum to 100%.

TABLE 7.4: COMPONENT VALUE VARIABLES

COMPONENT VALUE	EXPLANATION
USEVAL	protion of REDWTP indicated for own use
ALTRUIST	portion of REDWTP indicated for others in community
BEQUEST	portion of REDWTP indicated for future generations
EXIST	portion of REDWTP indicated to ensure that ground-water is uncontaminated even if no one ever uses it

As a first step, a linear functional form was estimated for comparison to the Box-Cox regressions. Ordinary least squares was applied to the untransformed reduced willingness to pay using the full set of explanatory variables and regional dummy variables. The mean of predicted values from this linear form will equal the raw mean, which provides an upper bound estimate of values. The R-squared value from the linear regression was 0.07.

As a second step, a Box-Cox estimation procedure was used to transform the dependent variable if an assumption is made that all error is measurement error as discussed above. This procedure significantly increased the R-squared value as would be expected by controlling for the influence of outliers. The Box-Cox estimation was performed on the entire set of explanatory variables and predicted values were retained for each observation. The α value from the Box-Cox transformation was 0.15 suggesting a skew in the distribution of errors approaching the log distribution (a = 0). The R-squared from the regression using the Box-Cox transformation was 0.30.

Table 7.5 presents the mean values for the willingness to pay and the predicted willingness to pay variables for complete groundwater cleanup and the alternative scenarios examined.

TABLE 7.5: MEAN WTP, STANDARD DEVIATION AND SAMPLE SIZE

SCENARIO	FULL SAMPLE	REGRESSION SAMPLE	BOX-COX PREDICTIONS
COMPLETE CLEANUP	11.58 (26.00) n = 2315	11.70 (23.30) n = 1983	7.01 (5.29) n = 1983
CONTAINMENT	5.96 (11.36) n = 404	6.38 (11.91) n = 348	3.95 (4.73) n = 348
PUBLIC TREATMENT	7.98 (24.62) n = 400	7.18 (22.98) n = 345	4.02 (3.95) n = 345
NATIONAL NO CONTEXT	2.67 (10.27) n = 393	2.98 (10.95) n = 343	1.34 (2.46) n = 343
CONTEXT	2.03 (7.55) n = 626	2.15 (8.00) n = 542	1.13 (2.31) n = 542
TEN % SHORTFALL	6.98 (19.72) n = 408	7.38 (20.86) n = 355	3.86 (4.40) n = 355
SEVENTY % SHORTFALL	21.95 (46.07) n = 389	22.99 (47.71) n = 345	13.34 (12.74) n = 345

The mean from the raw data is presented in the first column along with the variance and sample size for each variable. The second column presents the mean for the WTP values for observations used in the regression on complete cleanup. The sample size is smaller in the regressions than in the data set due to missing values for some explanatory variables for some of the observations. The "BOX-COX PREDICTIONS" is the

mean predicted WTP from the Box-Cox transformation on complete cleanup times the individual's stated adjustment for the scenario being valued.

We will discuss these results in the following order: (7.3) the regression on WTP for complete groundwater cleanup: (7.4) the component values of WTP for complete cleanup: (7.5) two alternatives to complete cleanup- containment and public treatment: (7.6) the WTP for national groundwater cleanup: (7.7) how the degree of water shortage affects the WTP for groundwater cleanup: and (7.8) comparison of three approaches for estimating non-use values for complete groundwater cleanup to test the robustness of our measurement of non-use values.

7.3 Complete Groundwater Cleanup

The first regression (Table 7.6) is an ordinary least squares regression of the untransformed reduced WTP on the full set of explanatory variables. Many of these variables, such as RESPONS. would not be available to policy makers without conducting fbrther in depth surveying. The only explanatory variables significant at the 5% level from this regression are INCOMEVD, WHITE, COMPLETE, RESPONS and NEWYORK.

915 asked individuals to rank on a scale from 1 to 7 how responsible they feel for helping to pay to cleanup such a groundwater contamination problem in their community. The high t-value on RESPONS (6.571) suggests the importance of feelings of moral responsibility in an individual's willingness to pay to cleanup environmental damage. For policy purposes though, it would be difficult if not impossible to derive such an index of responsibility without conducting a similar survey.

INCOMEVD is positive and significant as expected: those with higher income are, on average, willing to pay more. The dummy variable WHITE is significant at the 5% level in this regression but not in the Box-Cox transformation as discussed below. The regional dummy variable NEWYORK is significant but the regional dummy variables (as a group) in the linear regression are not significant (F (9.1957) = 1.29, ns). These regional dummy variables can be expected to capture regional characteristics not accounted for in variables such as INCOMEVD, WHITE. or EDUC that may account for differences in the population composition in different parts of the country.

The second regression (Table 7.7) uses the Box-Cox transformation and produces a considerably higher R-squared value (0.30). The explanatory variables which are significant at the 5% level now also include AGE, EDUC, USE, SOURCES, OTHENV, and GRNDWTR. NEWYORK and WHITE are no longer significant at the 5% level as they possibly were influenced by outliers in the previous regression. In the regression using the Box-Cox transformation the regional variables as a group are significant (F (9,1957) = 2.30, p c 0.014) yet none are individually significant. The negative coefficient on AGE indicates that older people are less willing to pay to clean up groundwater.

The positive and significant coefficients for income and education are plausible in that environmental goods are often believed to be superior goods (those goods having positive income elasticities). It is reasonable to expect an increased willingness to pay as education and income and possibly environmental awareness increase.

SOURCES IS the number of sources of groundwater contamination that an individual indicates exist in his or her community. An increase in

SOURCES may indicate either an increased awareness of potential sources of contamination or a belief that there are numerous groundwater contamination problems in one's community.

OTHENV is the mean attitude of the individual toward other environmental problems such as pollution, saving endangered species and reducing global warming. GRNDWI'R is the individual's response to the same type of scaling question with respect to how concerned he or she is with groundwater pollution. The negative coefficient on OTHENV and the positive coefficient on GRNDWTR are indicative of the relative weights that the individual puts on groundwater pollution relative to other environmental problems. Thus, the more important other environmental problems are relative to groundwater pollution the less an individual is willing to pay to cleanup groundwater pollution. This suggests that these other environmental goods are viewed as substitutes for groundwater cleanup.

COMPLETE is a 1 to 7 scaling of how satisfied an individual would be with the complete groundwater cleanup program as a method to deal with the groundwater pollution problem in the hypothetical scenario. The positive coefficient indicates that the more satisfied an individual is with the proposed program the more he or she would be willing to pay to have that program implemented. COMPLETE may also be an indication of whether or not the individual believes that such a cleanup program could be workable, which is an important factor in whether or not an individual may reject the scenario offered. MEANNCOM, which is not significant, is a similar aggregated scaling of alternative programs to the complete groundwater cleanup.

It should be noted that neither KIDS nor GENDER were significant in either the linear or Box-Cox regressions. In addition it is interesting that

although they had small negative coefficients, neither LANDFILL nor EXPOSED had significant impacts on willingness to pay. This suggests that individuals treated the survey questions as hypothetical and answered them without reference to their own relationship to landfills or exposure to contamination. This is important for the validity of the contingent valuation method in assuring us that the individuals were actually answering the questions with regard to the hypothetical scenario.

EXPOSED is the dummy variable for areas where groundwater contamination is known to exist and SOURCES is the respondents self-reported awareness of sources of groundwater contamination. Although being "EXPOSED" suggests that the individuals may have local experience with groundwater contamination it did not play a significant role in the willingness to pay. This maybe due to a number of factors. First, the individuals may not know that they live close to a source of groundwater contamination and thus this has no effect on their WTP. The Pearson correlation coefficient between EXPOSED and SOURCES is 0.09 which was significantly greater than zero at the 1% level of significance. The small positive correlation provides evidence that individuals had some awareness of local sources of groundwater contamination.

Second, they may know that they live close to a contamination source, yet their willingness to pay to cleanup, given that they have this information, is not significantly different from those people only dealing with this as a purely hypothetical issue. If so, this provides significant validation of the completeness of the information presented to people in the hypothetical condition.

Third, they may know they live near groundwater contamination yet still be treating the survey as a hypothetical exercise in the same vein as

other respondents to the survey. This also provides support for the contingent valuation method because individuals are able to considerthe scenario presented in the survey without interpreting it in terms of their own circumstances.

The a value of 0.15 suggests a skew in the errors approaching a log distribution. The skew of the untransformed REDWTP of 10.23 (with Kurtosis = 142.63) indicates a strongly rightward skewed distribution with a thicker right tail than a normal distribution. The residuals from the linear regression on the untransformed REDWTP have a skew of 9.32 (Kurtosis = 124.23). As discussed above the skew on the residuals of the linear model indicate that the BOX-COX transformation is an appropriate econometric method to deal with large outlying bids without resorting to arbitrary trimming of the right hand tail. The skew of the residuals from the regression on the BOX-COX transformed dependent variable was 0.29 (with Kurtosis = 1.39).

Interpretation of the coefficients in the linear functional form is straightforward for the continuous variables such as age or income. For instance, the coefficient of 0.052 on income suggests that as income increases by $1.000 we would expect that the individual's willingness to pay for the complete groundwater cleanup program would increase by about 5¢. The same linear interpretation does not hold for the coefficients in the Box-Cox transformation and thus the coefficients are not directly comparable between the two regressions.

Using the BOX-COX transformation, predicted values for WTP were estimated for each individual based on the transformation. The mean predicted WTP from the Box-Cox transformation, $7.01. can be viewed as an appropriate value for policy purposes if all error is assumed to be

measurement error. The mean value of REDWTP of $11.58 can be considered an upper bound for policy purposes.

One additional question is the functional form of the WTP equation implied by the BOX-COX transformation which attempts to correct for a skewed error distribution. To address this issue we reestimated the Box-Cox model with the addition of squared terms for all significant variables. The mean of the predicted values in this case was $6.86 (as opposed to $7.01) and the Box-Cox coefficient was .13 (rather than .15). Thus, the impact of using a more flexible fictional form for WTP was fairly small.

TABLE 7.6: LINEAR REGRESSION ON UNTRANSFORMED REDWTP

Analysis of Variance

Source	DF	sum of Squares	Mean Square	F Value	Prob>F
Model	25	73000.37173	2920.01487	5.699	0.0001
Error	1957	1002691.0502	512.36129292		
C Total	1982	1075691.422			

Root MSE	22.63540	R-square	0.0679
Dep Mean	11.70280	Adj R-sq	0.0560
C.V.	193.41868		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for HO: Parameter-0	Prob > |T|
INTERCEP	1	-6.763461	5.64874322	-1.197	0.2313
INCOMEVD	1	0.052187	0.01680193	3.106	0.0019
KIDS	1	-0.721015	1.20841415	-0.597	0.5508
AGE	1	-0.032784	0.03898204	-0.841	0.4005
WHITE	1	-4.483774	1.78162471	-2.517	0.0119
EDUC	1	0.274099	0.31431016	0.872	0.3833
GENDER	1	1.063677	1.16045964	0.917	0.3595
NORTHEAS	1	2.082240	2.93395747	0.710	0.4780
NEwYoRK	1	5.299471	2.66018878	1.992	0.0465
MIDATLAN	1	1.455949	2.59242466	0.562	0.5744
SOUTH	1	-0.704027	2.45371442	-0.287	0.7742
LAKES	1	1.429176	2.36324675	0.605	0.5454
SOUTHWES	1	0.344791	2.65311797	0.130	0.8966
MOUNTAIN	1	2.294621	3.20595526	0.716	0.4742
WEST	1	-1.186594	2.78602501	-0.426	0.6702
NORTHWES	1	-0.618157	3.16203331	-0.195	0.8450
LANDFILL	1	-1.744474	1.26009156	-1.384	0.1664
EXPOSED	1	-0.506656	0.87579951	-0.579	0.5630
USE	1	0.632029	1.07223918	0.589	0.5556
SOURCES	1	0.912289	0.48909623	1.865	0.0623
RECYCLES	1	0.166939	0.25356772	0.658	0.5104
OTHENV	1	-0.931303	0.68753063	-1.355	0.1757
GRNDWTR	1	1.019863	0.53051013	1.922	0.0547
COMPLETE	1	0.831090	0.30137190	2.758	0.0059
MEANNCOM	1	0.3752S1	0.46932833	0.800	0.4240
RESPONS	1	2.191863	0.33355416	6.571	0.0001

TABLE 7.7: LINEAR REGRESSION ON BOX-COX TRANSFORMATION OF REDWTP (a= 0.15)

Analysis of Variance

Source	DF	sum of Squares	Mean Square	F Value	Prob>F
Model	25	29051.93129	1162.07725	34.272	0.0001
Error	1957	66357.51024	33.90777		
C Total	1982	95409.44153			

Root MSE	5.82304	R-square	0.3045
Dep Mean	6.90664	Adj R-sq	0.2956
C.V.	84.31072		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for HO: Parameter-O	Prob > |T|
INTERCEP	1	-5.832276	1.45315957	-4.014	0.0001
INCOMEVD	1	0.026445	0.00432236	6.118	0.0001
KIDS	1	0.016927	0.31086890	0.054	0.9566
AGE	1	-0.040563	0.01002827	-4.045	0.0001
WHITE	1	0.776703	0.45832938	1.695	0.0903
EDuc	1	0.382580	0.08085742	4.732	0.0001
GENDER	1	0.100170	0.29853243	0.336	0.7373
NORTHEAS	1	-0.352492	0.75477114	-0.467	0.6405
NEwYoRK	1	0.938023	0.68434316	1.371	0.1706
MIDATLAN	1	0.453276	0.66691059	0.680	0.4968
SOUTH	1	-1.129931	0.63122688	-1.790	0.0736
LAKES	1	0.151642	0.60795375	0.249	0.8031
SOUTHWES	1	-0.706929	0.68252417	-1.036	0.3004
MOUNTAIN	1	0.320851	0.82474355	0.389	0.6973
WEST	1	-0.195098	0.71671498	-0.272	0.7855
NORTHWES	1	-0.043883	0.81344447	-0.054	0.9570
LANDFILL	1	-0.545102	0.32416310	-1.682	0.0928
EXPOSED	1	-0.229042	0.22530258	-1.020	0.3078
USE	1	0.850450	0.27583740	3.083	0.0021
SOURCES	1	0.424435	0.12582177	3.373	0.0008
RECYCLES	1	0.085447	0.06523121	1.310	0.1904
OTHENV	1	-0.606282	0.17686973	-3.428	0.0006
GRNDWTR	1	0.469827	0.13647564	3.443	0.0006
COMPLETE	1	0.358245	0.07752901	4.621	0.0001
MEANNCOM	1	0.223914	0.12073641	1.855	0.0638
RESPONS	1	1.592300	0.08580801	18.557	0.0001

Variable	Label	N	Mean	Std Dev
REDWTP	reduced wtp	2315	11.5783585	25.9979281
PREDWTP	pred in dollars	1983	7.0077342	5.2925489

7.4 Components of Total Value for Complete Cleanup

Question 14 asked individuals to indicate how much of their willingness to pay just for the stated groundwater cleanup program they would allocate to different components. "THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE we label USEVAL. This is a use value that would directly enter the household utility function as a consumed commodity. "THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE we have labelled ALTRUIST for altruistic value. This is essentially a non-use value for the household but households exhibit interdependent utility functions. The household gains value by knowing that other households gain value through having clean water to use. "THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE" we label BEQUEST value. Interdependent utility also exists between generations, so the present generation gains value in knowing that future generations have water to use. This is not a use value&K current households and is categorized as a bequest value in the economic literature. 'THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT' we label EXIST value. This is non-use value and fits accepted definitions of an existence value.

A limited number of people incompletely assigned percentage splits to these values. Forty eight people had percentages summing over 100%. Of these, 17 put 100% for all four of the values. Fourty-eight people entered 0 in at least one of the four spaces but did not enter a positive percent in any of the spaces (27 people entered 0 in all four spaces). A number of people did not enter values adding up to 100%. To account for these discrepancies

we normalized the percentages for the allocation of values to sum to 100%. For individuals entering '0' in all four slots we set their percentages as missing values and they were excluded from the calculation of the mean percentage splits. Of the 2090 individuals who entered a non-zero value for at least one of the component values, 1856 (88.8%) entered values that summed to 100% prior to normalization.

There was no significant difference in the allocation of percents to different components by region. There was no effect of survey version on either the component values ($t(1853) = 1.13$, n.s.) nor on percentage splits ($t(1878) = 0.95$, n.s.). Table 7.8 shows the means of the normalized percent splits by component.

TABLE 7.8: PER CENT SPLITS BY COMPONENT (N=2090)
(MEAN NORMALIZED %ALLOCATED TO COMPONENT)

	MEAN	STD DEV	MINIMUM	MAXIMUM
OWNUSE (USEVAL)	**35. 19%**	**26.26**	0	100
COMMUN (ALTRUIST)	20.61%	17.84	0	100
FUTURE (BEQUEST)	25.01%	23.70	0	100
NOUSE (EXIST)	19.20%	28.22	0	100

Table 7.9 shows the means of the component values for the respondents derived from the REDWTP, their stated bids. These means were calculated for each individual by multiplying the REDWTP by the normalized percentage for each component and then taking the means for the component The data shown are for the 1742 individuals for whom we could calculate such component values for both the REDWTP and for the predicted WTP following the Box-Cox transformation.

TABLE 7.9: COMPONENT VALUES OF REDUCED WTP (UPPER BOUND)

VALUE	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	4.20	10.03	0	200.40	1742
ALTRUIST	2.45	6.62	0	200.00	1742
BEQUEST	3.35	12.50	0	400.00	1742
EXIST	2.35	6.40	0	75.00	1742
TOTAL (REDWTP)	12.35	22.05	0	400.00	1742

The same procedure was followed to calculate the appropriate values for the component values under an assumption of all error being measurement error. Following the Box-Cox transformation the predicted total willingness to pay was multiplied by the normalized percentages for components for each individual. The means of these individual component values are presented in Table 7.10. As stated above, these are calculated using the same individuals for whom information was available for all component value calculations.

TABLE 7.10: COMPONENT VALUES FROM PREDICTED WTP (LOWER VALUE)

VALUE	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	2.43	2.52	0	23.05	1742
ALTRUIST	1.49	1.71	0	16.03	1742
BEQUEST	1.96	2.86	0	54.17	1742
EXIST	1.52	3.08	0	29.76	1742
TOTAL (DPRED)	7.40	5.31	0.20	54.17	1742

The sum of the non-use values, BEQUEST and EXIST comprise roughly 40% of the total value individuals place on groundwater cleanup for the scenario provided. How these values may differ in alternative

circumstances is discussed below in the section on three alternative approaches to measuring non-use values.

7.5 Alternative Programs

It is entirely possible that a complete cleanup program as described in the hypothetical scenario would not be possible in actual situations where groundwater contamination has occurred. Such an extensive cleanup maybe either technically impossible or may be prohibitively expensive making it necessary to consider less comprehensive alternatives. Two variants of the survey elicited willingness to pay for alternative programs.

Version A considered willingness to pay for a containment program. In this alternative the groundwater contamination is contained within a limited area by a series of wells in the area to which the contamination was moving. If this program were undertaken the households would have the same quantity of usable water because new, unpolluted, wells would be drilled to replace contaminated wells. Respondents were asked how much they would be willing to pay for such a containment program as a per cent of how much they were willing to pay for complete cleanup. In addition to providing water for use such a program may include values for preventing further groundwater contamination. As stated in the valuation question for this option "This approach does not completely clean up existing contaminated groundwater. It prevents the spread of contamination and will require new wells to be drilled outside of the containment zone." Thus, this option will include use values but is expected to include only some non-use (bequest and existence) values.

Version C considered a public water treatment program. In this alternative hte local government would build and maintain a water treatment plant to remove contaminants from the water supply prior to the water entering the water distribution system. The underground contamination would not be cleaned up or controlled. Respondents were asked how much they would be willing to pay for such a public water treatment program as a per cent of how much they were willing to pay for complete cleanup. As this approach would only assure a clean supply of water for current use it is reasonable to believe that values for this program are primarily for use and altruistic values. There maybe some degree of bequest value if individuals feel that the capital equipment for a water treatment plant is passed on to future generations leaving them primarily with operating, replacement snd maintenance costs for future use.

Two other alternative programs were outlined in the survey but variants to determine WTP for these alternatives were not developed. In the home treatment (HOMETRT) alternative individual households would buy and install their own charcoal filtration systems. In the water rationing (RATION) alternative the local government would institute a water rationing system to reduce water use by the 40% shortage caused by groundwater contamination. Individuals in all versions of the survey were asked to rate how satisfied they are with each alternative on a scale of one to seven with 1 = NOT SATISFIED AT ALL and 7 = EXTREMELY SATISFIED. The mean response to these alternative programs is listed in the Table 7.11.

Within subjects tests show that the complete cleanup is valued more than the containment program (REDWTP > CONTWTP: $t(403) = 12.21$, $p < 0.0001$) and the complete cleanup is more highly valued than the public treatment program (REDWTP > PUBWTP: $t(399) = 6.14$, $p < 0.0001$). As

the containment and public treatment valuation options did not occur together in any of the survey versions it is not possible to perform a within subjects test of the valuation of the containment and public treatment programs.

TABLE 7.11: RANKINGS OF ALTERNATIVE PROGRAMS

PROGRAM	- LEVEL OF SATISFACTION	MEAN WTP (RAW DATA)
COMPLETE	4.35 n = 2566	11.70 n = 1983
PUBLTRT	3.74 n = 2561	7.98 n = 400
CONTAIN	3.45 n = 2554	5.96 n = 404
HOMETRT	2.81 n = 2586	N.A.
RATION	2.51 n = 2591	N.A.

The ranking of programs by the mean level of satisfaction corresponds to the ranking of the programs by willingness to pay. In such an ordering complete cleanup would be the most preferred followed by public treatment and then containment. Testing for the difference in mean ranking of public treatment versus containment there is not a statistically significant difference ($t(803) = 1.22$, ns). *A priori* we expect the containment program to be preferred to the public treatment program as it ensures continued clean water supply in addition to controlling the contamination underground. Public treatment does nothing for underground water pollution. A plausible explanation for the apparent preference of public treatment over containment is that individuals may not believe that the containment option redly solves the problem of contaminated groundwater since it requires continuing operation over time. It is likely that individuals

find the public treatment scenario more "understandable" as they quite likely receive water from such a system.

The raw mean of willingness to pay for the containment program for the regression sample, $6.38, was about 55% of the willingness to pay for the complete cleanup program. The mean predicted value for. containment of $3.95 is 56% of the mean predicted WTP for complete groundwater cleanup ($7.01). The lower values for containment probably reflect the desire of individuals as revealed in the initial verbal protocols to have a complete, once and for all, solution to the problem. This also corresponds almost exactly with the percent splits identified previously where use values comprised 56% of the value stated for complete groundwater cleanup. This scenario does not clean up the currently contaminated groundwater, but only protects the groundwater surrounding the area from future contamination. The lower values for containment suggest that individuals acted as if this scenario does not induce bequest or existence values, as we expected ***a priori.***

The raw mean willingness to pay for the regression sample for the containment program of $6.38 provides an upper bound and the mean of the percent adjustments applied to the predicted values following the Box-Cox transformation of $3.95 provides an appropriate estimation of willingness to pay for such a program for policy purposes if the assumption is made that all error is measurement error.

The mean willingness to pay for the public treatment option is $7.18 and the mean WTP following applying the percent adjustment to predicted values from the Box-Cox transformation is $4.02. These are 61% and 58% respectively of the mean reduced willingness to pay and the mean predicted willingness to pay for complete groundwater cleanup. AS before these are

upper bounds and appropriate estimates depending on the degree of model error versus measurement error which can not be known *a priori*. These willingness to pay values are higher than the values for containment and lower than for complete cleanup as discussed previously.

The value for public treatment can be regarded as a use value since the source of groundwater contamination is not dealt with in this option. The groundwater problem is left for future generations as this option merely provides treatment for current water use to prevent any shortage in current water supply. In relation to our earlier classifications of value into use, altruistic, bequest and existence, the public treatment program clearly includes use value. The public treatment program would likely include some value for other households in the community for current use which we have labelled altruistic value. Future generations are described as having to pay for themselves, so this value likely does not include bequest value unless. respondents place a bequest value on providing durable capital equipment in the form of the water treatment plant to future generations. It is reasonable to argue that public treatment does not include an existence value as the source of groundwater contamination is not dealt with nor is currently contaminated groundwater cleaned up unless it is pumped for use.

7.6 National Groundwater Cleanup

Versions B and E of the survey contained a section dealing with the "National Groundwater Problem." In both versions subjects were asked how much they were willing to pay to help fund complete groundwater cleanup In other communities across the nation. In Version B subjects Were given information regarding the national extent of groundwater contamination and

it was emphasized that such funds would supplement money from local finds for groundwater cleanup. Version E did not provide the information on the number of people affected by groundwater contamination, how much groundwater supplies for domestic water use or ask how likely the individual felt it was that he or she would move to a different community. Version E also did not emphasize that the money they "contributed" would be supplemental to local programs in communities which did not choose to pay for complete groundwater cleanup. Given these differences, Version B is labelled the "FULL CONTEXT' version and Version E the "NO CONTEXT" version of the national willingness to pay question.

Version B, which contained the full context national groundwater question. was also the version used for over-sampling areas known to have groundwater contamination problems as described earlier (see Section 7.3 on complete groundwater cleanup). For data analysis, this stratified random sample for the national survey variant is referred to as Version F or the full context-oversimple version.

Table 7.12 shows the mean willingness to pay for groundwater cleanup by context and by version. The untransformed mean is shown in the second column and the predicted mean following the adjustment to the predicted WTP from the Box-Cox transformation is shown in the third column. The no context and full context means are shown and then the full context versions are split between the random full context (Version B) and the oversimple of areas with contaminated sites (Version F).

Within subjects tests showed that individuals valued the complete cleanup of the local groundwater contamination significantly higher than helping clean up the national groundwater problem (REDWTP > NATWTP: $t(1018) = 13.37$, $p < 0.001$) as would be expected.

TABLE 7.12 NATIONAL WTP BY CONTEXT VS. NO-CONTEXT
CONTEXT DIVIDED INTO RANDOM SAMPLE AND OVER—SAMPLE

	MEAN (std. dev.) n = sample	PREDICTED MEAN (std. dev.) n = sample
NO CONTEXT (VERSION E)	2.67 (10.27) **n** = 393	1.34 (2.46) n = 343
FULL CONTEXT (VERSIONS B & F)	2.03 (7.55) n= 626	1.13 (2.31) n = 542
RANDOM SAMPLE (VERS1ON B)	1.97 (7.25) n = 401	1.19 (2.41) n = 348
OVER SAMPLE (VERSION F)	2.15 (8.06) n = 225	1.02 (2.11) n = 194

Although the raw WTP dropped by almost 24% from the no context to the full context versions, the difference between the means is not statistically significant at the 5% level ($t(655.6) = 1.06$, ns). The variance has also fallen from the no context to full context version and is statistically significant ($F(392,625) = 1.85$, $p < .01$).

Following the valuation question, an allocation question was asked to determine how individuals constructed their WTP for solving the national groundwater problem. The categories correspond to the USE, ALTRUIST, BEQUEST and EXIST categories used for decomposing the willingness to pay for local groundwater cleanup. In this component allocation question a category was also added for "OTHER". The primary difference in these categories is that use value is contingent on the individual moving to another community. Use value will therefore incorporate a degree of risk

assessment in terms of whether the individual feels he or she will ever move to another community and if so how likely that community would have contaminated groundwater. It seems likely that an individual will choose to move to a community without groundwater contamination given the option and thus may have a very small use value component for helping to clean up the national groundwater contamination problem.

Table 7.13 shows the variables specific to the national groundwater versions. The third and fourth columns indicate the questton number by survey version (Versions B and F are identical).

AS with the component breakdowns for the complete cleanup scenario, the percentages for the component values are normalized. This normalization was undertaken to make the sum of the percents equal to 100%. For individuals who did not enter a value in some components, but did in others, their missing values were set to zero. After setting missing values to zeros the component values were normalized to sum to 100%. Individuals who entered zero in all components were deleted from the calculation of mean component values. Of the 1239 respondents for the national value sections 743 provided some positive value for the component breakdown question allowing us to normalize their percent splits. Four hundred and forty five of these (60%) required no normalization (correctly summed their percentages to 100%). Two individuals entered 100% for all five component values.

The mean component splits are shown in Table 7.14 for the no context version and in Table 7.15 for the full context versions. There was not a significant difference between the regions in terms of component values for willingness to pay for national groundwater cleanup. Of the 743

TABLE 7.13: ADDITIONAL VARIABLES IN THE NATIONAL SURVEY

VARIABLE	EXPLANATION	QUESTION (version B & Version F)	QUESTION (VERSION E)
NATIONAL	% of REDWTP for national groundwater cleanup program	917	916
MOVE	Asked how likely individual would move in the next ten years (1 = not likely 7 = certain) (not asked in Version E)	916	not asked
DIFFCOMM	Use value - own use value if individuals moved to a different community	Q18	917
OTHPPLE	Altruistic value (other people in community)	Q18	917
FUTURGEN	Bequest value (future generations)	918	Q17
NONUSENL	Existence value (non-use - national)	918	917
0THER2	Other uses	Q18	Q17
NATLRESP	How responsible individual feels for helping to clean up national problem (1= not at all 7 = extremely)	Q19	Q18

surveys which indicated component values allowing these calculations, 446 were from the full context versions (293 from the random sample Version B and 153 from the over-sample Version F) and 297 were from Version E, the no-context version.

TABLE 7.14: NORMALIZED COMPONENT PERCENTS NO CONTEXT VERSION

	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	29.95	26.32	0	100	297
ALTRUIST	20.37	19.18	0	100	297
BEQUEST	26.18	25.07	0	100	297
EXIST	19.00	27.27	0	100	297
OTHER	4.48	17.72	0	100	297

TABLE 7.15: NORMALIZED COMPONENT PERCENTS CONTEXT VERSIONS

	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	32.98	28.61	0	100	446
ALTRUIST	20.35	18.65	0	100	446
BEQUEST	26.36	24.76	0	100	446
EXIST	18.49	26.98	0	100	446
OTHER	1.82	9.93	0	100	446

Testing for the effect of context on component allocation in the national willingness to pay showed no significant difference in mean percent by component except for the category OTHER where the mean allocated to OTHER in the no context version is higher than in the context version ($t(741) = 2.6134$. $p < 0.009$). This maybe a reflection of the uncertainty that individuals face in the no context version of determining how they are construction their valuations. It is interesting to note that the distribution of component values for the national groundwater program is roughly the same as the distribution of component values for the complete groundwater cleanup program (see Table 7.8). Even though the component breakdown for the complete cleanup did not include the category "OTHER" the similarity in the distributions suggests that individuals maybe constructing their values for national groundwater cleanup under the assumption that they may be living in diffent areas wen If they indicated that they do not expect to move. Otherwise the use potions of the national component allocation would be expected to be much smaller.

Tables 7.16 and 7.17, respectively, present the upper bound and lower willingness to pay for the national groundwater cleanup program calculated from the component breakdowns shown above. The upper bound is

calculated from the untransformed willingness to pay and the lower WTP from the predicted willingness to pay following the regression using the Box-Cox transformation under the assumption of all error being measurement error. These values are shown for all survey versions combined.

TABLE 7.16: COMPONENT VALUES OF NATIONAL WTP (UPPER BOUND) ALL VERSIONS

VALUE	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	0.82	2.88	0	43.84	675
ALTRUIST	0.63	2.08	0	-25.00	675
BEQUEST	1.16	7.32	0	150.30	675
EXISTENCE	0.70	2.59	0	37.50	675
OTHER	0.06	0.56	0	10.00	675
TOTAL	2.28	8.70	0	150.30	1019

TABLE 7.17: COMPONENT VALUES OF NATIONAL WTP (LOWER VALUE) ALL VERSIONS

VALUE	MEAN	STD DEV	MINIMUM	MAXIMUM	N
USE	0.43	0.83	0	6.98	613
ALTRUIST	0.34	0.65	0	5.72	613
BEQUEST	0.52	1.42	0	20.34	613
EXISTENCE	0.36	0.95	0	9.93	613
OTHER	0.04	0.25	0	3.31	613
TOTAL	1.21	2.37	0	27.12	885

The MOVE question asked how likely it was that the individual would move In the next ten years (1 = not likely, 7 = certain). We would anticipate that individuals would be willing to pay more to solve a national problem if they expected to move in the next ten years to a location than if they were strongly attached to their own locality. The mean response to this question was 2.95 (Std. dev.= 2.21) for the 729 individuals who answered suggesting that for the most part individuals did not see that it was very likely they

would be moving to another community much less one with contaminated groundwater.

Individuals were also asked how responsible they felt for cleaning up groundwater contamination problems in other communities. This questton corresponds to the RESPONS question on local complete groundwater cleanup. As with the MOVE variable the NATLRESP (national responsibility) was a 1 to 7 ranking with 1 meaning “NOT AT ALL RESPONSIBLE” and 7 meaning "EXTREMELY RESPONSIBLE". The mean value of 2.59 (std. dev. 1.59, n = 1168) for national responsibility suggests that individuals did not consider themselves responsible for helping to clean up groundwater pollution in communities other than their own. The mean for the similar responsibility question for local groundwater cleanup was 4.15 (std. 1.79, n = 2547). This difference probably reflects in part the difference in scenarios offered the individuals. In the local groundwater contamination the respondents are specifically told that their landfill polluted their water supply. In the national full context version individuals are being asked to help pay for other communities to clean up their groundwater above and beyond what the people in that other community are willing to pay. NATLRESP was not significantly different between the no context and full context versions of the survey ($t(1\ 166) = 0.212$, ns).

It is interesting to note the positive correlation between how likely the individual feels he or she will move to another community in the next ten years (MOVE) and the feeling of national responsibility (NA’’P). The Pearson Correlation Coefficient between these variables IS 0.21 which is significantly greater than zero at the 0.001 level of significance (707 df). NATLRESP is also positively and significantly related to predicted national willingness to pay (Pearson Correlation Coefficient of 0.49, significantly

greater than zero at 0.001.877 df). The correlation between MOVE and NATLWTP was not significant at the5% level (r = 0.07, 538 df, p < 0.10). These correlations suggest that values for cleaning up groundwater contamination outside of one's area is based on one's feelings of responsibility more so than the likelihood that they will move: yet their feelings of responsibility are closely related to the likelihood that they will move.

Additionally, it is interesting to note that NATLRESP is negatively correlated with the percent component allocation to use values (r = -0.19, 740 df, p < 0.001) and positively correlated with per cent component allocations to bequest value (r = 0.08, 740 df, p < 0.03) and positively correlated with the per cent component allocation to existence value (r = 0.14, 740 df, p < 0.001). Obviously, since the normalized percentages sum to 100, another variable cannot be positively correlated with all of the components. These correations do suggest though that values increase because of feelings of moral responsibility, which are more important for non-use values (bequest and existence values) than for use values (use and altruistic values).

7.7 Variations in Shortages of Supply

The base scenario presented in the survey was for a potential 40% shortage of water supply due to the groundwater contamination. Obviously, not all 'real world groundwater contamination situations will create a 40% shortage in the local water supply. Therefore Version D of the survey presented the respondents with alternative scenarios in which the percentage shortage of the water supplied was varied. The actual

groundwater contamination conditions are identical to the original scenario. Just the degree of reliance on groundwater sources for local water supply is varied. Individuals were asked to adjust their WTP bid from the 40% shortage scenario if they faced only a 10% shortfall in their water supply and then if they faced a 70% shortfall in their water supply in the same conditions as the original scenario. The percent stated adjustment to their bid was multiplied by their REDWTP and predicted reduced WTP to derive a willingness to pay if faced with a 10% or 70% water supply shortfall due to groundwater contamination.

Table 7.18 gives the raw means for WTP under the three different conditions. These means are calculated just for the group that completed Version D of the survey to make within subjects comparison between scenarios possible. Three hundred forty four individuals answered all of the relevant questions for Version D. The means presented in this table represent upper bound estimates of the willingness to pay.

TABLE 7.18: WTP AS A FUNCTION OF % WATER SHORTAGE
RAW MEANS (UPPER BOUND)

PERCENT SHORTAGE	WTP MEAN	STD DEV	MINIMUM	MAXIMUM	N
10	7.57	21.16	0	320.00	344
40	13.14	28.67	0	400.00	344
70	23.04	47.77	0	600.00	344

The Box-Cox predicted bid for each individual in the 40% scenario was multiplied by that individual's stated percentage adjustments to derive a lower value estimate of the respondents WTP when faced with the 10% and 70% shortage scenarios. Table 7.19 presents these lower value estimates.

TABLE 7.10 WTP AS A FUNCTION OF% WATER SHORTAGE
PREDICTED MEANS (LOWER VALUE)

PERCENT SHORTAGE	WTP MEAN	STD DEV	MINIMUM	MAXIMUM	N
10	3.96	4.42	0	29.76	344
40	7.19	5.19	0.35	29.76	344
70	13.37	12.75	0.35	76.82	344

It is possible that some error is present in these estimates because of an anchoring and adjustment process beginning from the first value obtained for the 40% shortage scenario. If this has occurred then the calculated WTP in the 10% scenario is likely to be higher than the true WTP and the WTP in the 70% scenario is likely to be lower than the true WTP.

7.8 Three Approaches to Estimating Non-Use Value

7.8.1 Introduction

In the preceding sections we have discussed the results of individual parts of the groundwater survey. In this section we analyze results from different versions of the survey, each of which provide estimates of non-use values using different conceptual approaches. The first approach uses the stated percentage splits allocating the WTP between different component values. The second approach considers the difference between willingness to pay for complete groundwater cleanup and willingness to pay for the public water treatment program. This difference is based on the different component values that make up the WTP in the two scenarios. The third approach extrapolates non-use value based on differences in WTP when faced with different levels of water shortage as examined in Version D.

7.8.2 Percentage Splits

The first approach is applicable to all survey versions as all versions included the basic willingness to pay question followed by the percentage splits question as discussed in Section 7.4. above. For this calculation the individual's predicted WTP is multiplied by each of his or her percentage splits for the components of total value (USE, BEQUEST. ALTRUIST and EXIST). The means of these are replicated below (see Section 7.4 above for a complete explanation).

TABLE 7.20: COMPONENT VALUE - MEAN PREDICTED WTP

VALUE	MEAN (UNTMNSFORMED)	MEAN (PREDICTED)
USE	4.20	2.43
ALTRUIST	2.45	1.49
BEQUEST	3.35	1.96
EXIST	2.35	1.52
TOTAL	12.35	7.40
SUM OF BEQUEST AND EXIST	**5.70**	**3.48**

The mean of the sum of the predicted bequest and existence values is $3.48 with a standard deviation of 3.97 for the 1742 individuals for whom this could be calculated. This number will be compared to the results from the other methods of calculating non-use values.

7.8.3 Scenario Differences

In this approach, each individual's predicted willingness to pay for the public treatment program is subtracted from the willingness to pay for complete groundwater cleanup. Since the public treatment program is expected to include primarily use values and altruistic values the difference

between complete cleanup and public treatment will be comprised mainly of bequest and existence values. This figure can be compared to the sum of the bequest and existence values from the percentage splits method as: WTP for Complete Cleanup minus WTP for Public Treatment ≅ Bequest + Existence Value. The mean estimate of the sum of bequest and existence values from the scenario differences approach is $2.81 with a standard deviation of 3.11. This was calculated for 349 individuals for whom the appropriate data were available. The maximum difference in these values was $19.38.

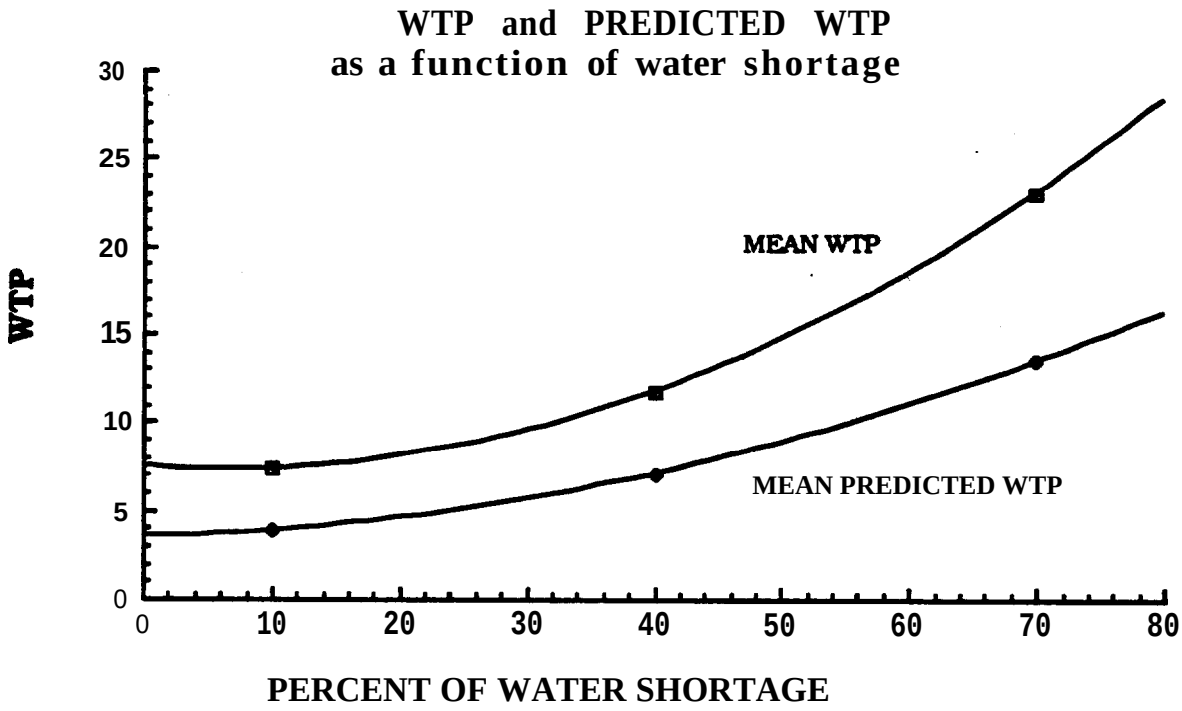
7.8.4 Extrapolation Approach

In this approach the individual's predicted willingness to pay for complete groundwater cleanup in the 40% shortage condition is multiplied by the stated percentage decrease or increase in willingness to pay in the 10% or 70% water shortage condition respectively. With three points indicating the relationship between the willingness to pay for complete groundwater cleanup and the degree of water shortage the individual faces, a second degree polynomial can be fitted. The intercept of this polynomial, where the individual faces no water shortage, will indicate the willingness to pay for water cleanup for purposes other than use, i.e., non-use values. As other individuals in this situation also do not face a water shortfall, this value will be comprised of bequest and existence values only.

As discussed in Chapter VI, the level of water shortage has a statistically significant effect on the WTP for groundwater cleanup. WTP values do increase as the level of water shortage increases ($t(387) = 9.91$, $p < 0.001$). Testing for slope changes is also significant. The slope of between 10 and 40 percent is less than the slope between 40 and 70 percent shortage indicatig a quadratic function ($t(387) = 3.83$, $p < 0.001$).

Figure 7.1 charts the three WTP figures based on different levels of water shortage for both the raw means and the predicted means as derived in the previous section.

FIGURE 7.1: MEAN WTP AS A FUNCTION OF % OF WATER SHORTAGE



Second degree polynomials in the percent water shortage were fitted to each individual's predicted values for a 10%, 40%, and 70% shortage. The constant term for each individual provides an estimate of non-use value since any residual value when use is zero should comprise non-use values. For the 344 predicted value derived from the Box-Cox transformation the mean of these individual intercepts is $3.54(standard deviation $5.86).

7.8.5 Summary

Table 7.21 summarizes the three methods of estimating non-use values for groundwater. The numbers shown are the lower value results as derived above. The data shown for the percent splits approach is for the respondents who did not answer either the public water treatment version (C) or the different degrees of shortage version (D) so that comparisons may be made between groups. The mean and standard deviation for the percent splits approach excluding these other Individuals is virtually identical to that if they are Included (see Table 7.20).

TABLE 7.21: COMPARISON OF DIFFERENT APPROACHES TO ESTIMATING NON-USE VALUES (for predicted values)

METHOD	BEQUEST PLUS EXISTENCE	STANDARD DEVIATION	N
PERCENT SPLITS	3.49	3.97	1126
SCENARIO DIFFERENCES	2.81	3.11	345
EXTRAPOLATION	3.54	5.86	344

The percent splits approach and the extrapolation approach are not statistically different yet the scenario difference approach is less than the other two (Tukey's Studentized Range, a = .05, df = 1812). The lower value for the scenario difference approach is expected if individuals are placing a bequest value on the capital equipment for the public water treatment option. If this occurs the scenario difference approach would be canceling some portion of bequest values and would understate the non-use value total of bequest and existence values.

Three different approaches haveexamined non-use values in this survey. For the specific contingent valuation question at hand these

approaches have produced remarkably similar quantitative estimates for non-use values of an exotic commodity. While these values are not exceptionally large they are significantly larger than zero indicating that non-use values are likely to be a valid component of the valuation of such a commodity.

7.9 Conclusion

This chapter has considered the implications of the data from the groundwater survey in terms of individual's willingness to pay for cleanup of contaminated groundwater under a variety of scenarios. Regressions on the reduced willingness to pay for complete groundwater cleanup seine as the basis for the values for alternative scenarios. Using the untransformed reduced WTP as an upper bound estimate and the predicted WTP from the regression using the Box-Cox transformation as a lower value estimate provides a range of valuations for policy purposes. The Box-Cox transformation deals with outliers without arbitrary trimming and significantly increase the explanatory power of the regression (R^2 of .30). The Box-Cox coefficient of 0.15 suggests the nearly log-normal distribution of the errors as seen in other work as discussed in Chapter III.

The regressions showed several socio-demographic and regional variables to be significant in explaining willingness to pay, including income, age and education in the regression using Box-Cox transformation. In addition to these variables, the RESPONS variable is significant in both the untransformed and Box-Cox transformation regression, with t values of 6.57 and 18.56 respectively. The importance of this variable in explaining willingness to pay must be emphasized and requires considerable attention

in future research. The interpretation and availability of such a variable in policy analysis are questions yet to be dealt with.

This chapter also brought together three different methods for estimating non-use values. The percent splits approach, scenario difference approach and extrapolation approach provide remarkably internally consistent estimates of non-use values. Such internal consistency both supports the validity of contingent valuation methodology and of each approach individually for estimating non-use values.

Chapter VIII

Conclusions

Several general conclusions can be drawn from the study:

1. Consistent estimate of non-use values were obtained. 2. The strategy of reducing the length of the perfect infromation/full context survey through use of self reports appears to have been successful. 3. The mean of the national sample was very similar to the mean of the Denver samples used in pretesting. This suggests that a strategy of obtaining better values from a smaller number of people using a perfect information/complete context instrument may be desirable. In other words, the national survey may have added little to our knowledge of benefits. 4. However, the national survey produced a large enough data set to estimate econometric models predicting values. This allows use of the Box-Cox procedure to correct for a skewed error distribution. A national sample also maybe needed to estimate regional variations in values. 5. More complex Issues than groundwater cleanup may require more information than a mail survey can present. Door to door surveys or use of market research centers around the country in which respondents can be presented with a nearly unlimited amount of information and context (since they are paid) can provide national data sets in such cases. The expense of these approaches is of serious concern. However, where programs potentially costing hundreds of billions

of dollars are at issue, costs of obtaining informed values are trivial by comparison.

Some problems remain unresolved with this study:

1. Although respondents in pretesting seemed comfortable with the notion that the water supply in their own community had been contaminated by their own landfill so that this hypothetical community represented the relevant market area. early attempts by Industrial Economics Inc. to apply this definition of "market area" for estimating benefits of corrective action have proven difficult. For example, water districts often encompass larger areas than individuals might assume to comprise their own community. Thus, additional research into the appropriate market area would be highly desirable. Note that the estimates of national non-use values per household were quite small with a modal value of zero. Thus, non-use values most likely fall off rapidly with distance. Estimation of the appropriate market area could be accomplished in the short run by using small Denver pm-test samples wherein distance to the contaminated groundwater source could be varied in different versions of the existing survey instrument. Other attributes such as extent of the water district, whether the community's own landfill (or some other source) caused the contamination could also be tested. Similarly, a variation in the size of the contaminated area and the speed at which decontamination occurs (very recent evidence suggests that it may take 30 or more years to decontaminate some aquifers) may be important issues to explore. Since the Denver pretest results were so similar to the national values, these issues could be addressed at relatively low cost using the market research center approach described above.

2. As noted above. national non-use values had a modal value of zero (see chapter 6). Many valid zero bids were also obtained from the containment scenario. Containment may be of great importance since complete cleanup often appears to be infeasible. Where a large numberof valid zero bids are present the Box-Cox procedure developed to account for measurement error fails to be an appropriate model. As a result we applied the reported adjustments by respondents (fraction of value of the complete cleanup value allocated to national or containment scenarios) to obtain estimates of national and containment values. The data suggest, however, that these reported adjustments themselves may show a skewed error distribution even though they were applied to the predicted values which were corrected for skewed error in the values obtained for complete cleanup. It maybe more appropriate to use the adjusted raw values for national and containment scenarios (as shown in Chapter 6) directly and develop an appropriate statistical model which allows for a skewed error distribution and true zero bids. Appendix E describes the development of such an econometric model which we hope to employ in future research.

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APPENDIX A

SURVEY INSTRUMENT FOR OCTOBER 1990 PRETEST

Initials: _____

I. THE ISSUES

We are interested in your opinion about water use and potential groundwater contamination. We need your answers to these questions to help make decisions about future groundwater programs.

Q-1 Have you read or heard anything about groundwater being contaminated somewhere in your state or somewhere in your own county, city, or community? (circle one)

1) NO
2) YES -- IN MY STATE
3) YES -- IN MY COUNTY, CITY, OR COMMUNITY
4) DON'T KNOW

Q-2 Have you read or heard about instances of' groundwater contamination in your county, city, or community coming from any of these specific sources? (Circle all that apply)

1. NO -- HAVENT HEARD
2. YES -- BUT CANT RECALL SPECIFIC SOURCE
3. YES -- SUPERFUND OR OTHER TOXIC OR HAZARDOUS WASTIE SITE
4. YES -- A PUBLIC LANDFILL
5. YES -- AGRICULTURAL APPLICATION OF PESTICIDES OR FERTILIZERS
6. YES -- SEPTIC TANKS
7. YES -- LEAKY UNDERGROUND STORAGE TANKS OR LAGOONS
8. YES -- A CHEMICAL SPILL
9. YES -- OTHER (please specify) _____

Q-3 How much do you agree or disagree with the following statement We should protect groundwater at all costs.

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

initials: _

II. PRELIMINARY EVALUATION

Now we are going to present you wtth a hypothetical situation in which part of a city's groundwater supply has been contaminated. and you will be asked to evaluate a particular response option. Later in the survey you will be given a lot of facts and information about groundwater which may or may not assist you in your evaluation. Right now. though. we would like to get a preliminary evaluation from you.

Note that the situation we are going to describe is completely hypothetical. It may differ considerably from your current water use situation and from the groundwater situation in your community. and so we would like you to imagine that you live in the city wtth the groundwater problem described and respond as if you were truly facing this situation.

Imagine your city currently gets 50% of its water from groundwater. You have been getting all of your water from the city's public water supply. Now. suppose it is discovered that over the years toxic chemicals from the municipal landfill have been slowly leaking into the water table and the city's groundwater supply is now contaminated. The contamination has been occurring for a number of years and la the result of standard landfill practices. The area of contamination is about 2 square miles and is away from residential areas.

Scientists believe that drinking the contaminated water increases the rtsk of cancer. They have estimated the level of rtsk to be about 10 additional deaths per million people who drink the water per year.

Q-4 How accurately do you believe scientists can estimate the health&k posed by toxic chemicals'?

NOT AT ALL ACCURATELY						EXTREMELY ACCURATELY
1	2	3	4	5	6	7

The city government decides that, due to the contamination. the groundwater cannot be used as it is. Further, your city's other sources of water have only a 50-50 chance of reliably maktng up the shortfall caused by the groundwater contamination. Thus, although the water supplied to you will remain safe, there is a 50-50 chance of a 50% shortfall in your community's water supply next year.

Q-5 Do you agree or disagree with the city's decision to prohibit use of the groundwater, given the level of health risk estimated by scientists?

1. AGREE
2. DISAGREE
3. NOT SURE

Suppose that your city proposes to pay for a complete groundwater treatment operation to remove all of the contamination in the groundwater right now. leaving no contamination for the future. All of the water at the contaminated groundwater site would be pumped Up from the water table as soon as possible and cleaned by charcoal filters, which trap the contaminants. This cleaned water would then be reinjected back into the water table and stored there for future use. once the possibility of future recontamination has been removed. This would be done by digging Up all of the contaminated soil under the landfill and placing it, as well as all of the material in the old landfill, into a new landfill wtth a sealed bottom liner and a waterproof cover on the top.

Initials: _____

Scientists are satisfied with the quality of drinking water in areas where these methods have been used. This option guarantees that the 50-50 chance of a 50% shortage caused by groundwater contamination is eliminated. In addition. contaminated water would never enter the public water supply and the groundwater in your city would no longer be contaminated and would be available for future use.

A referendum is proposed to the voters of your city which calls for an increase in local water bills to pay for the costs of pumping Up and cleaning the contaminated water and constructing the new landfill. The money generated could be used only to pay for the groundwater treatment program. If the referendum is passed, everyone would pay the higher rate in order to fund the treatment project. It is Important to note that this increase would continue indefinitely into the future until the project is finished. ***At the moment we don't know what the complete groundwater treatment program will cost, so we neeed to find out how much it is worth to people.***

Q-6 Would you consider voting for a referendum to support a permanent water bill increase which would go to funding a complete groundwater treatment operation to make up the potential 50% shortfall due to groundwater contamination, ***if the groundwater treatment could be guaranteed ?***

1. No → **Why?**

2. YES →

Q-7 What is the most your household would be willing to pay EACH MONTH on top of your current water bill before you would vote NO on COMPLETE GROUNDWATER TREATMENT? (Circle the best response.)

$.50	$1.50	$4	$10	$30	$75	$200	$500
$.75	$2	$5	$15	$40	$100	$300	MORE THAN $500
$1	$3	$8	$20	$50	$150	$400	DONT KNOW

The amount you indicate will tell us what it is really worth to your household to get this program If the needed groundwater treatment actually cost less than people are willing to pay. you would only have to pay what it would cost. If the groundwater treatment turned out to cost more than people are willing to pay, U would not be done.

initials: ____

III. WATER USE IN YOUR COMMUNITY AND YOUR HOME

Now we are going to present several sets of statements and questions which present information about groundwater, ask you to think about many aspects of water use issues, and ask you to evaluate several different response options. After these sections you will be asked to reconsider the preliminary evaluation of the COMPLETE GROUNDWATER TREATMENT program which you did in Section II. The first set of questions deals wtth water and groundwater use in your community.

Water for residential use can come from many different sources, including surface sources such as reservoirs or lakes and groundwater sources. Groundwater comes from precipitation that falls on the land surface and seeps underground. At some depth underground the soil or rock becomes saturated with water. Groundwater is extracted for human use by digging wells or taking water from naturally occurring springs.

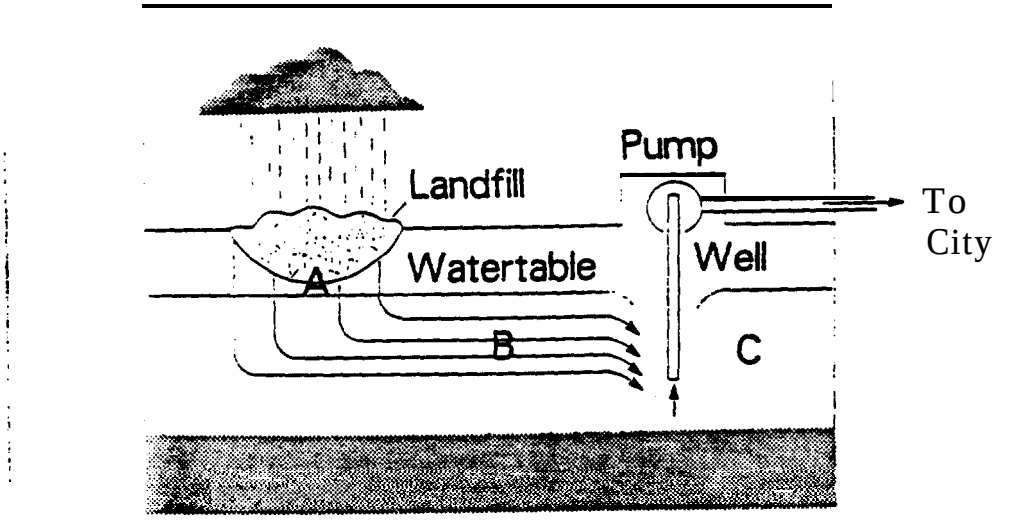
Q-8 Do you or people in your city or community get any part of your water for home use from groundwater?

1. NO --WE DONT USE GROUNDWATER
2. YES -- I USE GROUNDWATER IN MY HOME
3. YES -- SOME PEOPLE IN MY COMMUNITY USE GROUNDWATER BUT I DONT
4. DON-I' KNOW

Q-9 Often. garbage and waste placed in a community's landfill. similar to the one shownin diagram 1 below, can leak out and contaminate groundwater. Does your community have a local landfill?

1. NO
2. YES
3. DONT KNOW

DIAGRAM 1



initials: ____

When-rainwater seeps through garbage and waste. It dissolves some of the chemicals in the discarded trash. Gradually, this material. which la sometimes toxic. can seep tnto the water table and contaminate the water below, as A shows in diagram 1.

Q-10 Do YOU know if the water under your local landfill is contaminated?

1. NO
2. YES
3. NO-- WE DONT HAVE A LANDFILL
4. DONT KNOW

Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see Bin diagram 1). Many people are surprised to learn that the flow la very very slow; usually less than 100 feet per year. After many years, the landfill may eventually contaminate water drawn by a well (see C in diagram 1) which supplies water to the citizens of the community.

Q-11 Does your community currently draw water from wells which are in danger of becoming contaminated?

1. NO
2. YES
3. DON'T KNOW

Because groundwater moves very slowly, the area contaminated by a specific source is usually small, on the order of a square mile or two. Larger areas may be contaminated only if there are multiple sources or if the source is a widespread land-use practice such as agricultural application of fertilizer or pesticides.

Q-12 Are you aware of anyspecific contaminants that are in groundwater that is currently used in your home or by people in your community?

1. NO
2, YES --IN MY HOME
(Please identify contaminant(s): _____)
3. YES --IN MY COMMUNITY
(Please identify contaminant(s): _____)

Q-13 Are you aware of any specific instances of groundwater tn your community that is no longer used because it is contaminated?

1. NO
2. YES (Please explain briefly)_____

_____

Q-14 Have your familuy or people in your community ever been bothered by any health problems which you believe have been caused or aggravated by groundwater contamination?

1. NO
2. YES -- MYSELF OR MY FAMILY
(Please identify problem(s): _____)
3. YES -- PEOPLE IN MY COMMUNITY
(Please identify problem(s): _____)

Initials: _____

Q-15 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY
2. A PRIVATE WATER SUPPLIER
3. OUR PRIVATE WELL -- SKIP TO QUESTION Q-22
4. OTHER (Pease specify) _____
5. DONT KNOW

Q-16 Has your community imposed voluntary or mandatory water use restrictions since you've lived there?

1. NO
2. YES -- VOLUNTARY
3. YES -- MANDATORY
4. DONT KNOW

Q-17 Does your household pay a water company or other supplier directly for the water used in your home?

1. NO → PLEASE GO TO QUESTION Q-21
2. YES ↓

Q-18 Are you the person who actually pays your households water bill?

1. NO
2. YES

Q-19 How frequently are you billed?

1. MONTHLY
2. QUARTERLY
3. ANNUALLY
4. OTHER (please specify) _____

Q-20 About how much is your average monthly water bill?

DURING THE SUMMER? $_____
DURING THE WINTER? $_____

PLEASE GO TO Q-22

Q-21 How much would you estimate the average household monthly water bill is in your community for people using the public water supply system?

$ _____

Q-22 Does your household normally use bottled water, trucked-in water, a water purifier, or any other specially treated water for drinking or cooking?

1. NO
2. YES

Initials: _____

IV. OPTION 1: BUYING WATER FROM ANOTHER CITY

Now you will begin to evaluate several responses a city might take instead of COMPLETE GROUNDWATER TREATMENT. For each of these evaluations the situation is identical except for the response option chosen by the city. That is. once again you should imagine that your city currently gets 50% of its water from streams and lakes and 50% d its water from groundwater. You have been getting all of your water from this public water supply. It is discovered that over the years tocix chemicals from the municipal landfill have been slowly leaking into the water table and the city's groundwater supply is now contaminated. The contamination has been occurring for a number of years and is the result of standard landfill practices. The area of contamination la about 2 square miles and la away from residential areas.

The level of risk is also the same as before: scientists believe that drinking the contaminated water increases the risk of cancer. They have estimated the level of risk to be about 10 additional deaths per million people who drink the water per year. You should note. however, that this is about the same level of risk a typical person has of developing cancer from exposure to medical x-rays (see f in diagram 2).

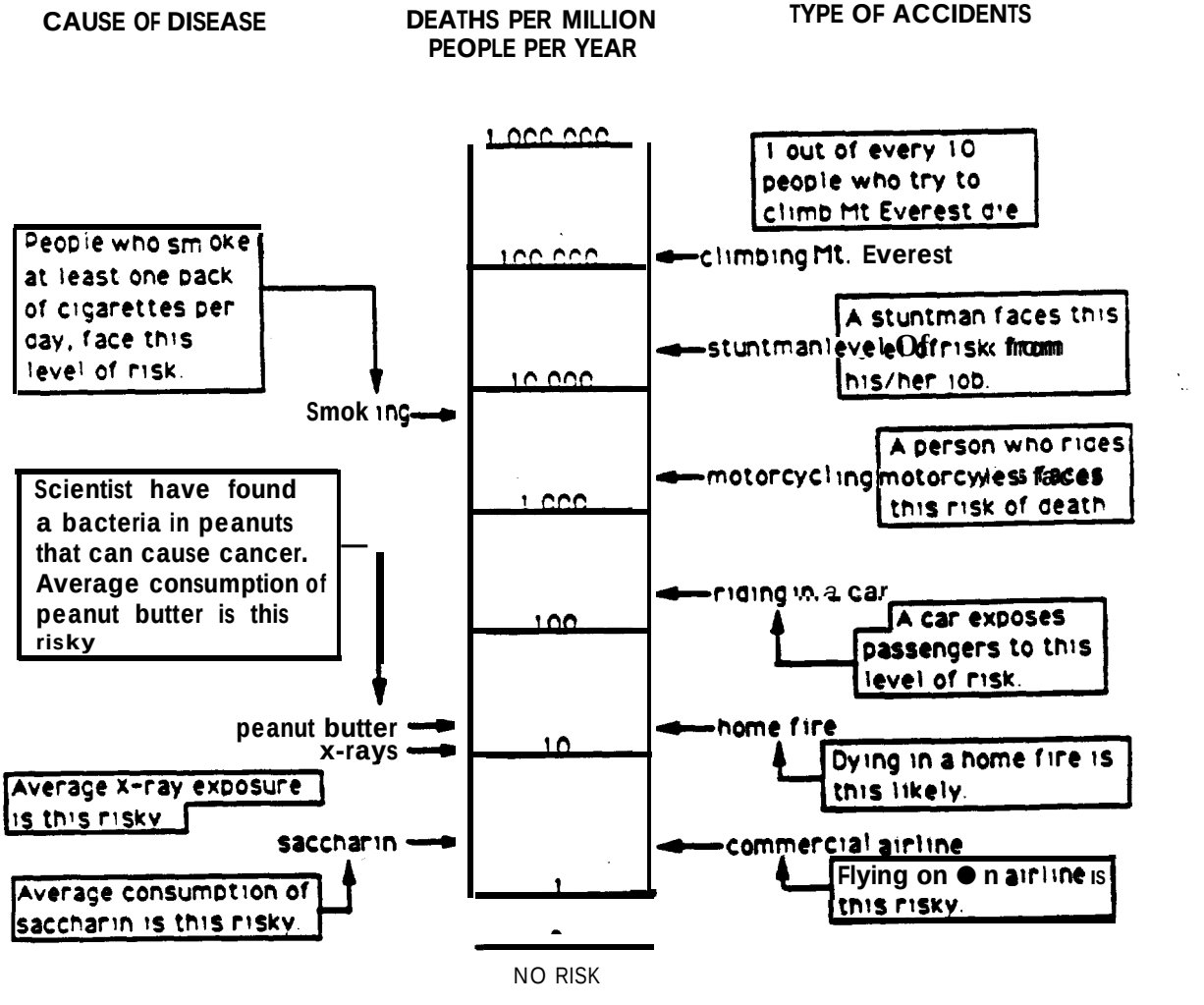


DIAGRAM 2

Initials: ._.

Just as before, the city government decides that, due to the contamination. the groundwater cannot be used as it is. Further, your city's reservoirs that depend on surface water have only a 50-50 chance of reliably making up the shortfall caused by the groundwater contamination. Thus, although the water supplied to you will remain safe, there is a 50-S0 chance of a 50% shortfall in your community's water supply next year.

Q-23 In the circumstances described above. if your city called for mandatory water restrictions limiting water use to 50% of what you use. by what amount do you think you would: (circle percentage)

1)	**Water your lawn less?**	**0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100**
2)	**Wash your car less?**	**0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100**
3)	**Cut back on water used in cooking, cleaning, and drinking?**	**0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100**

Suppose that rather than COMPLETE GROUNDWATER TREATMENT. your city instead proposes to accept a proposal from a nearby city. which has offered to sell enough of their surplus water to make up your city's potential shortfall for one year. This guarantees that the 50-50 chance of a shortage is eliminated. A referendum is proposed to the votera of your city which calls for a one year increase in local water bills to pay the nearby city for the water. Your city would have to pay the nearby city for the water and would also have to pay for the construction of a pipeline to transport the water. You would have to pay the increased water bill whether or not the 50% shortfall occurred next year.

The money generated through this surcharge could only be used to pay for the water bought for your city for next year. If the referendum is passed, everyone would pay the higher rate in order to fund the proposed water purchase. It is important to note that the surcharge would be canceled at the end of the year. However, another solution would need to be found after that. *At the moment we don't know how much U would cost to buy the water from the nearby city and build the pipeline, so we need to find out how much it is worth to people.*

initials: ____

Q-24 Would you consider voting for a referendum to support a one-year water bill increase which would go to pay for the water bought to make up the possible 50% shortfall due to the groundwater contamination for the next year?

1. No → **Why?**

2 YES →

Q-25 What is the most your household would be willing to pay EACH MONTH on top of your current water bill for the next year before you would vote NO on BUYING WATER FROM ANOTHER CITY?
(Circle the best response.)

$.50	$1.50	$4	$10	$30	$75	$200	$500
$.75	$2	$6	$15	$40	$100	$300	MORE THAN $500
$1	$3	$8	$20	$50	$150	$400	DONT KNOW

The amount youindicate will tell US What it is really worth to your household if the needed water actually cost less than people are willing to pay, you would only have to pay what it would cost. If the water turned out to cost more than people are willing to pay, the purchase would not be carried out.

V. OPTION 2 IN-HOME WATER PURIFICATION

Now think back on the situation described above and imagine that your city can no longer buy water from a nearby community to make up its shortfall. ?'list is, either you suffer a shortage or your water supply becomes contaminated and you and/or your community must clean up the water before it is used. There are a range of options which you and your community can undertake to deal wtth the problem. Some protect you and your family right now. Others protect you and future generations by cleaning up the contamination.

Some of the options are private rather than public options. For example, you could install an in-home water purification system. This system Is attached to your incoming water pipe. Water coming into your home la run through a charcoal filter which removes the harmful contaminants. That Is. all the water used in your home is made free of contamination. The system, whick must be installed by a plumber, costs $180.00, but requires occasional maintenance and charcoal replacement. which costs $300.00 per year.

initials: _____

Q-26 How satisfied are you that IN-HOME WATER PURIFICATION would protect your family from groundwater contamination?

NOT SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	?

Q-27 Would you be willing to pay to have IN-HOME WATER PURIFICATION installed in your home. or would you prefer to accept the consequences of the 50-50 chance of a S096 water shortage?

1. PREFER TO PAY FOR IN-HOME WATER PURIFICATION
2. PREFER TO ACCEPT WATER SHORTAGE

VI. OPTION 3: CREATING A FUND FOR FUTURE USE

Suppose that in addition to any private options you take, such as in-home water purification, a group of concerned citizens has decided to set up a fund which would be used in the future to deal with the groundwater contamination. This fund would be set up in a bank account paying 10% interest compounded annually at a very reliable financial institution which is federally insured. It is proposed that local water bills could be increased and the money put into this new fund to pay for groundwater contamination solutions in the future. That is. the funds could be used by future generations to deal with contaminated groundwater any way they wish. The fund would function like a regular savings account. That is, if one dollar were put into the fund today, in fifty years it would be worth $117.36, adjusting for inflation.

Q-28 How satisfied are you that CREATING A FUND FOR FUTURE USE would protect future generations from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-29 How fair do you believe CREATING A FUND FOR FUTURE USE is to future generations?

NOT AT ALL FAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

imagine that a referendum for an increase in your water bill is proposed. The money raised from this increase will go into a fund that future generations may use to solve groundwater contamination problems. This is on top of any private measures you have taken such as IN-HOME WATER PURIFICATION. If the referendum is passed, *everyone* would be paying higher monthly water bills. The money would be used only for SETTING UP A FUND FOR FUTURE USE to solve groundwater contamination problems and no other purpose. *At the moment we don't know what it will cost in the future to solve groundwater problems, so we need to find out how much it is worth to people today.*

Initials: _____

Q-30 **Would you consider voting for a referendum which would require you to pay higher monthly water bills to CREATE A FUND FOR FUTURE USE *if this fund could be guaranteed?***

1. **No** → **Why?**

2. **YES** →

Q-31 What is the most your household is willing to pay EACH MONTH on top of your current water bill before you would vote NO on SETTING UP A FUND FOR FUTURE USE? (Circle the best response.)

$.50	**$1.50**	**$4**	**$10**	**$30**	**$75**	**$200**	**$500**
$.75	**$2**	**$5**	**$15**	**$40**	**$100**	**$300**	**MORETHAN $500**
$1	**$3**	**$8**	**$20**	**$50**	**$150**	**$400**	**DONT KNOW**

The amount you indicate will tell us what it is really worth to your household to set up this find for future use.

VII. OPTION 4 WATER SUPPLY TREATMENT

Suppose that instead of the previous options, your city proposes to build and maintain a water supply treatment facility to clean up the contaminated groundwater. The water at the contaminated groundwater site is pumped up from the water table as it is needed and cleaned by charcoal filters, which trap the contaminantts. before it 1s put in the public water supply. This cleaned water is then distributed through the water system to people's homes. Scientists are satisfied with the quality of drinking water in areas where these methods have been used. This option guarantees that the 50-50 chance of a 50% shortage caused by groundwater contamination is eliminated. However, although the water throughout the public water system would be safe, the groundwater in your city would remain contaminated, and people in the future would have to pay for the operation of the treatment system.

Q-32 **How satisfied are you that BUILDING A WATER SUPPLY TREATMENT FACILITY would protect your family from groundwater contamination?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Initials: ____

Q-33 How satisfied are you that BUILDING A WATER SUPPLY TREATMENT FACILITY would protect future generations from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-34 HOW fair do you believe BUILDING A WATER SUPPLY TREATMENT FACILITY is to future generations.?

NOT AT ALL FAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

Imagine that a referendum is proposed to the voters of your city which calls for an increase in local water bills to pay for the cost of building, operating, and maintaining a water supply treatment facility. The money generated could be used only to pay for the treatment facility. If the referendum is passed, everyone would pay the higher rate in order to fund the proposed facility. It is important to note that this increase would continue indefinitely tnto the future. ***At the moment we don't know what the water supply treatment facility will cost so we need to find out how much it is worth to people.***

Q-35 Would you consider voting for a referendum to support a permanent water bill increase shich would go to building, operating. and maintaining a water supply treatment facility to make up the potential 50% shortfall due to groundwater contamination. ***If the water supply treatment could & guaranteed?***

1. No → Why?

2. YES →

Q-36 What is the most your household would be willing to pay EACH MONTH on top of your current water bill before you would vote NO on WATER SUPPLY TREATMENT? (Circle the best response.)

$.50	$1.50	$4	$10	$30	$75	$200	$500
$.75	$2	$5	$15	$40	$100	$300	MORE THAN $500
$1	$3	$8	$20	$50	$150	$400	DONT KNOW

The amount you indicate will tell us what U is really worth to your household to get this program If the needed facility actually cost less than people are willing to pay, you would only have to pay what it would cost. If the facility -Out to cost more than people are willing to pay, it would not be built.

Initials: _____

VIII. FINAL EVALUATION OF COMPLETE GROUNDWATER TREATMENT

Now that you have evaluated several other options and considered new information about groundwater and water use issues, we would like you to reevaluate the COMPLETE GROUNDWATER TREATMENT option. That is, below is presented the identical scenario which you valued in Section II. We would like you to read through the scenario again and answer the valuation question again in light of the information you have read and the answers you have given since the flint evaluation. You may decide to give the same answer as before or a different answer. It is entirely up to you.

Suppose that your city proposes to pay for a complete groundwater treatment operation to remove all of the contamination in the groundwater right now, leaving no contamination for the future. All of the water at the contaminated groundwater site would be pumped up from the water table as soon as possible and cleaned by charcoal filters, which trap the contaminants. This cleaned water would then be reinfected back into the water table and stored there for future use. once the possibility of future recontamination has been removed. This would be done by digging up all of the contaminated soil under the landfill and placing it. as well as all of the material in the old landfill. into a new landfill with a sealed bottom liner and a waterproof cover on the top.

Scientists are satisfied with the quality of drinking water in areas where these methods have been used. This option guarantees that the 50-50 chance of a 50% shortage caused by groundwater contamination is eliminated. In addition, contaminated water would never enter the public water supply and the groundwater in your city would no longer be contaminated and would be available for future use.

Q-37 How satisfied arc you that COMPLETE GROUNDWATER TREATMENT would protect your family from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-36 How satisfied are you that COMPLETE GROUNDWATER TREATMENT would protect future generations from groundwater

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-39 How fair do you believe COMPLETE GROUNDWATER TREATMENT is to future generations?

NOT AT ALL FAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

Initials: _____

A referendum is proposed to the voters of your city which calls for an increase in local water bills to pay for the costs of pumping up and cleaning the contaminated water and constructing the new landfill. The money generated could be used only to pay for the groundwater treatment program. If the referendum is passed, everyone would pay the higher rate in order to fund the treatment project. It is important to note that this increase would continue indefinitely into the future until the project is finished. ***At the moment we don't know what the complete groundwater treatment program will cost, so we need to find out how much it is worth to people.***

Q-40 Would you consider voting for a referendum to support a permanent water bill increase which would go to funding a complete groundwater treatment operation to makeup the potential 50% shortfall due to groundwater contamination ***if the groundwater treatment could be guaranteed?***

1. No → **Why?**

2. YES →

Q-41 What is the most your household would be willing to pay EACH MONTH on top of your current water bill before you would vote NO on COMPLETE GROUNDWATER TREATMENT (Circle the best number.)

$.50 $1.50 $4 $10 $30 $75 $200 $500

$.75 $2 $5 $15 $40 $100 $300 MORE THAN $500

$1 $3 $8 $20 $50 $150 $400 DONT KNOW

The amount youindicate will tell us what it is really worth to your household to get this program If the needed groundwater treatment actually cost less than people are willing to pay, you would only have to pay what it would cost. If the groundwater treatment turned out to cost more than people are willing to pay, it would not done.

Q-42 About what percentage of your answer to Q-41 did you include because of concern for: (please state a percentage from 0% to 100% for each category)

You and your family?	**--------- %**
Future generations?	**--------- %**
Not allowing contaminants to remain in the groundwater independent of any present or future use?	**--------- %**
Other reasons? (please specify: _____)	**--------- %**
	TOTAL = 100%

Initials: _____

There are many tax programs that could be used to fund the COMPLETE GROUNDWATER TREATMENT program. Suppose that instead of the permanent increase in monthly water bills, the only way to fund the COMPLETE GROUNDWATER TREATMENT program would be to have a one-time increase in water bills. There would be no additional water bill increases after the one-time payment: your water bill would go back to its original level the next month. This one-time increase would have to cover the entire cost of the treatment program. AU other details of the scenario are identical except for the one-time nature of the payment.

Q-43 Again, assume that the groundwater treatment could be guaranteed. Would you consider voting for a referendum to support a one-time Increase in water bills which would go to funding a COMPLETE GROUNDWATER TREATMENT operation to make up the potential 50% shortfall due to groundwater contamination?

1. No → Why?

2. YES ↓

Q-44 What is the most your household would be willing to pay in a one-time water bill increase before you would vote NO on COMPLETE GROUNDWATER TREATMENT? (Circle the best response.)

$1 $5 $15 $40 $100 $300 $2000 $5000

$2 $s $20 $50 $150 $500 $3000 MORE THAN $5000

$3 $10 $30 $75 $200 $1000 $4000 DONT KNOW

The amount you indicate will tell us what it is really worth to your household to get this program If the needed groundwater treatment actually cost less than people are willing to pay, you would only have to pay what it would cost. If the groundwater treatment turned out to cost more than people are willing to pay, it it would not be done.

(NOTE: If You answered "NO to both questions Q-40 and Q-43, go to question Q-48. Otherwise, continue wtth question *Q-45.)*

Q-45 Does the permanent monthly payment or the one-time payment better reflect your households value for COMPLETE GROUNDWATER TREATMENT?

1. THE PERMANENT MONTHLY PAYMENT
2. THE ONE-TIME PAYMENT
3. THE MONTHLY AND ONE-TIME PAYMENT'S ARE ABOUT THE SAME
4. ANOTHER PAYMENT 1S BETTER ($ _____ PER _____)

initials: _____

Q-46 In questions Q-41 and Q-44 you were asked to state the dollar amounts you would be willing to pay for COMPLETE GROUNDWATER TREATMENT. Would you say that the dollar amounts you stated were

1. **JUST FOR THESTATED GROUNDWATER PROGRAM (GO TO Q-48)**
2. **SOMEWHAT FOR THE GROUNDWATER REFERENDUM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES**
3. **BASICALLY A CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES**
4. **OTHER (Please specify)** _____

Q-47 About what percent of your dollar amount was just for the stated groundwater program?

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q-46 Now suppose that instead ofjust evaluating a single option, you have the opportunity to choose whichever option you prefer. Please rank the different options below in order from most preferred (= 1) to least preferred (=6). Please give each option a rank

	Rank
NO WATER PROJECTS AT ALL -- ACCEPT SHORTAGE	- - - -
BUY WATER FROM A NEARBY CITY	- - - -
INSTALL IN-HOME WATER PURIFICATION SYSTEM	- - - -
CREATE A FUND FOR FUTURE USE	- - - -
WATER SUPPLY TREATMENT	- - - -
COMPLETE GROUNDWATER TREATMENT	- - - -

Initials: _____

IX. YOUR FINAL OPINIONS AND EVALUATION

Please look back to question 9-7, your preliminary monthly value for COMPLETE GROUNDWATER TREATMENT. and record your answer here: $_____ .

Now record here your answer to question Q-4?. your final monthly value for COMPLETE GROUNDWATER TREATMENT: $ _____ .

We are interested in the reasons why your preliminary and final values mayor may not differ. Therefore. If your final value Is different from your preliminary value, please take a few minutes to describe in your own words why you decided to change your preliminary value. If your final value is the same as your preliminary value. please take a few minutes to describe in your own words why your value did not change.

---

initials: _____

Now we are going to ask you to look back to some of the specific questions you have answered and tell us whether or not they made a difference in your final evaluation.

Q-49 Questions Q-8 to Q-14 asked you about groundwater use in your own community and any specific contamination or health problems you know about. Did thinking about your local landfill and local groundwater situation lead you to change your preliminary value?

1. NO -NO CHANGE FOR THIS REASON
2. YES-I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-50 Before Q-8 you were told what groundwater is. where it comes from, and how it is extracted for human use. Did reading this information lead you to change your preliminary value?

1. NO -NO CHANGE FOR THIS REASON
2. YES -1 LOWERED MYVALUE FOR THIS REASON
3. YES --1 RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-51 After Q- 10 you were told that groundwater in fact moves very, very slowly: usually less than 100 feet per year. Did learning this information lead you to change your preliminary value?

1. NO -NO CHANGE FOR THIS REASON
2. YES -I LOWERED MYVALUE FORTHIS REASON
3. YES --I RAISED MYVALUE FOR THIS REASON

Why or why not?

Initials: _____

Q-52 **Questions Q-17 to Q-21 asked for specific information about your current water bill. Did thinking about your current water bill lead *you* to change your preliminary value?**

1. NO - NO CHANGE FOR THIS REASON
2. YES - I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-53 **Section IV asked you to evaluate a plan in which the city would buy water from another ctty to make up the potential shortfall due to groundwater cent-aUon. Did the possibility of getting water from another source cause you to change your preliminary value?**

1. NO -NO CHANGE FOR THIS REASON
2. YES -1 LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-54 **Question Q-23 asked you to think about what you would do if your city imposed mandatory water use restrictions. Did the possibility of conserving water so that less of the contaminated groundwater would have to be replaced cause you to change your preliminary value?**

1. NO -NO CHANGE FOR THIS REASON
2. YES -I LOWERED MY VALUE FOR THIS REASON
3. YES --I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-55 **Section V brought up the possibility of private options for cleaning the contaminated water. Did learning about these private options cause you to change your preliminary value?**

1. NO - NO CHANGE FOR THIS REASON
2. YES - I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Initials: _____

Q-56 Before Question Q-28 you read that one dollar put into a bank account today would be worth $117.36 in fifty years. Did learning that your payments could be earning interest and increasing in value over the years cause you to lower your preliminary value?

1. NO -NO CHANGE FORTHIS REASON
2. YES- I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-57 Section VII presented the option of water supply treatment. which would clean the contaminated water as is is needed rather than cleaning it up all at once. Did thinking about this option cause you tho change your preliminary value?

1. NO -NO CHANGE FOR THIS REASON
2. YES - I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAISED MY VALUE FOR THIS REASON

Why or why not?

Q-58 Diagram 2 presented a 'risk ladder' which compared the rtsk of drinking the contaminated groundwater wtth several other risks. Did learning about these risk comparisons cause you to change your preliminary value?

1. NO -NO CHANGE FOR THIS REASON
2. YES - I LOWERED MY VALUE FOR THIS REASON
3. YES -- I RAWED MY VALUE FOR THIS REASON

Why or why not?

Q-59 Did going through the information and response options in the surveys make you any more or less optimistic about our ability to deal with groundwater contamination problems now and in the future?

1. NO - MADE NO DIFFERENCE
2. YES -- MADE ME MORE OPTIMISTIC
3. YES -- MADE ME LESS OPTIMISTIC

(NOTE: If your preliminary and final values were Identical, please STOP and wait for the next survey section. Otherwise, continue with question Q-60.)

Initials: ,_

Q-60 Are there any other factors we may have overlooked which contributed to a difference between your preliminary and final values?

1. NO
2. YES

IF YES: Please describe briefly _____

Q-61 Which value do you think best represents your true monthly value for the COMPLETE GROUNDWATER TREATMENT program:

1. MY PRELIMINARY VALUE
2. MY FINAL VALUE
3. AN INTERMEDIATE OR OTHER VALUE: $ _____ PER MONTH

Q-62 Which value would you like government policymakers to use to make decisions about how much people value groundwater protection?

1. MY PRELIMINARY VALUE
2. MY FINAL VALUE
3. AN INTERMEDIATE OR OTHER VALUE: $ _____ PER MONTH

Initials: _____

X. ABOUT YOU

Finally, we would like to ask you a few questions about yourself.

Q-63 **Your sex:**

1. FEMALE
2. MALE

Q-64 **Your age:** _____ **YEARS**

Q-65 **Including yourself, how many members in your household arc in each age group? (If none. write "0")**

_ UNDER 18 YEARS OF AGE
_ 18 - 64
_ 65 AND OVER

Q-66 **How much formal education have you completed? (circle number)**

1. NO FORMAL EDUCATION
2. SOME GRADE SCHOOL
3. COMPLETED GRADE SCHOOL
4. SOME HIGH SCHOOL
5. COMPLETED HIGH SCHOOL
6. TRADE SCHOOL
7. SOME COLLEGE
8. COMPLETEDCOLLEGE
9. SOME GRADUATE WORK
10. ADVANCED COLLEGE DEGREE

Q-67 **In the pasta. has your household submitted any of the following materials for recycling? (circle all that apply)**

1. NEWSPAPER
2. GLASS
3. ALUMINUM OR OTHER METALS
4. PLASTIC
5. OTHER (please specify)

_____

Q-68 **In the past year. have you held membership or donated time or money to any environmental organizations or groups (such as Greenpeace or the Sierra Club)?**

1. NO
2. YES -- ONE GROUP
3. YES - TWO OR THREE GROUPS
4. YES - MORE THAN THREE GROUPS

Q-69 **How would you describe your racial or ethnic background? (circle one)**

1. WHITE OR CAUCASIAN
2. BLACK OR AFRICAN AMERICAN
3. HISPANIC OR MEXICAN AMERICAN
4. ASIAN OR PACIFIC ISLANDER
5. NATIVE AMERICAN INDIAN
6. OTHER (please specify)

_____

Initials: ____

Q-70 What is your total annual household income before taxes and other deductions? (circle one)

1. UNDER $9,999
2. $10,000 -19,999
3. $20,000 - 29,999
4. $30,000 -39,999
5. $40,000 - 49,999
6. $50,000 -59,999
7. $60,000 -69,999
8. $70,000 -79.999
9. $80,000 -89,999
10. $90,000 -99,999
11. $100,000 -119,999
12. $120,000 -139,999
13. $140,000 -159.999
14. $160,000 -179,000
15. $180,000 -199,999
16. $200,000 and OVER

IS there anything we have overlooked? Please use the space below to write any comments or suggestions you may have about the survey. We will also be happy to answer any questions you may have about the survey or our research when everyone has finished.

APPENDIX B

SURVEY INSTRUMENT FOR DECEMBER 1990 PRETEST

Initials: _____

I. THE ISSUES

We are interested in your opinion about water use and potential groundwater contamination. We need your answers to these quest.ions to help make decisions about future groundwater programs.

Q-1 Have you read *or* heard anything about groundwater being contaminated somewhere in your state or somewhere in your own county, city, or community? (circle one)

1) NO
2) YES -- IN MY STATE
3) YES -- IN MY COUNTY, CITY, OR COMMUNITY
4) DONT KNow

Q-2 Have you read or heard about instances of groundwater contamination in your county, city, or community coming from any of these specific sources? [Circle all that apply)

1. NO -- HAVENT HEARD
2. YES -- BUT CANT RECALL SPECIFIC SOURCE
3. YES -- SUPERFUND OR OTHER TOXIC ORHAZARDOUS WASTE SITE
4. YES --A PUBLIC LANDFILL
5. YES -- AGRICULTURAL APPLICATION OF PESTICIDES OR FERTILIZERS
6. YES -- SEPTIC TANKS
7. YES -- LEAKY UNDERGROUND STORAGE TANKS ORLAGOONS
8. YES --A CHEMICAL SPIIL
9. YES -- OTHER (please specify) _____

Q-3 How much do you agree or disagree with the following statement: "We should protect groundwater at all costs."

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

initials: ____

II. WATER USE IN YOUR COMMUNITYfAND YOUR HOME

Water for residential use can come from many differnt sources. including surface sources such as reservoirs or lakes and groundwater sources. Groundwater comes from precipitation that falls on the land surface and seeps underground. At some depth underground the soil or rock becomes saturated with water. Groundwater is extracted for human use by digging wells or taking water from naturally occurring springs.

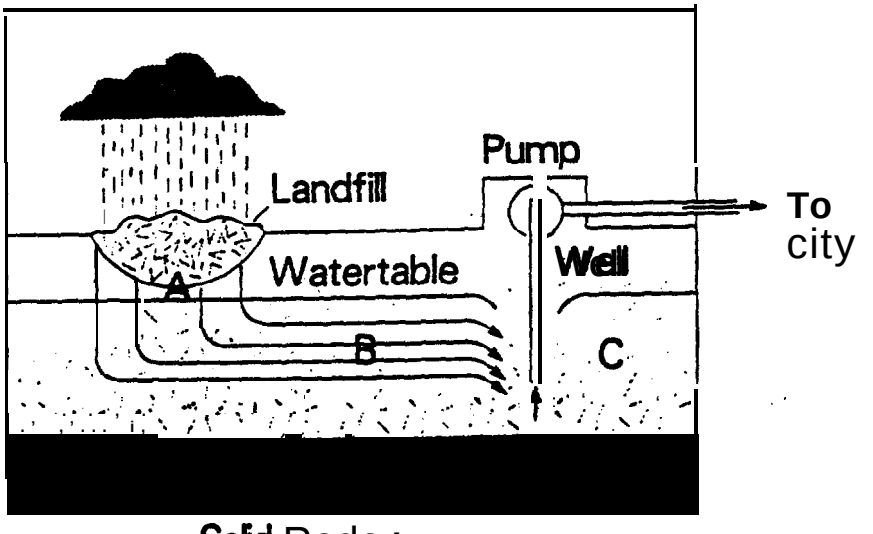
Q-4 **Do you or people in your city or community get any part of your water for home use from groundwatcr?**

1. NO -WE DONT USE GROUNDWATER
2. YES -- I USE GROUNDWATER IN MY HOME
3. YES - SOME PEOPLE IN MY COMMUNITY USE GROUNDWATER BUT I DONT
4. DONT KNOW

Q-5 **Often, garbage and waste placed in a community's landfill, similar to the one shown in diagram 1 below, can leak out and contaminate groundwater. Does your community have a local landfill?**

1. NO
2. YES
3. DONT KNOW

DIAGRAM 1



Initials: _____

When rainwater seeps through garbage and waste, it dissolves some of the chemicals in the discarded trash. Gradually, this material, which is sometimes toxic. can seep into the water table and contaminate the water below. as A shows in diagram 1.

Q-6 Do you know if the water under your local landfill is contaminated?

L NO
2. YES
3. NO -- WE DONT HAVE A LANDFILL
4. DONT KNOW

Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B in diagram 1). Many people are surprised to learn that the flow is very very slow usually less than 100 feet per year. After many years. the landfill may eventually contaminate water drawn by a well (see C in diagram 1) which supplies water to the citizens of the community.

Q-7 Does your community currently draw water from wells which are in danger of becoming contaminated?

1. NO
2. YES
3. DONT KNOW

Because groundwater moves very slowly, the area contaminated by a specific source is usually small, on the order of a square mile or two. Larger areas may be contaminated only if there are multiple sources or if the source is a widespread land-use practice such as agricultural application of fertilizer or pesticides.

Q-8 Are you aware of any specific contaminants that are in groundwater that is currently used in your home or by people in your community?

1. NO
2. YES-- IN MY HOME
   (Please identify contaminant(s): _____)
3. YES --IN MY COMMUNITY
   (Please identify contaminant(s): _____)

Q-9 Are you aware of any specific instances of groundwater in your community that is no longer used because it is contaminated?

1. NO
2. YES (Please explain briefly)_____

_____

Q-10 Have your family or people in your community ever been bothered by any health problems which you believe have been caused or aggravated by groundwater contamination?

1. NO
2. YES -- MYSELF OR MY FAMILY
   (Please identify problem(s): _____)
3. YES -- PEOPLE IN MY COMMUNITY
   (Please identify problem(s): _____)

Initials: _____

Q-11 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY
2. A PRIVATE WATER SUPPLIER
3. OUR PRIVATE WELL -- SKIP TO QUESTION 9-22
4. OTHER (Please specify) _____
5. DONT KNOW

Q-12 Has your community imposed voluntary or mandatory water use restrictions since you've lived there?

1. NO
2. YES -- VOLUNTARY
3. YES -- MANDATORY
4. DONT KNOW

Q-13 Does your household pay a water company or other supplier directly for the water used in your home?

1. No → PLEASE GO TO QUESTION Q-17
2. YES ↓

Q-14 Are you the person who actually pays your household's water bill?

1. NO
2. YES

Q-15 How frequently are you billed?

1. MONTHLY
2. QUARTERLY
3. ANNUALLY
4. OTHER (please specify) _____

Q-16 About how much is your average monthly water bill?

DURING THE SUMMER? $_____
DURING THE WINTER? $_____

PLEASE GO TO Q-18

Q-17 How much would you estimate the average household monthly water bill is in your community for people using the public water supply system?

$_____

Q-18 Does your household normally use bottled water, trucked-in water. a water purifier, or any other specially treated water for drinking or cooking?

1. NO
2. YES

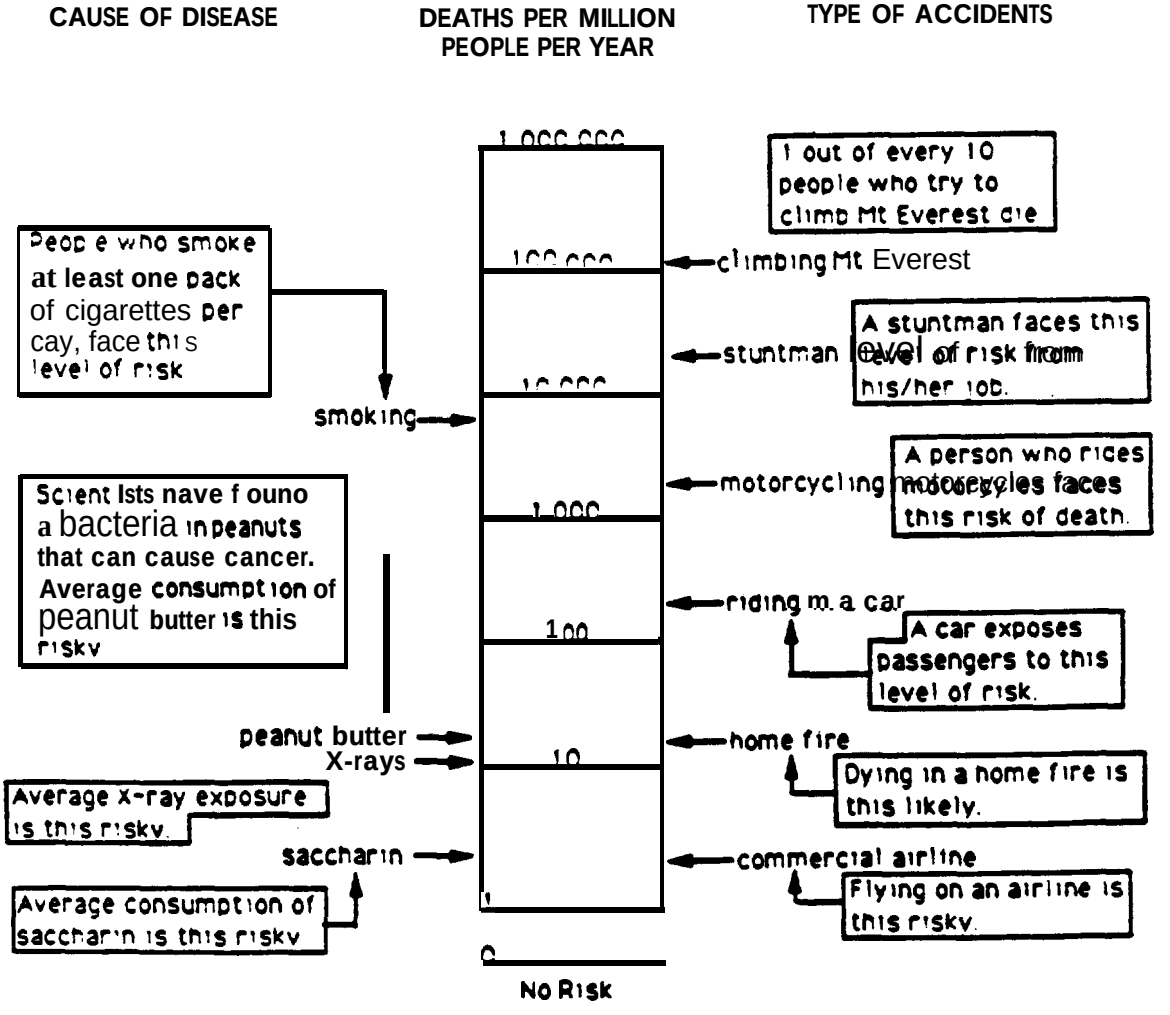
Initials: _____

III. OPTION 1: BUYING WATER FROM ANOTHER CITY

The previous sections have asked about the water and groundwater situation in your community and in your own household. Now, however. we are going to ask you to respond to some situations that are Completely hypothetical. We will describe a situation in which groundwater has been contaminated and you will be asked to evaluate the potential responses that a city or community might make. The situation described may differ considerably* your current water use situation and from the groundwater situation in your community, and so we would Uke you to imagine that you live in the city with the groundwatcr problem described and respond as if you were truly facing this situation.

Imagine your city currently gets 50% of its water from streams and lakes and 50% of its water from groundwater. Now. suppose it is discovered that over the yearn leachate from the municipal landfill has been slowly leaking into the water table and the city's groundwater supply is now contaminated With a toxic chemical. The contamination haa been occurring for a number of years and is the result of standard landfill practices. The area of contamination is about 2 square miles and is away from residential areas.

Scientists believe that drinking the contaminated water increases the risk of cancer. They have estimated the level of risk to be about 10 additional deaths per milllon people who drink the water per year. This la about the same level of risk a typical person has of developing cancer from exposure to medical x-rays (see diagram 2).



Initials: _____

Q-19 **How accurately do you believe scientists can estimate the health risk posed by toxic chemicals?**

NOT AT ALL ACCURATELY						EXTREMELY ACCURATELY
1	2	3	4	5	6	7

The city government decides that, due to the contamination, the groundwater cannot be used as it is. Further, your city's reservoirs that depend on surface water have only a 50-50 chance of reliably making up the shortfall caused by the groundwater contamination. Thus. although the water supplied to you will remain safe, there is a 50-50 chance of a 50% shortfall in your community's water supply next year.

Q-20 **Do you agree or disagree with the city's decision to prohibit use of the groundwater, given the level of health risk estimated by scientists?**

1. AGREE
2. DISAGREE
3. NOT SURE

Q-21 ***In*** **the circumstances described above. If your city called for mandatory water restrictions limit ing water use to 50% of what you use. by what amount do you think you would: (circle percentage)**

1)	**Water your lawn less?**	0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 10
2)	**Wash your car less?**	0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 10
3)	**Cut back on water used in cooking, cleaning. and drinking?**	0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 10

Suppose that your city proposes to accept a proposal from a nearby city,which has offered to sell enough of their surplus water to make up your city's potential shortfall for one year. This guarantees that the 50-50 chance of a shortage is eliminated. A referendum is proposed to the voters of your city which calls for a one year increase in local water bills to pay the nearby city for the water. Your city would have to pay the nearby city for the water and would also have to pay for the construction of a pipeltne to transport the water. You would have to pay the increased water bill whether or not the 50% shortfall occurred next year.

The money generated through this surcharge could only be used to pay for the water bought for you; city for next year. If the referendum is passed. everyone would pay the higher rate in order to fund the proposed water purchase. It is important to note that the surcharge would be canceled at the end of the year. However, another solution would need to be found after that. *At the moment we don't know how much it would cost to buy the water from the nearby city and build the pipeline, so we need to find out how much it is worth to people.*

Initials: ____

Q-22 Would you consider voting for a referendum to support a one-year water bill increase which would go to pay for the water bought to make up the possible 50% shortfall due to the groundwater contamination for the next year?

1. No → **Why?**

2. YES ↓

Q-23 What is the most your household would be willing to pay EACH MONTH on top of your current water bill for the nat year before you would vote NO on BUYING WATER FROM ANOTHER CITY?
(Circle the best response.)

$.50	**$1.50**	**$4**	**$10**	**$30**	**$75**	**$200**	**$500**
***.75**	**$2**	**$5**	**$15**	**$40**	**$100**	**$300**	**MORE THAN $500**
$1	**$3**	**$8**	**$20**	**$50**	**$150**	**$400**	**DONT KNOW**

The amount you indicate will tell us what it is really worth to your household. If the needed water actually cost less than people are willing to pay, you would only have to pay what it would cost. If the water turned out to cost more than people are willing to pay. the purchase would not be carried out.

IV. OPTION 2 IN-HOME WATER PURIFICATION

Now think back on the situation described above and imagine that your city can no longer buy water from a nearby community to make up its shortfall. That is. either you suffer a shortage *or* your water supply becomes contaminated and you and/or your community must clean up the water before It is used. There are a range of options which you and your community can undertake to deal with the problcm. Some protect you and your family right now. Others protect you and future generations by cleaning up the contamination.

Some of the options are private rather than public options. For example, you could install an in-home water purification system. This system is **attached to your incoming water pipe. Water coming into your home is run through a charcoal filter which removes the harmful contaminants. That is. all the water used in your home is made free of contamination. The system, which must be installed by** a **plumber. costs $180.00, but requires occasional maintenance and charcoal replacement, which costs $300.(X) per year.**

Initials: _____

Q-24 How satisfied are you that IN-HOME WATER PURIFICATION would protect your family from groundwater contamination?

NOT SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-25 Would you be willing to pay to have IN-HOME WATER PURIFICATION installed in your home. or would you prefer to accept the consequences of the 50-50 chance of a 50% water shortage?

1. PREFER TO PAY FOR IN-HOME WATER PURIFICATION
2. PREFER TO ACCEPT WATER SHORTAGE

V. OPTION 3: CREATING A FUND FOR FUTURE USE

Suppose that in addition to any private options you take, such as in-home water purification. a group of concerned citizens has decided to set up a fund which would be used in the future to deal with the groundwater contamination. This fund would be set up In a bank account paying 10% interest compounded annually at a very reliable financial institution which is federally insured. It ts proposed that local water bills could be increased and the money put into this new fund to pay for groundwater contamination solutions in the future. That is. the funds could be used by future generations to deal with contaminated groundwater any way they wish. The fund would function like a regular savings account. That is. if one dollar were put into the fund today, in filly years it would be worth $117.36, adjusting for inflation.

Q-26 How satisfied are you that CREATING A FUND FOR FUTURE USE would protect future generations from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-27 How fair do you believe CREATING A FUND FOR FUTURE USE is to future generations?

NOT AT ALL FAIR						EX TREMELY FAIR
1	2	3	4	5	6	7

Imagine that a referendum for an increase in your water bill is proposed. The money raised from this increase will go tnto a fund that future generations may use to solve groundwater contamination problems. This is on top of any private measures you have taken such as IN-HOME WATER PURIFICATION. If the referendum is passed. everone would be paying higher monthly water bills. The money would be used@ for SETTING UP A FUND FOR FUTURE USE to solve groundwater contamination problems and no other purpose. ***At the moment we don't know what it will cost in the future to solve groundwater problems, so we need to find out how much it is worth to people today.***

Initials: ____

Q-28 Would you consider voting for a referendum which would require you to pay higher monthly water bills to CREATE A FUND FOR FUTURE USE ***if this fund could be guaranteed.?***

1. No → **Why?**

2. YES →

Q-29 What is the most your household is willing to pay EACH MONTH on top of your current water bill before you would vote NO on SETTING UP A FUND FOR FUTURE USE? (Circle the best response.)

$.50	**$1.50**	**$4**	**$10**	**$30**	**$75**	**$200**	**$500**
$.75	**$2**	**$5**	**$15**	**$40**	**$100**	**$300**	**MORE THAN $500**
$1	**$3**	**$8**	**$20**	**$50**	**$150**	**$400**	**DONT KNOW**

The amount you indicate sill tell us what it is really worth to your household to set up this fund for future use.

VI. OPTION 4: WATER SUPPLY TREATMENT

Suppose that instead of the previous options, your city proposes to build and maintain a water supply treatment facility to clean up the contaminated groundwater. 'The water at the contaminated groundwater site is pumped up from the water tableas it is needed and cleaned by charcoal filters, which trap the contaminant is, before it is put in the public water supply. This cleaned water is then distributed through the water system to people's homes. Scientists are satisfied with the quality of drinking water in areas where these methods have been used. This option quarantees that the 50-50 chance of a 50% shortage caused by groundwater contamination is eliminated. However, although the water throughout the public water system would be safe, the groundwater in your city would remain contaminated, and people in the future would have to pay for the operation of the treatment system.

How satisfied are you that BUILDING A WATER SUPPLY TREATMENT FACILITY would protect your faintly from groundwater contamination?

NOTAT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Initials: _____

Q-31 How satisfied are you that BUILDING A WATER SUPPLY TREATMENT FACILITY would protect future generations from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-32 How fair do you believe BUILDING A WATER SUPPLY TREATMENT FACILITY is to future generations?

NOT AT ALL FAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

Imagine that a referendum is proposed to the voters of your city which calls for an Increase in local water bills to pay for the cost of building, operating, and maintaining a water supply treatment facility. The money generated could be used only to pay for the treatment facility. If the referendum is passed, everyone would pay the higher rate in order to fund the proposed facility. It is important to note that this increase would continue indefinitely tnto the future. *At the moment we don't know what the water supply treatment facility will cost, so we need to find out how much it is worth to people.*

Q-33 Would you consider voting for a referendum to support a permanent water bill increase which would go to building, operating. and maintaining a water supply treatment facility to make up the potential 50% shortfall due to groundwater contamination. *If the water supply treatment could be guaranteed.?*

1. No → **Why?**

2. YES ↓

Q-34 What is the most your household would be willing to pay EACH MONTH on top of your current water bill before you would vote NO on WATER SUPPLY TREATMENT? (Circle the best response.)

$.50	$1.50	$4	$10	$30	$75	$200	$500
$.75	$2	$5	$15	$40	$100	$300	MORE THAN $500
$1	$3	$8	$20	$50	$150	$400	DONT KNOW

The amount you indicated will tell us what it is really worth to your household to get this program if the needed facility actually cost less than people are willing to pay you would only have to pay what it would cost. If the facility turned out to cost more than people are willing to pay, u would not be built.

Initials: ____

VII. OPTIONS: COMPLETE GROUNDWATER TREATMENT

Suppose that instead of previous options your city proposes to pay for a complete groundwater treatment 'operation to remove all 'of 'the contamination in the groundwater right now, leaving no contamination for the future. All of the water at the contaminated groundwater site would be pumped up from the water table as soon as possible and cleaned by charcoal filters, which trap the contaminants. This cleaned water would then be reinfected back tnto the water table and stored there for future use, once the possibility of future recontamination has been removed. This would be done by digging up all of the contaminated soil under the landfill and placing It, as well as all of the material in the old landfill, into a new landfill with a sealed bottom liner and a waterproof cover on the top.

Scientists are satisfied with the quality of drinking water in areas where these methods have been used. This option quarantees that the 50-50 chance of a 50% shortage caused by groundwater contamination is eliminated. In addition, contaminated water would never enter the public water supply and the groundwater in your city would no longer be contaminated and would be available for future use.

Q-35 How satisfied are you that COMPLETE GROUNDWATER TREATMENT would protect your family from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-36 How satisfied are you that COMPLETE GROUNDWATER TREATMENT would protect future generations from groundwater contamination?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q-37 How fair do you believe COMPLETE GROUNDWATER TREATMENT is to future generations?

NOTAT ALL FAIR						EXTREMELY FAIR
1	2	3	4	5	6	7

Initials: _ .

A referendum is proposed to the voters of your city which calls for an increase in local water bills to pay for the costs of pumping up and cleaning the contaminated water and constructing the new landfill. The money generated could be used only to pay for the groundwater treatment program. If the referendum is passed, everyone would pay the higher rate in order to fund the treatment project. It is important to note that this increase would continue indefinitely into the future until the project is finished. ***At the moment we don't know what the completer groundwater treatment program will cost so we need to find out how much it is worth to people.***

Q-38 **Would you consider voting for a referendum to support a permanent water bill increase which would go to funding a complete groundwater treatment operation to make up the potential 50% shortfall due to groundwater contamination.** ***if the groundwater treatment could be guaranteed 7***

1. **No** → **Why?**

2. **YES** ↓

Q-39 What is the most your household would be willing to pay EACH MONTH on top of your current water bill before you would vote NO on COMPLETE GROUNDWATER TREATMENT? (Circle the best number.)

$.50	$1.50	$4	$10	$30	$75	$200	$500
$.75	$2	$5	$15	$40	$100	$300	MORE THAN $500
$1	$3	$8	$20	$50	$150	$400	DONT KNOW

The **amount** ***you indicate will tell us what it is really worth to your household to get this program If the needed groundwater treatment actually cast less than people are willing to pay, you would only have to pay what it would cost. If the groundwater treatment turned out to cost more than people are willing to pay, it would*** **not done.**

Q-40 About what percentage of your answer to Q-39 did you Include because of concern for: (please state a percentage from 0% to 100% for each category)

You and your family?	_____ %
Future generations?	_____ %
Not allowing contaminants to remain in the groundwater independent of any present or future use?	_____ %
Other reasons? (Please specify: _____)	_____ %
	TOTAL = 100%

Initials: _____

There are many tax programs that could be used to fund the COMPLETE GROUNDWATER TREATMENT program. Suppose that instead of the permanent increase in monthly water bills. the only way to fund the COMPLETE GROUNDWATER TREATMENT program would be to have a one-time increase in water bills. There would be no additional water bill increases after the one-time payment: your water bill would go back to its original level the next month. This one-time increase would have to cover the entire cost of the treatment program. All other details of the scenario are identical except for the one-time nature of the payment.

Q-41 Again. assume that the groundwater treatment could be quaranteed. Would you consider voting for a referendum to support a one-time increase in water bills which would go to funding a COMPLETE GROUNDWATER TREATMENT operation to make up the potential 50% shortfall due to groundwater contamination?

1. No → **Why?**

2. YES →

Q-42 What is the most your household would be willing to pay in a one-time water bill increase before you would vote NO on COMPLETE GROUNDWATER TREATMENT? (Circle the best response.)

$1	**$5**	$15	$40	$100	**$300**	**$2000**	**$5000**
$2	**$8**	**$20**	**$50**	**$150**	**$500**	**$3000**	**MORE THAN $5000**
$3	**$10**	**$30**	**$75**	**$200**	**$1000**	**$4000**	**DONT KNOW**

The amount you indicate will tell us what it is really worth to your household to get this program. If the needed groundwater treatment actually cost fess than people are willing to pay, you would only have to pay what it would cost. If the groundwater treatment turned out to cost more than people are willing to pay, it would not done.

(NOTE: **If you answered "NO" to both questions Q-38 and Q-41, go to question Q-46. Otherwise, continue with question Q-43.)**

Q-43 Does the permanent monthly payment or the one-time payment better reflect your households value for COMPLETE GROUNDWATER TREATMENT?

1. **THE PERMANENT MONTHLY PAYMENT**
2. **THE ONE-TIME PAYMENT**
3. **THE MONTHLY AND ONE-TIME PAYMENTS ARE ABOUT THE SAME**
4. **ANOTHER PAYMENT IS BETTER ($ _____ PER _____)**

Initials: _____

VIII. ABOUT YOUR EVALUATION OF COMPLETE GROUNDWATER TREATMENT

We arc interested in how you decided upon the monthly value you stated for complete groundwater treatment. If you were willing to vote yes on COMPLETE GROUNDWATER TREATMENT . what reasoning or strategies dtd you use to arrive at your dollar value? If you voted noon COMPLETE GROUNDWATER TREATMENT. why did you vote no? What, if anything. would it take for you to change your mind and vote yes? Please take a few minutes to describe your reasoning in your own words in the space below.

Initials: ____

Q-41 In questions Q-39 and Q-42 YOU were asked to state the dollar amounts you would be willing to pay for COMPLETE GROUNDWATER TREATMENT . Would you say that the dollar amounts you stated were

1. JUST FOR THE STATED GROUNDWATER PROGRAM (GO TO Q-46)
2. SOMEWHAT FOR THE GROUNDWATER REFERENDUM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES
3. BASICALLY A CONTRIBUTION TO ALL ENVIRONMENIAL CAUSES
4. OTHER (please specify) _____

Q-45 About what percent of your dollar amount was just for the stated groundwater program?

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q-46 Now suppose that instead of just evaluating a single" option. you have the opportunity to choose whichever opUon you prefer. Please rank the different options below in order from most preferred (= 1) to least preferred (=6). Please give each option a rank.

	Rank
NO WATER PROJECTS AT ALL -- ACCEPT SHORTAGE	- - - -
BUY WATER FROM A NEARBY CITY	- - - -
INSTALL IN-HOME WATER PURIFICATION SYSTEM	- - - -
CREATE A FUND FOR FUTURE USE	- - - -
WATER SUPPLY TREATMENT	- - - -
COMPLETE GROUNDWATER TREATMENT	- - - -

Initials: _____

When thinking about your value for COMPLETE GROUNDWATER TREATMENT. some information may have been more relevant than other information. Certain items may have caused you to think 'Oh. my value was too high. I have to lower it to take this into account. Or some items may have caused YOU to think 'Oh. my value was too low. 1 have to raise it to take this into account." We are now going to ask you to look back to some of the specific questions you have answered and tell us whether or not you took this information tnto account when determining your value for COMPLETE GROUNDWATER TREATMENT.

Q-47 Questionns Q-4 to Q-10 asked you about groundwater use in your own community and any specific contamination or health problems you know about. Did thinking about your local landfill and local groundwater situation have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO - NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Before Q-4 you were told what groundwater is, where it comes from, and how it is extracted for human use. Did readtng this information have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO -NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-49 After Q-6 You were told thatgroundwater in fact moves very. very slowly: usually less than 100 feet per year. Did learning this information have any affect *on your* value for COMPLETE GROUNDWATER TREATMENT?

1. NO - NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INN) ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Initials: _

Q-50 Questions Q-13 to Q-17 asked for specific information about your current water bill. Did thinking about your current water bill have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO - NO AFFECT AT ALL
2. YES -I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-51 Section III asked you to evaluate a plan in which the city would buy water from another city to make up the potential shortfall due to groundwater contamination. Did thinkings about the possibility of getting water from another source have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO- NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-52 Question Q-2 1 asked you to think about what you would do if your city imposed mandatory water use restrictions. Did thinking about the possibility of conserving water so that less of the contaminated groundwater would have to be replaced have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO - NO ACCOUNT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Initials: _____

Q-53 Section IV brought Up the possibility of private options for cleaning the contaminated water. Did thinking about these private options have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO- NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-54 Before Question Q-26 you read that one dollar put into a bank account today would be worth $117.36 in filly years. Did thinking about the fact that your payments could be earning interest and increasing in value over the years have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO -NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-55 Section VI presented the option of water supply treatment. which would clean the contaminated water as it is needed rather than cleaning it up all at once. Did thinking about this option have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO - NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTER TAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE ARER TAKING THIS INTO ACCOUNT

Why or why not?

Initials: . _ .

Q-56 Diagram 2 presented a "risk ladder" which comparedthe risk of drinking the contaminated groundwater With several other risks. Did thinking about these risk comparisons have any affect on your value for COMPLETE GROUNDWATER TREATMENT?

1. NO- NO AFFECT AT ALL
2. YES - I LOWERED MY VALUE AFTERTAKING THIS INTO ACCOUNT
3. YES -- I RAISED MY VALUE AFTER TAKING THIS INTO ACCOUNT

Why or why not?

Q-57 Did going though the information and response options in the surveys make you any more or less optimistic about our ability to deal with groundwater contamination problems now and in the future?

1. NO -- MADE NO DIFFERENCE
2. YES -- MADE ME MORE OPTIMISTIC
3. YES -- MADE ME LESS OPTIMISTIC

initials: _____

X. ABOUT YOU

Finally, we would like to ask you a few questions about yourself.

Q-59 Your sex:

1. P E W
2. MALE

Q-60 Your age: _____ YEARS

Q-61 including yoursel, how many members in your household are in each age group? (If none. write "0")

___ UNDER 18 YEARS OF AGE
___ 18-64
65 AND OVER

Q-62 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION
2. SOME GRADE SCHOOL
3. COMPLETED GRADE SCHOOL
4. SOME HIGH SCHOOL
5. COMPETED HIGH SCHOOL
6. TRADE SCHOOL
7. SOME COLLEGE
8. COMPLETED COLLEGE
9. SOME GRADUATE WORK
10. ADVANCED COLLEGE DEGREE

Q-63 In the past month. has your household submitted any of the following materials for recycling? (circle all that apply)

1. NEWSPAPER
2. GLASS
3. ALUMINUM OR OTHER METALS
4. PLASTIC
5. OTHER (P i - S - _____

Q-64 In the past year, have you held membership or donated time or *money* to any environmental organizations or groups [such as Greenpeace or the Serra Club)?

1. NO
2. YES -- ONE GROUP
3. YES -- TWO OR THREE GROUPS
4. YES -- MORE THAN THREE GROUPS

Q-65 How would you describe your racial or ethnic background? (circle one)

1. WHITE OR CAUCASIAN
2. BLACK OR AFRICAN AMERICAN
3. HISPANIC OR MEXICAN AMERICAN
4. ASIAN OR PACIFIC ISLANDER
5. NATIVE AMERICAN INDIAN
6. OTHER [P I - S - _____

Initials: _____

Q-66 **What is your total annual household income before taxes and other deductions? (circle one)**

1. UNDER $9,999
2. $10,000 - 19,999
3. $20,000 - 29,999
4. $50,000 - 59,999
5. $40,000 - 49,999
6. $50,000 - 59,999
7. $60,000 - 69,999
8. $70,000 - 79,999
9. $80,000 - 89,999
10. $90,000 - 99,999
11. $100,000 - 119,999
12. $120,000 - 139,999
13. $140,000 - 159,999
14. $160,000 - 179,000
15. $180,000 - 199,999
16. $200,000 and OVER

IS there anything we have overlooked? Please use the space below to write any comments or suggestions you may have about the survey. We@ also be happy to answer any questions you may have about the survey or our research when everyone has finished.

APPENDIX C

VERBAL PROTOCOLS

Valuation

Our water bill is about $15-$20 (answer R gave). I feel it is pretty important for the people to be drinking safe water. A $15 to $20 increase per month to ensure that we would have enough water and it would be safe would be okay. Peoples' health is more important than going ahead and letting people use water that is not safe.

$5/month for 50 years is a lot of money. $2 or $3 would be big money too but I would consider voting if it was going to cost me $2/year which is $6 or $7 for my household.

(complete groundwater treatment) This is a big one. it's got to be worth more, $8-10/month

If my water bill is only S20 it could double and it wouldn't affect me a whole lot. I would say that should certainly cover another 50%. I thought about the baseball vote just recently and that that would be about S 10/year is what I was told and voted no on that one but I would double my water bill because my health is very important to me. I splurge, I'd go to S25.

I would say $5 and not have to worry about it. i was thinking that it was a good start in terns of setting up a plan to solve the water problems. I remember having skepticisms about how the money would be used.

When i looked at the dollar amount I was thinking in terms of not so much what i could econom-ically afford but generai. What 1 would want to pay over an indefinite time. I could blow S20 a month and it wouldn't have a big economic impact on myself, i think if everybody spent that amount of money you would have a good amount of money to start cleaning up the water, As far as trying to think in terms of well, here's how much i think it might cost and if everybody put in this much you would have enough. Not in those terms.

I put down S 10 because I used to donate that much every month to United Way. It would be my charitable contribution in a way. I didn't spend a whole lot of time in thought about those questions.

Mental Model of Trust Fund

No. Just in the sense that I don't know if...I don't know in a sense that it would be there. They might spend it on something else. Priorities get mixed up.

Well, again, when are they going to dip into it to use it. I don't know. What I stated before was that local government and unions, people want to dip into this fund that sits thereto use it and will make it Up later and whether or not that happens is..we sure hope so but to take it in and say it cannot be touched and we are going to let it grow for x amount of years you have to trust that that is going to happen.

I think it's a crock...it's like freezing your body to see if there is something in the future to handle it. I'm not a big believer in that.

I don't lend much credence to guarantees through government systems or whoever is handling the water. If they could give some feedback on what money they received and what sort of use the money is going towards I would be a lot more satisfied. Until then I would be willing to risk only a bit until we find out what will happen with that.

I'd like to believe it, but when they start talking about the S&L scandal, I don't know.

Psycho-Economics

(worth of $1 in bank for 50 years) probably 10 cents

I don't think it would be there the way my bank has service charges, They'd take it. In SO years, 1 should know, I'd guess S25.

S 100 for S 1 after 50 years? I don't really believe that.

Comparison Risks

Well, I've been told that x-rays/a lot of x-rays aren't good for you/ten out of a million would be less than one percent. I would say it's about the same.....In retrospect it seems like I was pretty carried away on saving 10 lives . . ..it suddenly occurs to me that I jumped on a bandwagon where for these other things, x-rays and such that I don't think twice about it. Ten out of a million people seemed to really get my attention in answering the survey. And it was a huge concern to me. If I had looked at this (risk ladder) before i gave my answers to all of those questions I would have said Oh, shit, screw it, I want to give them a nickel. I own a motorcycle that is 100 times more dangerous, who cares? I ride my bike anyway. It

doesn't slow me down. I'd jump at the chance to climb Mt. Everest. I guess I can really see a huge difference in my perspective.

I think if you do both at the same time your chances are really high. If you are saying I just smoke cigarettes or I just drink water I would have to say they are about the same.

I remembered they measured the health risk of radon gas, this many chest x-rays, 200 per year is equal to this level of radon in the air.

Whose Responsibility?

hm, I'm kind of irate that I am stuck in this situation, I am forced to pay for something that I thought would be safe all along. I was really kind of bothered by the fact that I have to pay for water that was contaminated by somebody else. Through somebody else's negligence. Like most people I guess the consumer has to pay for it so I will just toss upset in there. I realize I have to pay for it anyway whether it's out of my pocket or some other way.

Interesting Mental Models

I just imagine this green stuff that was in 55-gallon drums that's ail, seeping into the ground, I had a definite picture in my head.

Our community has a landfill. I never use it. I put my trash on the curb.

(Wash car less? R answered 100%) I would still get it washed at the car wash, 100% less.

Emotional Involvement

Some paragraphs were a little long, I wished they weren't that dry. I thought they could have been a little lighter. Gotten more involved. I felt like I was reading a dictionary rather than something to do with my community.

Sensitivity to Higher Risk

(Would YOU pay more for higher risk?) Well no, because if everyone in the city paid S 10 a month that would create a huge amount of money and make a huge difference.

(pay more for higher risk?) No. No. But if they said your personal friend was affected and was one of 25, maybe.

Why Zero Bid?

. ..mandatory water usage would be a better idea. Mandatory water restrictions/ effective but unpopular however, a suitable solution in my opinion. I thought of my sister in California who has mandatory water restrictions. I know it's not ail that hard.

I would say not, take a chance that it wouldn't run out/be needed.

I decided that I wouldn't vote for it because I don't make that much money and I don't want to pay any more . . ..I think that the government should use my tax money. They should use the money I already pay.

Don't pay for an extra year of procrastination. All you are doing (by buying water from another community) is buying yourself a year.

Meaning of Questions

(S gave $15-$20 to original question but only $10 to referendum question). Ya, I was thinking about (what other people would pay). In general I think 1 would be wilting to pay more than other people. I think I lowered my dollar amount to make it acceptable. I would want something like that to pass.

Yes, I did think about (what other people would do) and also about how are they going to do this so it can get passed. The people that get it on (the ballot) are going to want it passed, I was thinking about what other people might vote for.

i don't know exactly what referendum means.

I was thinking that I am not registered to vote. I have put it off for years; I'm not voting. We decided we would get registered and vote.

I was thinking about if I actually would vote. Recently I decided I would vote in the next election because I didn't vote lost year.

Percentage Splits

I am a pretty selfish person, 9096 about the family and me and divided up the other 10%. I thought about dividing up after.

I'd say I don't quite understand the last part . . ..future use. The only reason I care about it being in the ground is because we are going to use it.

Family 100%, future generations 100%, Not allowing contaminants to remain 100%.

Mental Model of Groundwater

Probably not very fast. Probably depends on where the water comes from. 2 feet/second. 2 hours . . .. Maybe 10 miles.

Very surprised (to learn groundwater speed). I didn't realize that.

Extremely surprised, Think about a potted plant, pour it in and it runs out immediately,

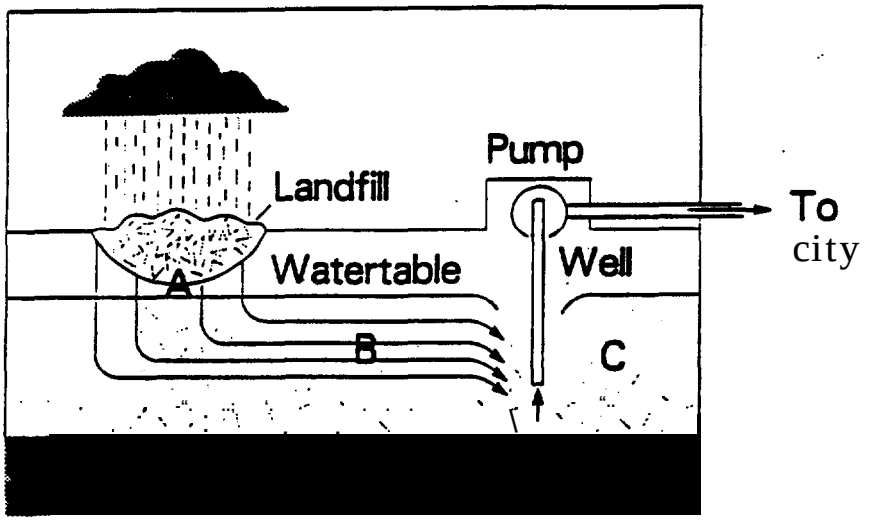
30 miles an hour/ tops. it shoots out of there pretty quick,

Urn, I'd say pretty quick. Like in miles per hour? It's got to be quicker than people would guess. Not nearly as quick as a river but I know it flows out of the fields.

It seems like it could go through a mile in a matter of an hour if the water is moving that fast . . ..I would have to guess on something that is fairly shallow like a city water supply it could goat the most maybe 10 or 15 miles.

Not surprised, I thought it moved slower. I had a geology class recently and that was part of the aquifer and aquafluids so I was aware on how groundwater works and functions.

GROUNDWATER CONTAMINATION: WHAT IS YOUR OPINION?



This survey should b. completed by a head of your household.

Please return survey to:
Center for Economic Aalysis
University of Colorado
Boulder, Colorado 80309-0257

APPENDIX D

FACSIMILE SURVEYS

THE ISSUES

About 50% of the water used by the U.S. population for drinking, cooking, bathing and other home purposes comes from groundwater. We are interested in your views on what, if anything, should be done to clean up contaminated groundwater which can no longer be used without treatment.

Q1 Are you aware of groundwater contamination in your community coming from any of these specific sources? (Circle the best answer)

1. No (44.47%)

2. YES (Circle all that apply)

A. SUPERFUND SITE (2.07%)	B. HAZARDOUS WASTE SITE (12.01%)	C. LANDFILL (57.56%)
D. SEPTIC TANK (13.870A)	E. AGRICULTURAL RUNOFF (17.39%)	F. INDUSTRY (20.29%)

G. OTHER (Please Specify) _____ (.007%0)

Q2 Because the rest of this survey concerns only groundwater contamination, it is useful to understand how important you feel cleaning up contaminated groundwater is in comparison to other issues. From least to most concerned, how do you rate the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL CONCERNED						GREATLY CONCERNED	
Improving public roads	1	2	3	4	5	6	7	(4.42)
Improving the education system	1	2	3	4	5	6	7	(5.99)
Reducing air pollution	1	2	3	4	5	6	7	(5.72)
Saving endangered species	1	2	3	4	5	6	7	(4.61)
Reducing global warming	1	2	3	4	5	6	7	(4.95)
Promoting recycling	1	2	3	4	5	6	7	(5.53)
Cleaning up rivers and lakes	1	2	3	4	5	6	7	(6.06)
Cleaning up groundwater	1	2	3	4	5	6	7	(6.01)

Water for residential use can come from many different sources, including rivers, lakes, and groundwater. Groundwater comes from rain and snow that falls on the land and seeps underground. At some depth underground the soil or rock becomes saturated with water, and this water can then be pumped to the surface.

Q3 Does your household get any part of its water from groundwater?

1. NO -WE DON'T USE GROUNDWATER AT ALL	(29%)
2. YES - PART OF OUR WATER COMES FROM GROUNDWATER	(16.4%)
3. YES - ALL OF OUR WATER COMES FROM GROUNDWATER	(34.3%)
4. DON'T KNOW	(20.3%)

Q4 Sometimes, garbage and waste placed in a community's landfill, similar to the one shown on the cover of this survey, can leak out and contaminate groundwater. Does your community have a landfill?

1. NO	(33.1 %)
2. YES	(58.5%)
3. DON'T KNOW	(8.4%)

Rainwater seeping through a landfill may dissolve some of the chemicals in the discarded trash. This material, which can be toxic, may seep into the water table and contaminate the water below (as A shows on the front cover). Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B on the front cover). Many people are surprised to learn that this flow is very very slow; usually less than 100 feet per year. After many years, the landfill may contaminate water drawn by a well supplying water to the citizens of the community (see C on the front cover).

Q5 Does your community currently draw water from wells which have been or are in danger of becoming contaminated?

1. NO	(46.2%)
2. YES - CONTAMINATED BY A LANDFILL	(6.9%)
3. YES - CONTAMINATED BY ANOTHER SOURCE (please specify) __	(6.1%)__
4. DON'T KNOW	(40.8%)

HOW COMMUNITIES CAN RESPOND TO CONTAMINATED GROUNDWATER

In the rest of the survey, we would like you to consider an imaginary situation Suppose that you live in a community which has groundwater contamination as the result of a leaking public landfill. Contaminants have been found in groundwater which normally supply 40% of the water used by the community. Contamination covers approximately five acres underground (in an area 700 feet long and 390 feet wide and 25 feet deep). The other 60% of the water supply is from uncontaminated surface water sources. In answering the following questions, you should assume that:

- **The contamination is the result of standard public landfill practices used in the past that were believed to be safe at the time. No private company or party is at fault.**

- **Scientists estimate that drinking the contaminated water would increase the risk of cancer, resulting in about 10 additional deaths per million people who drink the water per year (about the same level of risk a typical person has of developing cancer from exposure to routine medical x-rays).**

- **Local government has concluded that the water must not be used for drinking or cooking unless it is treated to remove the contaminants. It could, however, be used as is for such purposes as bathing, washing clothes, or watering lawns.**

There are many ways a community might respond to such a groundwater problem. For each of the following cleanup options please circle the number indicating how satisfied you are with that solution.

Q6 COMPLETE CLEANUP. The water bills of current users would be increased to pay for a complete groundwater cleanup. An underground concrete wall would be built around the landfill down to the solid rock layer to seal it off from the groundwater. All contaminated water would be pumped up and cleaned. The clean water would be reinfected back underground for use now and in the future. This would benefit your household and future generations by ensuring that about the same amount of clean water is available as before the contamination occurred. How satisfied are you with this option?

NOT SATISFIED AT ALL						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(4.46)

Q7 CONTAINMENT. Wells would be drilled in the area to which contaminated groundwater is moving. Contaminated water would be pumped up to stop it from spreading further. This water would be cleaned and pumped back underground into the containment area. This approach does not complete clean up the contamination. Your household would have the same amou of clean water to use since new supply wells would be drilled outside of the containment area. The water bills of current users would be increased to pay for the containment system. Future generations would pay for operation and maintenance costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.46)

Q8 PUBLIC TREATMENT. The local government would increase water bills of users to pay for the construction, maintenance and operation of a water treatment plant to remove contaminants from the water as needed. Contaminants would remain in the ground yet never enter the public wate supply. Future generations would have to pay for their own treatment costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.67)

Q9 HOME TREATMENT. Each household purchases and installs its own charcoal filtration system to remove contaminants before the water is used in the home. These systems typically cost $180 to install and an additional $25 per month for maintenance. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMEMLY SATISFIED	
1	2	3	4	5	6	7	(2.87)

Q10 WATER RATIONING. The local government would 'institute a mandatory water conservation program to avoid having to make up the 40% shortfall. The contaminated water would not be cleaned up nor used. Surface water from lakes and streams provides the 60% of available clean water. Water bills would not increase but everyone would have to cut their water use by 40%. Realizing that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen, how satisfied are you with water rationing as an option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.46)

HOW MUCH IS IT WORTH TO YOU TO COMPLETELY CLEAN UP CONTAMINATED GROUNDWATER?

Your answers to the next questions are very important. We do not yet know how much it will cost to clean up contaminated groundwater. However, to make decisions about new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth" to people like you.

Q11 Suppose that the complete cleanup program described in Q6 could be achieved in your imaginary community. What would a complete cleanup program be worth to your household, if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering, you should assume that:

- **The money would be used only in this hypothetical community for sealing off the landfill, cleaning the contaminated water and for purchasing clean water until the cleanup is completed. The cost of the project (unknown at this time) would be spread out over a ten year period.**
- **If the program turns out to cost less than people are willing to pay, each household would only pay a share of what it costs. If it turns out to cost more than people are willing to pay, the program would not be carried out.**
- **Scientists are satisfied that water cleaned and reinfected using these methods will be contaminant-free and safe to drink.**
- **The program would also provide benefits to future generations. New families moving in or just starting out would not have to pay any money to ensure the groundwater they used was clean.**

Now, what is the most your household would be willing to pay each month on top of your current water bill for the next 10 years for the complete groundwater cleanup program? (Circle the best response.)

(12.23)

$0	**$1.50**	**$4**	$10	$30	**$75**	**$200**
$0.50	**$2**	**$5**	**$15**	**$40**	**$100**	**$500**
$1	**$3**	**$8**	**$20**	**$50**	**$150**	**MORE THAN $500**

Q12 Some people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount you stated your household would be willing to pay for complete groundwater cleanup (Q1 1) is: . (Circle number)

1. JUST FOR THE STATED GROUNDWATER PROGRAM (Go to Q 14)

2. SOMEWHAT FOR THE GROUNDWATER PROGRAM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES

3. BASICALLY A CONTRIBUTION TO ALL ENVIRONMENTAL OR OTHER WORTHWHILE PUBLIC CAUSES

4. OTHER (Please specify)_____

1- 71 .5%, 2-1 6.3%, 3-10.50A, 4-1 .7%

Q13 About what percent of your dollar amount is just for the stated complete groundwater cleanup program? (Circle percent)

(76.1 2°/0)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q14 Of the amount you would pay just for the complete groundwater cleanup program, about what percent would be to ensure

(36.32)%	THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE
(21 .43)%	THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE
(23.94)%	THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE
(18.31)%	THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
= 100%	TOTAL

Q15 On a scale from 1 to 7, how responsible would you feel for helping to pay to clean up such a groundwater contamination problem in your community.

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE	
1	2	3	4	5	6	7	(4.15)

HOW MUCH IS IT WORTH TO YOU TO PREVENT FURTHER SPREADING OF CONTAMINATED GROUNDWATER?

Suppose that a complete groundwater cleanup is not technically possible in your imaginary community. So, your community proposes a CONTAINMEN PROGRAM like that described in Q7 in which groundwater would be contained and isolated, and movement of the groundwater would be controlled.

Q16 What would a containment program iike that described in Q7 be worth to your household if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? in answering you should assume that:

- **The money would be used for design, construction, operation, and maintenance of the groundwater containment system. initial costs for design and construction would be spread out over a ten year period. Future generations would have to pay for their own operation and maintenance costs.**
- **if the program turned out to cost less than people were willing to pay, each household would pay a share of what it cost. if it turned out to cost more than people were willing to pay, the program would not be carried out.**
- **Scientists are satisfied that contaminated groundwater can be contained to prevent further spreading and that groundwater outside this zone would be contaminant-free and safe to drink.**
- **This approach does not completely clean up the existing contaminated groundwater. it prevents the spread of the contamination and wiii require new wells to be drilled outside of the containment zone.**

Now, of the dollar amount You would have paid just for complete groundwater cleanup, what percent would you be willing to pay for the containment program described above? (Circle percent)

(42.85%)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

ABOUT YOU AND YOUR HOUSEHOLD

H1 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNT (69.3%)
2. A PRIVATE WATER SUPPLIER (8.7%)
3. OUR PRIVATE WELL (18.2%)
4. OTHER (Please specify) _____ (3.8%)

H2 Your gender:

1. FEMALE (33%)
2. MALE (67%)

H3 Your age: (50.91 YEARS

H4 Including yourself, how many members in your household are in each age group? (If none, write "0")

____ UNDER 18 YEARS OF AGE (1.09)
____ 18-64 (1.87)
____ 65 AND OVER (.85)

H5 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION (.2%)
2. SOME GRADE SCHOOL (1.3%)
3. COMPLETED GRADE SCHOOL (3.4?40)
4. SOME HIGH SCHOOL (5.7%)
5. COMPLETED HIGH SCHOOL(18.4%)
6. TRADE SCHOOL (7%)
7. SOME COLLEGE (27%)
8. COMPLETED COLLEGE (18.8%)
9. SOME GRADUATE WORK (5.9?40)
10. ADVANCED COLLEGE DEGREE(12.40A)

H6 Do you recycle or take special precautions in disposing of any of the following materials? (circle appropriate response for each)

1. NEWSPAPER YES NO DON'T KNOW (72.1% Yes)
2. GLASS YES NO DON'T KNOW (56.9'% Yes)
3. ALUMINUM OR OTHER METALS YES NO DON'T KNOW (76.7% Yes)
4. PLASTIC YES NO DONTKNOW (54.2% Yes)
5. PAINTS AND PAINT THINNERS YES NO DON'T KNOW (46.7% Yes)
6. USED ENGINE OIL AND COOLANT/ANTIFREEZE YES NO DON'T KNOW (62.1% Yes)
7. HOUSEHOLD CHEMICALS YES NO DON'T KNOW (40.6% Yes)
8. OTHER (please specify) _____ (2.3%)

H7 In the past year, have you held membership or donated time or money to any environmental organizations or groups?

1. No	(71 .6%)
2. YES - ONE GROUP	(20.3%)
3. YES - TWO OR THREE GROUPS	(6.5%)
4. YES - MORE THAN THREE GROUPS	(1 .5%)

H8 How would you describe your racial or ethnic background? (circle one)

1. WHITE OR CAUCASIAN	(90.5%)
2. BLACK OR AFRICAN AMERICAN	(4.3%)
3. HISPANIC OR MEXICAN AMERICAN	(2.2%)
4. ASIAN OR PACIFIC ISLANDER	(1.1%)
5. NATIVE AMERICAN INDIAN	(.6%)
6. OTHER (please specify) _____	(1 .3%)_____

H9 What is your present employment? (Circle the best answer)

1. EMPLOYED FULL TIME (56.8°4)
2. EMPLOYED PART TIME (6.6)
3. FULL TIME HOMEMAKER (3.2%)
4. UNEMPLOYED (1.9%)
5. RETIRED (25.8%)
6. STUDENT (1.3%)
7. OTHER (Please specify)(4 . 4 %)_____

H10 What is your total annual household income before taxes and other deductions? (circle one)

1. UNDER $9,999 (8.5%)	9. $80,000-89,999 (2.1%)
2. $10,000-19,999 (17.8%)	10. $90,000-99,999 (3.1%)
3. $20,000-29,999 (15%)	11. $100,000-119,999 (3.8%)
4. $30,000-39,999 (16.2%)	12. $120,000-139,999 (1.4%)
5. $40,000-49,999 (12.2%)	13. $140,000-159,999 (o%)
6. $50,000-59,999 (11.7%)	14. $160,000-179,000 (.2%)
7. $60,000-69,999 (4.2%)	15. $180,000-199,999 (.2%)
8. $70,000-79,999 (2.6%)	16. $200,000 and OVER (.9%)

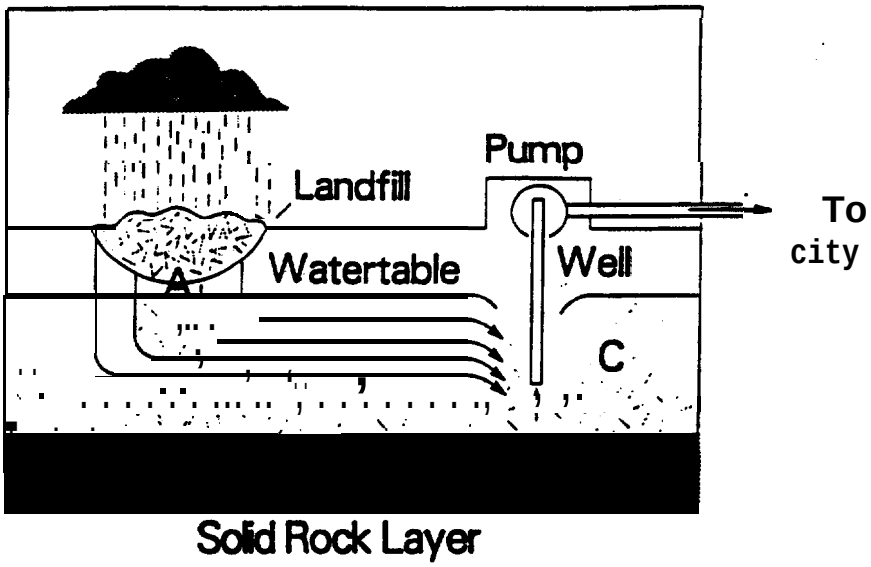
Is there anything we **have overlooked? Please use the space below to write any comments or suggestions you may have about the survey.**

YOUR PARTICIPATION IS GREATLY APPRECIATED!

☐ 1 **Check this box if you would like a summary of the results.**

(If different from mailing label, list your name and address here.)

GROUNDWATER CONTAMINATION: WHAT IS YOUR OPINION?



This survey should be completed by a head of your household.

Please return survey to:
Center for Economic Analysis
University of Colorado
Boulder. Colorado 80309-0257

THE ISSUES

About 50% of the water used by the U.S. population for drinking, cooking, bathing and other home purposes comes from groundwater. We are interested in your views on what, if anything, should be done to clean up contaminated groundwater which can no longer be used without treatment.

Q1 Are you aware of groundwater contamination in your community coming from any of these specific sources? (Circle the best answer)

1. NO (48.9%)

2. YES (Circle all that apply) (51.1%)

A. SUPERFUND SITE (3.48%) **B. HAZARDOUS WASTE SITE** (9.20%) **C. LANDFILL (61.14%)**

D. SEPTIC TANK (13.50?4) **E. AGRICULTURAL RUNOFF (19.01%)** **F. INDUSTRY (20.24%)**

G. OTHER (Please Specify) (9 . 0 0 / 0)_____

Q2 Because the rest of this survey concerns only groundwater contamination, it is useful to understand how important you feel cleaning up contaminated groundwater is in comparison to other issues. From least to most concerned, how do you rate the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL CONCERNED						GREATLY CONCERNED	
Improving public roads	1	2	3	4	5	6	7	(4.54)
Improving the education system	1	2	3	4	5	6	7	(5.83)
Reducing air pollution	1	2	3	4	5	6	7	(5.79)
Saving endangered species	1	2	3	4	5	6	7	(4.67)
Reducing global warming	1	2	3	4	5	6	7	(5.01)
Promoting recycling	1	2	3	4	5	6	7	(5.55)
Cleaning up rivers and lakes	1	2	3	4	5	6	7	(6.07)
Cleaning up groundwater	1	2	3	4	5	6	7	(5.95)

Water for residential use can come from many different sources, including rivers, lakes, and groundwater. Groundwater comes from rain and snow that falls on the land and seeps underground. At some depth underground the soil or rock becomes saturated. with water, and. this water can then be pumped to the surface.

Q3 Does your household get any part of its water from groundwater?

1. NO -WE DON'T USE GROUNDWATER AT ALL (28.5%)
2. YES - PART OF OUR WATER COMES FROM GROUNDWATER(22.0%)
3. YES - ALL OF OUR WATER COMES FROM GROUNDWATER (32.4%)
4. DON'T KNOW (17.2%)

Q4 Sometimes, garbage and waste placed in a community's landfill, similar to the one shown on the cover of this survey, can leak out and contaminate groundwater. Does your community have a landfill?

1. NO (27.1 %)
2. YES (62.4%)
3. DON'T KNOW (10.2%)

Rainwater seeping through a landfill may dissolve some of the chemicals in the discarded trash. This material, which can be toxic, may seep into the water table and contaminate the water below (as A shows on the front cover). Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B on the front cover). Many people are surprised to learn that this flow is very very slow; usually less than 100 feet per year. After many years, the landfill may contaminate water drawn by a well supplying water to the citizens of the community (see C on the front cover).

Q5 Does your community currently draw water from wells which have been or are in danger of becoming contaminated?

1. NO (51.9%)
2. YES - CONTAMINATED BY A LANDFILL (6.1%)
3. YES - CONTAMINATED BY ANOTHER SOURCE (Please specify)(5.4%).
4. DON'T KNOW (34.69%)

HOW COMMUNITIES CAN RESPOND TO CONTAMINATED GROUNDWATER

In the rest of the survey, we would like you to consider an imaginary situati Suppose that you live in a community which has groundwater contamination as the result of a leaking public landfill. Contaminants have been found in groundwater which normally supply 40% of the water used by the community. Contamination covers approximately five acres underground (in an area 700 feet long and 390 feet wide and 25 feet deep). The other 60% of the water supply is from uncontaminated surface water sources. In answering the following questions, you should assume that:

- **The contamination is the result of standard public landfill practices used in the past that were believed to be safe at the time. No private company or party is at fault.**

- **Scientists estimate that drinking the contaminated water would increas the risk of cancer, resulting in about 10 additional deaths per million people who drink the water per year (about the same level of risk a typical person has of developing cancer from exposure to routine medical x-rays).**

- **Local government has concluded that the water must not be used for drinking or cooking unless it is treated to remove the contaminants. It could, however, be used as is for such purposes as bathing, washing clothes, or watering lawns.**

There are many ways a community might respond to such a groundwater problem. For each of the following cleanup options please circle the number indicating how satisfied you are with that solution.

Q6 COMPLETE CLEANUP. The water bills of current users would be increased to pay for a complete groundwater cleanup. An underground concrete wall would be built around the landfill down to the solid rock layer to seal it off from the groundwater. All contaminated water would be pumped up and cleaned. The clean water would be reinfected back underground for use now and in the future. This would benefit your household and future generations by ensuring that about the same amount of clean water is available as before the contamination occurred. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(4.39)

Q7 **CONTAINMENT.** Wells would be drilled in the area to which contaminated groundwater is moving. Contaminated water would be pumped up to stop it from spreading further. This water would be cleaned and pumped back underground into the containment area. This approach does not completely clean up the contamination. Your household would have the same amount of clean water to use since new supply wells would be drilled outside of the containment area. The water bills of current users would be increased to pay for the containment system. Future generations would pay for operation and maintenance costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.49)

Q8 **PUBLIC TREATMENT.** The local government would increase water bills of users to pay for the construction, maintenance and operation of a water treatment plant to remove contaminants from the water as needed. Contaminants would remain in the ground yet never enter the public water supply. Future generations would have to pay for their own treatment costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.80)

Q9 **HOWM TREATMENT.** Each household purchases and installs its own charcoal filtration system to remove contaminants before the water is used in the home. These systems typically cost $180 to install and an additional $25 per month for maintenance. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.77)

Q1 0 **WATER RATIONING.** The local government would institute a mandatory water conservation program to avoid having to make up the 40°A shortfall. The contaminated water would not be cleaned up nor used. surface water from lakes and streams provides the 60% of available clean water. Water bills would not increase but everyone would have to cut their water use by 40%. Realizing that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen, how satisfied are you with water rationing as an option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.53)

HOW MUCH IS IT WORTH TO YOU TO COMPLETELY CLEAN UP CONTAMINATED GROUNDWATER?

Your answers to the next questions are very important. We do not yet know how much it will cost to clean up contaminated groundwater. However, to make decisions about new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth to people like you.

Q11 Suppose that the complete cleanup program described in Q6 could be achieved in your imaginary community. What would a complete cleanup program be worth to your household, if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering, you should assume that:

- **The money would be used only in this hypothetical community for sealing off the landfill, cleaning the contaminated water and for purchasing clean water until the cleanup is completed. The cost of the project (unknown at this time) would be spread out over a ten year period.**
- **If the program turns out to cost less than people are willing to pay, each household would only pay a share of what it costs. If it turns out to cost more than people are willing to pay, the program would not be carried out.**
- **Scientists are satisfied that water cleaned and reinfected using these methods will be contaminant-free and safe to drink.**
- **The program would also provide benefits to future generations. New families moving in or just starting out would not have to pay any money to ensure the groundwater they used was clean.**

Now, what is the most your household would be willing to pay each month on top of your current water bill for the next 10 years for the complete groundwater cleanup program? (Circle the best response.)

(12.26)

$0	**$1.50**	$4	**$10**	$30	$75	$200
$0.50	$2	$5	$15	$40	$100	‘ ?$500
$1	$3	$8	$20	$50	$150	**MORE THAN $500**

Q12 Some people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount you stated your household would be willing to pay for complete groundwater cleanup (Q11) is: (Circle number)

1. JUST FOR THE STATED GROUNDWATER PROGRAM (Go to Q 14)

2. SOMEWHAT FOR THE GROUNDWATER PROGRAM AND SOMEWHAT A GENERAL CONTRIBUTION TO AU ENVIRONMENTAL CAUSES

3. BASICALLY A CONTRIBUTION TO ALL ENVIRONMENTAL OR OTHER WORTHWHILE PUBLIC CAUSES

4. OTHER (Please specify)_____

1 -69.5%, 2-1 6.3%, 3-1 1.0%, 4-3.2%

Q13 About what percent of your dollar amount is just for the stated complete groundwater cleanup program? (Circle percent)

(75.93%)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q14 Of the amount you would pay just for the complete groundwater cleanup program, about what percent would be to ensure

(33.41) % THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE
(20.62) % THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE
(24.13) % THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE
(21.83) % THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
= 100 % TOTAL

Q15 On a scale from 1 to 7, how responsible would you feel for helping to pay to clean up such a groundwater contamination problem in your community.

NOT AT ALL RESPONSIBLE					EXTREMELY RESPONSIBLE		
1	2	3	4	5	6	7	(4.26)

ABOUT THE NATIONAL GROUNDWATER PROBLEM

To plan new groundwater cleanup programs, decision makers want to know ho much it is worth to you to help solve groundwater problems, not just in your community, but across the entire nation. According to the Environmental Protection Agency (EPA) there are about 6000 landfills in the U.S. of which about 2000 are or will leak contaminants into the groundwater. There also are about 2400 other types of sites leaking contaminants. On average these sites are about the size described in the previous section.

The Environmental Protection Agency estimates that in the U. S.:

- **groundwater supplies about 53% of the water used for domestic purposes such as cooking, bathing, and drinking**
- **in 1987 about 6% of the people supplied by public groundwater systems were using water that violated EPA standards.**

Q16 How likely do you feel it is that you will move to another community in the next ten years?

NOT AT ALL LIKELY						CERTAIN	
1	2	3	4	5	6	7	(2.85)

Suppose that each community across the country makes certain that no one is drinking contaminated water. Some communities might choose to fund complete groundwater cleanup, but others may choose other programs such as a water supply treatment, containment, or mandatory water conservation. However, some contaminants in some communities would remain in the groundwater indefinitely.

Q17 What would it be worth to your household to help fund complete groundwater cleanup for communities other than yours which do not choose to pay for it? In answering, you should assume that:

- **The money would be used only to increase local programs to the level of complete groundwater cleanup programs as described in Q6. The money paid for these programs would supplement, not replace, whatever people living in the affected communities were willing to pay.**

■ **If the supplemental programs to bring complete cleanup to all sites across the country turn out to cost less than people are willing to pay, each household would only pay a share of what it costs. If they turn out to cost more than people are willing to pay, the programs would not be performe**

Now, of the dollar amount you would have paid just for complete groundwater cleanup in your community how much, in addition, would you pay to help fund supplemental complete groundwater cleanup in other communities across the country. (Circle the best percent response).

(11.29%)

No MORE		A LITTLE MORE		HALF AGAIN AS MUCH		EQUAL AMOUNT	MORETHAN EQUAL
0%	5%	10%	25%	50%	75%	100%	100%+

Q18 Of the extra amount you would pay just to help fund supplemental complete groundwater treatment programs across the nation, about what percent would be to ensure

(32.72) % THAT YOUR HOUSEHOLD WILL HAVE CLEAN WATER TO USE IF YOU MOVE TO A DIFFERENT COMMUNITY

(21 .38) % THAT OTHER PEOPLE ACROSS THE COUNTRY WILL HAVE ENOUGH CLEAN WATER TO USE

(26.30) % THAT FUTURE GENERATIONS OF PEOPLE ACROSS THE COUNTRY WILL HAVE ENOUGH CLEAN WATER TO USE

(17.59) % THAT GROUNDWATER ACROSS THE NATION IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT

(2.01) % OTHER (Please describe: _____)

= 100 % TOTAL

Q19 On a scale from 1 to 7, how responsible do you feel for helping to pay to clean up groundwater contamination problems in other communities across the nation?

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE	
1	2	3	4	5	6	7	(4.26)

ABOUT YOU AND YOUR HOUSEHOLD

H1 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY (71.4%)
2. A PRIVATE WATER SUPPLIER (7.5%)
3. OUR PRIVATE WELL (16%)
4. OTHER (Please specify) _____(5.1%)_____

H2 Your gender:

1. FEMALE (30%)
2. MALE (70%)

H3 Your age: ____ (52.12)_YEARS

H4 Including yourself, how many members in your household are in each age group? (If none, write "0")

(.96) UNDER 18 YEARS OF AGE
(1.75) 18-64
(.83) 65 AND OVER

H5 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION (.2%)
2. SOME GRADE SCHOOL (1.5%)
3. COMPLETED GRADE SCHOOL (1.3%)
4. SOME HIGH SCHOOL (5.3%)
5. COMPLETED HIGH SCHOOL (20.4%)
6. TRADE SCHOOL (6.6%)
7. SOME COLLEGE (23.6%)
8. COMPLETED COLLEGE (20.6%)
9. SOME GRADUATE WORK (8.1%)
10. ADVANCED COLLEGE DEGREE (12.5%)

H6 Do you recycle or take special precautions in disposing of any of the following materials? (circle appropriate response for each)

1. NEWSPAPER YES NO DON'T KNOW (73.1% yes)
2. GLASS YES NO DON'T KNOW (6006% yes)
3. ALUMINUM OR OTHER METALS YES NO DON'T KNOW (83.4% yes)
4. PLASTIC YES NO DON'T KNOW (58.1% yes)
5. PAINTS AND PAINT THINNERS YES NO DON'T KNOW (49.2% yes)
6. USED ENGINE OIL AND COOLANT/ANTIFREEZE YES NO DON'T KNOW (62.7% yes)
7. HOUSEHOLD CHEMICALS YES NO DON'T KNOW (44.5% yes)
8. OTHER (please specify) _____(5.3% yes)_____

H7 In the past year, have you held membership or donated time or money to any environmental organizations or groups?

1. NO (70.970)
2. YES -- ONE GROUP (19.5'%0)
3. YES - TWO OR THREE GROUPS (8.3'%)
4. YES - MORE THAN THREE GROUPS (1 .30A)

H8 How would you describe your racial or ethnic background? (circle one)

1. WHITE OR CAUCASIAN (90.5%)
2. BLACK OR AFRICAN AMERICAN (5.7%)
3. HISPANIC OR MEXICAN AMERICAN (1.9%)
4. ASIAN OR PACIFIC ISLANDER (11%)
5. NATIVE AMERICAN INDIAN (0%)
6. OTHER (please specify) _____(.8%)_____

H9 What is your present employment? (Circle the best answer)

1. EMPLOYED FUU TIME (53.7%)
2. EMPLOYED PART TIME (7.6%)
3. FULL TIME HOMEMAKER (4.3%)
4. UNEMPLOYED (1 .3%)
5. RETIRED (27.8%)
6. STUDENT (1 .3%)
7. OTHER (Please specify)(5 . 1 %) _____

H10 What is your total annual household income before taxes and other deductions? (circle one)

1. UNDER $9,999 (8.7%)
2. $10,000- 19,999 (13.6%)
3. $20,000-29,999 (15%)
4. $30,000 - 39,999 (16.6%)
5. $40,000 -49,999 (14.1%)
6. $50,000-59,999 (1 1.5%)
7. $60,000-69,999 (4.7%)
8. $70,000-79,999 (4.4%)
9. $80,000-89,999 (3.3%)
10. $90,000-99,999 (1 .9%)
11. $100,000 " 119,999 (3.3%)
12. $120,000-139$999 (*9%)
13. $140,000-159,999 (.5%)
14. $160,000-179,000 (O%)
15. $180,000-199,999 (.2%)
16. $200,000 and OVER (1 .4%)

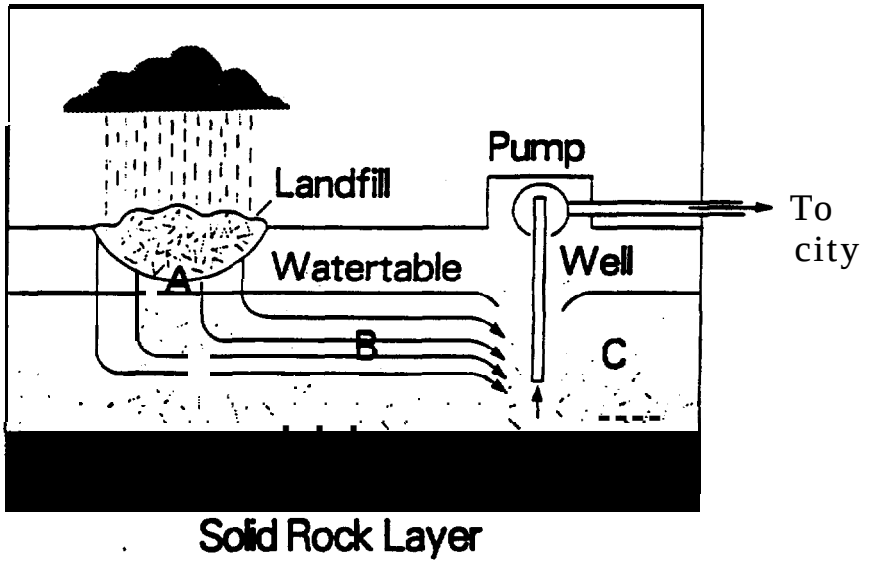
Is there anything we have overlooked? Please use the space below to write any comments or suggestions you may have about the survey.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

n ☐ **Check this box if you would like a summary of the results.**

(If different from mailing label, list your name and address here.)

GROUNDWATER CONTAMINATION: WHAT IS YOUR OPINION?



This survey should be completed by a head of your household

Please return survey to:
Center for Economic Analysis
University of Colorado
Boulder, Colorado 80309-0287

THE ISSUES

About 50% of the water used by the U.S. population for drinking, cooking, bathing and other home purposes comes from groundwater. We are interested in your views on what, if anything, should be done to clean up contaminated groundwater which can no longer be used without treatment.

Q1 Are you aware of groundwater contamination in your community coming from any of these specific sources? (Circle the best answer)

1. No (49%)

2. YES (Circle all that apply) (51%)

A. SUPERFUND SITE (3.9%) **B. HAZARDOUS WASTE SITE (10.2%)** **C. LANDFILL (59.2%)**

D. SEPTIC TANK (11 .4%) **E. AGRICULTURAL RUNOFF (19.6%)** **F. INDUSTRY (21.4%)**

G. OTHER (Please Specify)(6.9%)

Q2 Because the rest of this survey concerns only groundwater contamination, it is useful to understand how important you feel cleaning up contaminated groundwater is in comparison to other issues. From least to most concerned, how do you rate the issues listed below? (Circlenumber of best response for each issue.)

	NOT AT ALL CONCERNED						GREATLY CONCERNED	
Improving public roads	1	2	3	4	5	6	7	(4.37)
Improving the education system	1	2	3	4	5	6	7	(5.94)
Reducing air pollution	1	2	3	4	5	6	7	(5.73)
Saving endangered species	1	2	3	4	5	6	7	(4.61)
Reducing global warming	1	2	3	4	5	6	7	(4.96)
Promoting recycling	1	2	3	4	5	6	7	(5.62)
Cleaning up rivers and lakes	1	2	3	4	5	6	7	(6.00)
Cleaning up groundwater	1	2	3	4	5	6	7	(6.00)

Water for residential use can come from many different sources, including rivers, lakes, and groundwater. Groundwater comes from rain and snow that falls on the land and seeps underground. At some depth underground the soil or rock becomes saturated with water, and this water can then be pumped to the surface.

Q3 Does your household get any part of its water from groundwater?

1. NO -- WE DONT USE GROUNDWATER AT ALL (28.5%)
2. YES - PART OF OUR WATER COMES FROM GROUNDWATER (17.3?40)
3. YES - ALL OF OUR WATER COMES FROM GROUNDWATER (34.470)
4. DONT KNOW (19.80/o)

Q4 Sometimes, garbage and waste placed in a community's landfill, similar to the one shown on the cover of this survey, can leak out and contaminate groundwater. Does your community have a landfill?

1. NO (28.3%)
2. YES (59.9%)
3. DON'T KNOW (11.8%)

Rainwater seeping through a landfill may dissolve some of the chemicals in the discarded trash. This material, which can be toxic, may seep into the water table and contaminate the water below (as A shows on the front cover). Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B on the front cover). Many people are surprised to learn that this flow is very very slow; usually less than 100 feet per year. After many years, the landfill may contaminate water drawn by a well supplying water to the citizens of the community (see C on the front cover).

Q5 Does your community currently draw water from wells which have been or are in danger of becoming contaminated?

1. NO (49.6%)
2. YES - CONTAMINATED BY A LANDFILL (7.3%)
3. YES - CONTAMINATED BY ANOTHER SOURCE (Please specify) .(7 . 3 %)
4. DON'T KNOW (35.9"/0)

HOW COMMUNITIES CAN RESPOND TO CONTAMINATED GROUNDWATER

In the rest of the survey, we would like you to consider an imaginary situatio Suppose that you live in a community which has groundwater contamination as the result of a leaking public landfill. Contaminants have been found in groundwater which normally supply 40% of the water used by the community. Contamination covers approximately five acres underground (in an area 700 feet long and 390 feet wide and 25 feet deep). The other 60% of the water supply is from uncontaminated surface water sources. In answering the following questions, you should assume that:

- **The contamination is the result of standard public landfill practices used in the past that were believed to be safe at the time. No private company or party is at fault.**

- **Scientists estimate that drinking the contaminated water would increase the risk of cancer, resulting in about 10 additional deaths per million people who drink the water per year (about the same level of risk a typical person has of developing cancer from exposure to routine medical x-rays).**

- **Local government has concluded that the water must not be used for drinking or cooking unless it is treated to remove the contaminants. It could, however, be used as is for such purposes as bathing, washing clothes, or watering lawns.**

There are many ways a community might respond to such a groundwater problem. For each of the following cleanup options please circle the number indicating how satisfied you are with that solution.

Q6 COMPLETE CLEANUP. The water bills of current users would be increased to pay for a complete groundwater cleanup. An underground concrete wall would be built around the landfill down to the solid rock layer to seal it off from the groundwater. All contaminated water would be pumped up and cleaned. The clean water would be reinfected back underground for use now and in the future. This would benefit your household and future generations by ensuring that about the same amount of clean water is available as before the contamination occurred. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(4.27)

Q7 CONTAINMENT. Wells would be drilled in the area to which contaminated groundwater is moving. Contaminated water would be pumped up to stop it from spreading further. This water would be cleaned and pumped back underground into the containment area. This approach does not complete clean up the contamination. Your household would have the same amount of clean water to use since new supply wells would be drilled outside of the containment area. The water bills of current users would be increased to pay for the containment system. Future generations would pay for operation and maintenance costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3:47)

Q8 PUBLIC TREATMENT. The local government would increase water bills of users to pay for the construction, maintenance and operation of a water treatment plant to remove contaminants from the water as needed. Contaminants would remain in the ground yet never enter the public water supply. Future generations would have to pay for their own treatment costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.86)

Q9 HOME TREATMENT. Each household purchases and installs its own charcoal filtration system to remove contaminants before the water is used in the home. These systems typically cost $180 to install and an additional $25 per month for maintenance. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.85)

Q10 WATER RATIONING. The local government would institute a mandatory water conservation program to avoid having to make up the 40% shortfall. The contaminated water would not be cleaned up nor used. Surface water from lakes and streams provides the 60% of available clean water. Water bills would not increase but everyone would have to cut their water use by 40%. Realizing that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen, how satisfied are you with water rationing as an option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.46)

HOW MUCH IS IT WORTH TO YOU TO COMPLETELY CLEAN UP CONTAMINATED GROUNDWATER?

Your answers to the next questions are very important We do not yet know how much it will cost to clean up contaminated groundwater. However, to make decisions about new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth to people like you.

Q11 **Suppose that the complete cleanup program described in Q6 could be achieved in your imaginary community. What would a complete cleanup program be worth to your household, if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering, you should assume that:**

- **The money would be used only in this hypothetical community for sealing off the landfill, cleaning the contaminated water and for purchasing clean water until the cleanup is completed. The cost of the project (unknown at this time) would be spread out "over a ten year period.**
- **If the program turns out to cost less than people are willing to pay, each household would only pay a share of what it costs. If it turns out to cost more than people are willing to pay, the program would not be carried out.**
- **Scientists are satisfied that water cleaned and reinfected using these methods will be contaminant-free and safe to drink.**
- **The program would also provide benefits to future generations. New families moving in or just starting out would not have to pay any money to ensure the groundwater they used was clean.**

Now, what is the most your household would be willing to pay each month on top of your current water bill for the next 10 years for the complete groundwater cleanup program? (Circle the best response.)

(16.31)

$0	**'$1** .50	$4	$10	$30	$75	$200
$0.50	$2	$5	$15	$40	$100	'$500
$1	$3	$8	$20	$50	$150	**MORE THAN $S00**

Q12 Some **people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount you stated your household would be willing to pay for complete groundwater cleanup (Q11) is: , (Circle number)**

1. **JUST FOR THE STATED GROUNDWATER PROGRAM (Go to Q 14)**
2. **SOMEWHAT FOR THE GROUNDWATER PROGRAM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES**
3. **BASICALLY A CONTRIBUTION TO ALL ENVIRONMENTAL OR OTHER WORTHWHILE PUBLIC CAUSES**
4. **OTHER (Please specify)** _____

1-69.1% 2-18.1% 3-9.5’%0, 4-3.3%

Q13 **About what percent of your dollar amount is just for the stated complete groundwater cleanup program? (Circle percent)** **(76.630A)**

NONE		SOME		HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q14 **Of the amount you would pay just for the complete groundwater cleanup program, about what percent would be to ensure**

(35.11) %	THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE
(21.01) %	THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE
(23.53) %	THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE
(20.35) %	THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
= 100 %	TOTAL

Q15 **On a scale from 1 to 7, how responsible would you feel for helping to pay to clean up such a groundwater contamination problem in your community.** **(4.2)**

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE
1	2	3	4	5	6	7

HOW MUCH IS IT WORTH TO YOU TO HAVE A CLEAN SUPPLY OF WATER?

Suppose that a complete groundwater cleanup is not technically possible in your imaginary community. So, your community proposes a PUBLIC TREATMENT PROGRAM like that described in Q8, in which groundwater would be treated and cleaned as it was pumped to the surface for use. The water underground would still be contaminated.

Q16 What would a public treatment program like that described in Q8 be worth to your household if you faced the problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering you should assume that:

- **The money would be used for design, construction, operation, and maintenance of the water supply treatment system. Initial costs for design and construction would be spread out over a ten year period. Future generations would have to pay for their own treatment costs.**
- **If the program turned out to cost less than people were willing to pay, each household would pay a share of what it cost. If it turned out to cost more than people were willing to pay, the program would not be carried out.**
- **Scientists are satisfied that contaminated groundwater can be treated and cleaned so that it would be contaminant-free and safe to drink.**
- **This approach does not clean up all of the existing contaminated groundwater. It only cleans water that is to be used as it is pumped up and used for the public water supply.**

Now, of the dollar amount you would have paid just for complete groundwater cleanup, what percent would you still be willing to pay for the public treatment program described above? (50.30)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

ABOUT YOU AND YOUR HOUSEHOLD

H1 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY (76.1?40)
2. A PRIVATE WATER SUPPLIER (7.4%)
3. OUR PRIVATE WELL (14.9?40)
4. OTHER (Please specify) (1.5%)_____

H2 Your gender:

1. FEMALE (31%)
2. MALE (69%)

H3 Your age: _____(50.31)_ YEARS

H4 Including yourself, how many members in your household are in each age group? (If none, write "0")

(1.16) UNDER 18 YEARS OF AGE
(1.16) 18-64
(.78) 65 AND OVER

H5 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION (.2%)
2. SOME GRADE SCHOOL (1.3%)
3. COMPLETED GRADE SCHOOL (3.4%)
4. SOME HIGH SCHOOL (4.4%)
5. COMPLETED HIGH SCHOOL (17.2%)
6. TRADE SCHOOL (8.8%)
7. SOME COLLEGE (26.7%)
8. COMPLETED COLLEGE (20.6%)
9. SOME GRADUATE WORK (4.6%)
10. ADVANCED COLLEGE DEGREE (12.6%)

H6 Do you recycle or take special precautions in disposing of any of the following materials? (circle appropriate response for each)

1. NEWSPAPER YES NO DON'T KNOW (75.3% yes)
2. GLASS YES NO DON'T KNOW (60.9% yes)
3. ALUMINUM OR OTHER METALS YES NO DON'T KNOW (81.2% yes)
4. PLASTIC YES NO DON'T KNOW (68.1% yes)
5. PAINTS AND PAINT THINNERS YES NO DON'T KNOW (48.8% yes)
6. USED ENGINE OIL AND COOLANT/ANTIFREEZE YES NO DON'T KNOW (62.3% yes)
7. HOUSEHOLD CHEMICALS YES NO DON'T KNOW (43.7% yes)
8. OTHER (please specify) _____

H7 In the past year, have you held membership or donated time or money to any environmental organizations or groups?

1. **NO (70%)**
2. **YES -- ONE GROUP (22.4%)**
3. **YES - TWO OR THREE GROUPS (6.7%)**
4. **YES - MORE THAN THREE GROUPS (.8%)**

H8 How would you describe your racial or ethnic background? (circle one)

1. **WHITE OR CAUCASIAN (88.5%)**
2. **BLACK OR AFRICAN AMERICAN (5.7°/0)**
3. **HISPANIC OR MEXICAN AMERICAN (3.6%)**
4. **ASIAN OR PACIFIC ISLANDER (1.3°/0)**
5. **NATIVE AMERICAN INDIAN (00/')**
6. **OTHER (please specify) _____(1 .0%)_____**

H9 What is your present employment? (Circle the best answer)

1. **EMPLOYED FULL TIME (59%)**
2. **EMPLOYED PART TIME (5.2%)**
3. **FULL TIME HOMEMAKER (1.5%)**
4. **UNEMPLOYED (2.5%)**
5. **RETIRE D(27.7%)**
6. **STUDENT (1.5%)**
7. **OTHER (Please specify)_____(2.7%)_____**

H10 What is your total annual household income before taxes and other deductions? (circle one)

1. **UNDER $9,999 (8.6?40)**
2. **$10,000 - 19,999 (14.796)**
3. **$20,000 - 29,999 (16.8'%0)**
4. **$30,000 - 39,999 (17.1%)**
5. **$40,000 - 49,999 (10.0%)**
6. **$50,000-59,999 (10.5'Mo)**
7. **$60,000-69,999 (4.4%)**
8. **$70,000-79,999 (5.60/e)**
9. **$80,000 - 89,999 (4.9%)**
10. **$90,000 - 99,999 (1.4%)**
11. **$100,000 - 119,999 (3.3%)**
12. **$120,000-139,999 (*2%)**
13. $140,000-159,999 (.7%)
14. $160,000-179,000 (.5%)
15. $180,000-199,999 (.2'%)
16. $200,000 and **OVER**(.9%)

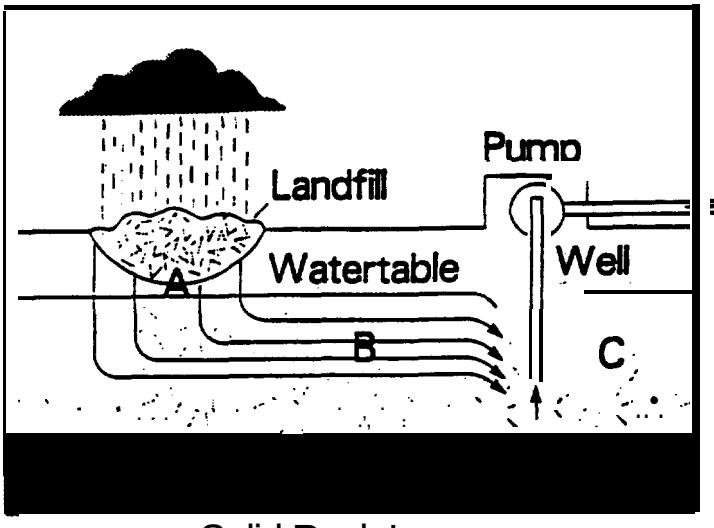
Is there anything we have overlooked? Please use the space below. to write any comments or suggestions you may have about the survey.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

☐ **Check this box if you would like a summary of the results.**

(If different from mailing label, list your name and address here.)

GROUNDWATER CONTAMINATION: WHAT IS YOUR OPINION?



This survey should be completed by a head of your household.

Please return survey to:
Center for Economic Analysis
University of Colorado
Boulder, Colorado 80309-0257

THE ISSUES

About 50°A of the water used by the U.S. population for drinking, cooking, bathing and other home purposes comes from groundwater. We are interested in your views on what, if anything, should be done to clean up contaminated groundwater which can no longer be used without treatment.

Q1 Are you aware of groundwater contamination in your community coming from any of these specific sources? (Circle the best answer)

1. NO (48%)

2. YES (Circle all that apply) (5296)

A. SUPERFUND SITE (4.8%) **B. HAZARDOUS WASTE SITE (9.5%)** **C. LANDFILL (58.1 '/')**

D. SEPTIC TANK (16.2%) **E. AGRICULTURAL RUNOFF (20°/0)** **F. INDUSTRY (21 .5%)**

G. OTHER (Please Specify) (6.9%) _____

Q2 Because the rest of this survey concerns only groundwater contamination, it is useful to understand how important you feel cleaning up contaminated groundwater is in comparison to other issues. From least to most concerned, how do you rate the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL CONCERNED						GREATLY CONCERNED	
Improving public roads	1'	2	3	4	5	6	7	(4.5)
Improving the education system	1	2	3	4	5	6	7	(5.9)
Reducing air pollution	1	2"	3	4	5	6	7	(5.7)
Saving endangered species	1	2	3	4	5	6	7	(4.7)
Reducing global warming	1	2	3	4	5	6	7	(4.9)
Promoting recycling	1	2	3	4	5	6	7	(5.6)
Cleaning "up rivers and lakes	1	2	3	4	5	6	,7	(6.1)
Cleaning up groundwater	1	2	3	4	5	6	7	(6.0)

Water for residential use can come from many different sources, including rivers, lakes, and groundwater. Groundwater comes from rain and snow that falls on the land and seeps underground. At some depth underground the soil or rock becomes saturated with water, and this water can then be pumped to the surface.

Q3 Does your household get any part of its water from groundwater?

1. NO -WE DON'T USE GROUNDWATER AT ALL (28.5%)
2. YES - PART OF OUR WATER COMES FROM GROUNDWATER (18.1%)
3. YES - ALL OF OUR WATER COMES FROM GROUNDWATER (31 .1%)
4. DON'T KNOW (22.3%)

Q4 Sometimes, garbage and waste placed in a community's landfill, similar to the one shown on the cover of this survey. can leak out and contaminate groundwater. Does your community have a landfill?

1. NO (30.8%)
2. YES (58.6%)
3. DON'T KNOW (1 0.6)

Rainwater seeping through a landfill may dissolve some of the chemicals in the discarded trash. This material, which can be toxic, may seep into the water table and contaminate the water below (as A shows on the front cover). Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B on the front cover). Many people are surprised to learn that this flow is very very slow; usually less than 100 feet per year. After many years, the landfill may contaminate water drawn by a well supplying water to the citizens of the community (see C on the front cover).

Q5 Does your community currently draw water from wells which have been or are in danger of becoming contaminated?

1. NO (48.1%)
2. YES - CONTAMINATED BY A LANDFILL (8.8%)
3. YES - CONTAMINATED BY ANOTHER SOURCE (Please specify) ___(6.1%)_____
4. DON'T KNOW (36.9%)

HOW COMMUNITIES CAN RESPOND TO CONTAMINATED GROUNDWATER

In the rest of the survey, we would like you to consider an imaginary situation. Suppose that you live in a community which has groundwater contamination as the result of a leaking public landfill. Contaminants have been found in groundwater which normally supply 40% of the water used by the community. Contamination covers approximately five acres underground (in an area 700 feet long and 390 feet wide and 25 feet deep). The other 60°A of the water supply is from uncontaminated surface water sources. In answering the following questions, you should assume that:

- **The contamination is the result of standard public landfill practices used in the past that were believed to be safe at the time. No private company or party is at fault.**

- **Scientists estimate that drinking the contaminated water would increase the risk of cancer, resulting in about 10 additional deaths per million people who drink the water per year (about the same level of risk a typical person has of developing cancer from exposure to routine medical x-rays).**

- **Local government has concluded that the water must not be used for drinking or cooking unless it is treated to remove the contaminants. It could, however, be used as is for such purposes as bathing, washing clothes, or watering lawns.**

There are many ways a community might respond to such a groundwater problem. For each 'of the following cleanup options please circle the number indicating how satisfied you are with that solution.

Q6 **COMPLETE CLEANUP. The water bills of current users would be increased to pay for a complete groundwater cleanup. An underground concrete wall would be built around the landfill down to the solid rock layer to seal it off from the groundwater. All contaminated water would be pumped up and cleaned. The clean water would be reinfected back underground for use now and in the future. This would benefit your household and future generations by ensuring that about the same amount of clean water is available as before the contamination occurred. How satisfied are you with this option?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(4.34)

Q7 **CONTAINMENT.** Wells would be drilled in the area to which contaminated groundwater is moving. Contaminated water would be pumped up to stop it from spreading further. This water would be cleaned and pumped back underground into the containment area. This approach does not completely clean up the contamination. Your household would have the same amount of clean water to use since new supply wells would be drilled outside of the containment area. The water bills of current users would be increased to pay for the containment system. Future generations would pay for operation and maintenance costs. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.40)

Q8 **PUBLIC TREATMENT.** The local government would increase water bills of users to pay for the construction, maintenance and operation of a water treatment plant to remove contaminants from the water as needed. Contaminants would remain in the ground yet never enter the public water supply. Future generations would have to pay for their own treatment costs. How satisfied are you with this option?

NOT AT AU SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.77)

Q9 **HOME TREATMENT.** Each household purchases and installs its own charcoal filtration system to remove contaminants before the water is used in the home. These systems typically cost $180 to install and an additional $25 per month for maintenance. How satisfied are you with this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.89)

Q10 **WATER RATIONING.** The local government would institute a mandatory water conservation program to avoid having to make up the 40% shortfall. The contaminated water would not be cleaned up nor used. Surface water from lakes and streams provides the 60°A of available clean water. Water bills would not increase but everyone would have to cut their water use by 40%. Realizing that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen, how satisfied are you with water rationing as an option?

NOT AT AU SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.61)

HOW MUCH IS IT WORTH TO YOU TO COMPLETELY CLEAN UP CONTAMINATED GROUNDWATER?

Your answers to the next questions are very important. We do not yet know how much it will cost to clean up contaminated groundwater. However, to make decisions about new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth' to people like you.

Q11 Suppose that the complete cleanup program described in Q6 could be achieved in your imaginary community. What would a complete cleanup program be worth to your household, if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering, you should assume that:

- The money would be used only in this hypothetical community for sealing off the landfill, cleaning the contaminated water and for purchasing clean water until the cleanup is completed. The cost of the project (unknown at this time) would be spread out over a ten year period.
- If the program turns out to cost less than people are willing to pay, each household would only pay a share of what it costs. If it turns out to cost more than people are willing to pay, the program would not be carried out.
- Scientists are satisfied that water cleaned and reinfected using these methods will be contaminant-free and safe to drink.
- The program would also provide benefits to future generations. New families moving in or just starting out would not have to pay any money to ensure the groundwater they used was clean.

Now, what is the most your household would be willing to pay each month on top of your current water bill for the next 10 years for the complete groundwater cleanup program? (Circle the best response.)

(13.94)

$0	$1.50	$4	$10	$30	$75	\ $200
$0.50	$2	$5	$15	$40	$100	$500
$1	$3	$8	$20	$50	$150	MORE THAN $500

Q12 Some people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount YOU stated your household would be willing to pay for complete groundwater cleanup (QI 1) is: (Circle number)

1. JUST FOR THE STATED GROUNDWATER PROGRAM (Go to Q 14)

2. SOMEWHAT FOR THE GROUNDWATER PROGRAM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES

3. BASICALLY A CONTRIBUTION TO ALL ENVIRONMENTAL OR OTHER WORTHWHILE PUBLIC CAUSES

4. OTHER (Please specify) _____

1 -66'/0, 2-20"?'0, 3-1 0.7%, 4-3.3%

Q13 About what percent of your dollar amount is just for the stated complete groundwater cleanup program? (Circle percent)

(76.68%)

NONE	SOME			HALF			MOST			ALL
o%	10%	20%	300/0	40%	500/0	60%	70%	80%	90%	100%

Q14 Of the amount you would pay just for the complete groundwater cleanup program, about what percent would be to ensure

(37.96) % THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE
(25.62) % THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE
(30.49) % THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE
(24.77) % THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
= 100 % TOTAL

Q15 On a scale from 1 to 7, how responsible would you feel for helping to pay to clean up such a groundwater contamination problem in your community.

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE	
1	2	3	4	5	6	7	(4.2)

WHAT IF YOU DEPENDED LESSOR MORE ON GROUNDWATER

Dependency on groundwater is different for every location at which contamination has occurred. Some areas use groundwater for all of their domestic water supply while others use none. To plan new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth to people like you in these different situations.

WHERE GROUNDWATER SUPPLIES 10% OF DOMESTIC WATER

Q16 Consider an imaginary leaking landfill identical to that described above except that now groundwater supplies 10*A of the domestic water supply instead of 40%. Remembering that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen how satisfied are you with water rationing as an option where water use would have to be cut by 10% ?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.64)

Q17 What would a complete cleanup program like that described in Q6 be worth to your household if your imaginary community faced a groundwater problem where 10% of the local domestic water supply comes from groundwater which was contaminated and could not be used without treatment? In answering you should assume that:

- **The hypothetical situation is now one in which only 10% of the water you use in your community comes from groundwater resources. The other 90% of your water comes from surface water sources such as lakes and streams.**
- **The complete cleanup program is identical to the program described in the previous section.**

Now, of the dollar amount you would have paid just for complete groundwater cleanup when faced with 40'% of your water supply contaminated, what percent would you still be willing to pay for complete groundwater cleanup if faced with 10% of your water supply coming from contaminated groundwater?

(46.51%)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

WHERE GROUNDWATER SUPPLIES 70% OF DOMESTIC WATER

Q1 a **Consider an imaginary leaking landfill identical to that described abo except that now groundwater supplies 70% of the domestic water supply instead of 40%. Remembering that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen how satisfied are you with water rationing as an option where water** use would **have to be cut by** 70%?

NOT AT AU SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.35)

Q19 What would a complete cleanup program like that described in Q6 be **worth to your household if your imaginary community faced a groundwater problem where 70% of the local domestic water supply comes from groundwater which was contaminated and could not be used without treatment? In answering you should assume that:**

- **The hypothetical situation is now one in which 70% of the water you use in your community comes from groundwater resources. The other 30% of your water comes from surface water sources such as lakes and streams.**

- **The complete cleanup program is identical to the program described in the previous section.**

Now, of the dollar amount you would have paid just for complete groundwater cleanup when faced with 40% of your water supply contaminated, what percent would you be willing to pay for complete groundwater cleanup if faced with 70% of your water supply coming from contaminated groundwater? (Circle the best per cent response)

(1 66.24%)

SAME			TWICE AS MUCH		3 TIMES AS MUCH	MORE THAN 4X AS MUCH	
100%	125%	150°A	175%	200?/0	250%	30096	350"! 400%+

ABOUT YOU AND YOUR HOUSEHOLD

HI Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY (73.7%)
2. A PRIVATE WATER SUPPLIER (6.6%)
3. OUR PRIVATE WELL (1 5.6%)
4. OTHER (Please specify) (4.1%)

HZ Your gender:

1. FEMALE (31%)
2. MALE (690/o)

H3 Your age: (50.31) YEARS

H4 Including yourself, how many members in your household are in each age group? (If none, write "O")

(1.1 2) UNDER 18 YEARS OF AGE
(1.85) 18-64
(.69) 65 AND OVER

H5 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION (.2%)
2. SOME GRADE SCHOOL (1 .1%)
3. COMPLETED GRADE SCHOOL (3%),
4. SOME HIGH SCHOOL (5.4?40)
5. COMPLETED HIGH SCHOOL (24.1%)
6. TRADE SCHOOL (6.9%)
7. SOME COLLEGE (23.3%)
8. COMPLETED. COLLEGE (17%)
9. SOME GRADUATE WORK (6.5%)
10. ADVANCED COLLEGE DEGREE (12.5%)

H6 Do you recycle or take special precautions in disposing of any of the following materials? (circle appropriate response for each)

1. NEWSPAPER — YES NO DON'T KNOW (73% yes)
2. GLASS — YES NO DON'T KNOW (61.6% yes)
3. ALUMINUM OR OTHER METALS — YES NO DON'T KNOW (64.1% yes)
4. PLASTIC — YES NO DON? KNOW (55.4% yes)
5. PAINTS AND PAINT THINNERS — YES NO DON'T KNOW (49.796 yes)
6. USED ENGINE OIL AND COOLANT/ANTIFREEZE — YES NO DON'T KNOW (65.2% yes)
7. HOUSEHOLD CHEMICALS — YES NO DON'T KNOW (46% yes)
8. OTHER (please specify) (4.8% yes)

H7 In the past year, have you held membership or donated time or money to any environmental organizations or groups?

1. NO
2. YES - ONE GROUP (70.4%)
3. YES - TWO OR THREE GROUPS (20%)
4. YES - MORE THAN THREE GROUPS (8.3%)

H8 How would you describe your racial or ethnic background? (circle one)

1. WHITE OR CAUCASIAN (88%)
2. BLACK OR AFRICAN AMERICAN (4.6%)
3. HISPANIC OR MEXICAN AMERICAN (3.3%)
4. ASIAN OR PACIFIC ISLANDER (2.070)
5. NATIVE AMERICAN INDIAN (.7?40)
6. OTHER (please specify) (1 . 5 %)_____

H9 What is your present employment? (Circle the best answer)

1. EMPLOYED FULL TIME (55.3°/0)
2. EMPLOYED PART TIME (5.8%)
3. FULL TIME HOMEMAKER (4.3°/0)
4. UNEMPLOYED (2.8%)
5. RETIRED (27.5%)
6. STUDENT (1 .1%)
7. OTHER (Please specify)(3 . 2 %)_____

HI O What is your total annual household income before taxes and other deductions? (circle one)

1. UNDER $9,999 (9.9%)
2. $10,000 - 19,999 (14.9'%0)
3. $20,000-29,999 (17.5?40)
4. $30,000-39,999 (1 5.8%)
5. $40,000-49,999 (12.5%)
6. $50,000-59,999 (9.2%)
7. $60,000 -69,999 (6.6%)
8. $70,000-79,999 (2.6%)
9. $80,000-89,999 (2.1 %)
10. $90,000-99,999 (2.4%)
11. $100,000-119,999 (2.1%)
12. $120,000-139,999 (2.1%)
13. $140,000 " 159,999 (.9%)
14. $160,000-179,000 (.2%)
15. $180,000-199,999 (.7%)
16. $200,000 and OVER (.5%)

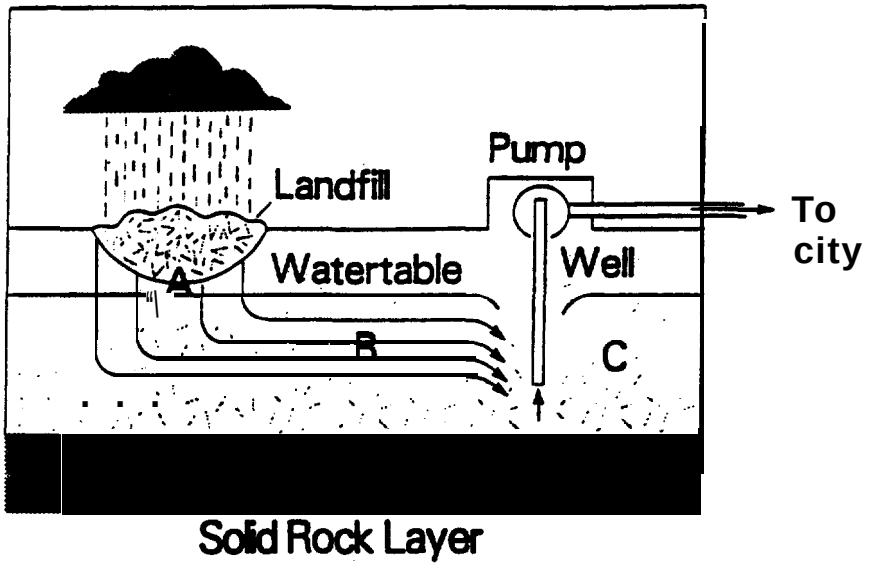
Is there anything we have overlooked? Please use the space below to write any comments or suggestions you may have about the survey.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

☐ Cheek **this box if you would like a summary of the results.**

(If different from mailing label, list your name and address' here.)

GROUNDWATER CONTAMINATION: WHAT IS YOUR OPINION?



This survey should be completed by a head of your household.

Please return survey to:
Center for Economic Analysis
University of Colorado
Boulder, Colorado 80309-0257

THE ISSUES

About 50% of the water used by the U.S. population for drinking, cooking, bathing and other home purposes comes from groundwater. We are interested in your views on what, if anything, should be done to clean up contaminated groundwater which can no longer be used without treatment.

q1 Are you aware of groundwater contamination in your community coming from any of these specific sources? (Circle the best answer)

1. NO (49940)

2. YES (Circle all that apply)

A. SUPERFUND SITE (4%) **B. HAZARDOUS WASTE SITE (12%)** **C. LANDFILL (58%)**

D. SEPTIC TANK (12%) **E. AGRICULTURAL RUNOFF (16%)** **F. INDUSTRY (20%)**

G. OTHER (Please Specify) _____(6%)_____

Q2 Because the rest of this survey concerns only groundwater contamination, it is useful to understand how important you feel cleaning up contaminated groundwater is in comparison to other issues. From least to most concerned, how do you rate the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL CONCERNED						GREATLY CONCERNED
Improving public roads	1	2	3	4	5	6	7 (4.48)
Improving the education system	1	2	3	4	5	6	7 (5.99)
Reducing air pollution	1	2	3	4	5	6	7 (5.74)
Saving endangered species	1	2	3	4	5	6	7 (4.65)
Reducing global warming	1	2	3	4	5	6	7 (4.89)
Promoting recycling	1	2	3	4	5	6	7 (5.66)
Cleaning" up rivers and lakes	1	2	3	4	5	6	7 (6.07)
Cleaning up groundwater	1	2	3	4	5	6	7 (6.05)

Water for residential use can come from many different sources, including rivers, lakes, and groundwater. Groundwater comes from rain and snow that falls on the land and seeps underground. At some depth underground the soil or rock becomes saturated with water, and this water can then be pumped to the surface.

Q3 Does your household get any part of its water from groundwater?

1. **NO -WE DON'T USE GROUNDWATER AT ALL (26.7%)**
2. **YES - PART OF OUR WATER COMES FROM GROUNDWATER (16.2%)**
3. **YES - ALL OF OUR WATER COMES FROM GROUNDWATER (35.5%)**
4. **DON'T KNOW (21.6%)**

Q4 Sometimes, garbage and waste placed in a community's landfill, similar to the one shown on the cover of this survey, can leak out and contaminate groundwater. Does your. community have a landfill?

1. **NO (27.9%)**
2. **YES (59.3%)**
3. **DON'T KNOW (12.8%)**

Rainwater seeping through a landfill may dissolve some of the chemicals in the discarded trash. This material, which can be toxic, may seep into the water table and contaminate the water below (as A shows on the front cover). Once contaminants reach the water table, they spread very slowly underground in the direction water is flowing (see B on the front cover). Many people are surprised to learn that this flow is very very slow; usually less than 100 feet per year. After many years, the landfill may contaminate water drawn by a well supplying water to the citizens of the community (see C on the front cover).

Q5 Does your community currently draw water from wells which have been or are in danger of becoming contaminated?

1. **NO (51 .8%)**
2. **YES - CONTAMINATED BY A LANDFILL (6.4%)**
3. **YES - CONTAMINATED BY ANOTHER SOURCE (Please specify) (7 . 7 %)**
4. **DON'T KNOW (34%)**

HOW COMMUNITIES CAN RESPOND TO CONTAMINATED GROUNDWATER

In the rest of the survey, we would like you to" consider an imaginary situatio Suppose that you live in a community which has groundwater contamination as the result of a leaking public landfill. contaminants have been found in groundwater which normally supply 40% of the water used by the community. Contamination covers approximately five acres underground (in an area 700 feet long and 390 feet wide and 25 feet deep). The other 60% of the water supply is from uncontaminated surface water sources. In answering the following questions, you should assume that:

- **The contamination is the result of standard public landfill practices used in the past that were believed to be safe at the time. No private company or party is at fault.**

- **Scientists estimate that drinking the contaminated water would increase the risk of cancer, resulting in about 10 additional deaths per million people who drink the water per year (about the same level of risk a typical person has of developing cancer from exposure to routine medical x-rays).**

- **Local government has concluded that the water must not be used for drinking or cooking unless it is treated to remove the contaminants. It could, however, be used as is for such purposes as bathing, washing clothes, or watering lawns.**

There are many ways a community might respond to such a groundwater problem. For each of the following cleanup options please circle the number indicating how satisfied you are with that solution.

Q6 COMPLETE CLEANUP. The water bills of current users would be increased to pay for a complete groundwater cleanup. An underground concrete wall would be built around the landfill down to the solid rock layer to seal it off from the groundwater. All contaminated water would be pumped up and cleaned. The clean water would be reinfected back underground for use now and in the future. This would benefit your household and future generations by ensuring that about the same amount of clean water is available as before the contamination occurred. How satisfied are you with 'this option?

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(4.42)

Q7 **CONTAINMENT. Wells would be drilled in the area to which contaminated groundwater is moving. Contaminated water would be pumped up to stop it from spreading further. This water would be cleaned and pumped back underground into the containment area. This approach does not complete clean** up the contamination. **Your household would have the same amount of clean water to use since new supply wells would be drilled outside of the containment area. The water bills of current users would be increased to pay for the containment system. Future generations would pay for operation and maintenance costs. How satisfied are you with this option?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.5)

Q8 **PUBLIC TREATMENT.** The **local government would increase water bills of users to pay for the construction, maintenance and. operation of a water treatment plant to remove contaminants from the water as needed. Contaminants would remain in the ground yet never enter the public water supply. Future generations would have to pay for their own treatment costs. How satisfied are you with this option?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.76)

Q9 **HOME TREATMENT. Each household purchases and installs its own charcoal filtration system to remove contaminants before the water is used in the home. These systems typically cost $180 to install and an additional $25 per month for maintenance. How satisfied are you with this option?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.78)

Q10 **WATER RATIONING. The local government would institute a mandatory water conservation program to avoid having to make up the 40°A shortfall. The contaminated water would not be cleaned up nor used. Surface water from lakes and streams provides the 60% of available clean water, Water bills would not increase but everyone would have to cut their water use by 40%. Realizing that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen, how satisfied are you with water rationing as an option?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.56)

HOW MUCH IS IT WORTH TO YOU TO COMPLETELY CLEAN UP CONTAMINATED GROUNDWATER?

Your answers to the next questions are very important We do not yet know how much it will cost to clean up contaminated groundwater. However, to make decisions about new groundwater cleanup programs that could cost you money, decision makers want to learn how much clean groundwater is worth-to people like you.

Q11 Suppose that the complete cleanup program described in Q6 could be achieved in your imaginary community. What **would a complete cleanup program be worth to your household, if you faced the hypothetical problem of 40% of your water supply coming from contaminated groundwater as we have described? In answering, you should assume that:**

- **The money would be used only in this hypothetical community for sealing off the landfill, cleaning the contaminated water and for purchasing clean water until the cleanup is completed. The cost of the project (unknown at this time) would be spread out over a ten year period.**
- **If the program turns out to cost less than people are willing to pay, each household would only pay a share of what it costs. If it turns out to cost more than people are willing to pay, the program would not be carried out.**
- **Scientists are satisfied that water cleaned and reinfected using these methods will be contaminant-free and safe to drink.**
- **The program would also provide benefits to future generations. New families moving in or just starting out would not have to pay any money to ensure the groundwater they used was clean.**

Now, what is the most your household would be willing to pay each month On top Of your current water bill for the next 10 years for the complete groundwater cleanup program? (Circle the best response.)

(14.15)

$0	$1.50	$4	$10	$30	$75	$200
$0.50	$2	$5	$15	$40	$100	$500
$1	$3	$8	$20	$50	$150	MORE THAN $S00

Q12 Some people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount you stated your household would be willing to pay for complete groundwater cleanup (Q11) is: (Circle number)

1. JUST FOR THE STATED GROUNDWATER PROGRAM (Go to Q 14)

2. SOMEWHAT FOR THE GROUNDWATER PROGRAM AND SOMEWHAT A GENERAL CONTRIBUTION TO ALL ENVIRONMENTAL CAUSES

3. BASICALLY A CONTRIBUTION TO AU ENVIRONMENTAL OR OTHER WORTHWHILE PUBLIC CAUSES

4. OTHER (Please specify)_____

1 -68.2%, 2-1 5.6%, 3-11%, 4-5.2%

Q13 About what percent. of your dollar amount is just for the stated complete groundwater cleanup program? (Circle percent)

(73.73%)

NONE			SOME		HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q14 Of the amount you would pay just for the complete groundwater cleanup program, about what percent would be to ensure

(41 .46) %	THAT YOUR HOUSEHOLD HAS ENOUGH CLEAN WATER TO USE
(25.92) %	THAT OTHER HOUSEHOLDS IN YOUR COMMUNITY HAVE ENOUGH CLEAN WATER TO USE
(31 .84) %	THAT FUTURE GENERATIONS OF PEOPLE LIVING IN YOUR COMMUNITY WILL HAVE ENOUGH CLEAN WATER TO USE
(27.05) %	THAT THE GROUNDWATER IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
= 100 %	TOTAL

Q15 On a scale from 1 to 7, how responsible would you feel for helping to pay to clean up such a groundwater contamination problem in your community.

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE
1	2	3	4	5	6	7 (4.12)

ABOUT THE NATIONAL GROUNDWATER PROBLEM

To plan new groundwater cleanup programs, decision makers want to know how much it is worth to you to help solve groundwater problems, not just in your community, but across the entire nation.

Q16 What would it be worth to your household to help fund complete groundwater cleanup for communities other than yours which have groundwater contamination? These are communities that you or your family may move to someday. In answering, you should assume that if the programs turn out to cost less than people are willing to pay, each household would only pay a share of what it costs. If they turn out to cost more than people are willing to pay, the programs would not be carried out.

Now, of the dollar amount you would have paid just for complete groundwater cleanup in your community (Q13) how much, in addition.would you pay to help fund complete groundwater cleanup in other communities across the country. (Circle the best percent response).

(13.56?4)

NO MORE		A LITTLE MORE		HALF AGAIN A S MUCH		EQUAL AMOUNT	MORE THAN EQUAL
0%	5%	10%	25%	50%	75%	100%	100%+

Q17 Of the extra amount you would pay just to help fund complete groundwater treatment programs across the nation, about what percent would be to ensure.

(31 .85) % THAT YOUR HOUSEHOLD WILL HAVE CLEAN WATER TO USE IF YOU MOVE TO A DIFFERENT COMMUNITY
(24.36) % THAT OTHER PEOPLE ACROSS THE COUNTRY WILL HAVE ENOUGH CLEAN WATER TO USE
(25.74) % THAT FUTURE GENERATIONS OF PEOPLE ACROSS THE COUNTRY WILL HAVE ENOUGH CLEAN WATER TO USE
(26.14) % THAT GROUNDWATER ACROSS THE NATION IS UNCONTAMINATED EVEN IF NO ONE EVER USES IT
(10.92) % OTHER (Please describe: _____)
= 100 % TOTAL

Q18 On a scale from 1 to 7, how responsible do you feel for helping to pay to clean up groundwater contamination problems in other communities across the nation?

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE	
1	2	3	4	5	6	7	(2.6)

ABOUT YOU AND YOUR HOUSEHOLD

H1 Who is the primary water supplier for the water you currently use in your home?

1. THE CITY OR COUNTY (71.7%)
2. A PRIVATE WATER SUPPLIER (7.4%)
3. OUR PRIVATE WELL (18.9%)
4. OTHER (Please specify) (1.9%)

H2 Your gender:

1. FEMALE
2. MALE

H3 Your age: _____ YEARS

H4 Including yourself, how many members in your household are in each age group? (If none, write "0")

_____ UNDER 18 YEARS OF AGE
_____ 18-64
_____ 65 AND OVER

H5 How much formal education have you completed? (circle number)

1. NO FORMAL EDUCATION (0%)
2. SOME GRADE SCHOOL (1.5%)
3. COMPLETED GRADE SCHOOL (2.4%)
4. SOME HIGH SCHOOL (8%)
5. COMPLETED HIGH SCHOOL (18.9%)
6. TRADE SCHOOL (9.996)
7. SOME COLLEGE (21 .7%)
8. COMPLETED COLLEGE (17.8%)
9. SOME GRADUATE WORK (6.296)
10. ADVANCED COLLEGE DEGREE (13.5%)

H6 Do you recycle or take special precautions in disposing of any of the following materials? (circle appropriate response for each)

1. NEWSPAPER YES NO DON'T KNOW (74% yes)
2. GLASS YES NO DON'T KNOW (66.4% yes)
3. ALUMINUM OR OTHER METALS YES NO DON'T KNOW (63.7% yes)
4. PLASTIC YES NO DON'T KNOW (60.2% yes)
5. PAINTS AND PAINT THINNERS YES NO DON'T KNOW (48.2% yes)
6. USED ENGINE OIL AND COOLLANT/ANTIFREEZE YES NO DON'T KNOW (63.1% yes)
7. HOUSEHOLD CHEMICALS YES NO DON'T KNOW (44.5% yes)
8. OTHER (please specify) _____ (4.2% yes) _____

H7 In the past year, have you held membership or donated time or money to any environmental organizations or groups?

1. NO (76.8%)
2. YES -- ONE GROUP (1 5.6%)
3. YES - TWO OR THREE GROUPS (6%)
4. YES - MORE THAN THREE GROUPS (1 .7°/0)

H8 How would you describe your racial or ethnic background? (circle one)

1. WHITE OR CAUCASIAN (89.5%)
2. BLACK OR AFRICAN AMERICAN (4.5%)
3. HISPANIC OR MEXICAN AMERICAN (1 .3%)
4. ASIAN OR PACIFIC ISLANDER (2.1%)
5. NATIVE AMERICAN INDIAN (1 .3%)
6. OTHER (please specify) _____ (1 .3%) _____

H9 What is your present employment? (Circle the best answer)

1. EMPLOYED FULL TIME (55.7'%) 4. UNEMPLOYED (2.396)
2. EMPLOYED PART TIME (5.8%) 5. RETIRED (26.9%)
3. FULL TIME HOMEMAKER (5.1'%0) 6. STUDENT (.4%)
7. OTHER (Please specify) _____ (3.8%) _____

H10 What is your total annual household income before taxes and other deductions? (circle one)

1. UNDER $9,999 (7.9%)
2. $10,000 - 19,999 (18.9%)
3. $20,000 - 29,999 (15%)
4. $30,000 - 39,999 (14.7%)
5. $40,000 - 49,999 (11 .7%)
6. $50,000 - 59,999 (10.7%)
7. $60,000 - 69,999 (5.6%)
8. $70,000 - 79,999 (4.7%)
9. $80,000 - 89,999 (3.7%)
10. $90,000 - 99,999 (2.3%)
11. $100,000 - 119,999 (1.9%)
12. $120,000 - 139,999 (.7%)
13. $140,000 - 159,999 (.7%)
14. $160,000 - 179,000 (.5%)
15. $180,000 - 199,999 (0%)
16. $200,000 and OVER (.9%)

Is there anything we have overlooked? Please use the space below to write any comments or suggestions you may have about the survey.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

☐ **Check this box if you would like a summary of the results.**

(If different from mailing label, list your name and address here.)

APPENDIX E

MODELING WILLINGNESS-TO-PAY WITH TRUE ZERO BIDS AND RIGHT-SKEWED ERRORS

Modeling Willingness-to-Pay with True Zero Bids and Right-Skewed Errors

Introduction

It is often the case that it is likely that an individual has a positive value of an environmental action, and a bid of $0 is assumed to mean that the individual does not desire to reveal his or her true bid. This situation would occur, for example, if the environmental action was a local cleanup of the air or water, of obvious value to the responndent, but the issue of ***responsibility*** causes scenario rejection and a zero "protest" bid. This was the case in the study of Denver's "Brown Cloud." Thus, a two equation selection/bid scenario is the appropriate economic model. The parameters of the bid equation are then estimated by least squares corrected for the sample selection induced by the refusal to reveal bids.

In surveys about national environmental action, however, where the benefit of a remedial action is potentially far removed from the respondent (both geographically and conceptually), there is a possibility that individuals have a true WTP of $0, that is, they report $0 and in fact they would not be willing to pay anything for the action. In this case the two equation selection/bid model is not appropriate, and a new model is needed.

With all WTP data, whether observed zeroes are true or hide a positive bid, whether experimental or from the field, and whether they are obtained **from hypothetical or real situations, the bulk of the evidence suggests that right-skewed errors are present. This has meant that some transformation of the bids is desirable, and either the log normal distribution has been**

assumed or the Box-CoX transformation used. In the case of scenario rejection (protest zeroes), this has meant thatthe log of bids is the dependent variable in the sample selection corrected regression of bid data on demographic and other variables, or a Box-Cox transformation is applied and the Box-Cox parameter estimated along with the usual slope coefficients. Therefore, an important direction for future research is to analyze national level data or any situation where both true zeroes occur and bids are right-skewed. This section outlines the economic model and econometric procedure for the case of true zeroes and right-skewed bids.

The Economic Model

Suppose that WTP is a linear function of a vector of individual household characteristics, x. a (row) vector of coefficients, β, snd a random error:

(1) $W = \beta x + \varepsilon$.

Here ε represents *heterogeneity* error. That is, individuals with characteristics x have mean bid βx but actual bid W, and the difference is due to unmeasured attributes and heterogeneous tastes for the environment. Another form of error is also present In individual's revealed WTP, their bids (B). This error causes two effects on observed bids: a right skew for positive bids, as discussed above, and the reporting of a zero bid if the desired bid (W) is negative. That is, individuals may well have a negative desired willingness-to-pay for an environmental action from which they feel they derive no benefit. Conceptually, given continuous preferences, these

individuals would be better off if the environment could be "sold off" and they receive compensation for it.

Let v be this measurement or reporting error. Then a model for observed bids that incorporates both effects is:

$$(2)\quad B = \begin{cases} We^{v} & \text{if } We^{v} > 0 \\ 0 & \text{if } We^{v} \le 0 \end{cases}$$

Equations 1 and 2 area model of the formation of WTP and the mechanism for revealing it. In the next section, stochastic assumptions about ε and v are made, and estimation discussed.

Estimation

Since the formation of WTP (equation 1) is in the form of a conventional regression model, we assume the distribution of ε is normal, with zero mean and unknown variance σ_{ε}^2. To accommodate the right skew of bid errors, v is also assumed to normally distributed, with zero mean and unknown variance σ_{v}^2, and that the covariance between ε and v is $\sigma_{\varepsilon v}$.

The likelihood of a sample of observations has two forms of expressions, or regimes, one for B = O and one for B > 0. Since B = 0 whenever $W \le O \Rightarrow \beta\chi + \varepsilon \le 0 \Rightarrow \varepsilon \le -\beta\chi$, this event occurs with probability $\Phi(-\beta\chi/\sigma_{\varepsilon}^2)$, where $\Phi(.)$ is the cumulative distribution function of a standard normal random variable. Since $e^{v} > 0$, this means that B > 0 whenever $W > 0 \Rightarrow \varepsilon > -\beta x$. Also, when B > 0, $\ln B = \ln \beta x + v$. The increment to the likelihood for this type of observation is $\int_{-\beta x}^{\infty} \phi(\varepsilon, v = \ln B - \ln \beta x)\, d\varepsilon$, shere $\phi(.,.)$

is the bivariate normal density function. The likelihood function is the product over all observations in both regimes:

$$(3)\quad L = \prod_{0} \Phi(-\beta x/\sigma_{\varepsilon}^{2}) \prod_{1} \int_{-\beta x}^{\infty} \phi(\varepsilon, v = \ln B - \ln \beta x)\ de.$$

Maximizing this likelihood produces consistent estimates of β, from which WTP can be predicted from a sample of data which contain true zero bids.