

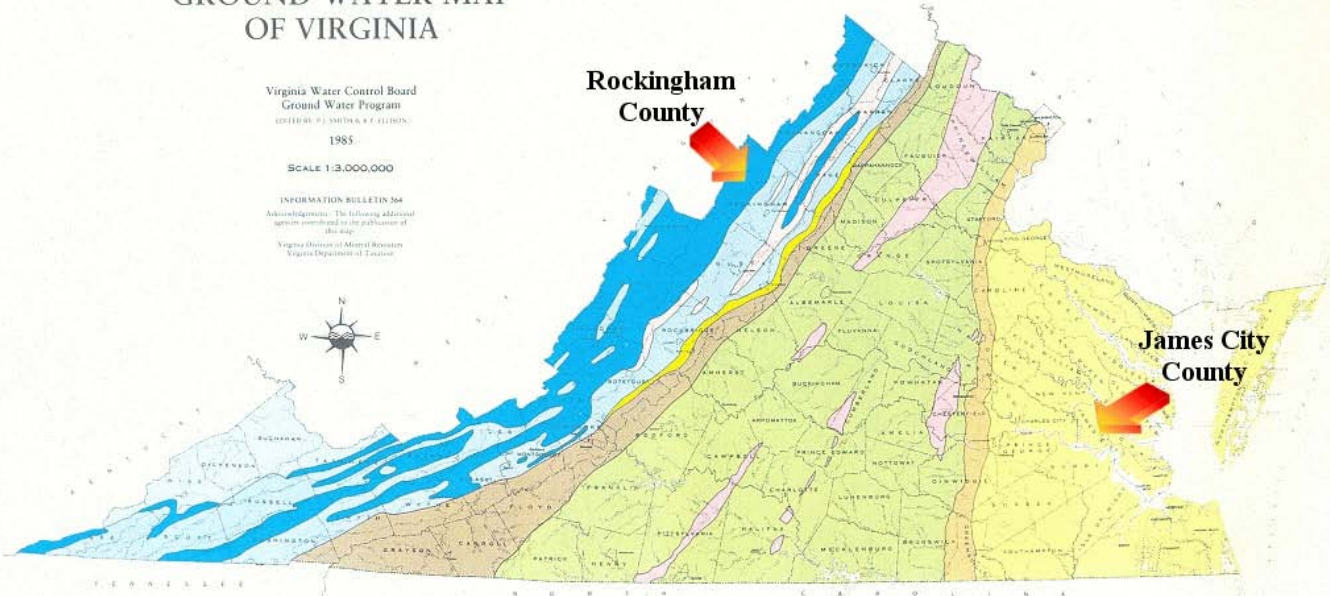
Figures

GROUND WATER MAP OF VIRGINIA

Virginia Water Control Board
Ground Water Program
EDITED BY P. J. SMITH & F. J. ELLIOTT
1985

SCALE 1:3,000,000

INFORMATION BULLETIN 564
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Virginia Division of Mineral Resources
Virginia Department of Tourism



GROUND WATER MAP OF VIRGINIA EXPLANATION

<p>Cumberland Plateau Ground Water Area</p> <ul style="list-style-type: none"> Nearly flat lying sedimentary rocks Small to moderate supplies available Generally poor quality water Moderate pollution potential 	<p>Ordovician Shale Ground Water Area</p> <ul style="list-style-type: none"> Predominantly shale units Small to moderate supplies available Generally hard water, high in iron and dissolved solids Moderate pollution potential 	<p>West Toe Ground Water Area</p> <ul style="list-style-type: none"> Thick terrace and alluvial deposits Large supplies available Generally good quality Moderate pollution potential 	<p>Triassic Basin Ground Water Area</p> <ul style="list-style-type: none"> Sedimentary rocks with igneous intrusions Moderate supplies available Generally poor quality Moderate to low pollution potential 	<p>Fall Zone Ground Water Area</p> <ul style="list-style-type: none"> Thin unconsolidated sediments overlying basement igneous and metamorphic rocks Moderate supplies available Generally good quality Moderate pollution potential
<p>Mountainous Terrain Ground Water Area</p> <ul style="list-style-type: none"> Folded, faulted sedimentary and carbonate rocks Relatively untested area with known moderate yields in alluvium, and possible high yields in carbonates Quality varies from good in quartzites to hard in carbonates, to poor in shales Low pollution potential, except along faults 	<p>Carbonate Ground Water Area</p> <ul style="list-style-type: none"> Folded and faulted carbonate rocks Moderate to large supplies available Generally hard water High potential for pollution in solution cavities and sinkholes 	<p>Blue Ridge Ground Water Area</p> <ul style="list-style-type: none"> Igneous and metamorphic rocks Small supplies available Generally good quality Moderate pollution potential 	<p>Piedmont Ground Water Area</p> <ul style="list-style-type: none"> Igneous and metamorphic rocks Small-to-moderate supplies available Generally good quality Moderate to low pollution potential 	<p>Coastal Plain Ground Water Area</p> <ul style="list-style-type: none"> Unconsolidated layered sediments Very large supplies available Generally good quality except some taste and odor problems, near the coast Moderate pollution potential; high pollution potential in Water Table Aquifer

Figure 1: Rockingham and James City Counties are shown on the groundwater map of Virginia.

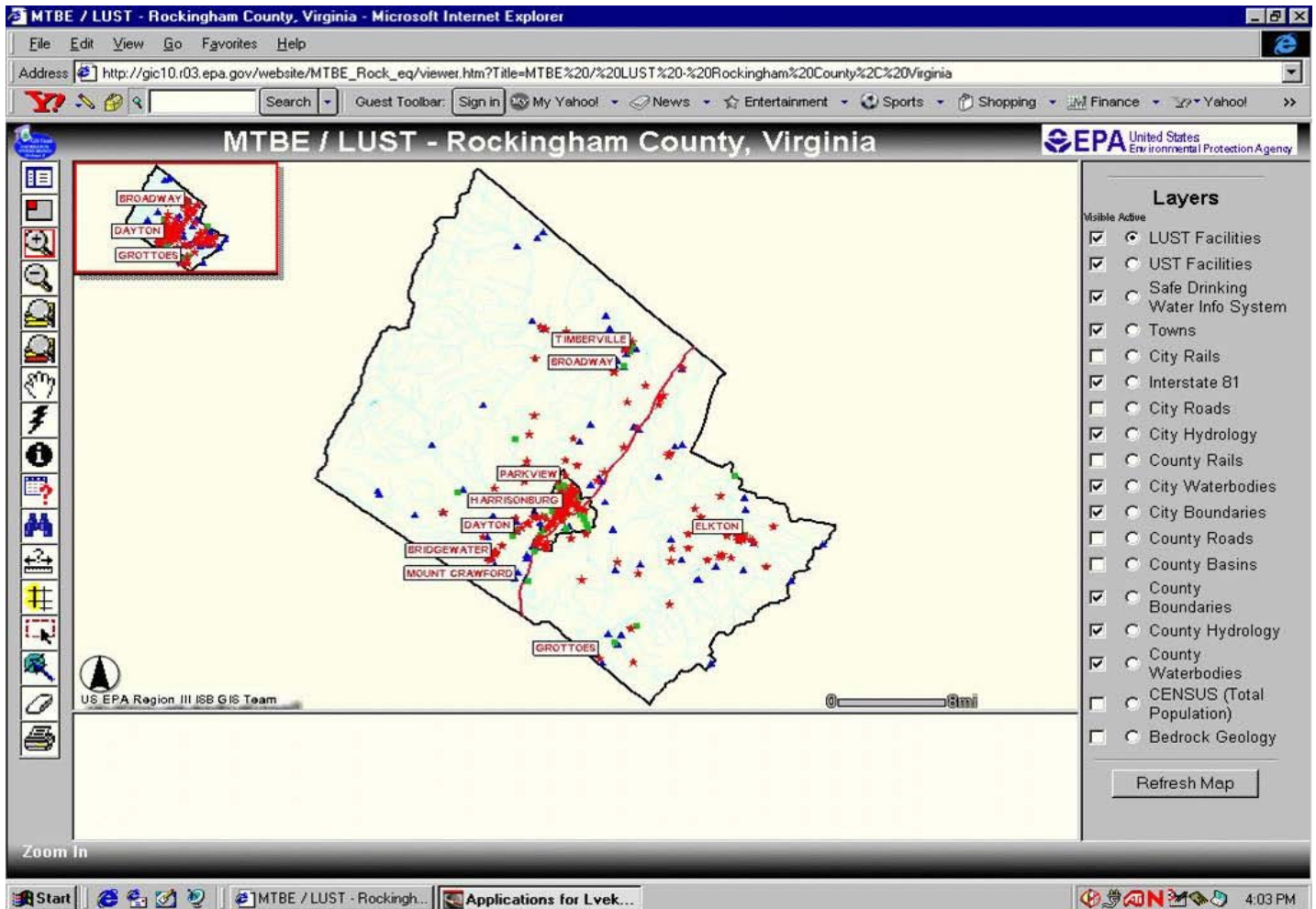
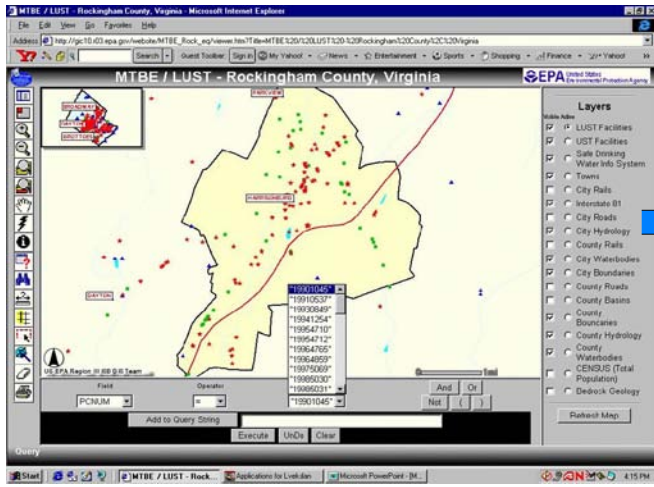
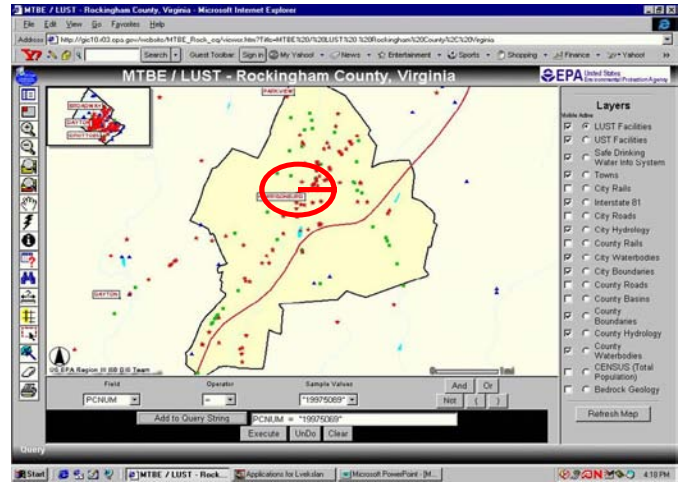


Figure 2: A default view of Rockingham County ArcIMS Application with all Layers(right) and Toolbar with tools for Map manipulation(left).

Click the query tool(?) form the tool bar on the left in order to create s query of the Active theme (LUST), then choose field name and data from sample list drop down box



Click "Add to query string" button and then "execute" button to select specific site



Buffer in 1 mile radius around selected LUST site with attribute SDWIS data and distance between LUST and SDWIS points

Creating buffer around selected LUST site. Select SDWIS from list of layers and one mile buffer radius

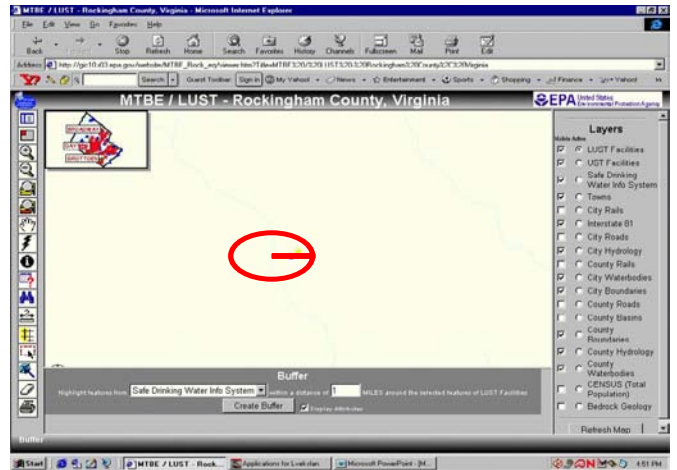
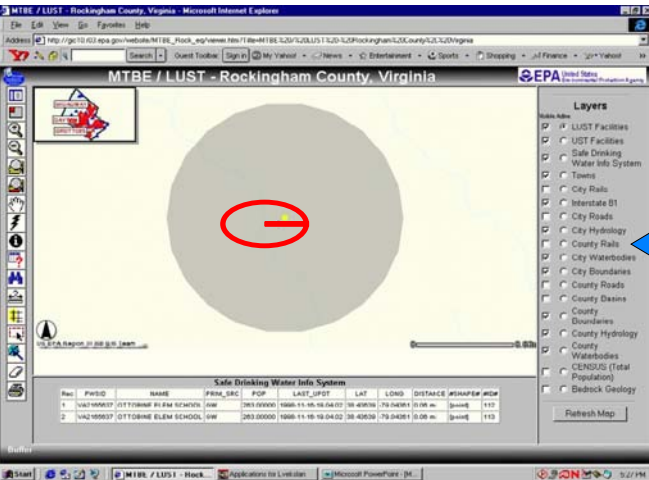
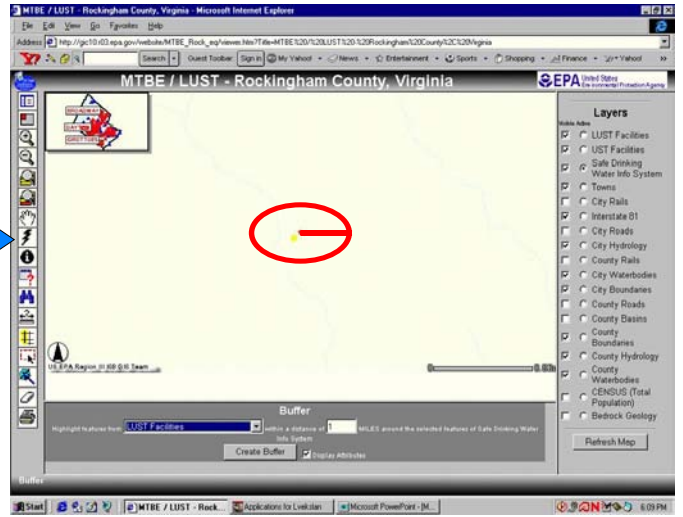
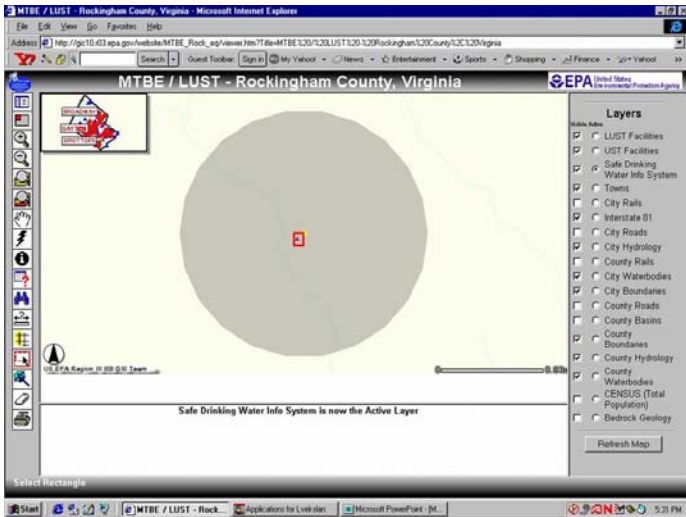


Figure 3: Steps of an online query for a specific LUST Site.

Selecting SDWIS point to be point of origin (selected point must be active layer)

Creating buffer around selected SDWIS site. Select LUST from list of layers and one mile buffer radius



Calculating the distance manually by selecting measure tool from the toolbox and clicking on the two points. Distance appears on the left upper corner of the map

Buffer in 1 mile radius around selected SDWIS site with attribute LUST data and distance between SDWIS and LUST points

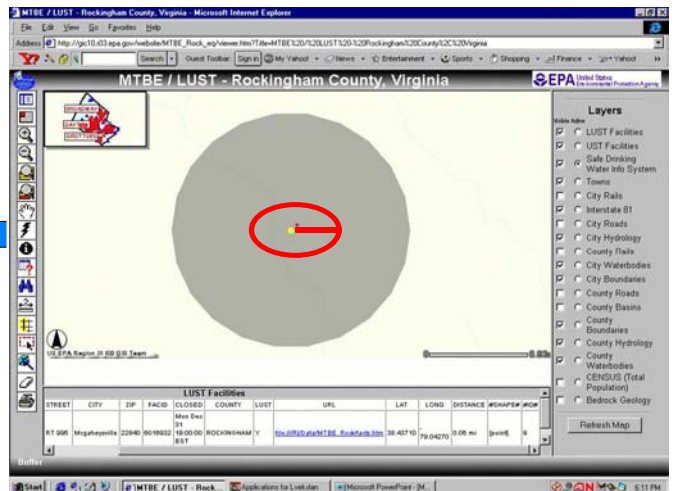
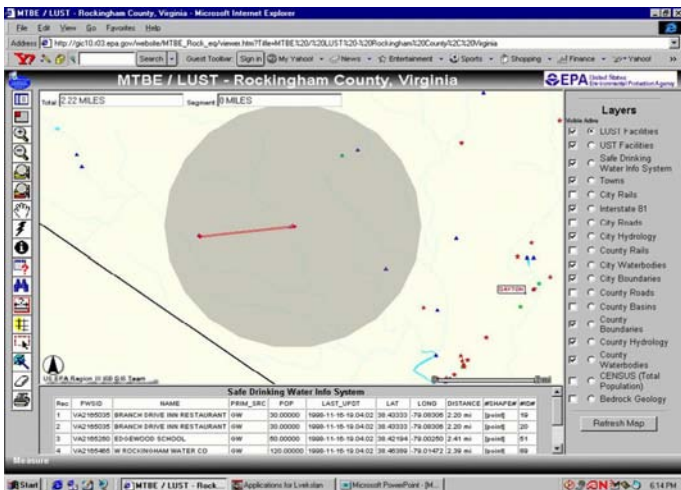


Figure 4: Steps of an online query for a specific well site.

By clicking blue hyperlink in attribute table to show the detailed site specific information

ROCK GIS can generate Summary Reports for a LUST site by clicking blue hyperlink in attribute table.

Link to General site information form

Link to Release Discovery form

Link to NFA Letter

Link to Site Plan form

Link to Ground Water Test Results form

Figure 5: ROCK GIS can generate Summary Reports for a LUST Site with detailed site specific information.

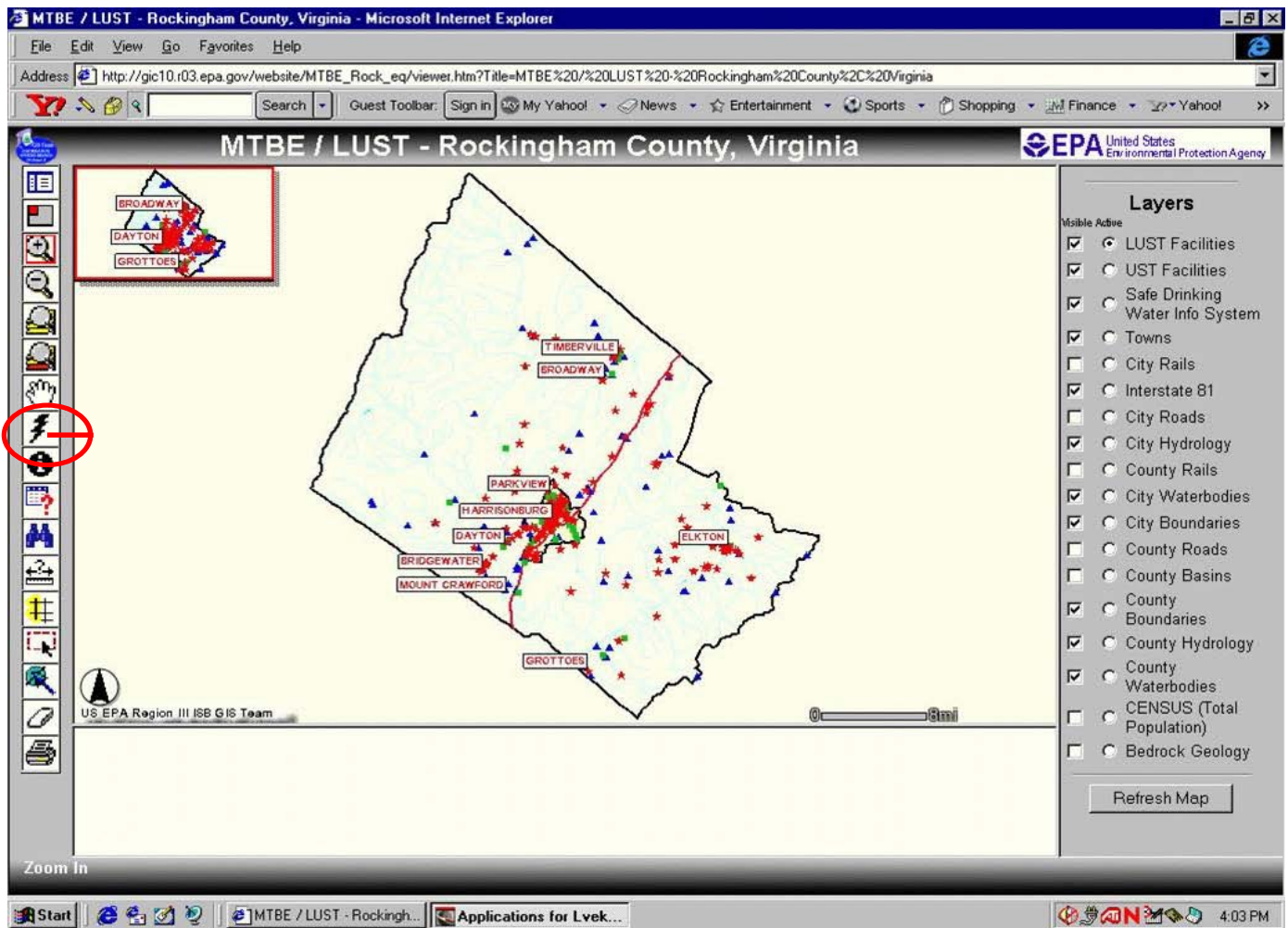
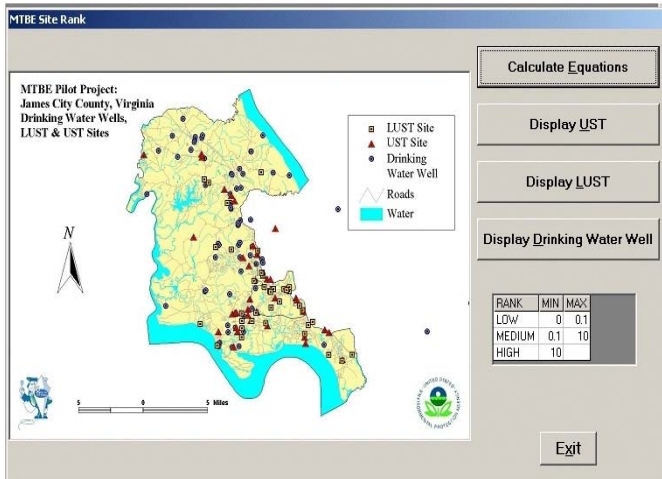


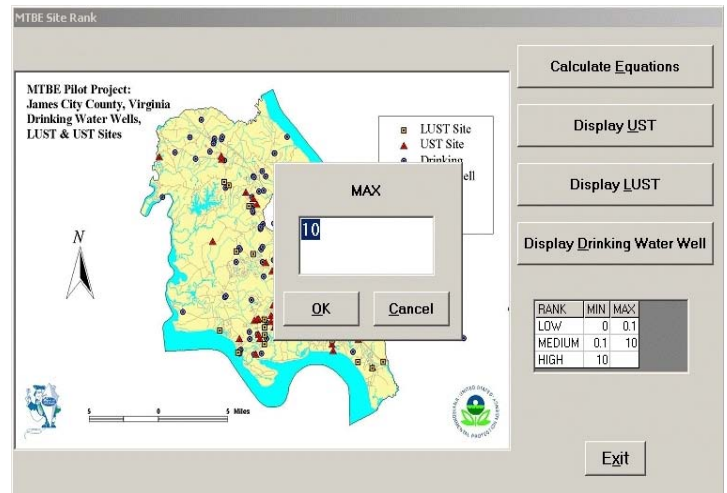
Figure 6: The “Lightning Bolt” icon on the Toolbar provides a useful Enforcement Tool. It creates a Hyperlink to specific State Databases and search for data related to the same Facility ID.

SiteRank Initial Screen

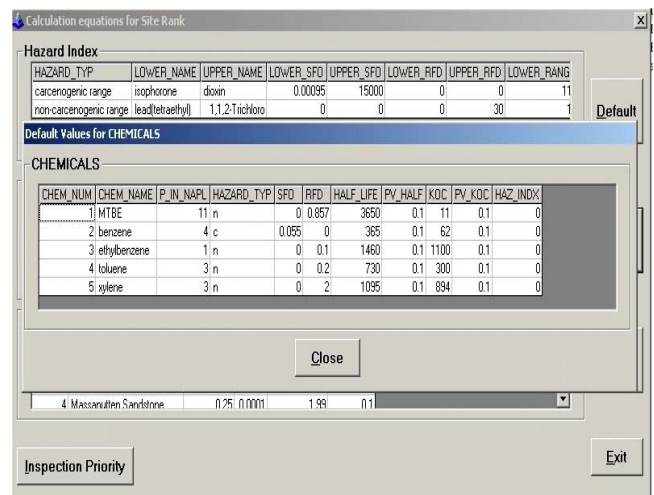
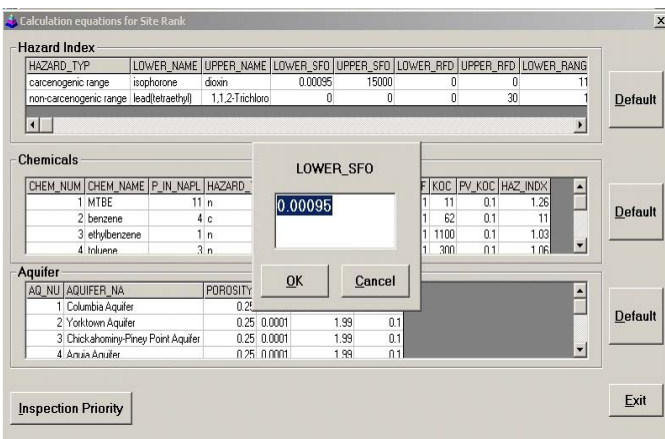


SiteRank - a Vulnerability Ranking Model for Water Wells impacted by MTBE. SiteRank Model overcomes some of the limitations of existing ranking models by combining simplified contaminant fate and transport modeling concepts with information about source proximity to the well within a mathematically consistent framework.

Ability to change Low, Medium, and High Ranking



Ability to change Hazard Index, Chemicals, or Aquifer data



Default Values For Hazard Index, Chemicals, and Aquifer Data

Figure 7: SiteRank -Vulnerability Ranking for Water Wells Impacted by releases from USTs and LUSTs.

Calculating Source Ranking Equations

Calculation equations for Site Rank

HAZARD_TYP	LOWER_NAME	UPPER_NAME	LOWER_SFD	UPPER_SFD	LOWER_RFD	UPPER_RFD	LOWER_RANG
carcinogenic range	isophorone	doxin	0.00095	15000	0	0	11
non-carcinogenic range	lead(tetraethyl)	1,1,2-Trichloro	0	0	0	30	1

Default

Chemicals

CHEM_NUM	CHEM_NAME	P.IN.	HAZ_IND
1	MTBE		1.26
2	benzene		11
3	ethylbenzene		1.03
4	toluene		1.06

Default

Aquifer

AQ_NUM	AQUIFER_NAME	LOWER_SFD	UPPER_SFD	LOWER_RFD	UPPER_RFD
1	Braler Shale	0.25	0.0001	1.99	0.1
2	Milboro and Onandaga Sh	0.25	0.0001	1.99	0.1
3	Cayuga Group Limestone	0.25	0.0001	1.99	0.1
4	Macedonville Sandstone	0.25	0.0001	1.99	0.1

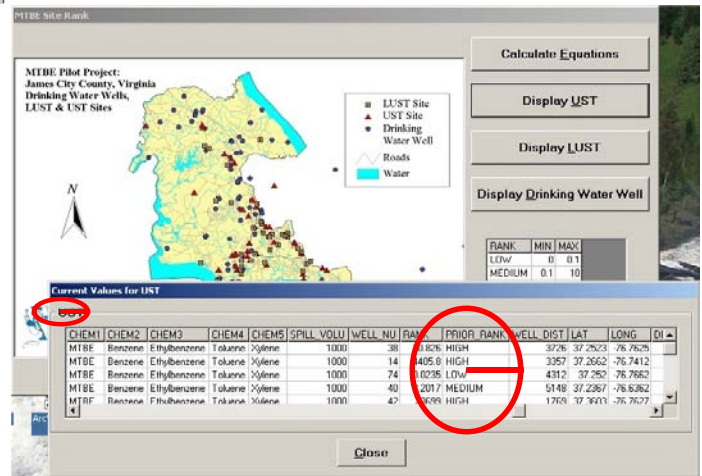
Default

Inspection Priority

Exit

Source Ranking Equations have been successfully calculated!

UST Site Priority Ranking



Well Site Priority Ranking

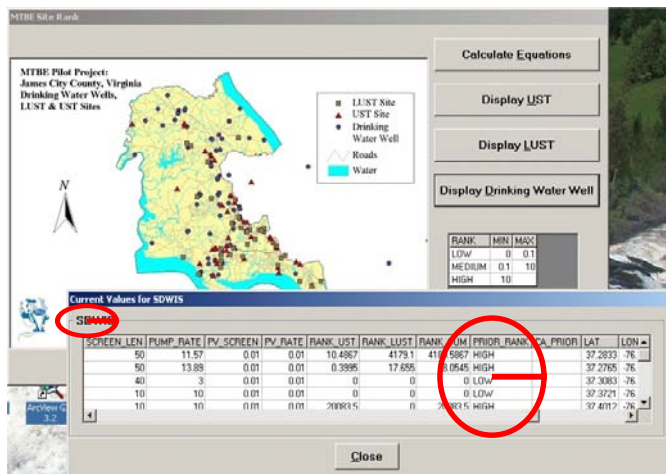


Figure 8: SiteRank - Reports of priority ranking.

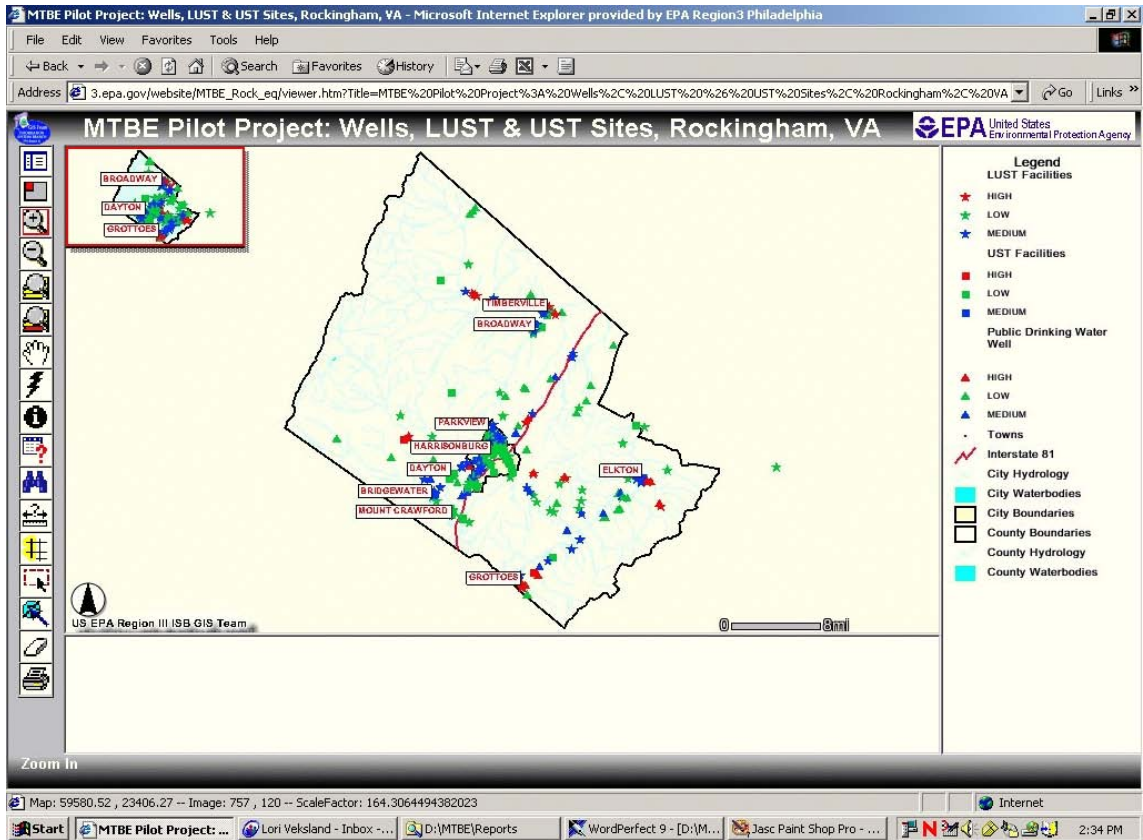


Figure 9: The results SiteRank for UST inspection priority and Drinking well vulnerability for Rockingham County.

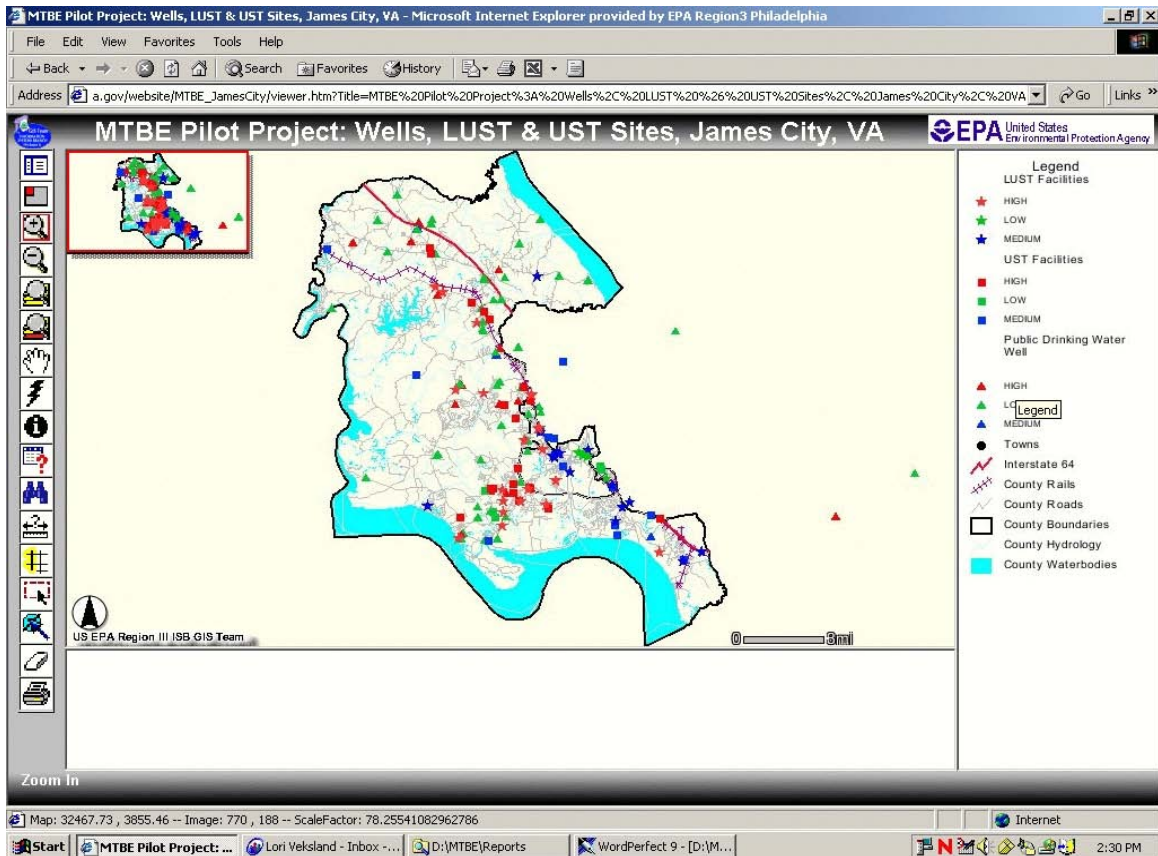


Figure 10: The results SiteRank for UST inspection priority and Drinking well vulnerability for James City County.

$AB-1: y = -684.1728 + 605.6322 \log(x); 800 \geq x > 80$
 $AB-2: y = -1097.079 + 775.2975 \log(x); 100,000 \geq x > 800$

$BC-1: y = -2758.618 + 2151.3314 \log(x); 200 \geq x > 50$
 $BC-2: y = -4636.37 + 2954.0823 \log(x); 1250 \geq x > 200$
 $BC-3: y = -14748 + 5968.91 \log(x); 11,000 \geq x > 1250$

Breakpt. \odot $AB-1: x=800$
 $BC-1: x=200$
 $BC-2: x=1250$

Boundary $x < 5 \rightarrow$ Exit, print (MTBC < 5 ppb)
 $x > 100,000 \rightarrow$ Exit, print (MTBE > 100,000 ppb)
 $y > 10,000 \rightarrow$ Exit, print (nearest receptor > 10,000 ft)

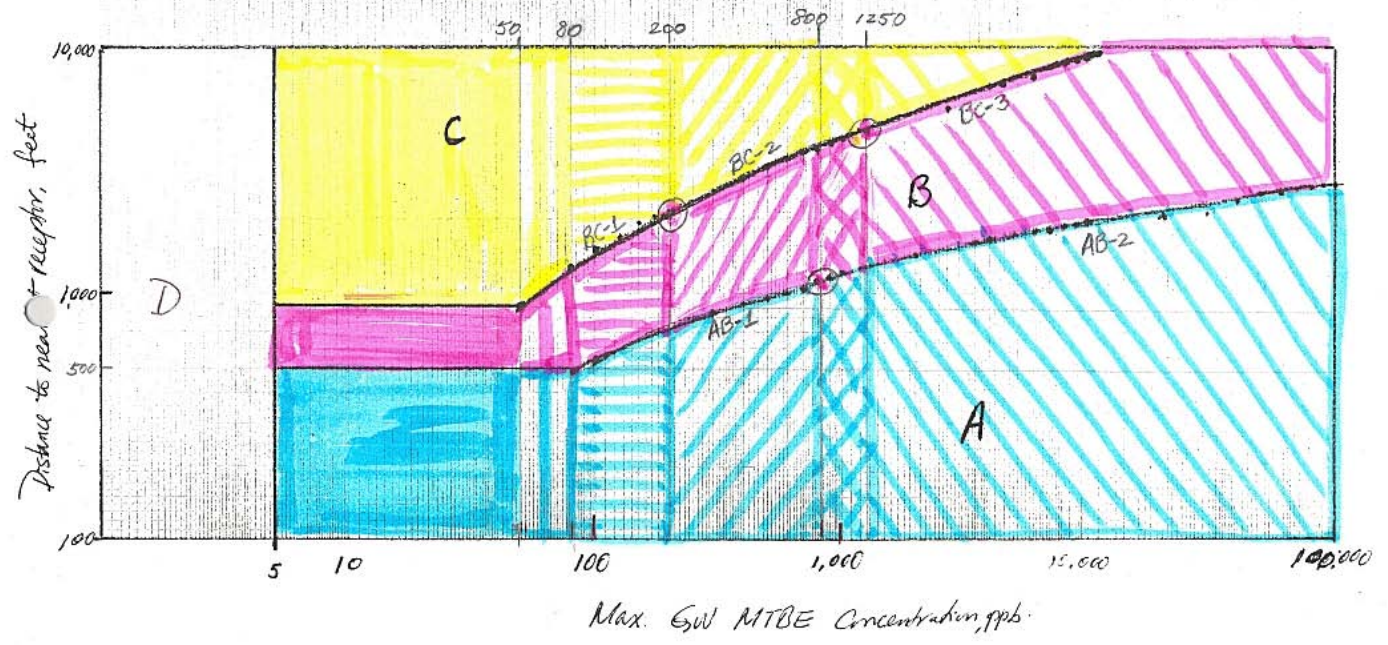


Figure 11: California Priority Scheme.

Programming in JavaScript allowed ArcIMS ROCK GIS to:

1. Calculate distance “on-the-fly” inside of specified buffer between LUST Site and Drinking Water Well Facilities.
2. Calculate priority classification for Corrective Action Investigations.

Corrective Action Priorities results were incorporated into the Safe Drinking Water Well Attribute Table.

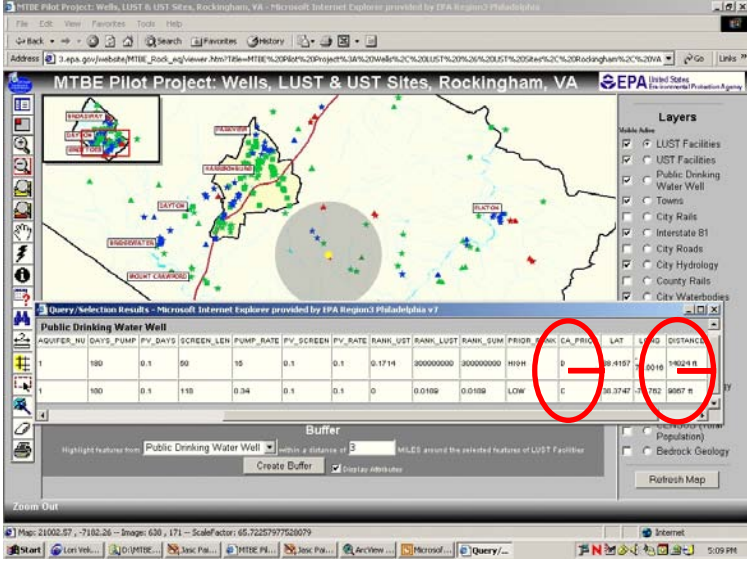
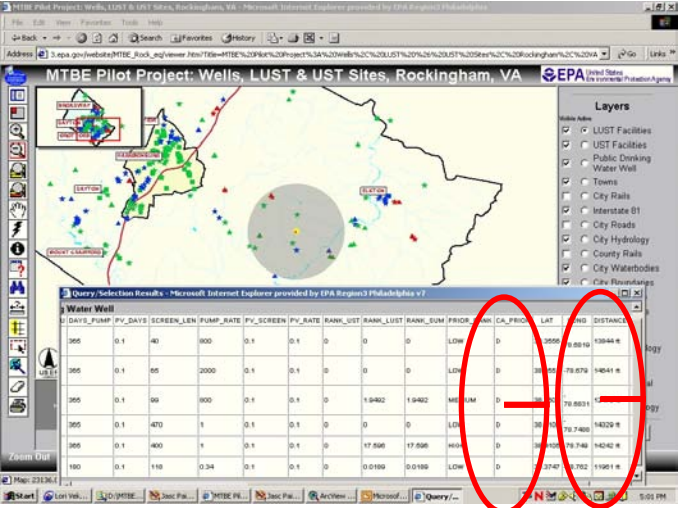
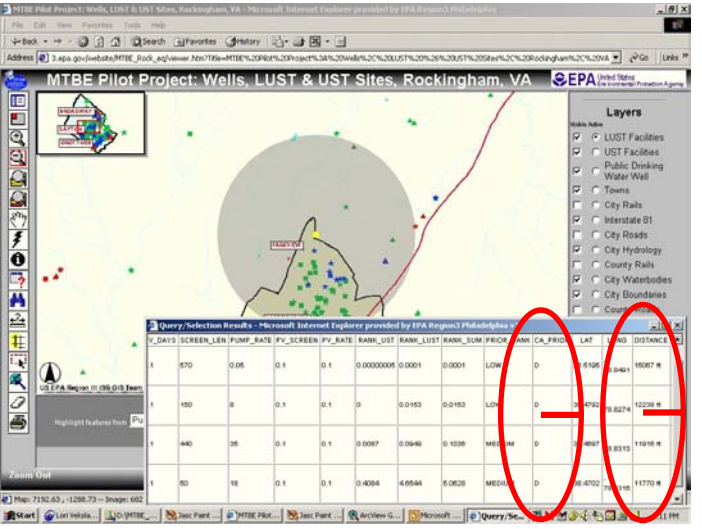
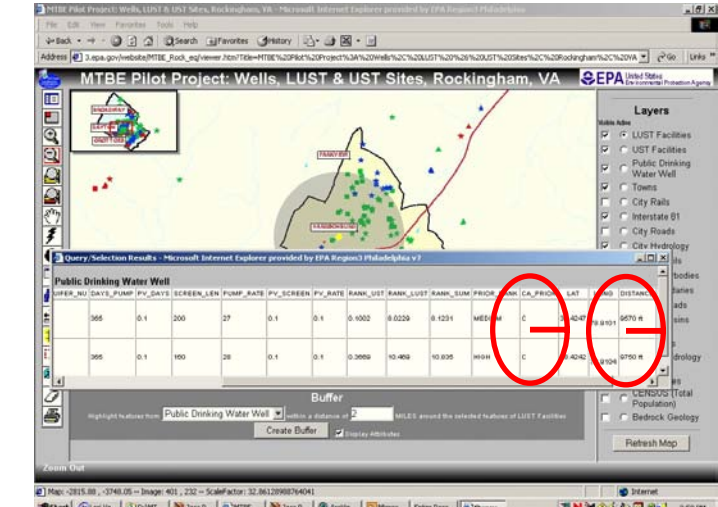


Figure 12: Assigning priority classes for corrective action investigation.

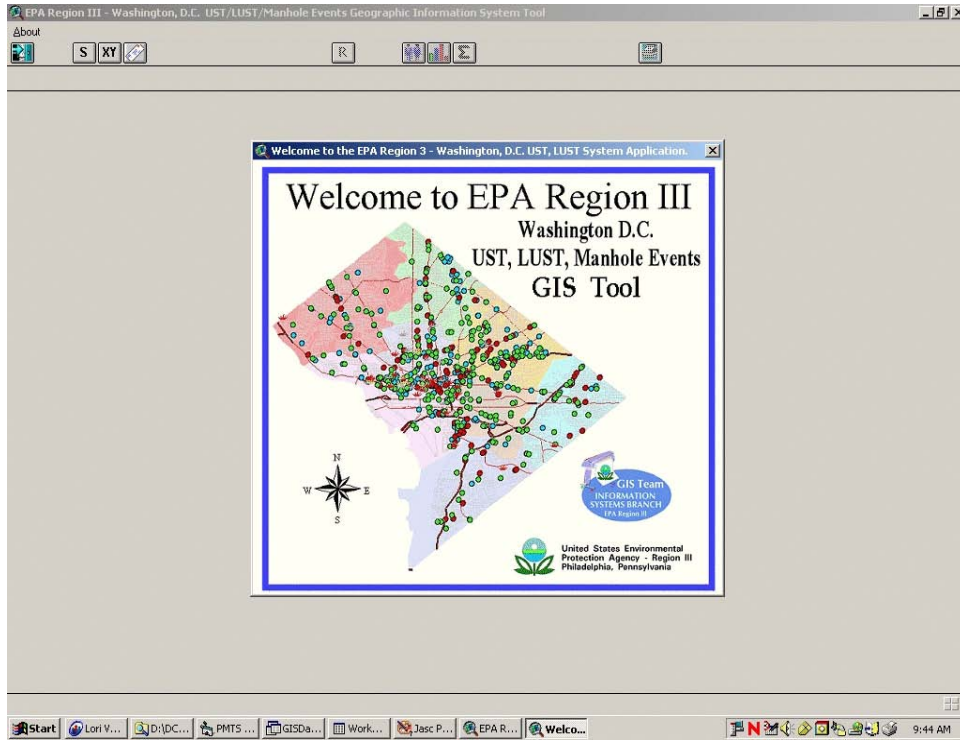


Figure 13: D.C. GIS Application

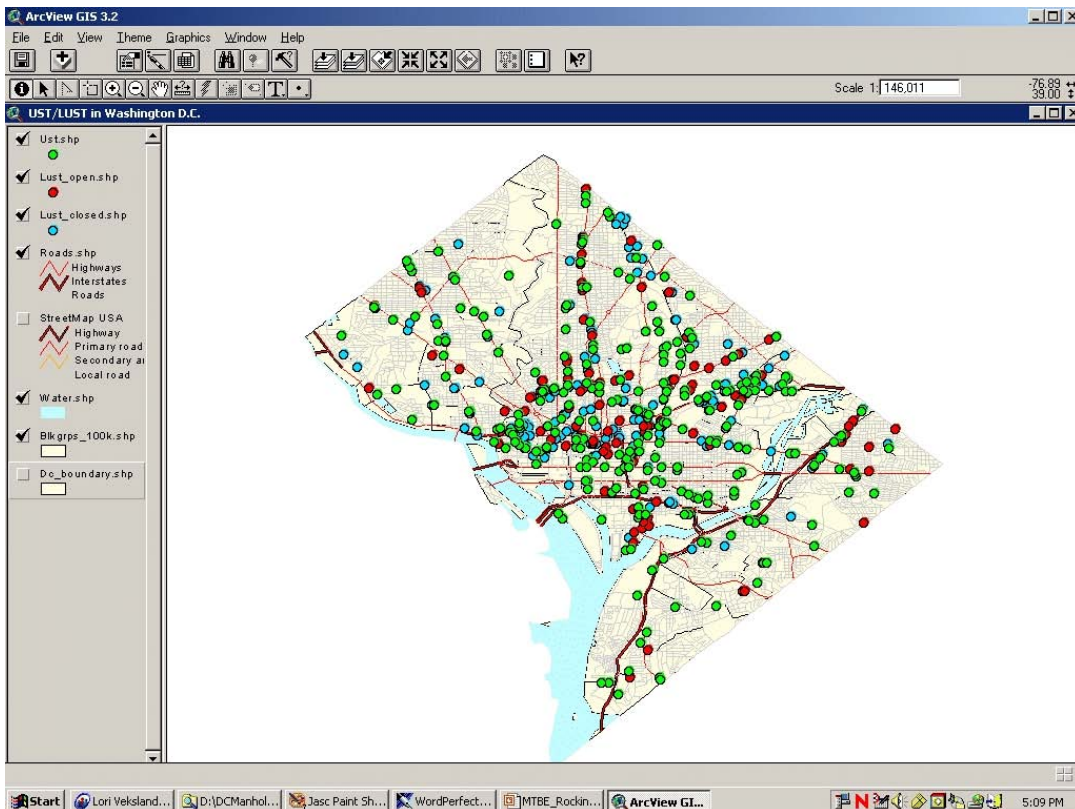


Figure 14: D.C. GIS Project for UST/LUST.

Report on the Mid-Atlantic States' MTBE Pilot Project

Questions and Answers

Q1: Why did Region III undertake this pilot?

A: Because of concerns in California and in other locations across the country with MTBE contamination of water supplies, Region III thought it important to conduct a pilot project to determine the possible extent of contamination in the Mid-Atlantic.

Q2: What did the Region do to check for MTBE contamination?

A: The Region decided to conduct an MTBE pilot study for two counties in Virginia. A sample from at least one well from each of the public water systems (PWS) in the two counties were tested for MTBE, TBA and BTEX. Also, all of the existing LUST site files for these two counties were reviewed to determine if MTBE was present.

Q3: What were the results of the sampling and file review events?

A: The major finding as a result of this pilot project is that MTBE was not found in any of the water samples taken from the 64 public water supplies of the pilot study areas. Based on existing site data, only 10 out of 215 LUST sites in the project areas had MTBE contamination in site ground water; however, not all sites had monitored for MTBE due to the date or nature of the release.

Q4: How were the data organized and used?

A: For LUST sites, UST facilities and PWS wells, locational (latitude/longitude), chemical and hydrogeologic data were organized and incorporated into a GIS application for the purpose of being processed by a risk-ranking tool.

Q5: How does the GIS-based ranking tool ascertain relative risk?

A: The ranking tool was designed to use information about the local aquifer, chemicals of concern, contaminant sources, and PWS pumping rates to calculate risk-ranking values. Chemical properties for MTBE and BTEX, and the parameter values for calculating the cancer risk or hazard index are provided within the application. For LUST cases, sites with higher concentrations of toxic, recalcitrant compounds will be ranked higher and wells with greater numbers of higher ranking sources in close proximity will be ranked as more vulnerable. For UST sites, the tool assumes a fixed release volume which is used to similarly quantify relative risk.

Q6: Can others use the GIS application or risk-ranking tool?

A: While Region III was able to use the application and tool, in its present form, others would need much support to perform similar functions using the existing software package. Region III plans to enhance the application and tool to make them more user friendly and transportable and subsequently provide the enhanced package to OUST for distribution to interested states. The participating states could use these tools to assist them in increasing efficiency/effectiveness in the implementation of UST/LUST programs.

Q7: What other benefits could be derived from this application?

A: While the stated benefits of this GIS application and tool regard risk-ranking, other benefits could be obtained from managing LUST and PWS data in GIS. For example, regulatory agencies could more easily address public requests (FOIAs) for local impacts by pulling information from the GIS application.

Q8: What is schedule to enhance the tool and make the application more user-friendly? What support is needed by Region III for this purpose.

A: Region III plans to address these refinements by the end of FY04 and subsequently forward the enhanced tools to the EPA Office of Underground Storage Tanks for potential distribution. Region III expects that it will be able to perform the general refinements in-house; however, user-interface improvements may require support from outside specialists.

Q9: What support does Region III plan to offer to other states or regions that are interested in developing a similar application?

A: Dependent on resource constraints at the time of a request for assistance, Region III would be willing to help a state/region initiate the development of a similar system