1. *Introduction:*

GIS has always been a tool that crosses the boundaries of disciplines and application areas. As GIS users we are all familiar with science and technology, and engineering applications. The power of GIS lies not only in the ability to visualize spatial relationships, but also beyond the space to a holistic view of the world with its many interconnected components and complex relationships. The ability to develop higher-level thinking and problem solving through the use of GIS definitely gives a better understanding for decision-based systems. Before finding the best site on a particular area, the owner had to do a lot of preparations like finding the number of people living in a given county or city, and if he is going to do that manually it is going to take a long time and still will not be able to find exactly all the details regarding the things that needed for his business and in the process wont find the best location as well. GIS provides ready to use data which helps in knowing all the details and much more than required and he can go in small details in finding the best possible location.

2. *The Problem*

It is always being the case that whenever you go to a new place to start business we need to know a lot of things about the country, state and the county that we want open the business and what are criteria for selecting the site on what basis the person is going to locate the business,

- Which area has more population and which has less and at which places these population has been concentrated, and how much is the population and of what age and how they are distributed and many more things need to known for a good selection of the site.

- Population density is one of the criteria that is important to an individual as it will let him know where the population per mile is situated and where there is not, which will help him to locate his area of interest.
- Question regarding the roads where usually vehicles move around.
- Questions regarding recreational area where young and old come for taking a break from the hectic and tiring schedule.

3. Objectives:

The objective of this project is to exploit the use of the software-ArcGIS in any field relevant to GIS. This project tried to provide a guideline for the state named Texas of USA for selection of a retail center. This will not in any way serve the purpose of as the best site for the location of the retail center but it just shows the use of this vast and expounding software. The criteria for the selection of the site are done depending on the data available.

4. Literature Review:

Geographic Information Systems (GIS) are computer-based systems that are used to store and manipulate geographic information. Managers within public and private organizations are being called upon to make decisions about the introduction of GIS technology and to establish policies for its use. Students and educators who use geographic are gaining access to GIS technology that can be used to increase the depth and breadth of their analyses. GIS technology has provided an exciting potential for geographic information to be used more systematically and by a greater diversity of disciples than ever before. The ease with which a GIS can manipulate geographic

information to be used more systematically can by a greater diversity of disciplines than ever before. A GIS is designed for the collection, storage and analysis of objects and phenomenon where geographic location is an important characteristic or critical to the analysis. The location of the fire station or the location where soil erosion is most severe is the key considerations in using this information. GIS has a wide variety of applications ranging from Marketing, Trade area analysis, agricultural, municipal, forestry and wild life management, archeology, geology and global scale application like ecological effects of increased atmospheric carbon dioxide and many more which includes the site selection as well. Despite all these applications it cannot exist on its own, basically it has five components software, hardware, people, applications and the data. The purpose of GIS is to establish a set of elements, interacting with the work force, through guidelines and standards, to improve the quality of the services and increase prevention relating to questions of safety, environment and health. The geographic information system (GIS) is to provide a spatial framework to support decisions for the intelligent use of earth's resources and to manage the man-made environment. The method of displaying, querying, editing and analyzing information depends on the way the geographic objects have been modeled.

4.1 Use of GIS in Site-Selection:

GIS systems offer a wide array of tools designed to help us find that perfect spot whether we are an entrepreneur looking for the hippest spot in town in which to open your new coffee shop. A telecom engineer looking for the optimal location for an aerial. A tour guide looking for the most perfect view point. A bank executive seeking to optimize the location of ATM machines or a supermarket manager wishing to increase the sales of dried figs. GIS systems offer the tools that will enable you to find

the answers to your questions and therefore enable you to find the best location. Using a GIS we can explore, analyze, and visualize a multitude of demographic and market research data from either external or in house resources to find out where your target population resides, works, and plays. The attractiveness of a store or the effectiveness of a service is dependent on distance and accessibility.

http://corpweb.semcor.com/gis/solutions/type/biz/site_selection.html

5. *Study Area:*

The study area of this project is the state of Texas in United States of America. Firstly, I don't know anything about Texas except that president of united states hails from this area, so it was a kind of looking to know more about it, after searching I did found out that is one of the most populated states, which was going one of the criteria for selection of the site for the business. This project can be replicated to any other country and regions as well.

6. *Data Source:*

This project is based on the data from the ESRI data source and the use of the software ArcGIS which was readily available to us.

7. *Tools of Study:*

There are many software's which can be used to do this kind of work, but the software available to us is the mostly widely used product available in the market throughout the world that is ESRI"S product ArcGIS.

7.1 Introduction to ArcGIS:

ArcGIS desktop is the collective name for three products, ArcView^{R} 8.x, ArcEditor^{TM} 8.X, and ArcInfo^{TM} 8.x. these products have the same interface and share much of their functionality. Arc Editor does everything ArcView does and goes beyond it; ArcInfo goes beyond Arc Editor. In ArcMap we make maps form layers of spatial data, choose colors and symbols, query attributes, analyze spatial relationships, and design map layouts. The ArcMap interface contains a list or table of contents of the layers in the map, a display area for viewing the map, and menus and tools for working with the map.

In Arc catalog, we browse spatial data contained on our computer's hard disk, on a network, or on the internet. We can search for the spatial data, preview it, and add it to ArcMap. Arc catalog also has tools for creating and viewing metadata (information about spatial data, such as who created it and when, it's intended use, its accuracy, and so forth.

In Arc Toolbox, we can use tools to convert spatial data from one format to another and to change the amp projection of data. With the arcinfo version of ArcGIS desktop, many analysis tools are also included.

7.1.1 Extending ArcGIS Desktop:

We can extend the capabilities of ArcView, ArcEditor or ArcInfo with a number of products. There are three where we can do the spatial analysis; they are ArcGIS spatial Analyst, ArcGIS 3D Analyst, and ArcGIS Geostatistical Analyst.

ArcGIS Analyst, we can create raster surfaces, query them, and do overlay analysis on them. We can also derive new surfaces from other raster or vector layers.

ArcGIS 3D Analyst, we can visualize and analyze vector and raster data in three dimensions. We can "fly through" terrain and examine it from any angle. We can determine which areas on a surface are visible from given points and whether a line of sights exists from one point to another.

ArcGIS Geostatistical Analyst, we can create continuous surfaces from a small number of sample number of sample points by predicting the values at unsampled locations.

ArcGIS Street Map contains street data for the entire United States. We can use it to create street maps and to find nearly any U.S. street address.

ArcPress for ArcGIS improves map printing speed and renders high-quality maps without requiring additional memory or hardware.

The MrSID Encoder for ArcGIS compresses large images such as satellite images and aerial photographs and displays them without losing accuracy.

7.1.2 The ArcGIS System:

ArcGIS Desktop is part of a larger system, the ArcGIS System, which includes ArcSDE (Spatial Database Engine) and ArcIMS (Internet Map Server).

ArcSDE lets us work with geographic data stored in a relational database management system such as Oracle, Microsoft SQL Server, and IBM and so on. ArcSDE manages the exchange of information between ArcGIS and the relational database, enabling many users to share and edit centrally stored geographic data at the same time.

ArcIMS delivers GIS over the internet. We can build Websites that provide maps, data, and GIS applications. ArcIMS websites bring GIS to people who don’t have GIS software and may include tools for zooming, querying, symbolizing, and analyzing

maps. ArcIMS can also send maps and data over the internet directly to ArcGIS Desktop products.

8. Methodology:

The aim of the project was to work with the state of Texas.

- A layer needed to be created of Texas from the whole of United States of America. Using selection tools and using the command "selection by location", the Texas was selected from whole map of USA and then by right clicking on the counties layer selecting the export command and then saving it, a new layer comes on the top of the other layers and this will be the state of Texas. Similarly other layers were selected like interstate, recreational areas, roads, cities, retail centers. This procedure can be applied for selecting a location using the procedure that is being used here.
- Now, the criteria for selecting the site started, that on certain basis the site was selected. A first criterion was finding the area with population of counties more than 30,000 and population density of more than 100 miles per person (this was done in order to reduce the number of results to a minimum). This was done by using the "selection by attribute" command.
- The second criterion was the selection of cities within these counties. Using the command "selection by location", the cities were selected with in these counties.
- The third criterion was finding a place 2 miles from the main road and the interstate highways. This is done because it will help to catch the people who are moving on the highways, and the persons using the roads. This was done using "selection of location" and giving a buffer distance of 2 miles within the

county of already selected counties whose population is greater than 30,000 and population density of more than 100.

- The fourth criterion is finding recreational areas which are near to these areas like roads and interstate highways which are in the counties already selected and that will be the final site of selecting a retail center.

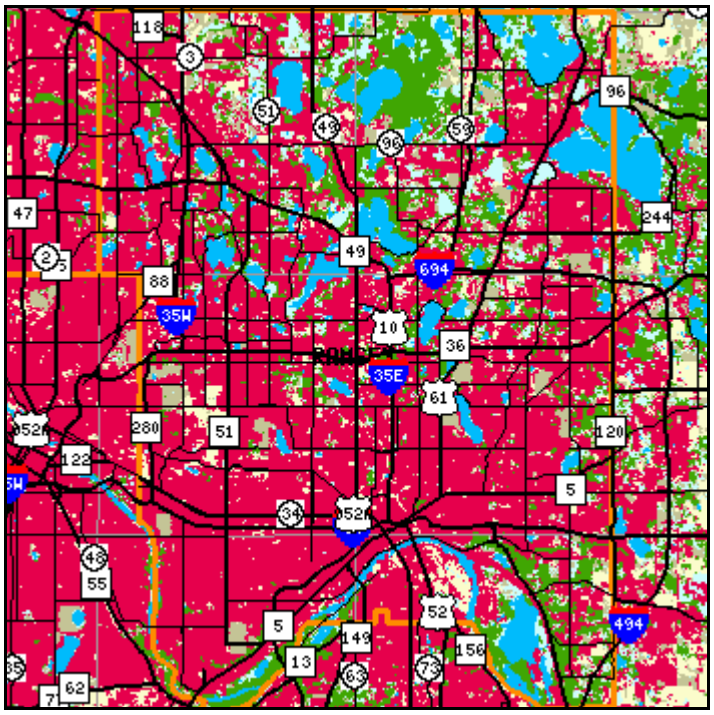
9. *Case Study of Minnesota County:*

Minneapolis and St. Paul are the largest cities located within Minnesota (Association of Minnesota counties, 2002). This area is part of the Twin City metropolitan area and has a population of 2,831,234 (Association of Minnesota counties, 2002). The main objective of the project was to locate the most suitable site for a landfill waste facility within Ramsey County, Minnesota. The objectives of this study were:

1) To identify key criteria necessary for the siting of a suitable landfill facility.
2) To apply these criteria in a GIS overlay analysis to locate most suitable site.
3) To make recommendations for the most suitable site for a new landfill facility

Figure 1: County map of Minnesota (Where 2havefun in Minnesota, 2002)

Figure 2: Enhanced Image of Ramsey County (Land Management Information Centre, 1990)



9.1: Identification of Suitable Criteria

- ✓ Proximity to Roads.

In order to minimize the cost of the landfill, it should be located within 1000 m of main roads (Dikshit, 2001). Locating the landfill close to a road will help reduce costs related to transportation and new road access to the site. To accomplish this, the roads layer from the data deli was reclassed to make sure that the site was not located directly on a road so roads were given a 0 and all other areas were given a 1. From here, distance was used to create a buffer of 1000m where areas within this buffer were given a 1 and areas outside the buffer were given a zero. This left a constraint map that showed areas that could be considered that were within 1000m of a road, no more, no less.

- ✓ Forest Cover

Due to the lack of availability of different land cover, it was decided that this landfill would take over existing forest as, unfortunately, this was the only land use that would yield a possible site. All other land uses would not end with a possible site. This meant that the protection of green space and animal habitat could not be considered if a site was to be found within Ramsey County. This is one of the factors that make it very difficult for a large city with a waste problem to locate the new site within their own county. To accomplish a possible site using forest as the land use cover, a forest layer was taken from the data deli. This layer was reclassed to give all forested areas a 1 and all other areas a 0 so that the landfill would only be sited on a forested land use.

- ✓ Distance to Surface Water

Due to the possibility of the contamination of water, it is necessary for the landfill to be at least 800m from any body of water including wetlands, streams, or lakes (Siddiqui, 1996). This was done by first reclassing everything to give the wetlands and lakes a value of 1. Then a constraint map was created using the distance function to make an 800m buffer. All areas within buffer were given a 0 and all others were given a 1. The same thing was done to the stream map to create a factor map as well.

- ✓ Slope

A low slope is required to minimize erosion and water runoff. A lower slope also facilitates the construction of the site to be much easier and lower costs. (Atkinson, 1995). The best slope for the development of a landfill is between 0% and 25% (MOEE, 1993). The MOEE (1993) states that any slope between 0% and 25% is

considered equally suitable and no preference is given to less steep slopes. To do this, the 30 M Digital Elevation Model (DEM) for Minnesota was used and Ramsey County was windowed out so that just that information was there. After this, the surface function was used to change the DEM to a percent. Any slope between 0% and 25% was given a 1 while any slope greater than 25% received a value of 0 creating another constraint map.

- ✓ Site Size

This new site needs to last for many years until a new alternative can be found to help with the growing garbage problem of Minnesota. Therefore, the site needs to be at least 101175 m^2. Once the ideal sites were found, any site that was less than 1 km2 were eliminated. This was not difficult as after all the criteria were met, there was only one possible location and it was greater than 101175 m^2.

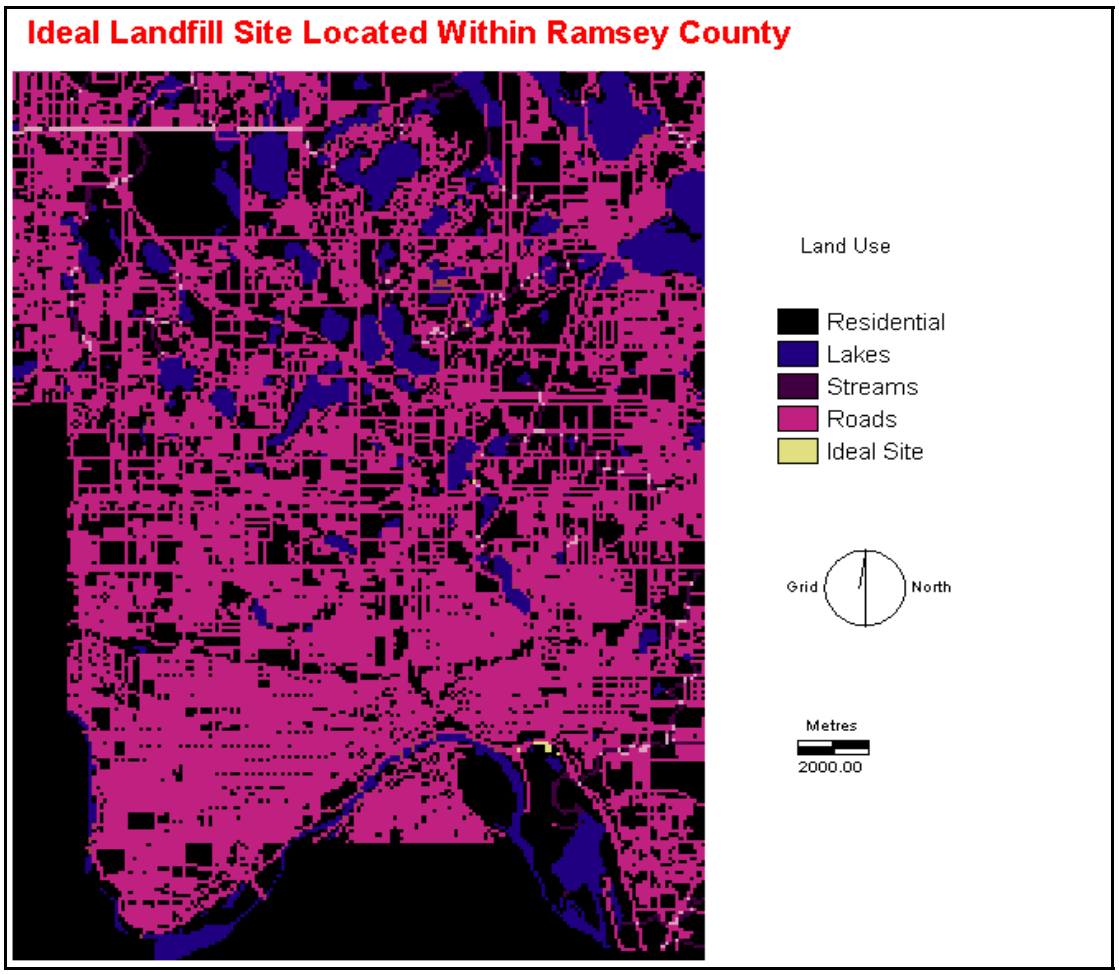
9.2: The Overlay Analysis

After all the constraint maps were made, they were overlayed by multiplying the images together in image calculator. This created the final map with the most ideal site that happened to be the only site. Figure 2.

9.3: Recommendations

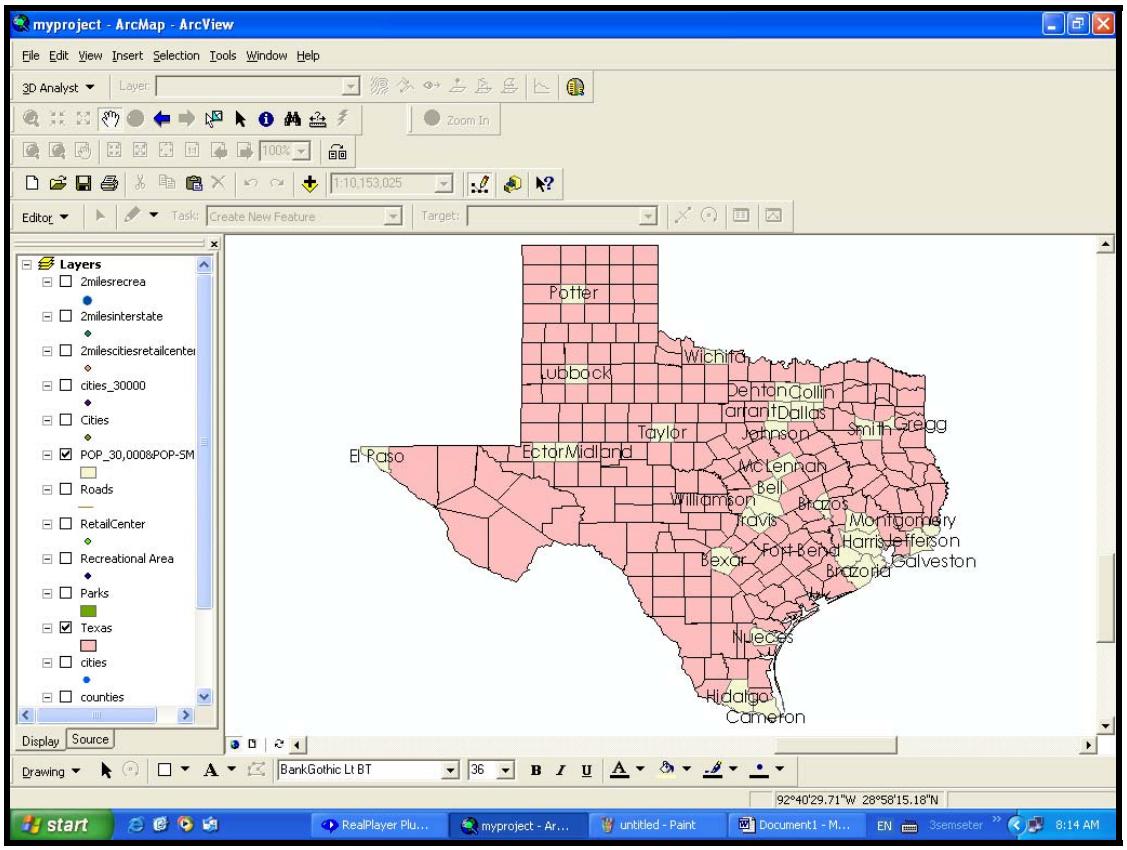
The site discovered in this research will be recommended to the proper officials of Ramsey County. Along with the recommendation of this site, there will be some suggestions put forward for further research into the site. The officials must make sure the site is not located within 3000m of an airport as this information was not available at the time of the research. It will also be recommended to them that they

use no more than 101175 m^2 to keep the impact on the forested areas to a minimum. Hopefully, this GIS research will help Ramsey County solve their dilemma of landfill sitting in the near future.



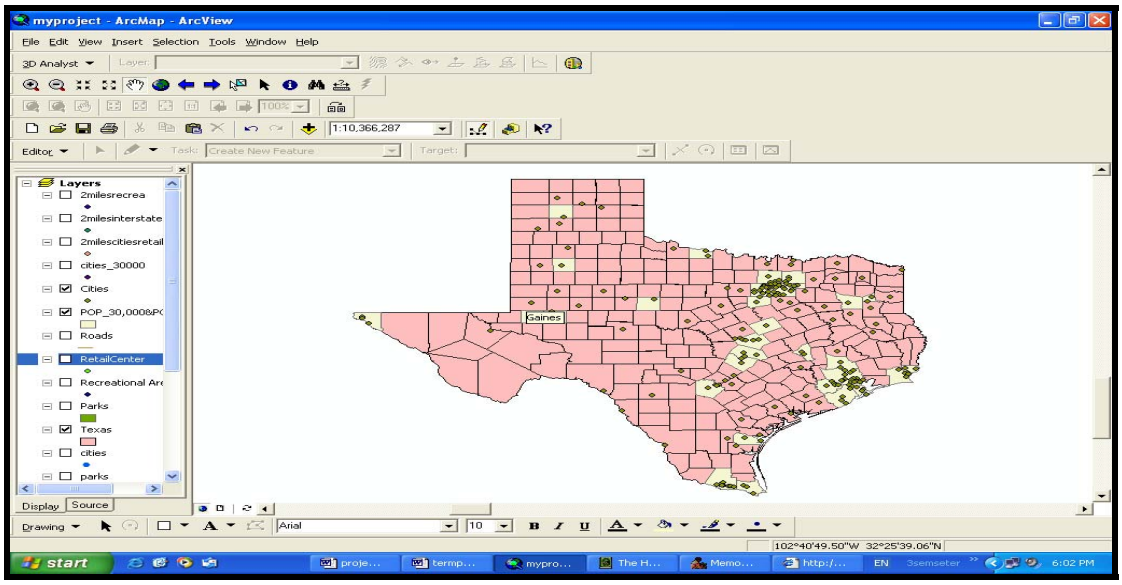
10. Analysis:

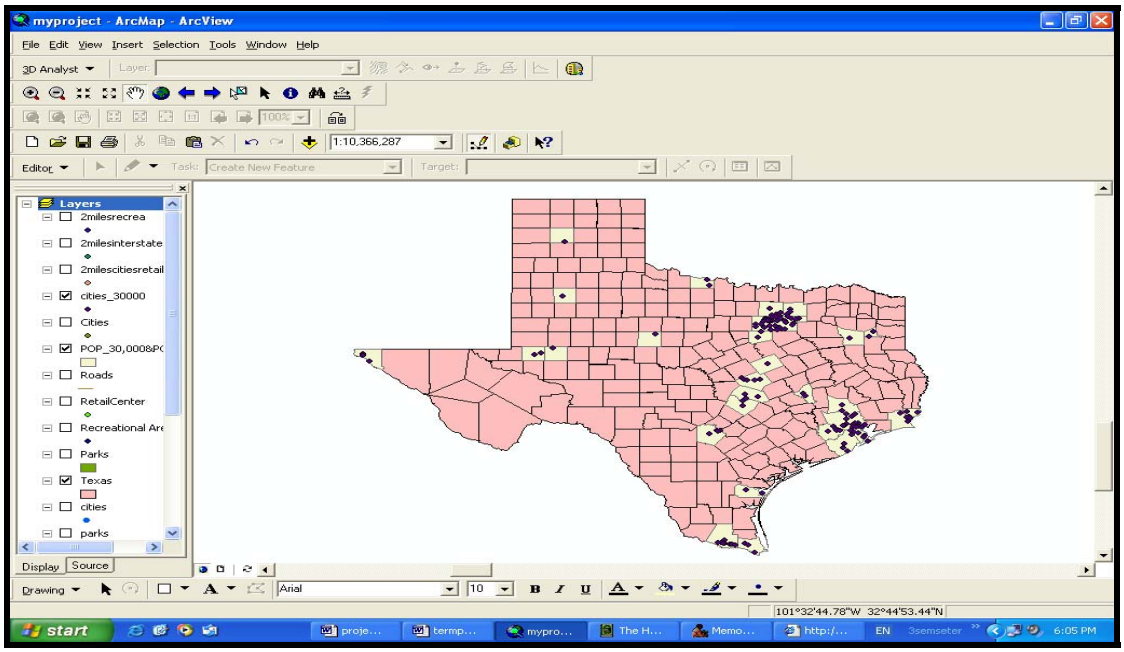
1. This map shows the number of counties selected in yellow and the number of retail centers are shown in that which are totally 99 from actual 1160, considerable reduction in number of retail centers available. But the number of counties has reduced from 254 counties to 31 counties, so our search for the site is restricted to just 31 counties. This shows what GIS can do with in short duration of time.



2. The second criteria for the selection for the retail was the selecting the cities which falls with in those counties and the number has considerably reduced to from 3149 to 182 for the condition population density and population more than 30,000 and when I

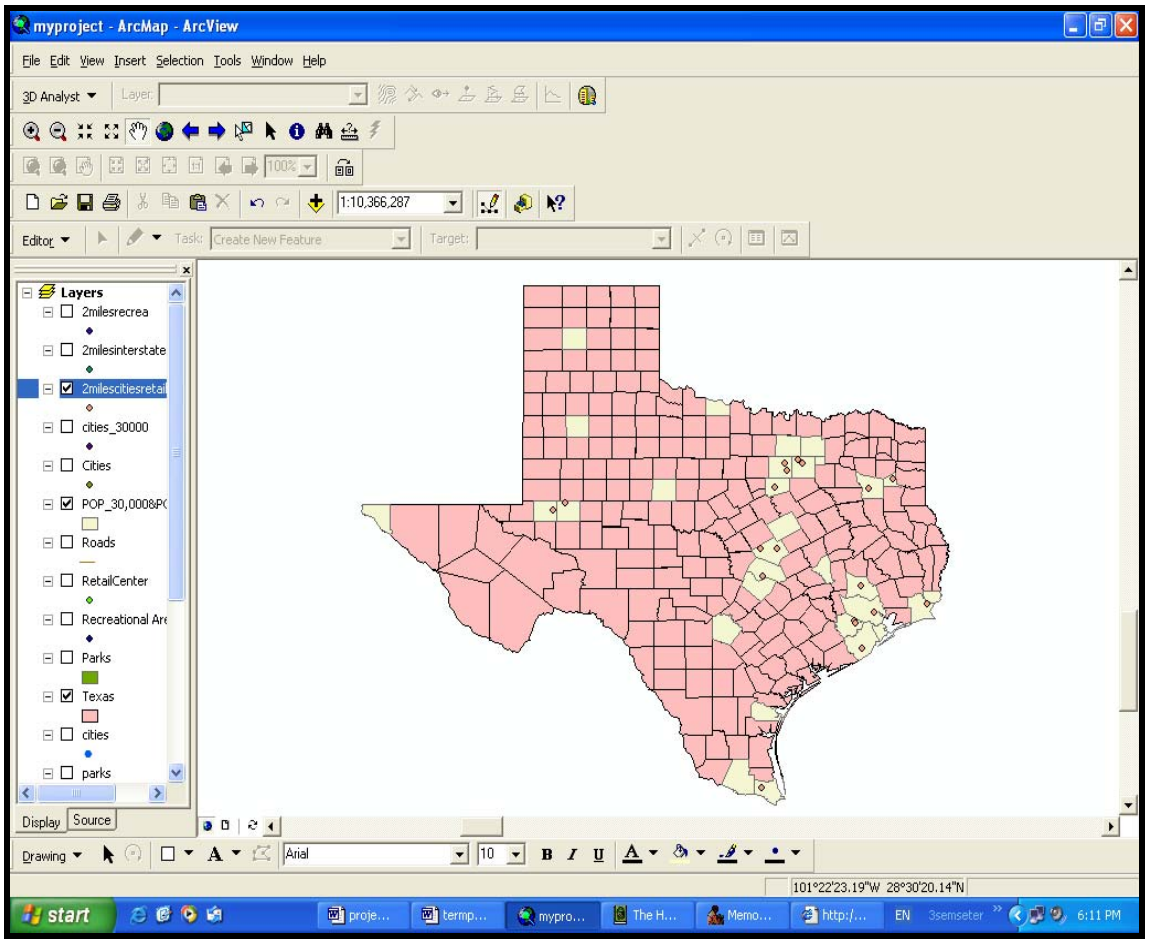
want to have the location with the selected counties it reduced to 134, which is shown in the next slide.





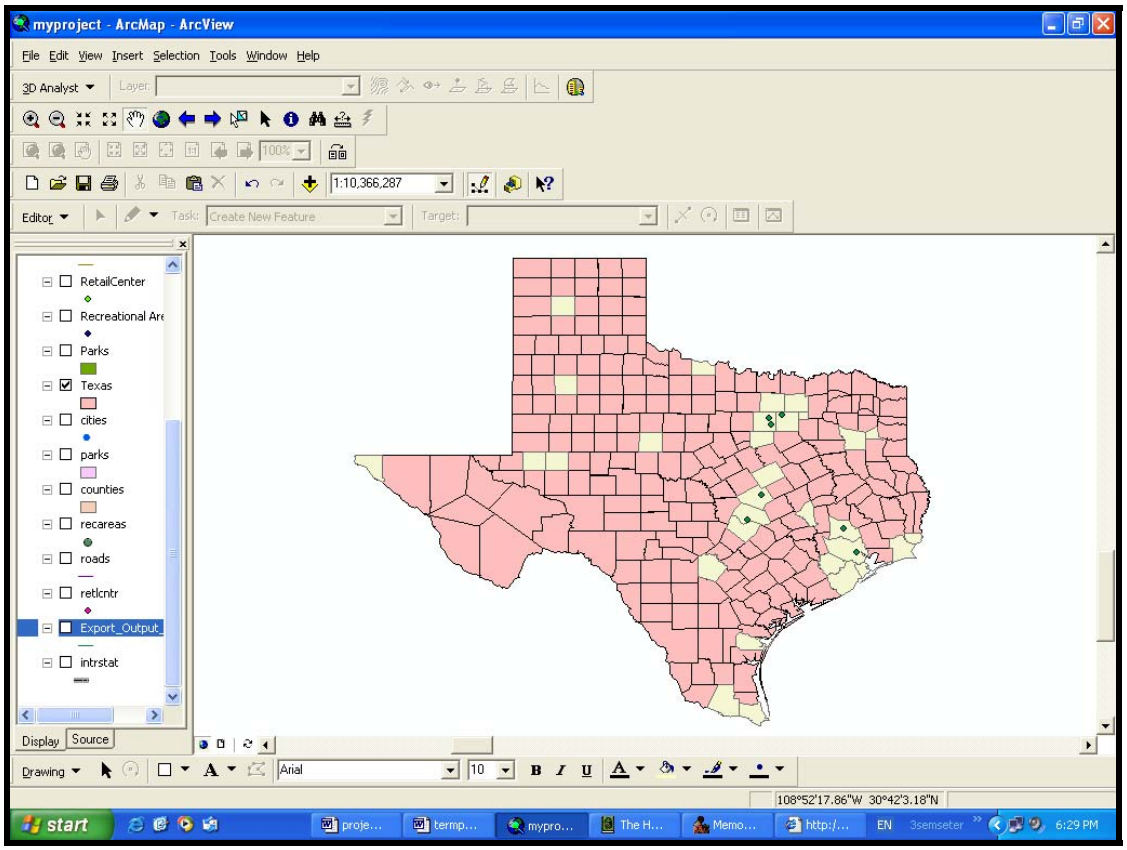
3. The next criterion was finding cities at a location which is 2 miles away from the existing selected cities, so that location should not have competition from the existing one. The concentration for the location has reduced from 134 to just 19. As the number of queries has increased, the more in depth we are getting in for the selection

of the site, we are closer to our best location on the basis of the queries that we have done or on the basis on the criteria that we have assumed earlier.

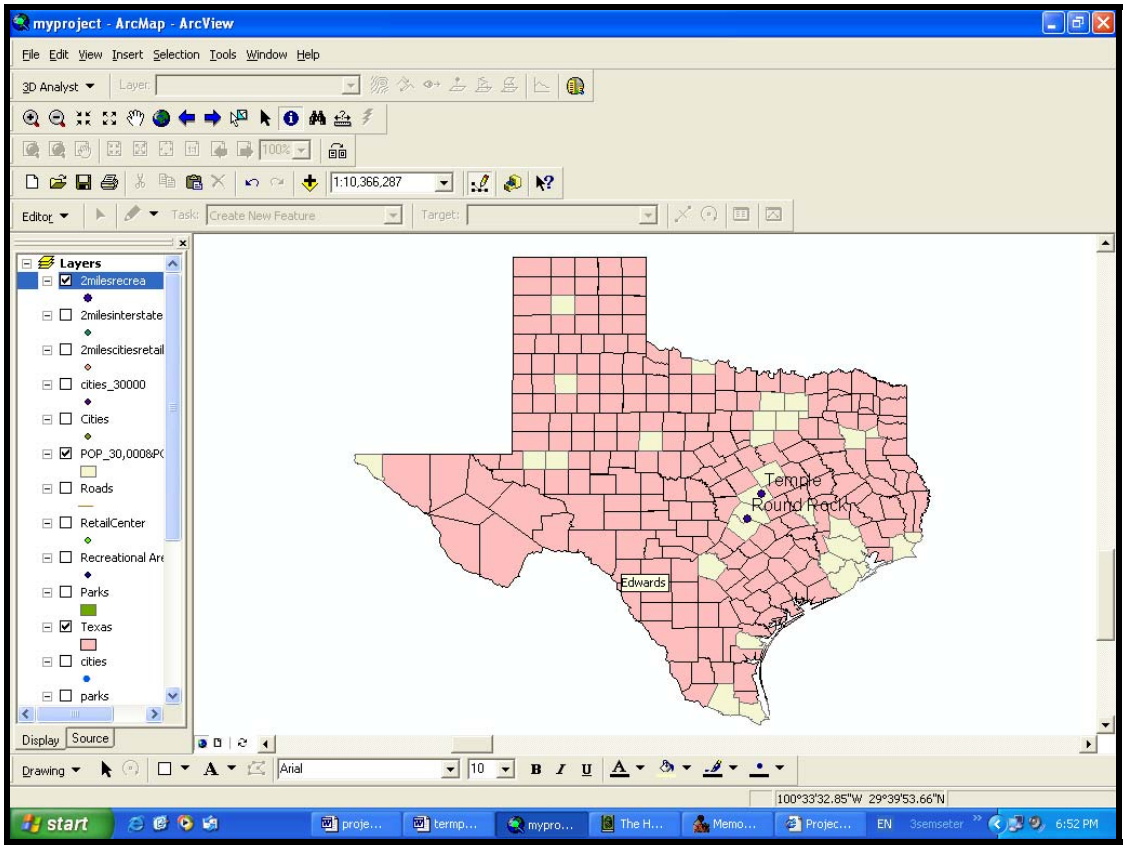


4. The next thing that we have been looking for after getting the cities is the interstate highways which fall within 2 miles from the cities, the main reason for selecting the interstate highways is to catch the travelers who are moving from one state to another, which will be a good source of income. The mode of transportation in U.S is mainly cars, so it will serve as good profitable thing to have your location near to interstates. The interstate highways were 17, but after analyzing it has reduced to 7, which are

passing through the cities which we have selected. Now we have to concentrate on these 7 places and the more queries we are going to give the more we are going to find the location according to it, this all done by GIS.



5. The last criterion is the finding a location 2 miles away from the cities which have recreational areas. This is due the fact that all people come to these places ranging from young to old and it will be a good business to open a retail shop from these areas. The number of selection has reduced from 7 sites to 2 sites. Out of these 2 we need to select one as our final destination for investing in opening retail shop. These two places were Temple and Round Rock. This is just a small application of GIS. This is the final result.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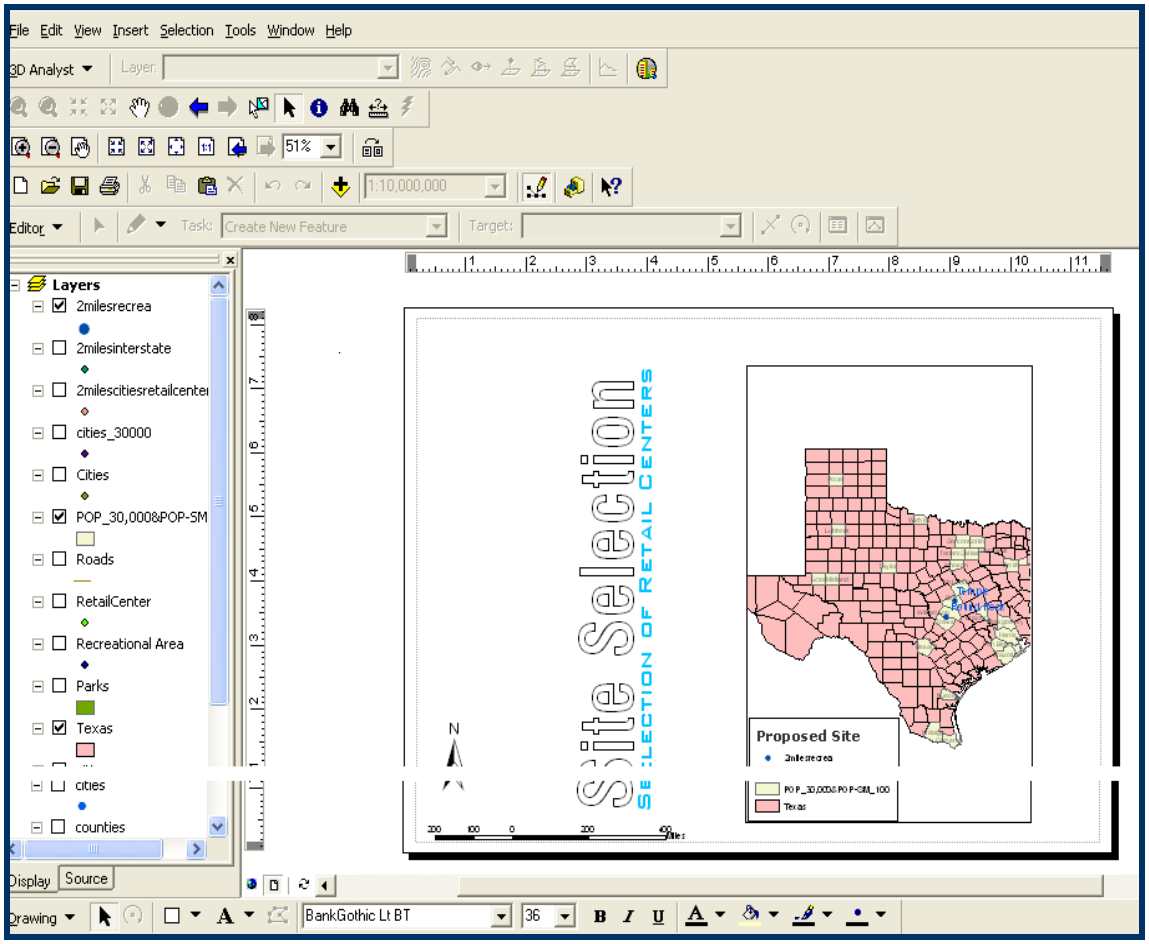
11. Conclusions:

1. The project showed a simple use of the vast technology of GIS in the selection of the location based on certain criteria's.

2. The more queries you give the more we go in depth of the things.



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Where 2havefun in Minnesota 2002. County maps of Minnesota <http://www.2havefun.com/Places/Maps/ramseycounty.shtml> (http://www.uoguelph.ca/geography/research/geog4480_w2002/Group20/pg6.htm)