

# Using GIS to Analyze Relationships to Explore Paranormal Occurrences in the Continental United States

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## Abstract

According to a poll conducted by Gallup, 37% of Americans believe houses can be haunted (Gallup, 2005). There are also hundreds of paranormal research groups and societies in all 50 states who investigate and research paranormal activity. Within the last decade, paranormal activity has become increasingly popular in the media, with numerous television shows that follow paranormal investigators or share personal paranormal experiences (Hill, 2012). However, interest in the paranormal is not new; people have believed in spirits since biblical times. Many hypotheses have surfaced as to why paranormal activity manifests at a particular location; some locations of which are related to the geology and hydrology of a location. These hypotheses include tectonic strain, stone tape, running water, and magnetic anomaly theories. This research attempts to spatially analyze variables that may promote and increase manifestation of paranormal activity. This research will also use alleged haunted locations to analyze correlations between the locations and individual geological and hydrological features. Results of this study indicate one or more geological or hydrological features are suitable for paranormal activity to manifest.

## Introduction

Paranormal is defined as not scientifically explainable (Merriam-Webster, 2013). Given the definition, it is not surprising the academic world recognizes parapsychology as a pseudoscience. One of the main arguments the scientific community disregards paranormal research as a science is because most investigators conduct research in a non-controlled environment and the results have yet to be proven as statistically significant (Townsend, 2006a).

Currently, most paranormal research is conducted by investigating an allegedly "haunted location" and collecting evidence. An unexplainable auditory phenomenon is considered to

occur more than a visual phenomenon (McCue, 2002).

Examples of auditory phenomenon include footsteps, knocking, voices, music, and sounds of objects moving, which can be heard first hand, or recorded. Recorded auditory manifestations recorded on magnetic tape which can be heard when the recording is played back later is known as Electronic Voice Phenomenon (EVP) (Barušs, 2001). Other unexplainable events associated with paranormal activity or a "haunting" include, feeling of cold masses or cold breezes, the sense of not being alone, the appearance of lights, phantom smells, and objects moving. It is also suggested animals have a heighten perception of paranormal activity and can become distressed (McCue, 2002). Manifestations of paranormal activity are

more common at night; however, occurrences have been reported during the day (McCue, 2002).

For the purposes of this research, a haunting is defined as a recurrent phenomenon (visual and/or auditory), of alleged paranormal nature associated with a particular location (McCue, 2002; Heath, 2005). However, it is also suggested haunting type phenomena may be connected to a person or family and may follow these individuals from one location to another (McCue, 2002).

The paranormal research community has adopted many hypotheses suggesting paranormal activity is influenced by geological features such as faults, magnetism/geomagnetism (Townsend, 2004), limestone, magnetite, and quartz (Cardinuto, 2011).

The tectonic strain theory is one of the most popular hypotheses linking geology to reports of paranormal activity (Townsend, 2006b; McCue, 2002). This hypothesis suggests stress less than what is required to generate an earthquake, within the Earth's crust, may result in piezoelectricity in sub-surface rock due to highly localized surface electromagnetic disturbances (Persinger, 1985; Townsend, 2006b).

The Stone Tape theory is popular among paranormal investigators. This theory suggests limestone, quartz and/or magnetite deposits can store information, such as an historical event. When the information is released, a residual haunting can occur (Cardinuto, 2011; Schill, 2013). A residual haunting occurs when a past event is imprinted on these features at a certain location and is 'replayed' in the present (Cardinuto, 2011; Schill, 2013). Paranormal investigators validate this hypothesis by using the First Law of Thermodynamics (Schill, 2013), which states, energy cannot be created or

destroyed, but can be changed from one form to another.

Parapsychologists have adopted a similar theory called place memory. It is thought information can be stored by the environment and retrieved through extrasensory perception. It is suggested that for place memory to exist, the living are involved, and emotion is involved in either the creation or retrieval of memory. Little is known about how place memory is stored, however parapsychologists do believe the local geomagnetic field, geological features, and weather may influence the storage and retrieval of place memory (Heath, 2005).

Paranormal investigators also suggest paranormal activity can alter magnetic fields, while others think paranormal activity uses energy from an area with a high magnetic field to manifest; thus, it is hypothesized an area with magnetite deposits can generate residual hauntings (Schill, 2013). In addition, quartz-based rock and rock containing magnetic minerals can have a significant effect on the spatial distribution of magnetic anomalies (French, Usman, Bunton-Stasyshyn, and Davis, 2009; Braithwaite, 2004). Paranormal research groups favor quartz due to its structure and ability to absorb and amplify energy such as a piezoelectric circuit (Schill, 2013).

It is also hypothesized running water can be used as a source of energy, much like a battery for paranormal activity. In *The Other Side: A Paranormal Blog* at [Rapid City Journal.com](http://Rapid City Journal.com), Mark Rowland, the lead investigator for the Black Hills Paranormal Investigations summarized this theory by explaining, "because paranormal activity is believed to be electrical in nature and water is an electrical conductor, water can conduct paranormal activity" (Rowland, 2009). Furthermore, Rowland suggests because

running water produces energy, and paranormal activity requires energy to manifest, it can draw the required energy from running water (Rowland, 2009).

The objective of this research is not to prove or disprove whether paranormal manifestations are a result of hallucinations or a real external event, but rather to use current hypotheses to conduct an analysis of locations where these hypotheses suggest paranormal phenomena may occur. In addition, locations investigated by the popular television show Ghost Hunters will be used to analyze correlations between the location they have investigated and the individual geological and hydrological features, as well as the calculated suitability of the location.

## Methods

### *Relevant Data*

Esri's ArcMap and ArcCatalog (version 10.1) were utilized for data analysis in all steps of this project. Data included U.S. National Atlas Water Features shapefile from Esri 2012 data, shapefiles of faults, Mineral Resources Data System (MRDS) and digital geology maps from the United States Geological Survey (USGS). These data are freely available to the public. A point shapefile was created by geocoding locations investigated by Ghost Hunters, a television show detailing paranormal activity. Location data was collected from an episodes list located on Wikipedia. Location data were then either geocoded using a batch geocode service or coordinates were collected from the historical site's respective Wikipedia page and truth checked. Attribute tables were exported to Excel using X Tools pro.

### *Manifestation Suitability Model*

The manifestation suitability model was developed after a review of similar models. Six parameters were chosen after reviewing paranormal theories. These included the following parameters: faults, streams, rock unit lithologies containing quartz, limestone deposits, locations with large localized deposits of quartz, and locations with large localized abundance of magnetite.

First, all 50 U.S. states' geology, faults, streams, and mineral data as well as tables containing geological unit descriptions were downloaded. Limestone and quartz polygons, streams, and fault lines, and quartz and magnetite points shapefiles were created by merging, querying, and exporting the data to new shapefiles.

Next, the geocoded haunted locations table was imported to ArcMap and a point shapefile was created.

Once the preliminary data manipulations were completed, the limestone and quartz polygons were converted to raster data (Figure 1).

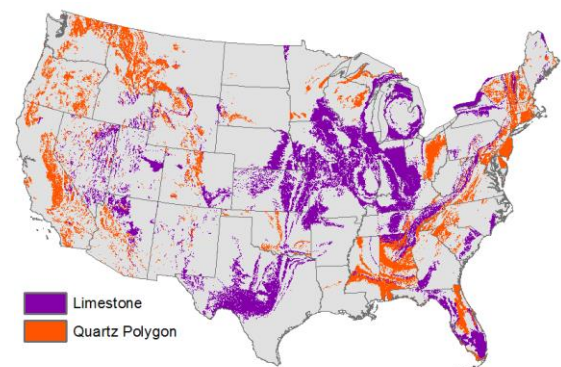


Figure 1. Limestone and quartz raster data.

The remaining data, running water, faults, quartz points, and magnetite were converted to raster data by using the spatial analyst tool, Euclidean Distance. All raster data had a cell size of 152.4 meters and all outputs were reclassified so no data equaled zero.

The paranormal hypotheses do not directly address the specific proximity to these environmental features required for paranormal activity to manifest, therefore distances used were chosen by a subjective interpretation of the hypotheses.

Running water theory suggests distances for paranormal activity to manifest would need to be relatively close to running water, therefore, a distance of 304 meters (1000 feet) was chosen for this analysis (Figure 2).

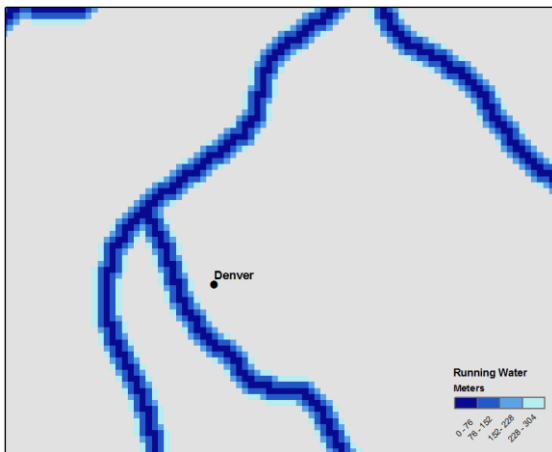


Figure 2. Sample of running water raster near Denver, created using Euclidean distance tool, a distance of 304 meters was used in this analysis.

Tectonic strain theory suggests energy required to influence paranormal activity is localized near fault lines. Rutkowski (1984) determined the radius of energy release for a very large earthquake to be about 12 miles to 31 miles. As a result, a distance 8046.72 meters (5 miles) was used for the fault parameter (Figure 3).

Stone tape theory suggests events from the past can be recorded on rocks such as limestone and lithologies containing quartz or areas with a high abundance of magnetite or quartz deposits. Therefore, paranormal activity should only

occur in a location where these features are present. However, because the shapefile for high abundances of magnetite or quartz is a point, a larger distance of 804.7 meters (.5 mile) was chosen for this analysis (Figure 4).

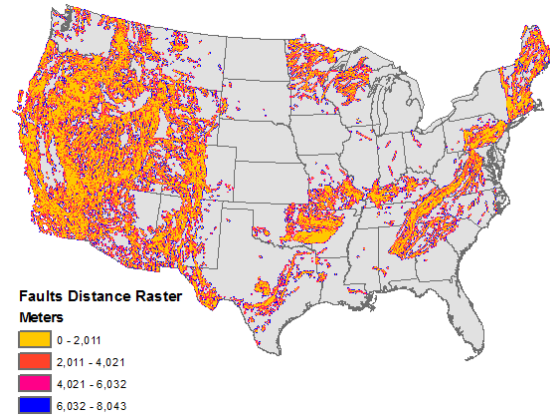


Figure 3. Fault raster created using Euclidean distance tool, a distance of 8046.72 meters was used in this analysis.

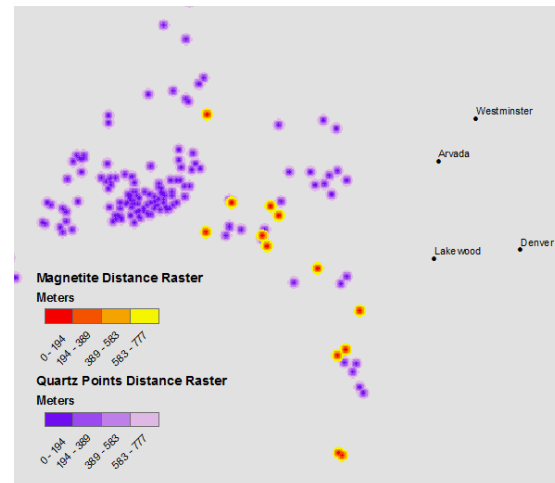


Figure 4. Magnetite and quartz point raster created using the Euclidean distance tool. Distances of 804.7 meters were used in this analysis.

Next, all raster data were reclassified in to equal intervals (Table 1). The reclassified raster data was then aggregated and summed (Figure 5).

Table 1. Raster data reclassified in to equal intervals.

Running Water	
Distance (Meters)	Reclassified
0 – 76	4
76 – 152	3
152 – 228	2
228 – 304	1
NoData	0

Quartz Points	
Distance (Meters)	Reclassified
0 – 194	4
194 - 389	3
389 - 583	2
583- 777	1
NoData	0

Faults	
Distance (Meters)	Reclassified
0 – 2011	4
2011 – 4021	3
4021 – 6032	2
6032 – 8043	1
NoData	0

Limestone	
Distance (Meters)	Reclassified
All	4
NoData	NoData

Magnetite	
Distance (Meters)	Reclassified
0 – 194	4
194 – 389	3
389 – 583	2
583- 777	1
NoData	0

Quartz Polygon	
Distance (Meters)	Reclassified
All	4
NoData	NoData

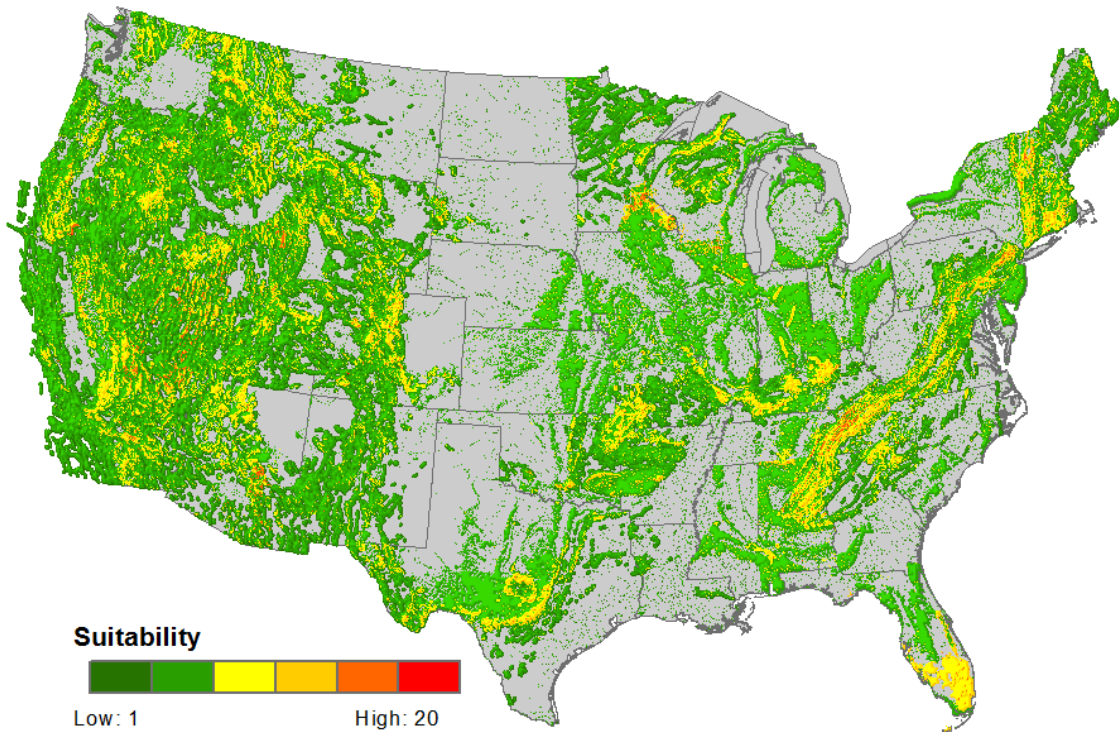


Figure 5. Paranormal activity predictive map. Red indicates areas where, given the theories, paranormal activity is more likely to manifest.

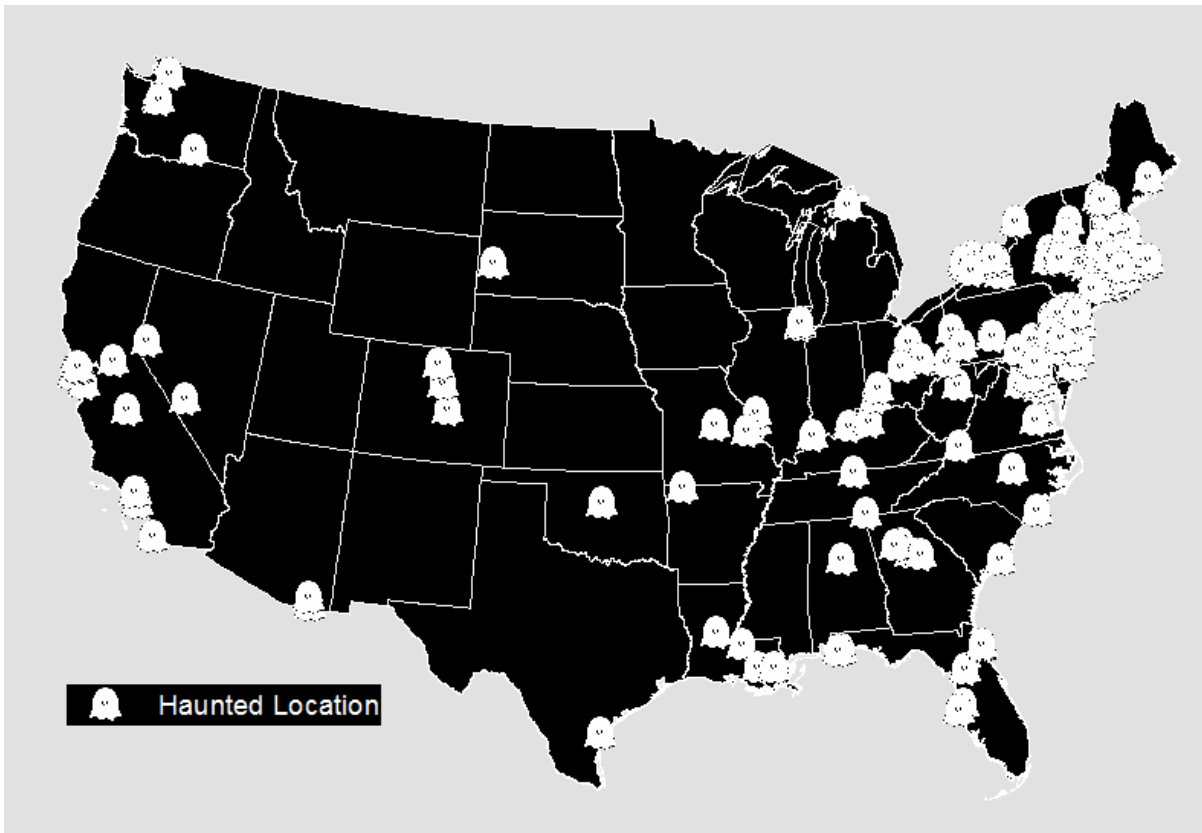


Figure 6. Alleged paranormal locations investigated by paranormal researchers/enthusiasts (Ghost Hunters).

### ***Correlation between Haunted Locations and Environmental Criteria***

To determine if there was a correlation between the haunted locations (Figure 6), environmental criteria and level of suitability, the calculated raster's values were extracted at each haunted point location. Then, fields generated in the attribute table were exported to Excel using X Tools pro.

Each haunted location was assigned a number based on the Ghost Hunters analysis and evidence review. Locations deemed haunted were assigned a one while locations that did not show any evidence of paranormal activity were assigned a zero. Locations where the investigation did not produce definitive results were deemed inconclusive and were not used in the correlation.

Next, a point biserial correlation was conducted using the new classifications of the haunted locations and suitability values. In addition, each environmental feature also was used in a point biserial correlation.

### **Results/Discussion**

#### ***Predictive Paranormal Modeling***

The purpose of this research was to spatially analyze variables that may promote and increase the manifestation of paranormal activity to determine the validity of popular paranormal hypotheses and theories. Secondly, it attempted to analyze correlations between alleged haunted locations and predictive suitability in the U.S. as well as individual geological and hydrological features.

The model returned a total of 1,030,036,346 acres (416,840,920 ha.), which is about 5.2% of the continental United States. Results suggest most suitable locations are located in the New England area and along the Appalachian Mountains, the north and south regions of the Rocky Mountains, as well as the west coast (Appendix A). The likelihood of paranormal activity manifesting near many of the environmental criteria (running water and faults) is already high because of the large density of those features in the United States. Further research is needed in the paranormal field to determine the distance from the environmental criteria paranormal activity can be and still manifest.

In Excel, alleged haunted locations were analyzed; each of the criteria was organized in pivot tables. The tables were used to determine if there were any commonalities between the haunted locations and criteria. Results indicate haunted locations were more common within suitable proximity to faults (53%) and lithology containing quartz (26%).

Additionally, haunted locations were least commonly associated with suitable areas of high quartz (2%) and magnetite deposits (1%). Table 2 illustrates results partitioned according to reclassifications. Point biserial correlation concluded haunted locations biserial classification and level of suitability were not significantly related  $r = 0.05$ ,  $p \geq 0.05$ , (Table 3).

***Correlation between Haunted Locations and Environmental Criteria***

Table 2. Percent of haunted locations located in each reclassified environmental feature.

<b>Running Water</b>	
<b>Distance</b>	<b>100 feet</b>
<b>Class</b>	<b>Percent</b>
4	4.15%
3	4.66%
2	2.07%
1	1.55%
0	87.56%
<b>Sites</b>	<b>12%</b>

<b>Faults</b>	
<b>Distance</b>	<b>5 miles</b>
<b>Class</b>	<b>Percent</b>
4	33.68%
3	11.40%
2	3.63%
1	4.15%
0	47.15%
<b>Sites</b>	<b>53%</b>

<b>Quartz Points</b>	
<b>Distance</b>	<b>.5 Miles</b>
<b>Class</b>	<b>Percent</b>
4	0.52%
3	1.04%
2	0.52%
0	97.93%
<b>Sites</b>	<b>2%</b>

<b>Magnetite</b>	
<b>Distance</b>	<b>.5 miles</b>
<b>Class</b>	<b>Percent</b>
3	0.52%
0	99.48%
<b>Sites</b>	<b>1%</b>

<b>Limestone</b>	
<b>Distance</b>	<b>0</b>
<b>Class</b>	<b>Percent</b>
4	12.95%
0	87.05%
<b>Sites</b>	<b>13%</b>

<b>Quartz Polygon</b>	
<b>Distance</b>	<b>0</b>
<b>Class</b>	<b>Percent</b>
4	26.42%
0	73.58%
<b>Sites</b>	<b>26%</b>



Table 3. Results for the point biserial correlation.

	Correlation	Probability
Suitability	0.05	0.26
Quartz Points	-0.15	0.03
Magnetite	0.05	0.26
Limestone	0.22	0.002
Faults	-0.04	0.30
Quartz Polygon	-0.01	0.45
Running Water	0.00	0.50

Limestone had the highest positive correlation with the haunted location biserial classification; the probability value indicates the correlation was highly significant,  $r = 0.22$ ,  $p \leq 0.01$ . The results also suggest a significant correlation between localized areas of quartz deposits and haunted locations,  $r = -0.15$ ,  $p \leq 0.05$ . The other criteria did not correlate to the haunted location biserial classification nor where they statistically significant. Statistics suggest paranormal theories may have some validity according to this research.

As a disclaimer, proactive methods were used to contact paranormal groups for localized data. Many paranormal groups were contacted and asked to share evidence-based haunted location data. Unfortunately, additional data was unable to be obtained from these sources in support of this exploratory research. For this research to succeed, a larger alleged haunted location dataset is needed, as well as data that is more dispersed throughout the county.

The Ghost Hunters haunted location data did not achieve either of these. The data is mostly located on the east coast, and only publically known sites were used, as private residence locations were not shared.

Another concern with the validity of this research is directly related to the

validity of the Ghost Hunters television show. Questions remain if their paranormal activity is real or staged for television scripts and ratings. This was particularly concerning when sites were categorized into “haunted” or “not haunted.” As the seasons of the television show progressed, more and more sites were stated to be haunted. From a research perspective, it should be known the validity of paranormal data may be called into suspect nature, as it is unknown if this could be the production team staging events or the Ghost Hunters having more publicized active locations to choose from. Consequently, the exploration of output findings based on methods herein may be enhanced with additional data.

## Conclusion

The haunted locations investigated by Ghost Hunters do not have a significant correlation with suitable locations for paranormal activity to manifest, however some of the criteria use in the suitability analysis do suggest a significant correlation with alleged haunted locations.

Furthermore, correlation does not represent causation. For this research project to be successful, paranormal theories for causation need to be researched further. In addition, the paranormal research community must be willing to work together and share their findings to utilize spatial analysis. Once better guidelines are established to determine the proximity to environmental features paranormal activity requires to manifest, the results of this type of analysis will provide a greater contribution to both the paranormal and scientific communities.

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Appendix A. Paranormal activity suitability map.

