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Characteristics of Cover-Collapse Sinkholes in Kentucky

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Kentucky Geological Survey
University of Kentucky, Lexington

Characteristics of Cover-Collapse Sinkholes in Kentucky

James C. Currens

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Technical Level



Statement of Benefit to Kentucky

Much of Kentucky is underlain by bedrock susceptible to sinkhole development. Sinkholes formed by sudden and unpredictable collapse of overlying soil, called “cover-collapse sinkholes,” may result in as much as \$80 million in damage annually. The information in this report was collected by the Kentucky Geological Survey over more than 20 years and improves our understanding of these potentially dangerous features.

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Characteristics of Cover-Collapse Sinkholes in Kentucky

James C. Currens

Abstract

Sudden collapse of unconsolidated earth materials over soluble bedrock, known as cover collapse, damages buildings, roads, utility lines, and farm equipment in Kentucky. It has also killed livestock, including Thoroughbred horses, and injured people. The estimated annual cost of sinkhole cover collapse in Kentucky ranges from \$20 million to \$84 million and is sensitive to rare but expensive events such as the 2014 National Corvette Museum collapse. The Kentucky Geological Survey began developing a catalog of case histories of cover-collapse occurrences in 1997, and receives an average of 24 reports each year. Three hundred fifty-four occurrences of cover-collapse sinkholes throughout Kentucky are documented, and cover-collapse variables such as diameter, elongation, and depth as a function of bedrock type and time of year have been statistically analyzed. Statewide, cover-collapse sinkholes are on average 2.7 m long, 1.9 m wide, and 2.4 m deep. Some can be substantially larger and deeper. Data in the catalog show that new occurrences of cover collapse may initiate the formation of new sinkholes, but cover collapse generally does not occur in existing sinkholes. Historically, the number of collapses is smallest in February, steadily increases to peak in July, and then decreases through December and into January.

Introduction

Karst is the term for a terrain characterized by dissolution of bedrock by the flow of water. Karstification results in sinkholes of various kinds, vertical shafts, springs, conduits, caves, and a seemingly infinite variety of other morphologies. The key characteristic of karst aquifers is turbulent flow in conduits and caves. In Kentucky, all of these features are developed in limestone or dolostone bedrock. The karst areas of Kentucky occur in four principal regions: the Inner Bluegrass, the Eastern Pennyroyal, the Western Pennyroyal, and the very narrow limestone exposure on the northwest slope of Pine Mountain (Fig. 1). The geology and hydrogeology of karst have been thoroughly reviewed in numerous publications (see White [1988], Ford and Williams [2007], and Palmer [2007]). For a less technical reference and additional detail on karst in Kentucky, see Currens (2002).

Purpose

The purpose of this report is to summarize the location and geometry data for cover collapse that have been compiled over three decades and use the resulting summary to develop a better understanding of the conditions that could predict where and when and why cover collapses occur.

Karst as a Geologic Hazard

Cover-collapse damage is distributed widely across Kentucky and frequently damages buildings, roads, utility lines, and farm equipment (Fig. 2). It has killed livestock, including some Thoroughbred horses, and has injured people. Of the nearly 4 million people in Kentucky, 2.9 million, or 67 percent of the population, lived on karst in 2010 (Cecil, 2015).

Estimated Cost

Because of the scarcity of data, the annual cost to the economy from karst geohazards is difficult to quantify. One estimate by Dinger and others

(2007) was \$20 million per year for Kentucky (approximately \$24 million per year when adjusted for inflation). This estimate was based on the number of cover-collapse sinkholes reported each year and an estimated average remediation cost.

A more accurate method would be to apply an annual average rate of formation across the state; however, only one calculation of the rate of formation of cover collapse in Kentucky has been published, and it was for a study area in Christian County, near Hopkinsville. The area was chosen because of the high percentage of calcite forming the bedrock, the modest local relief, and the abundant mapped sinkholes, which suggests the area is exceptionally favorable for the development of cover collapse (Currens and others, 2012). The rate observed was 0.58 collapses per square mile per year. The area of karst in Kentucky, multiplied by the rate of cover collapse cited above, results in an estimate of 8,466 collapses a year. This rate seems excessive when compared to our experience in the field, however.

The average cost per collapse was calculated from the case history catalog by assigning a dollar value to each type of damage description. The areas involved are mostly limited to the immediate vicinity of the cover collapse, and no adjustment was made for the size of the area involved. For example, the loss of pasture in an open field was val-

ued at \$6,000, but the loss of a residential lawn was set at \$3,000, the difference being the loss of production of the pasture. Damaged pavement was estimated at \$18,000. The two most expensive cover collapses for individual residences were \$12,000 and \$40,000. A revision of the 2007 cost estimate by Dinger and others includes the Feb. 25, 2002, Dishman Lane event in Bowling Green, which cost \$1.2 million (Fig. 3) and the Feb. 12, 2014, Corvette Museum event, also in Bowling Green, which cost more than \$3.2 million to repair (Fig. 4). The loss of the cars was estimated by the museum to be an additional \$3.1 million. The average estimated repair cost for the 104 cover-collapse events in Kentucky for which damage was recorded, including Dishman Lane and the Corvette Museum, is \$89,524. The Dishman Lane and Corvette Museum events were expensive enough to bias the average cost estimate. With those two costs removed, the estimate is reduced substantially to an average of \$16,709. Most cover collapses do not damage valuable pasture, destroy sports cars, or ruin costly homes, however. The actual average cost should be less than \$16,709, because most repairs will be done as cheaply as possible. Some sites are simply fenced off or ignored and have negligible economic impact. Furthermore, anecdotal information indicates that the few sinkholes that are repaired will cost less than \$6,000 each.

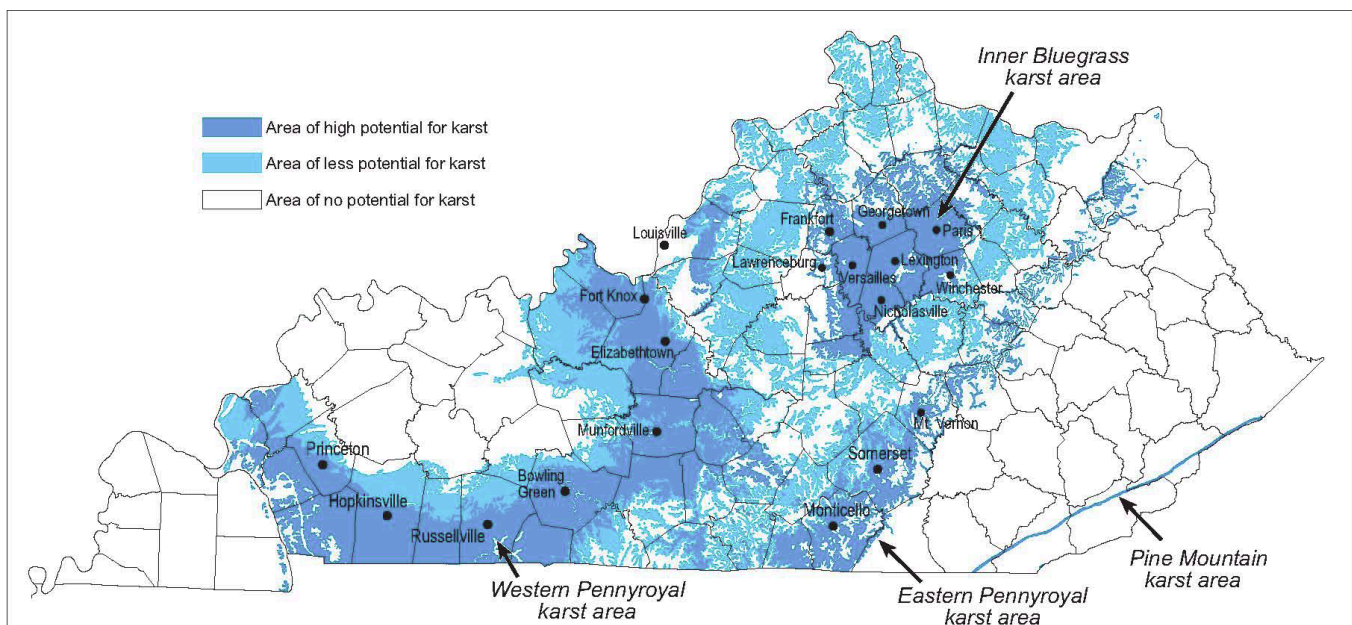


Figure 1. Karst occurrence in Kentucky. Darker blue areas have a higher density of karst features.



Figure 2. A cover-collapse sinkhole caused more than \$40,000 in damage to a home near Louisville in April 2001.



Figure 3. By chance, the collapse at Dishman Lane in Bowling Green did not cause any fatalities.

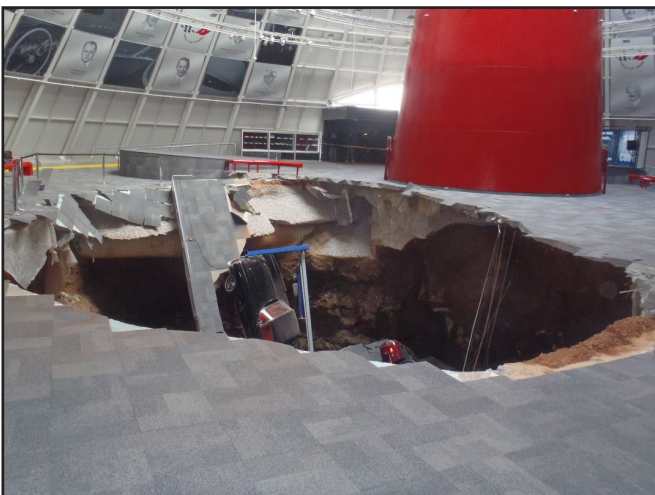


Figure 4. Cover collapse under the Skydome at the Corvette Museum, Bowling Green, Feb. 24, 2014.

If the Christian County rate of collapse is indeed a local maximum, and the estimated number of events statewide is reduced to 5,000 per year, the estimated statewide annual loss would remain at a significant \$83.5 million annually, using the \$16,709 average cost estimate. If a higher percentage of cover collapses has a repair cost near zero, the average annual cost could be nearer to the \$20 million estimated by Dinger and others (2007).

Previous Research

Classification

There are six basic types of karst sinkholes (Waltham and others, 2005): solution (of bedrock), soluble bedrock collapse, (insoluble) cap-rock collapse, cover subsidence, buried, and cover collapse (also locally called “dropout”). The terms used for five of the features are process-derived, whereas “buried” is morphology-derived. Of the six types of sinkholes, cover subsidence is the most common, but cover-collapse sinkholes are among the most destructive karst-related geologic hazards. The sudden and unpredictable collapse of unconsolidated earth material over karstic bedrock characterizes cover collapse. More than one process may operate sequentially or simultaneously to modify earth materials and produce a sinkhole (White, 1988). Bedrock does not typically collapse in a cover-collapse sinkhole.

Patterns of Cover Collapse

Hyatt and Jacobs (1996) reported the geometry of 312 new sinkholes along the Flint River in Georgia, which appeared in a few days and resulted from a 500-year return-frequency flood. The flooding occurred after 53 cm of rainfall in 19 hours from Tropical Storm Albert in July 1994. Hyatt and Jacobs (1996) found that the new sinkholes had nearly circular outlines at the intersection with the surface and apparently were not influenced by the regional bedrock jointing orientation. There was also no relationship between the shapes of old, existing sinkholes and the shapes (plan) of the new cover collapses.

The relationship between older sinkholes and historic, documented cover collapse has also been studied by Hyatt and others (1999). They found that older sinkholes tended to be weakly clustered in groups, rather than randomly distributed. They

also concluded, however, that a nearest-neighbor analysis indicated that “the vast majority of new sinkholes have not clustered around old ones” (Hyatt and others, 1999, p. 43).

More recently, the development of analytical models to describe the dynamics and flux of heat and fluid flow (air, water, CO₂) in the epikarst and the overlying cover have been evaluated by Covington (2016). The permeability of the cover and its thickness relative to the epikarst are important constraints on air flow between the karst subsurface and the surface. According to Covington (2016, p. 124–125), “If there is a thick, relatively [speaking], cover then this will shut down chimney-effect air flow within the fracture network below it.” By reciprocity then, if the cover has enough interconnected macropores, air flow would be concentrated along those efficient routes, and the cover material adjacent to the macropores would undergo more frequent wetting and drying cycles.

Methods

Source of Data

The Kentucky Geological Survey began recording case histories of cover collapses in 1997, with the long-term goal of compiling as large a data set as possible in order to analyze and better understand causes, and ultimately suggest methods to forecast cover collapse. The oldest documented event dates to 1960, and many of the early records were reconstructed from notes, photographs, and recollections from a variety of people, including geologists, cavers, homeowners, and farmers. Some of the recorded events were garnered from media accounts. Obtaining reports from other agencies that have occasion to encounter cover-collapse sites has been difficult because the work is outside those agencies’ mandated duties. Although the date and location of some older cases could be verified, the details, such as the dimensions of the intersection of the collapsed void with the top of the ground, were commonly missing.

Contemporary reports were vetted to decide whether to visit a site. The typical field trip is now in response to an inquiry or a request for assistance made by email or telephone call. Most of the calls are for sites that are minor or do not qualify as a cover collapse. If the decision was made not to

travel to the site, the owner of the property with the sinkhole was asked to print a form posted on the KGS website, fill it out, and then send it to KGS by U.S. Postal Service or email. Additional information gathered from an owner is important, and digital photographs are especially valuable. There was an online version of the form, but it had to be discontinued to exclude hackers. In spite of the constraints, the data set now has well over 350 records, enough to overcome some of the statistical limitations discussed in an earlier report that covered 247 sites (Currens, 2012).

Another positive result of the form is that, although the largest percentage of reports still originate from urban settings, the current distribution of reports is much more even statewide. The form for submitting cover-collapse locations, date of occurrence, and ancillary data can be found at www.uky.edu/KGS/karst/report_sinkhole.pdf (last accessed April 2018). The raw data are in Appendix 1.

Data Description

The kinds of data gathered at each cover-collapse site were based on the work of Wilson and Shock (1996). They assembled a database of information on nearly 2,000 cover-collapse events from across Florida. The data recorded by KGS are similar to those from Florida (Seal, 2005), but some parameters have been omitted or added as appropriate for Kentucky. For example, the dimensions of the sinkhole (azimuth and length of the axis of the feature) are important information that KGS collected and used to characterize the shape of the opening at ground level (Table 1). Although the people reporting the collapse are encouraged to submit this type of information, the dimensions are in fact seldom reported, and KGS staff have recorded most of the measurements. The rate at which KGS is receiving reports of cover collapse has increased because of the educational information that is now available online and the media’s interest in sinkholes in general.

The KGS data set includes the following information:

Location:

Longitude and latitude (degrees, minutes, seconds)

Longitude and latitude (decimal degrees)

Table 1. Descriptive statistics for reported cover collapses in Kentucky.					
<i>Parameter</i>	<i>Sample Size</i>	<i>Mean (m)</i>	<i>Maximum (m)</i>	<i>Geometric Mean (m)</i>	<i>Standard Deviation</i>
Length of long axis, m	219	2.74	45.72	0.25	3.85
Length of short axis, m	219	1.85	32.31	0.08	2.73
Observable depth, m	201	2.32	18.9	0.21	2.58
Diameter, $(l + w) \div 2$	250	2.38	39.01	0.19	3.42
Elongation, $l \div w$	219	1.96	10.60	0.17	2.11
Circularity, $\sqrt{L_{short}/L_{long}}$	222	0.84	1.0	-0.09	0.19

Elevation
7.5-minute topographic quadrangle
County

Date:

Year, season, month, day
Of occurrence
Of report

Dimensions:

Length, width, total depth
Azimuths of principal and secondary axes
Description of side slope angle
General shape
Sketch of cross section and plan

Hydrologic Setting:

Depth to water, if visible
Ground surface elevation
Bedrock exposed?
Depth to bedrock
General description of antecedent weather conditions
Soil type

Calculated Parameters

The lengths of the long and short axes of the opening created by cover collapse, L_{long} and L_{short} were measured at ground level in the field. The diameter, elongation index, and circularity index (a proxy for Riley sphericity) were calculated from the lengths of the long and short axes. These parameters were used to determine if there was any eccentricity resulting in a noncircular perimeter of the collapse at the surface. For example, linear lens-

es of coarser-grained earth materials interbedded in the cover or bedrock fractures could cause an elliptical plan view. The closer the elongation and circularity are to a ratio of 1:1, the more the plan view of the intersection of the cover-collapse soil arch with ground level approaches a perfect circle.

The diameter of the cover-collapse opening was calculated as the arithmetic mean of the length of the two axes, or $(L_{long} + L_{short})/2$.

The elongation (or eccentricity) index was calculated as the quotient L_{long}/L_{short} . It is a measure frequently reported by other authors, and values for the southeastern United States range from 1.0 to 2.3 (Beck, 1991).

There are multiple methods of quantifying circularity in the geologic, engineering, and mathematical literature. Brinkmann and others (2008) used a circularity index for sinkholes in Hillsborough, Fla. Their index is the quotient of the area of the map projection of a sinkhole and the area of a circle of the same perimeter as the sinkhole. Measurements in the KGS database do not include area and perimeter, so the Brinkmann and others (2008) method could not be used. Instead, the concept of projected sphericity developed by Riley (1941) was adapted for use in this report by substituting the long and short dimensions of an ellipse representing the map projection of the sinkhole for the inscribed and circumscribed diameters of the maximum cross-section area of a three-dimensional particle. The result is:

$$C = \sqrt{L_{short}/L_{long}}$$

where C is the circularity index and L_{short} and L_{long} are the short and long axes, respectively, of an ellipse approximating the shape of the sinkhole.

The depth of the collapse is another important parameter (Appendix 1). The true depth of a cover collapse can seldom be measured, however, and the observable depth is what is commonly reported. The true depth is typically obscured by the pile of soil and vegetation from the collapse of the arch. The overall depth of a cover collapse is constrained by relatively thin unconsolidated cover over the carbonate bedrock in the karst areas of Kentucky.

The composition of the unconsolidated cover also affects the stability of the arch over the void. After the collapse, the durability of the overhanging and vertical slopes is dependent on the cover composition (Hyatt and others, 1999; Tharp, 2003). The U.S. Natural Resources and Conservation Service's online soil map (websoilsurvey.sc.egov.usda.gov/App; last accessed September 2016) was used to plot the coordinate location of each cover collapse. The soil name at the site, according to the NRCS map, was recorded, and the soil texture for each site was classified. Further analysis of the soil type compared to other parameters remains to be done.

Statistical Analysis

Data analysis consisted of descriptive statistics, population testing, and GIS correlation. Multivariate analysis was also conducted to verify the results of the Student's t test, conducted with Excel, ArcGIS, and Statgraphics Centurion XVI software packages. The dimensions and parameters that were analyzed were length, width, observable depth, diameter, elongation index, and circularity index. A summary of the descriptive statistics can be found in Table 1. The data were grouped based on stratigraphy.

A second round of tests was performed on a data set that had been characterized according to urban or rural setting. The data set for each stratigraphic interval was tested for normal distribution and the equivalency of the mean. All of the data had a logarithmic distribution (Fig. 5), and all subsequent analyses were on logarithm-transformed data.

Results

Stratigraphy and Soils

The karst of Kentucky is developed on extensive outcrops of carbonate bedrock representing vast ranges in geologic age, distinct mineralogy, and characteristic primary sedimentary structures. Of a total of 354 cover-collapse sites, 41 percent are underlain by Mississippian carbonates, and 45 percent and 13 percent are underlain by Ordovician and Silurian-Devonian rocks, respectively; the stratigraphy of 1 percent of the sites is undetermined. The sites are located on 32 different formal stratigraphic units (Table 2). The areal distribution of the sites parallels the exposed area of carbonate bedrock of each geologic system in the state.

The most common soil is silty loam, and a substantial percentage of the soils is silty clay or clay loams. A minor fraction is sandy silt loam. Because most of the soils overlying karst in Kentucky are silt loams or silt-clay loams, a vertical cut in the soil may resist slope retreat for weeks or months, depending on the weather. Nineteen percent of the 222 collapses that were field-inspected by KGS personnel had overhanging walls (Table 2). Once the slope failed, however, the catchment of the newly formed sinkhole increased (*see Previous Research*, above, and Sowers [1996]).

Weather

Precipitation has long been thought to influence the timing and rate of cover collapse (Tharp, 1999). In fields and woodlands, where recharge is slowed and initially more evenly distributed by the canopy, grassland, or vegetative litter on the forest floor, the areal distribution of collapse is seemingly random. Closely spaced clusters in Georgia were associated with riverine flooding, however (described by Hyatt and Jacobs [1996]). Manmade structures, such as parking lots, can accentuate the collection of runoff, and are recognized as a frequent cause of collapse in urbanized areas. Case histories describing seemingly inconsequential water sources, such as downspout discharge, onsite sewage disposal, and air-conditioner condensate, also occur in the data set. The wetter months, therefore, have been assumed to have more frequent incidences of cover collapse (White and White, 1992).

Table 2. Cover-collapse density for surficial carbonate stratigraphic units by geologic period. M=Mississippian, S-D=Silurian-Devonian, O=Ordovician, P=Pennsylvanian.

<i>Stratigraphic Unit: Formation or Member</i>	<i>Occurrences</i>	<i>Percentage of Total Occurrences</i>	<i>Area Underlain by the Stratigraphic Unit (Acres)</i>	<i>Density of Cover Collapse per Stratigraphic Unit</i>	<i>System</i>
Ashlock Limestone Formation	1	0.27	52,066.5	0.000019	O
Brannon Member	17	4.66	15,255.7	0.001114	O
Beachwood and Sellersburg Limestones	1	0.27	423.4	0.002362	S-D
Bethel Sandstone	1	0.27	12,494.7	0.000080	M
Borden Formation	11	3.01	205,621.4	0.000053	M
Bull Fork Formation	3	0.82	109,044.1	0.000028	O
Calloway Creek Limestone	6	1.64	105,934.0	0.000057	O
Curdsville Limestone Member	4	1.10	NA	NA	O
Clays Ferry Formation	5	1.37	318,986.9	0.000046	O
Brassfield Dolomite	1	0.27	5,339.3	0.000009	O
Tyrone Limestone	4	1.10	2,899.7	0.000037	O
Drakes Formation	6	1.64	145,061.2	0.000056	O
Fairview Formation	1	0.27	114,647.7	0.000009	M
Girkin Formation	3	0.82	53,377.9	0.000028	O
Grant Lake Formation	1	0.27	112,538.5	0.000009	O
Grier Limestone	32	8.77	252.6	0.000297	M
Grundy Formation	1	0.27	314,480.0	0.000009	M
Kinkaid Limestone	1	0.27	6,661.9	0.000009	O
Kope Formation	1	0.27	197,412.4	0.000009	S-D
Laurel Dolomite	5	1.37	28,543.6	0.000046	O
Lexington Limestone	45	12.33	3,709.0	0.000418	S-D
Louisville Limestone	16	4.38	33,571.8	0.000149	O
McAfee series	2	0.55	NA	NA	O
Millersburg Member	1	0.27	374.3	0.000009	M
Renfro Member	1	0.27	17,914.2	0.000009	M
Renault Limestone	8	2.19	25,762.2	0.000074	S-D
Salem-Warsaw Limestones	5	1.37	230,527.8	0.000046	S-D
Sellersburg-Jeffersonville Limestones	19	5.21	16,759.7	0.000177	P
Sturgis Formation	1	0.27	NA	NA	M
Slade Formation	1	0.27	37,439.8	0.000009	M
St. Louis Limestone	53	14.52	4,395.6	0.000492	M
Ste. Genevieve Limestone	63	17.26	200,979.6	0.000585	O
Tanglewood Limestone	45	12.33	145.6	0.000418	O

The KGS data were reviewed to find collapse events with a date accurate to the nearest month of the collapse, resulting in 243 records. The records

with usable month data were tallied and paired with average statewide precipitation for Kentucky from 1895 through 2015, obtained from the Univer-

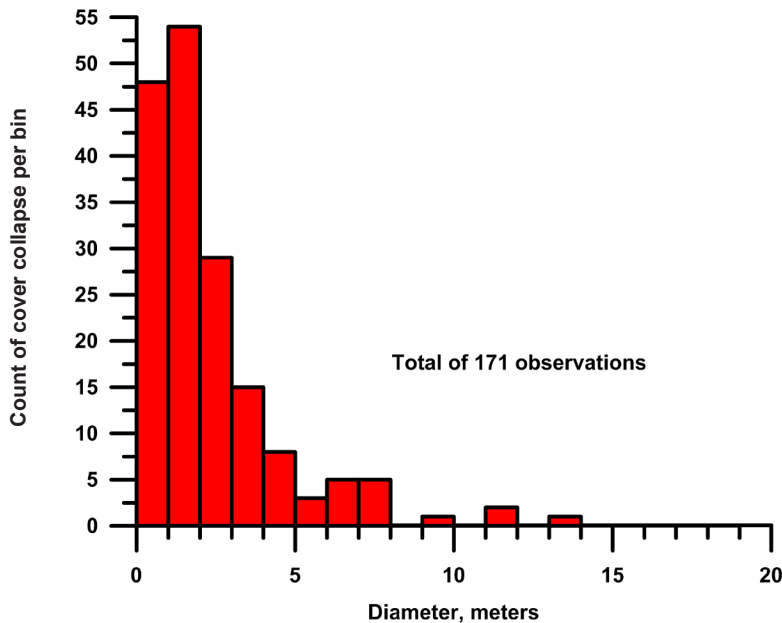


Figure 5. Size distribution of the diameter parameter calculated from measurements of the long and short axis lengths.

sity of Kentucky College of Agriculture (www.gwv.ca.uky.edu/ky/data.php#KY_Monthly_Data; last accessed August 2016) for the same month, irrespective of year. The data were plotted, and goodness-of-fit was $r^2=0.56$ (significant at $\alpha=0.05$). The comparatively weak correlation is likely caused by the precipitation data being too generalized. A polynomial regression drawn through all 12 monthly counts versus precipitation improved the prediction of the counts compared to linear regression ($r^2=0.77$, significant at $\alpha=0.05$) (Fig. 6).

Figure 6 shows the average monthly temperature and average monthly count of collapse events. The count and temperature data pairs were initially plotted as a single data set with 12 pairs of observations ($r^2=0.50$). Then the data were partitioned into two plots, which revealed a warming trend (February through July) and a cooling trend (August continuing into January) (Fig. 7). The correlation coefficient of the cooling subset is significantly improved ($r^2=0.95$) over the 12-month linear regression, whereas the warming trend was less improved over the linear regression ($r^2=0.64$), but still strong. The division of data into February–July and August–January periods reveals a clear relationship of the temperature data to the collapse counts. The count of collapses beginning in February steadily increases along with the temperature

through July, and the number of collapses in August decreases through December into January, tracking with the cooling air temperature.

The comparatively smaller number of reports of collapse in December and January was first ascribed to less outdoor activity by people during the winter. The data set was reviewed again, and 164 data pairs were selected that were precise enough to determine the period between date of the event and date of the report to the nearest week (Fig. 8). If reports were fewer because fewer people were active outdoors during the winter, then the time between the occurrence of the collapse and the report should also have been longer; but that was not the case. The graph of the length of time between the date of the collapse and the date of the report clearly shows that the longest delays are in the late spring

and early summer (gray dashed line), except for July. The July data are skewed by a cluster of cover collapses, which had an estimated similar date of occurrence and a uniform report date and a smaller than typical average delay. Otherwise, the winter months have some of the shortest delay times between occurrence of an event and its report, suggesting that winter collapses were found soon after they developed.

There are other possible explanations. One idea is that the ground surface is intermittently frozen from November to February. A cold front that results in a short but very cold period (temperatures near -10°C) may briefly freeze the soil in the shallow subsurface. When the temperature begins to warm, the deeper cold soil stays frozen and might inhibit infiltration of rain or snowmelt (Seyfried and Murdock, 1997).

Accounts of a farmer driving a tractor across a field of tall crops, hay, or weeds directly into a sinkhole that was not there the last time the field was mowed or tilled are common. Occasionally, a collapse does happen under the weight of an agricultural machine. This is caused by cover-collapse openings being less visible in the summer because of foliage. Although the size of the opening will have a bearing on the visibility in the summer, almost all openings will be more visible in the

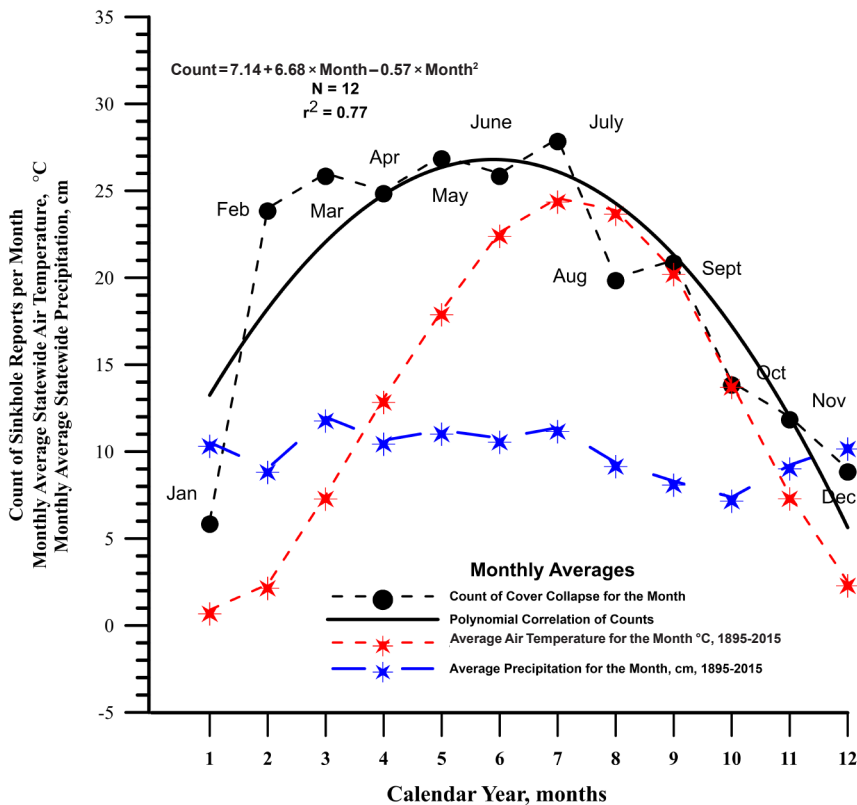


Figure 6. The statewide average temperature and precipitation and the counts of cover collapses for each month.

dormant season. Therefore, the short delay in reporting in the winter is most likely a result of the collapse features being more visible than in the summer, and not because of less observation time.

Qualitative Analysis of Cover-Collapse History

In addition to the quantitative measurement of sinkhole dimensions, qualitative observations were made. An unambiguous indicator of the recent reactivation of a cover collapse is human-generated debris, construction waste, lawn and tree waste, or household and farm trash being exposed in the wall of the collapse. The presence or absence of buried trash was noted for 124 cover-collapse sites, of which 10.7 percent had trash of some kind exposed in the wall of the collapse. Of the cover collapses found inside a mapped sinkhole, however, only one had trash present. The presence of manmade fill material therefore suggests that the single cover collapse located inside a sinkhole had been previously filled but continues to erode and enlarge. This enlargement process may only have

been recognizable because of the presence of the debris.

When the digitized outlines of topographically mapped (scale 1:24,000) sinkholes are overlaid on the locations of the 354 cover-collapse sites, only 27 cover-collapse sites, or 7 percent of the sites in the Kentucky sample set, fell within a mapped sinkhole (Plate 1). This suggests that cover collapse may be the origin of doline sinkholes in general. The reduction of the walls of the cover collapse from vertical to sloping is self-perpetuating as the collapse captures an increasing surface runoff area. Most of the precipitation is collected as overland flow within the watershed of the collapse. The flow from the network of surface channels that eventually develop enters the collapse and the conduit system. The flow then transitions directly from overland to subsurface when it enters the swallow hole. The water infiltrating the soil that other-

wise would contribute to the initiation of another collapse has been mostly diverted. The probability of a new cover collapse in that immediate vicinity is therefore reduced by the redistribution of the infiltration. The process is not part of the long-term and ongoing erosion of sinkholes, but it may initiate the early development of almost all sinkholes.

Statistical Analysis of Cover-Collapse Metrics

Analysis of the descriptive statistics indicates that cover collapses in Kentucky have morphology comparable to that in other parts of the contiguous southeastern United States (Beck, 1991; Hyatt and others, 1999). The average length of the long axis of the collapse opening at ground level is 2.74 m long and the average length of the short axis is 1.85 m. The observable depth averages 2.32 m (Table 1). The dimensions of the Dishman Lane collapse, the largest to date in Kentucky, were 45.72 m long and 32.31 m wide, and the depth was 9 m (Kambesis and others, 2003). Collapse features the size of the Dishman Lane collapse are very rare in Kentucky,

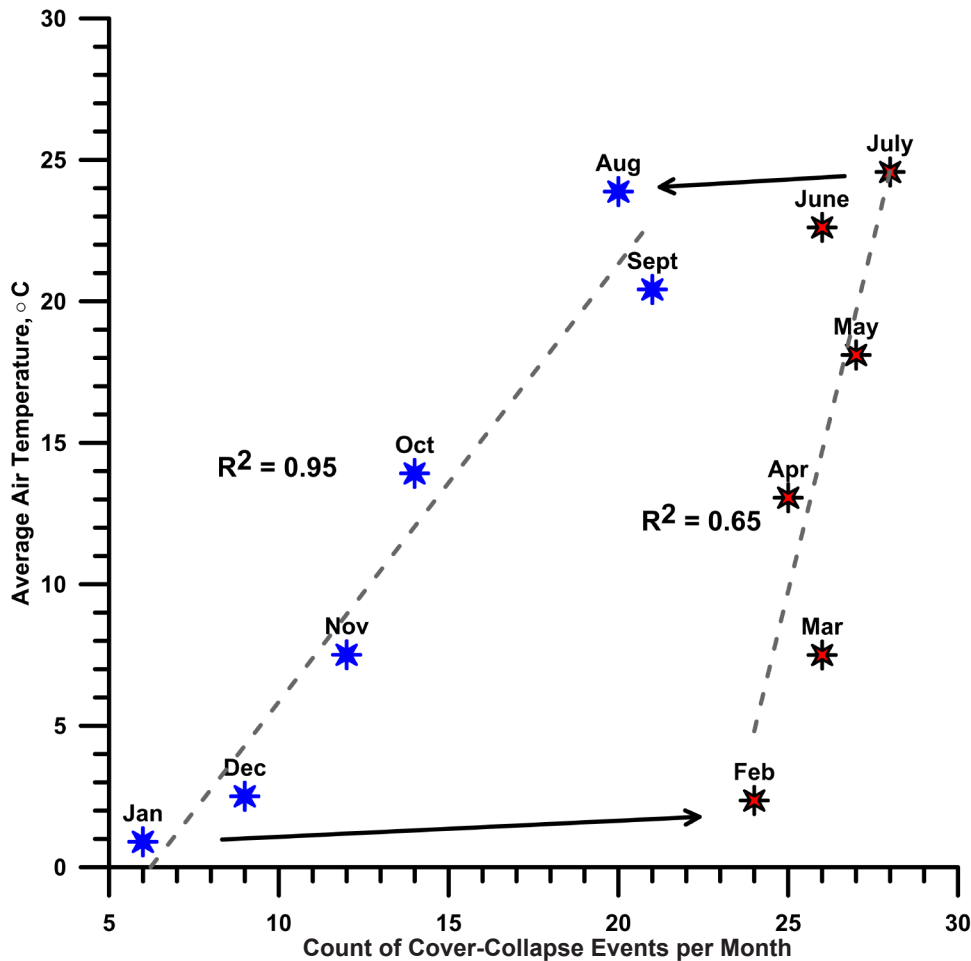


Figure 7. Count of cover-collapse events per month versus average air temperature.

however. The arithmetic mean of the 219 records is 1.96, and the geometric mean is 2.11. The mean of circularity for 222 data sets is 0.84. The distribution of the parameters for all of the sites in the database is asymmetric in a manner similar to a log-normal distribution (Fig. 5).

The data were divided into three subsets based on site stratigraphy; they were classified as Mississippian, Ordovician, and Silurian-Devonian. Forty-one percent of collapses are underlain by Mississippian rocks, and 45 percent are underlain by Ordovician rocks. The remaining collapses are underlain by Silurian and Devonian carbonates or the stratigraphy is undetermined. The variances of the untransformed data for these groups were then compared to each other using the F test to determine if the Student's t test could be applied. None of the untransformed dimensions—diameter, elongation, and circularity—was symmetrically dis-

tributed, and all exhibited significant skewness.

The depth, diameter, elongation, and circularity data were then log-transformed, and the stratigraphically grouped subsets were tested for equivalency of the means using Student's t test. Comparison of the log-transformed mean depths of cover-collapse sinkholes in the Mississippian with those in the Silurian-Devonian showed a statistically significant difference ($\alpha=0.05$ level). The mean depth of cover collapses on Mississippian strata could not be assumed to be different than the depth of those on Ordovician bedrock, however. There was no significant difference between the Silurian-Devonian and the Ordovician mean depths. This is because the depth of the Ordovician collapses are intermediate between the Mississippian and Silurian-Devonian. Also, the distribution of the variance is wide; that is, the variance remains large enough after transformation that there was some overlap of the distribution.

The F test found that the variance of the diameter for all three stratigraphic groups (Mississippian, Ordovician, Silurian-Devonian) was not equal. The Student's t test was therefore not valid for diameter. Elongation also failed the F test for the equivalence of the variance for the Mississippian to Ordovician comparison. But there was no significant difference between the variance for the Ordovician and the Silurian-Devonian and between the Mississippian and the Silurian-Devonian. Circularity failed to pass the F test when the Ordovician and Silurian-Devonian measurements were compared with those for the Mississippian, and the variance was found to be the same between the Ordovician and the Silurian-Devonian.

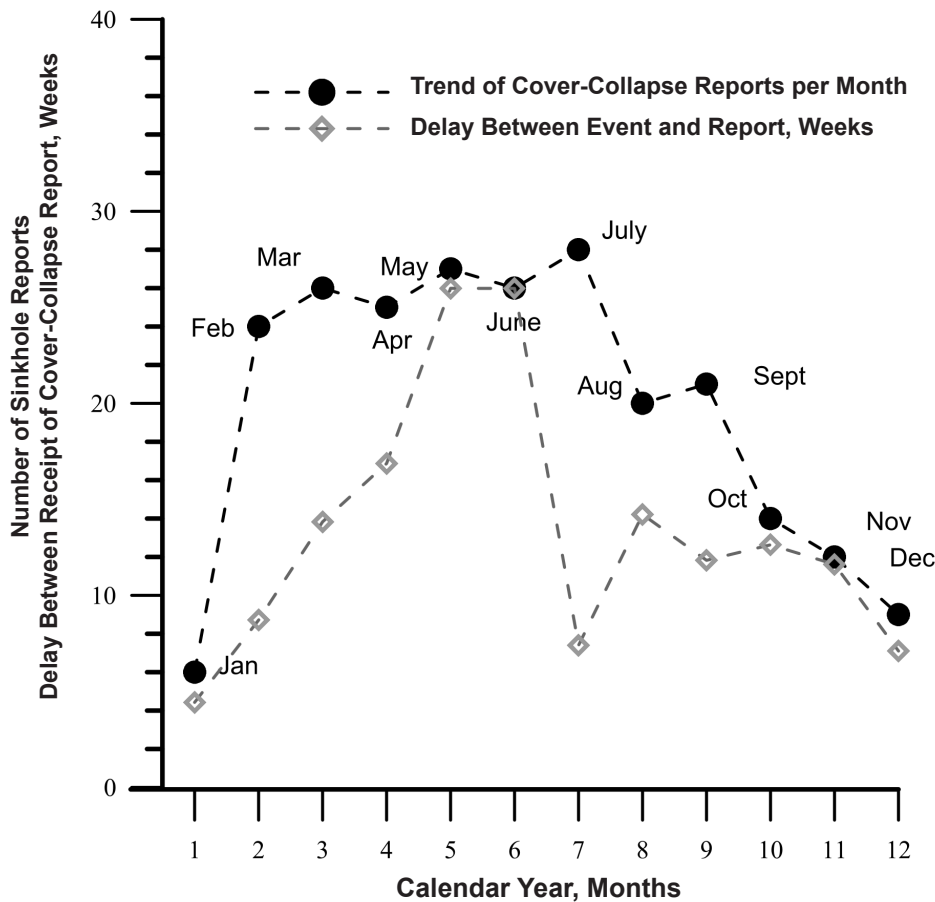


Figure 8. Comparison of the delay in weeks between a collapse and the receipt of a report at the Kentucky Geological Survey.

Student's *t* test was then used to evaluate the mean of the elongation for the Ordovician and the Silurian-Devonian and the circularity for the Ordovician and the Silurian-Devonian. All three means had statistically significant differences by the Student's *t* test at the $\alpha=0.05$ level (Table 3).

Another evaluation was made by dividing the entire data set into two groups determined by whether the county in which the sinkhole occurred is largely urban or rural. The depth, diameter, and circularity were all found to have equal variances (Table 3). The variance for elongation was not equal. Student's *t* test found that the means for the diameter and the circularity were not equal. But the mean depth was found to not be significantly different for the rural and urban sample sets at the $\alpha=0.05$ level.

The finding that the mean diameter and the circularity were not equal between the rural and

urban land use suggests that urbanization affects the ratio of the axes of the opening to the surface. In more urbanized locations, there is a great deal of construction of horizontal, impermeable surfaces, which increases the velocity and volume of runoff, provides artificially straight margins for infiltration along joints and edges in pavement, and creates areas of non-natural "cover" beneath which sinkholes can develop. These factors could significantly alter the shape and size of the sinkholes that form compared to those that develop under naturally occurring conditions. The similarity of the mean depths suggests that urbanization has little effect on sinkhole depth, however. I speculate that during the development of residential areas, relatively little earth is moved from deep cuts, which otherwise would reduce the depth of the epikarst. The limit of the epikarst depth imposes a constraint on cover-collapse depth.

Finally, a multivariate analysis subroutine in the Statgraphics Centurion XVI software was used to calculate the similarity between the stratigraphic data sets. The results were expressed in terms of the statistical significance of the correlation of any two pairs of data samples. There were no significant correlations among the sample data sets. The statistical analysis confirmed that the untransformed data sets were too skewed to be evaluated with the planned technique, the Student's *t* test. The transformed data could be tested for some parameters, but for the most part, there was no statistically significant difference of the mean among the groupings, as determined by Student's *t* test. Urban and rural cover collapses have different elongation and

Table 3. Summary of statistical comparison of cover-collapse parameters grouped by geologic period. Gray indicates the *F* test failed and therefore the Student's *t* test is not applicable. All data were log-transformed. All comparisons are to a 95 percent ($\alpha=0.05$) confidence interval. Student's *t* test is of the equivalency of the means. *F* test is of the equivalency of the variance. \neq indicates the comparison of the two samples is statistically different; = indicates the two sample sets are not statistically different. M=Mississippian, O=Ordovician, S+D=Silurian-Devonian, U=urban, R=rural.

Parameter	Mississippian vs. Ordovician	Mississippian vs. Silurian-Devonian	Ordovician vs. Silurian-Devonian	Urban vs. Rural
Depth	<i>F</i> test: M=O Student's <i>t</i> test: M=O	<i>F</i> test: M=S+D Student's <i>t</i> test: M \neq S+D	<i>F</i> test: O=S+D Student's <i>t</i> test: O=S+D	<i>F</i> test: U=R Student's <i>t</i> test: U=R
Diameter	<i>F</i> test: M \neq O Student's <i>t</i> test: M \neq O	<i>F</i> test: M \neq S+D Student's <i>t</i> test: M \neq S+D	<i>F</i> test: O \neq S+D Student's <i>t</i> test: O \neq S+D	<i>F</i> test: U=R Student's <i>t</i> test: U \neq R
Asymmetry	<i>F</i> test: M \neq O Student's <i>t</i> test: M \neq O	<i>F</i> test: M=S+D Student's <i>t</i> test: M \neq S+D	<i>F</i> test: O=S+D Student's <i>t</i> test: O \neq S+D	<i>F</i> test: U \neq R Student's <i>t</i> test: U \neq R
Circularity	<i>F</i> test: M \neq O Student's <i>t</i> test: M \neq O	<i>F</i> test: M \neq S+D Student's <i>t</i> test: M \neq S+D	<i>F</i> test: O=S+D Student's <i>t</i> test: O \neq S+D	<i>F</i> test: U=R Student's <i>t</i> test: U \neq R

circularity values, but the depth had equivalent means.

Summary and Conclusions

The gradual but persistent accumulation of reports on cover collapse in Kentucky over the last 30 years has resulted in a database containing more than 350 case histories. Older reports are often missing ancillary data, but recent records are more complete. The reports include the location, elevation, and date of the collapse and qualitative data such as the presence of trash, the exposure of utility lines, and evidence of a prior collapse. Non-parametric, qualitative data collected indicate that only 7 percent of the locations of collapse sites were inside a topographically mapped sinkhole. These results suggest that the cover-collapse process does not commonly continue to function inside mature sinkholes in Kentucky.

Forty-one percent of collapses are underlain by Mississippian rocks, whereas 45 percent are underlain by Ordovician carbonates. The remaining collapses are underlain by Silurian and Devonian carbonates or the stratigraphy is undetermined.

The frequency distribution of the raw data (depth and opening axis) and the calculated parameters (diameter, elongation, and circularity) were transformed for statistical analysis. Calculation of the variance and Student's *t* test for the mean suggest that there is less difference between the means of the parameters of cover collapses over Ordovician carbonates than of cover collapses over Silurian and Devonian carbonates. The Mississippian-hosted collapses, in contrast, have large

differences in variance for elongation, circularity, and diameter compared to differences in variance for the Ordovician and Silurian-Devonian cover collapses, which made comparison of the means by Student's *t* test inappropriate. Depth was found to have similar means among the stratigraphically grouped sample sets.

The most important finding from this research may be that when the total number of cover-collapse reports in a month are plotted against the average statewide temperature for that same month, two distinct subparallel trend lines are created. One line represents a warming trend that starts in February and follows in chronological order for the next five months. Then in August, the trend reverses direction, and the count of events per month decreases until January of the following year.

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Appendix 1. Selected parameters from the cover-collapse data file. GL=ground level. LFUCG=Lexington-Fayette Urban County Government. MSL=mean sea level. DOW=Kentucky Division of Water. GPS=Global Positioning System. USDA=U.S. Department of Agriculture. KYTC=Kentucky Transportation Cabinet. ArcGIS=software by Esri. NPS=National Park Service. WKU=Western Kentucky University. WKYT=Lexington, Ky., television station.

Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause	
2	16-May-01	-84.571944	37.798333	242	GL	map	1-May-01	Jim Currens	KGS	Jessamine	Little Hickman	calf fell into hole and died	no	no	no	no	dry, occasional thunderstorms	0.5	10	0.30	100	3.0	overhanging	yes	Tyrone Limestone	McAfee series	no	N/A	yes		no	
3	7-Dec-01	-85.690956	37.047458	155		map	1-Apr-00	Joseph Ray	DOW	Bullitt	Brooks	\$50,000; property reappraised from \$140K to \$90K	not for 22 years	no	no	no	dry, then wet	3.0		1.52		2.1	vertical(?)	no/maybe	Louisville Limestone	Baxter silt	no		no		no	
4	6-Mar-01	-85.685278	38.117500	152	GL	map	1-May-00			Jefferson	Brooks	operator of riding mower drove into it	no	no	no	no	unknown	1.2	250	0.91	160	0.9	unknown	no	Louisville Limestone	Crider silt loam	unknown	east	soil arch tunnel was visible		no	
5	21-Feb-01	-84.537222	38.034444	290	GL	map	15-Feb-01	Jim Currens	KGS	Fayette	Lexington West	no	no	clay pipe	no	no	3 in. of rain previous week	2.1	130	1.68	220	1.8	overhanging	no	Brannon Member and Grier Limestone	Maury series	no	N/A	no		no	
6	20-Feb-01	-84.542222	38.036667	282	GL	map	19-Feb-01	Jim Currens	KGS	Fayette	Lexington West	sidewalk	not at this spot, but adjacent	no	new storm sewer adjacent	no	3 in. of rain previous week	0.9	90	0.76	220	2.4	overhanging	no	Grier Limestone	Maury series	no	southwest?	soil pipe visible		no	
7	12-Mar-01	-84.559444	37.989722	287	GL	map	1-Jun-00	Jim Currens	KGS	Fayette	Nicholasville	no	no	unknown	unknown	unknown	unknown	0.9		0.91		0.2	unknown	N/A	Grier Limestone	McAfee series	unknown	south?			no	
8	22-Sep-00	-86.769167	36.704167	186	GL	map	1-Sep-97	Craig Givens	KGS	Logan	Adairville	no	no	no	no	no	dry following wet spring	15.5	0	12.20	90		85°	no	St. Louis Limestone	Cumberland silt	no	south	yes, enterable		no	
9	1-Aug-00	-84.882222	38.173056	221	GL	map	1-Aug-90	S. Mims	KSU	Franklin	Frankfort West	no	no	no	no	no	N/A	3.0	250	0.00	350	0.6			Borden Formation	Lenburg-Carpenter complex	no		no		no	
10	25-Nov-98	-85.061111	38.043611	213	GL	map	1-Jun-97	Jim Currens	KGS	Anderson	Glensboro	no	yes, soil mounded around sink	no	no	no	unknown	1.2	270	0.91	90	0.9	70°	no	Clays Ferry Formation	Allerium	no	N/A	open throats/ 1-ft diameter		no	
11	28-Feb-00	-84.497500	38.048611	306	GL	map	1-Oct-99	Jim Currens	KGS	Fayette	Lexington East	driveway pavement	no	unknown	unknown	unknown	drought	1.4	200	1.07	110	0.2	20°	no	Tanglewood Limestone		no	N/A	no			no
12	28-Feb-00	-85.640017	38.306450	174		Google Earth	1-Feb-00	Jim Currens	KGS	Jefferson	Jeffersonville	no	yes, former owner reported it filled	no	unknown	yes	summer/fall drought, dry winter	0.0		1.52		4.6	no soil exposed	no				no			yes	
13	10-Jun-99	-84.644444	37.985833	273	GL	map	20-Jun-99	Jim Currens	KGS	Jessamine	Keene	no	yes, trash	yes, domestic rubbish	no	no	very dry	4.9		1.22	315	0.6	overhung	no	Grier Limestone	Maury series	no	N/A	groundhog hole?		yes	
14	24-Mar-99	-84.576944	38.037778	299	GL	map	1-Mar-98	Jim Currens	KGS	Fayette	Lexington West	no	no	no	no	no	cold and wet	2.4	40	1.83	130	0.8	80°	no	Tanglewood Limestone	Maury series	no	none	no		no	
15	6-Nov-98	-84.544444	37.996667	300	GL	map	1-Sep-98	Jim Currens	KGS	Fayette	Georgetown	foundation subsidence and cracking	no	N/A	no	never holds water	dry	9.1	200	4.57	200		gentle 15°	no	Tanglewood Limestone at top of Brannon Member	Maury series	no	south?	no		no	
16	18-Jun-99	-84.715000	38.980833	270	GL	map	1-Jun-98	Jim Currens	KGS	Woodford	Keene	no	no	no	no	unknown	unknown	1.5	90	1.22	360	5.5	vertical to overhanging	yes	Tanglewood Limestone	Cynthiana series	no	N/A	yes; 8 ft long, 2 ft wide, 4 ft high		no	
17	20-Jul-00	-84.641667	37.922222	268	GL	map	1-Mar-97	Jim Currens	KGS	Jessamine	Keene	no	yes, enlarged in 1997	no	no	no	very wet	3.4	140	2.13	230		filled	no, filled	Lexington Limestone	Trappist series	no	south			no	
18	24-Dec-98	-84.842778	37.336111	183	MSL	map	1-Aug-98	John Kiefer	KGS	Hart	Canmer	no, pasture land	yes	no	no	probably	near drought conditions	12.2	45	10.67	315	18.9	~70-80°	at 32 ft depth	Borden Formation	Garmon series	no	water at bottom but not visible	no, but cave opening implied		no	
19	11-Apr-97	-84.710278	37.751389	241	GL	map	24-Mar-97	Kiefer & Currens	KGS	Mercer	Valley View	lawn	no	no	no	no	very wet; 10 in. of rain Feb-28-Mar. 1	3.0	25	2.44	205	3.0		no	Tyrone Limestone	Chenault series	dripping from roots	N/A	no		no	
20	18-Jun-97	-85.961667	37.809722	213	GL	map	June 1997	Drew Andrews	KGS	Hardin	Vine Grove	no	yes			floods	very wet	0.0		0.00					Clays Ferry Formation	Nolin series					no	
21	1-Jul-98	-84.468333	38.031111	361	GL	map	28-Jun-98	Jim Currens	KGS	Fayette	Lexington East	no	yes, former owner filled	no	no	no	4 in. rain day of collapse	2.7	15	1.52	280	0.6		no	Tanglewood Limestone	made land over clayey materials	no	?	no		yes	
22	19-Jun-97	-84.461111	37.962500	305	GL	map	16-Jun-97	Jim Currens	KGS	Fayette	Coletown	roadway	unknown	old bottles laid along fence	possible water main	unknown	very wet	2.7	40	1.83	310			no	Millersburg Member	Loradale series	no		no		unknown	
23	30-Sep-97	-84.530278	38.015833	300	GL	map	18-Jun-97	Jim Currens	KGS	Fayette	Lexington West	no	yes, along a stump	no	no	no	dry	0.6	90	0.61	360	0.6		lithology	Tanglewood Limestone	Donerail series	no		no		unknown	
24	21-Nov-97	-84.498611	37.167500	290	GL	map	1-Nov-97	Jim Currens	KGS	Pulaski	Shopville	no	yes, adjacent sinkhole	no	no	no	dry, fall rain just beginning	1.2	310	1.22		1.2		no	Borden Formation	Frederick series	no	N/A	no		no	
25	27-May-99	-84.489444	38.036944	299			unknown	Jim Currens	KGS	Fayette	Lexington East	no	yes, filled with 2 in. gravel	no	cable TV, 2-in. PVC pipe	unknown	dry	0.3		0.30		0.4	vertical	no	Tanglewood Limestone		no	?	no		yes	
26	28-Feb-00	-84.365278	37.918889	297	GL	map	19-Feb-00	Jim Currens	KGS	Fayette	Ford	no	yes, bowl-shaped sinkhole and older collapse	no	no	no	spring rain following drought in fall/winter	1.5	215	1.22	130	1.2	overhanging	yes	Grier Limestone and Curdsville Limestone Member	McAfee series	no	N/A	no		no	
27	7-Jul-98	-84.570278	37.999167	299	GL	map	30-Jun-98	Jim Currens	KGS	Fayette	Nicholasville	lawn	no	no	no	no	major rainstorm on 29-Jun	0.6	70	0.61	160	2.4		no	Brannon Member and Grier Limestone	Maury series	no	? 70°	no		no	
28	17-Apr-97	-84.735000	37.805556	258	GL	map	2-Mar-97	Jim Currens	KGS	Mercer	Wilmore	fence row barbed wire	no	no	no	no	9 in. rain fell 28-May-97	2.7	50	2.74	90	2.1		no	Curdsville Limestone Member	McAfee series	no	N/A	overhung soil		no	
29	5-Oct-	-85.695278	38.038333	153				Jim Currens	KGS	Bullitt	Louisville East		washed out 20 years ago and not since					2.4		0.00					Louisville Limestone	Caneyville series					no	
30	15-Oct-99	-87.510556	36.843056	159	GL	map		Stewart Boyd	N/A	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no	
31		-84.559167	37.990000	287				Jim Currens	KGS	Fayette	Nicholasville							1.7		0.00					Grier Limestone	Lindsay series					no	
32	1-Jul-96	-84.469444	38.029167	317				Jim Currens	KGS	Fayette	Lexington East				septic tank			0.0		0.00					Tanglewood Limestone						no	
33	16-May-94	-84.660000	38.038056	286			1-Feb-94	Jim Currens	KGS	Woodford	Versailles	a well	yes	no	yes	yes		2.4		0.00		2.4		yes	Tanglewood Limestone	Maury series					no	
34	3-Dec-95	-86.451111	36.959444	162		TopoZone	1-Sep-95	Vince Arrell & Lack Vongsvanh	N/A	Warren	Bowling Green South	none cited						3.7		2.74		1.5		yes	Ste. Genevieve Limestone	Crider-urban land complex	no		yes		no	
35	11-Feb-99	-84.707778	38.035833	287				Jim Currens	KGS	Woodford	Versailles	sinkhole flooding threatens home	no	no		N/A		0.0		0.00					Tanglewood Limestone	Maury series					no	
36	18-Apr-96	-84.531944	38.003611	305				Jim Currens	KGS	Fayette	Lexington West	sinkhole in garage						0.0		0.00				sediment dry, soft	Tanglewood Limestone	Maury series					no	

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Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause
37	8-May-96	-84.521944	37.981111	296				Jim Currens	KGS	Fayette	Nicholasville							1.4		0.00		1.5			base of Brannon Member	McAfee series					no
38	16-Nov-00	-84.574722	37.994722	305		mapblast.com	unknown	Jim Currens	KGS	Fayette	Nicholasville							0.0		0.00					Grier Limestone	Maury series					no
39	16-Nov-00	-84.448611	38.065833	305		mapblast.com	1-Dec-91	Jim Currens	KGS	Fayette	Lexington East							0.0		0.00					Grier Limestone	made land over silt materials					no
40	16-Nov-00	-84.688889	38.071667	305		mapblast.com	1-Aug-76	Jim Currens	KGS	Fayette	Versailles							0.0		0.00					Brannon Member, Lexington Limestone	McAfee series					no
41	1-Jun-90	-84.612500	37.758333	262	GL	map	1-May-90	Kiefer and Currens	KGS	Garrard	Little Hickman	lawn	no	yes, fence wire, propane tank	no	no	unknown	2.6		2.44		2.4	vertical	no	Grier Limestone	Lowell series	no	N/A	drain visible in bottom of sinkhole		no
42	11-Jul-01	-85.131944	36.750000	306		GPS	1-Jun-00	Tammy Jones	KGS	Clinton	Wolf Creek Dam	no	no	no	no	unknown, heavy vegetation	unknown	10.1		5.49	90	3.7	overhanging	no	St. Louis Limestone	Dewey series	yes		no		no
43	11-Jul-01	-85.131944	36.749444	225		GPS	22-Jun-05	Tammy Jones	KGS	Clinton	Wolf Creek Dam	no	no	no	no	unknown	unknown	3.7		2.74	105	13.7	overhanging—dangerous		St. Louis Limestone	Dewey series	no	N/A	possible		no
44	11-Jul-01	-85.080556	36.724444	315		GPS	1-Jun-91	Tammy Jones	KGS	Clinton	Savage	no	no	no	yes, domestic debris	unknown	unknown	1.1	10	1.14	295	1.7	90° slope		St. Louis Limestone	Caneyville-Dewey complex	no	south	possible opening visible		yes
45	12-Jul-01	-85.158333	36.695556	291		map	Jul-98	Joe Russell	USDA	Clinton	Albany							0.0		0.00					St. Louis Limestone	Dewey series					no
46	12-Jul-01	-85.176111	36.715000	291		map	Jul-98	Joe Russell	USDA	Clinton	Albany							0.0		0.00					St. Louis Limestone	Dewey series					no
47	12-Jul-01	-85.174444	36.723889	291		map	22-Jun-01	Joe Russell	USDA	Clinton	Albany							0.0		0.00					St. Louis Limestone	Dewey series					no
48	12-Jul-01	-85.110278	36.692778	291		map	Jun-97	Joe Russell	USDA	Clinton	Savage							0.0		0.00					St. Louis Limestone	Nolin series					no
49	12-Jul-01	-85.101389	36.696389	291		map	May-01	Joe Russell	USDA	Clinton	Savage							0.0		0.00					St. Louis Limestone	Dewey series					no
50	1-Aug-01	-84.722222	37.645000	282		map	25-Jul-01	Jim Currens	KGS	Boyle	Bryantsville	no	no	no	no	no	3 in. rainfall previous 24 hr	2.1	285	2.13	185	1.8	overhanging	no	Grier Limestone	Caleast series	no	N/A	no		no
51	8-Mar-01	-84.466667	38.084167			map		Tony Cooley	KGS	Fayette	Lexington East							0.0		0.00					Grier Limestone	Lowell series					no
52	8-Mar-01	-84.433333	38.075000	296		map		Tony Cooley	KGS	Fayette	Lexington East							0.0		0.00					Grier Limestone	Armour series					no
53	8-Mar-01	-84.080000	38.456944	301		map		Tony Cooley	KGS	Fayette	Lexington East							0.0		0.00					Grier Limestone	Allegheny series					no
54	8-Mar-01	-84.462500	38.847222	298		map		Tony Cooley	KGS	Fayette	Lexington East							0.0		0.00					Grier Limestone	Nolin series					no
55	6-Aug-01	-84.371667	38.238333	258		map				Bourbon	Centerville							0.0		0.00					Grier Limestone	Faywood series					no
56	6-Aug-01	-84.593056	38.134722	280		map				Fayette	Georgetown							0.0		0.00					Tanglewood Limestone	McAfee series					no
57	6-Aug-01	-84.594444	38.134722	280		map				Fayette	Georgetown							0.0		0.00					Tanglewood Limestone	Huntington series					no
58	27-Apr-94	-86.841667	36.684722	177		map	Apr-94	Jim Currens	KGS	Logan	Adairville	loss of pond	built in existing hole	no	no	yes	unknown	3.0		2.44		3.7			St. Louis Limestone	Pembroke series	no		yes		yes
59	30-Aug-01	-85.555556	38.305000	212		map	8-May-01	Jim Currens	KGS	Jefferson	Anchorage	no—lawn only	low spot	wood, plastic	no	1–2 days after rain	unknown	0.8	105	0.53	25	1.5	overhanging	no	Louisville Limestone	Alic Udarents complex	yes, standing	N/A	no		yes
60	4-Sep-01	-86.018056	37.037500	250		map	19-Oct-95			Edmonson	Mammoth Cave							0.0		0.00					St. Louis Limestone	Cider series					no
61	24-Jan-02	-85.090278	38.125833	265		map	May/ Jun-94	Jim Currens	KGS	Shelby	Waddy	no	no	no	no	no	unknown; 2 in. of rain overnight on 24-Jan-02	3.7	215	4.57	145	0.9		no	Calloway Creek Limestone (base of)	Lowell series	yes		no		no
62	24-Jan-02	-84.843972	38.325972	168		GPS	15-Dec-01	Jim Currens	KGS	Franklin	Switzer	no—lawn	no	no	no	no	winter rains beginning	1.1	250	0.91	145	2.1	overhanging to vertical	yes	Tanglewood Limestone	McAfee series	no	N/A	no		no
63	18-Dec-01	-85.073056	38.140278	268		map	10, 11, 12-Dec-01	Jim Currens	KGS	Shelby	Waddy	no	no	no	adjacent to hand-dug well	no	wet	0.6	30	0.61	120	0.9	overhanging—20°	no	Calloway Creek Limestone (base of)	Lowell series	yes	south to seep	no		no
64	18-Dec-01	-84.070556	38.142500	268		map	1-Jul-00	Jim Currens	KGS	Shelby	Waddy	no	no	no	no	no	wet	1.2	340	0.61	250	0.6	60°	no	Calloway Creek Limestone (base of)	Eden series	no	east	no		no
65	14-Feb-02	-84.558889	38.085556	281		map	11-Feb-02	Jim Rebmann	LFUCG	Fayette	Lexington West	retention basin	no	no	no	yes, retention barrier	rainy	3.0	280	1.22	200	3.0	vertical	yes	Tanglewood Limestone	Maury series	no	N/A	no		yes
66	14-Feb-02	-84.598611	37.997222	290		map	7-Feb-02	Jim Rebmann	LFUCG	Fayette	Nicholasville	no	unknown; most likely not	no; newly buried trash pushed in	no	unknown	rainy, melting snow	3.7	50	3.05	135			no	Grier Limestone under Brannon Member	Maury series	no	N/A	no		yes
67	15-Nov-02	-87.488611	36.827500	166		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					St. Genevieve Limestone	Vertrees series					no
68	15-Nov-02	-87.489444	36.827500	162		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					St. Genevieve Limestone	Pembroke series					no
69	15-Nov-02	-87.509444	36.833889	161		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Nicholson series					no
70	15-Nov-02	-87.510278	36.840278			map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Nolin series					no
71	15-Nov-02	-87.513056	36.842500	160		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Pembroke series					no
72	15-Nov-02	-87.506111	36.845556	166		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Nicholson series					no
73	15-Nov-02	-87.523333	36.850556	159		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Nolin series					no
74	15-Nov-02	-87.524444	36.850833	152		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Nolin series					no
75	15-Nov-02	-87.514444	36.860278	163		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					St. Genevieve Limestone	Pembroke series					no

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76	15-Nov-02	-87.512500	36.860278	168		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no
77	15-Nov-02	-87.541667	36.843333	168		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no
78	15-Nov-02	-87.530000	36.840000	163		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no
79	15-Nov-02	-87.516389	36.863611	165		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
80	15-Nov-02	-87.487222	36.877500	169		map	1-Nov-03	Lorin Boggs	NRCS	Christian	Kelly							0.0		0.00					Renault Limestone	Crider series					no
81	15-Nov-02	-87.486389	36.885556	173		map		Lorin Boggs	NRCS	Christian	Kelly							0.0		0.00					Renault Limestone	Pembroke series					no
82	15-Nov-02	-87.486389	36.885556	173		map		Lorin Boggs	NRCS	Christian	Kelly							0.0		0.00					Renault Limestone	Pembroke series					no
83	15-Nov-02	-87.487222	36.885833	173		map		Lorin Boggs	NRCS	Christian	Kelly							0.0		0.00					Renault Limestone	Nolin series					no
84	15-Nov-02	-87.489167	36.832500	155		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					alluvium	Nolin series					no
85	15-Nov-02	-87.485278	36.833056	157		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
86	15-Nov-02	-87.486389	36.833611	157		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
87	15-Nov-02	-87.482222	36.835556	159		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
88	15-Nov-02	-87.498889	36.836389	156		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Crider series					no
89	15-Nov-02	-87.484167	36.836667	159		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
90	15-Nov-02	-87.476389	36.842222	162		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Vertrees series					no
91	15-Nov-02	-87.480278	36.833333	161		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no
92	15-Nov-02	-87.470833	36.852778	165		map		Lorin Boggs	NRCS	Christian	Hopkinsville							0.0		0.00					Ste. Genevieve Limestone	Elk series					no
93	15-Nov-02	-87.533889	36.843056	168		map		Lorin Boggs	NRCS	Christian	Church Hill							0.0		0.00					Ste. Genevieve Limestone	Pembroke series					no
94	10-May-02	-84.470067	37.850815	290		map	1960+	Jim Currens	KGS	Jessamine	Valley View	no	unknown	no	no	no	unknown	1.5	270	0.91	0	2.4	overhanging	yes	alluvium	Fairmount-rock outcrop complex	no		no		no
95	30-Jan-03	-84.546389	38.186111	264		map	May-02	Randy Paylor	KGS	Scott	Georgetown	no	no	no	no	no	unknown	2.4	50	1.52	320	1.5	50° northwest side; undercut 70° on southeast side	no	Tanglewood Limestone	Huntington series	no		no		no
96	4-Feb-03	-85.684444	38.277778	166			Feb-02	Becky Homan	N/A	Jefferson	Jeffersonville	no	yes	no	no	no	unknown	0.9		0.91					Sellersburg-Jeffersonville Limestones	Crider series	no		no		no
97	23-Dec-02	-84.296667	38.268472	253		map	11-Dec-02	Jim Currens	KGS	Bourbon	Shawhan	calif	no	no	no	no	wet	1.8	170	1.22	80	3.0	overhanging	no	lower Lexington Limestone	McAfee series	no		no		no
98	5-Dec-02	-84.504167	37.958333	290			4-Nov-02	Jim Leach	L.E. Gregg Assoc.	Fayette	Nicholasville	no	no	no	no	no	unknown	3.7		1.22		4.9	vertical	yes	Brannon Member, Lexington Limestone	Armour series	no	north	no		no
99	27-Feb-02	-86.471472	36.949972	168		map	25-Feb-02	Jim Currens	KGS	Warren	Bowling Green South	yes; roadway, two pickups, two cars, 17:15 EST	yes, subsidence six weeks prior	no	yes; water, storm sewer, power	unknown	dry, occasional showers	45.7	160	32.32	240	9.1	vertical to 30°	yes, freshly broken	Ste. Genevieve Limestone	Crider series	yes	northwest	yes		yes
100	26-Aug-03	-84.617500	37.098333	298		map	3-Jun-15	Jim Currens	KGS	Pulaski	Somerset	landscaping	unknown	unknown	downspout	unknown	very wet	3.0	360	1.52	265		no	no	St. Louis Limestone	Frederick series	N/A		N/A		yes
101	15-Jul-03	-84.736056	38.145778	261		GPS	Jun-03	Jim Currens	KGS	Woodford	Midway	no	no	no	no	no	wet, record rainfall	3.4	240	2.74	150	10.1	overhanging to vertical	no	Tanglewood Limestone	Maury series	no		no; this may be one under the overhang		no
102	15-Jul-03	-84.744444	38.139694	256		map	1-Apr-03	Jim Currens	KGS	Woodford	Midway		no	no	no	no	very wet	0.9	180	0.67	270	1.4	slightly overhanging to vertical	no	Tanglewood Limestone	Maury series	wet		no		no
103	19-Jun-03	-84.557500	38.976517	297				gentle subsidence; NOT a cover collapse	Jim Currens	KGS	Fayette	Nicholasville	door frame on garage, concrete pad	yes, previous owner filled in hole	no, possible buried trash	no	very wet, near record	9.8	300	5.18	30	0.6	30°	no	Kope Formation	Eden series	no		no		yes
104	14-Apr-03	-84.695833	38.031111	296		map	10-Apr-03	Jim Currens	KGS	Woodford	Versailles	no	yes	no	no	no	recent rain	0.9	65	0.61	5	3.0		no	Tanglewood Limestone	Maury series	no	N/A	no		yes
105	24-Apr-03	-84.505383	38.006778	305		map	17-Apr-03	Jim Currens	KGS	Fayette	Lexington West	flowerbed	no	no	not exposed, but adjacent	no	spring season	1.2	30	0.46	300	0.6	overhanging	no	Brannon Member, Lexington Limestone	Maury series	no	N/A	no		no
106	15-Apr-03	-85.596389	38.340167	183		map	1-Nov-02	Jim Currens	KGS	Jefferson	Anchorage	sidewalk	no	no	no	yes	unknown	2.3	20	1.22	270	4.0		no	Sellersburg-Jeffersonville Limestones	urban land-Afflic Udarents complex	no	N/A	no		yes
107	21-Apr-03	-84.706389	38.986944	258			1-Oct-02	Brad Hazelbaker	N/A	Boone	Union		no	no	no	no	heavy rain	2.4		1.22		0.9		no	Fairview Formation	Ashton series	no	N/A	no		no
108	15-Mar-03	-85.487778	38.243333	216			15-Mar-03	Steve Hughes	N/A	Jefferson	Fisherville		no	no	no	slight depression, did not hold water	normal	1.8		0.91	45	0.6	30°	no	Drakes Formation	urban land-Afflic Udarents complex	no	N/A	no		no
109	1-Aug-03	-84.574167	38.196667	285		GPS	late summer 2003	Jennifer Watson	N/A	Scott	Georgetown							7.6		7.62					upper Lexington Limestone	McAfee series					no
110	spring 1983	-86.411944	36.941944	168		TopoZone	fall 1982	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no	no		4.9		4.60		6.4		yes	Ste. Genevieve Limestone	Crider-urban land complex			yes		no
111	spring 1983	-86.420556	36.953889	162		TopoZone	fall 1981	George Veni	WKU	Warren	Bowling Green South	none cited		no	no	no	flood	7.5		6.10		0.9		no	Ste. Genevieve Limestone	urban land-Udortherns complex	no		no		no

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112	spring 1983	-86.427222	36.954167	162		TopoZone	spring 1981	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	yes, sewer pipe and utility cable exposed	no		3.4		3.40		2.1		no	Ste. Genevieve Limestone	urban land-Udorthents complex	no		no		yes
113	spring 1983	-86.418611	36.948611	159		TopoZone	spring 1982	George Veni	WKU	Warren	Bowling Green South	none cited	yes	no	no			7.9		7.30				no	Ste. Genevieve Limestone	Crider-urban land complex	no		no		no
114	spring 1983	-86.406389	36.983889	146		TopoZone	spring 1982	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			15.8		0.00		3.4		yes	Ste. Genevieve Limestone	Crider-urban land complex			yes		no
115	spring 1983	-86.408889	36.981944	146		TopoZone	5-Jun-05	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			14.1		7.00		2.4		no	Ste. Genevieve Limestone	Crider-urban land complex			yes		no
116	29-May-84	-86.422222	36.929167	180		TopoZone	spring 1984	George Veni	WKU	Warren	Bowling Green South	none cited	injection well	no	no	no		6.0		3.50		2.0		no	Ste. Genevieve Limestone	urban land-Udorthents complex	no		no		yes
117	31-May-84	-86.409444	36.997222	152		TopoZone	1-May-84	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			1.5		1.20		0.5		no	Ste. Genevieve Limestone	Crider-urban land complex	no		no		no
118	18-Jun-84	-86.432500	36.961389	162		TopoZone	10-Jun-84	George Veni	WKU	Warren	Bowling Green South	none cited	yes	no	yes, sewer line	yes		1.0		1.00		1.0		yes	Ste. Genevieve Limestone	Crider-urban land complex	yes, sewage		yes		no
119	20-Jun-84	-86.577500	36.730833	204		TopoZone	10-Jun-84	George Veni	WKU	Simpson	Franklin	yes, damage to sewer line	no	no	upper 2 m reworked for pavement and sewage lines	no	not cited	1.5		1.00				no	St. Louis Limestone	Mountview series	yes, sewage		no		yes
120	11-Jul-84	-86.426944	36.903611	159		TopoZone	spring 1984	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			3.9		3.30		1.3		no	Ste. Genevieve Limestone	Lawrence series	no		yes		no
121	12-Jul-84	-86.423333	36.951944	165		TopoZone	spring 1982	George Veni	WKU	Warren	Bowling Green South	collapse occurred in retention basin and was repaired		no	no			6.7		3.00		5.8		yes	Ste. Genevieve Limestone	Crider series	yes, sewage	northeast	yes		yes
122	12-Jul-84	-86.425556	36.947778	165		TopoZone	6-Jun-81	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			6.0		5.00		2.0		no	Ste. Genevieve Limestone	urban land-Udorthents complex	no		no		no
123	14-Jul-84	-86.413333	36.939167	162		TopoZone	1-May-84	George Veni	WKU	Warren	Bowling Green South	none cited	yes	no	no, but hand pump 4 m away	no	flood	9.0		4.70		2.8		no	St. Louis Limestone	Baxter gravelly silt loam	no		no		no
124	14-Jul-84	-86.398611	36.919722	165		TopoZone	1-Jun-83	George Veni	WKU	Warren	Bowling Green South	none cited	yes	no	no			11.5		6.60		7.1		yes	St. Louis Limestone	Baxter gravelly silt loam			yes		no
125	14-Jul-84	-86.468611	36.987222	146		TopoZone	1-Nov-83	George Veni	WKU	Warren	Bowling Green South	none cited	yes	no	no			0.7		0.60		0.9		yes	Ste. Genevieve Limestone	Fredonia-Ver-trees-urban land complex			yes		no
126	14-Jul-84	-86.473889	36.988889	146		TopoZone	1-Nov-83	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no			1.2		1.00		0.4		no	Ste. Genevieve Limestone	Fredonia-Ver-trees-urban land complex			no		no
127	18-Jul-84	-86.296389	36.944722	159		TopoZone	fall 1981	George Veni	WKU	Warren	Bristow	no	no	yes	no	no	not cited	17.0		8.00		3.5		yes	St. Louis Limestone	Baxter gravelly silt loam	no		Yes, possible entrance under buried trash.		no
128	18-Jul-84	-86.327778	37.012500	168		TopoZone	spring 1982	George Veni	WKU	Warren	Bristow	no	no	yes	no	no		25.0		10.00		2.3		yes, 2.2m deep	St. Louis Limestone	Baxter series	no		maybe		no
129	18-Jul-84	-86.328889	37.012222	168		TopoZone	spring 1981	George Veni	WKU	Warren	Bristow	no	no	no	no	no		3.0		1.80		0.5		no	St. Louis Limestone	urban land-Udorthents complex	no		no		no
130	18-Jul-84	-86.330833	37.011944	168		TopoZone	spring 1982	George Veni	WKU	Warren	Bristow	no	no	no	no	no		2.0		1.50		0.4		no	St. Louis Limestone	urban land-Udorthents complex	no		no		no
131	18-Jul-84	-86.293889	37.012222	162		TopoZone	spring 1981	George Veni	WKU	Warren	Bristow					no		16.0		14.00		3.0			St. Louis Limestone	urban land-Udorthents complex	no		no		no
132	19-Jul-84	-86.910278	37.005556	232		TopoZone	May-84	George Veni	WKU	Barren	Glasgow North	none cited	yes	no	yes, sewer line	yes	very wet—May flood	1.8		5.00		2.2		no	alluvium	Newark series	no		no		no
133		-84.5506	38.07889444	274		Google Earth	14-Jul-10	Jim Currens	KGS	Fayette	Lexington West	yard					rainy	0.0		1.83		1.8			lower Lexington Limestone	McAfee series					no
135	18-Feb-03	-86.553333	36.743611	207			Feb-03			Simpson	Franklin	yes; manhole and pipes			possibly, from looking at photo			0.0		0.00					St. Louis Limestone	Baxter cherty silt loam					yes
136	18-Aug-93	-85.652778	38.222778	155		Google Earth	spring 1993	Kaye Little	ind-vidual	Jefferson	Louisville East		unknown	unknown	unknown	unknown	wet	0.0		0.00					Sellersburg-Jeffersonville Limestones	urban land					no
137	2-Aug-04	-84.256111	38.173056	268	GL	map	1-May-04	Shari Dutton	ind-vidual	Bourbon	Paris West	not yet—8 ft from neighbor's house	small hole	no	septic tank lateral line	yes	wet	1.2		1.22		1.5	overhanging	unknown	Tanglewood Limestone	Maury series					no
138	20-Aug-04	-85.670556	38.132500	156			unknown	Jim Currens	KGS	Jefferson	Louisville East	basement leaking			pipe 2–4 ft down			0.0		0.00					Sellersburg-Jeffersonville Limestones	urban land-Alfic Udarents-Crider complex					no
139	26-Aug-04	-84.552056	38.080861	284			24-Aug-04	Bruce Hatcher & Craig Lee	Qore Prop-erty Sci-ences	Woodford	Lexington West	occurred on devel-opment property						0.0		0.00		0.8			Lexington Limestone	Mercer series			yes	Solution channel that opens up to walking passage.	no
140	30-Aug-04	-84.680556	37.986944	274	GL	map	spring 2003	Missy Woods		Woodford	Keene	Thoroughbred pasture	in the bottom of a large sinkhole	no	no	unknown	wet	4.6	35	3.05			vertical	no	Lexington Limestone	Maury series					no
141	28-Sep-04	-84.555250	38.084222	284	GL	GPS	21-Sep-04	Bruce Hatcher & Jim Currens	Qore Prop-erty Sci-ences & KGS	Fayette	Lexington West	no	not shown on topo	no	no	no	wet	6.1	230	4.57	140	4.6	sloping	yes	Brannon Member	Maury series	no	unknown		Grader sank—no breakthrough; all of this feature as drawn on report has been excavated.	no
142	28-Sep-04	-84.553750	38.085417	285	GL	GPS	17-Sep-04	Bruce Hatcher & Jim Currens	Qore Prop-erty Sci-ences & KGS	Fayette	Lexington West	no	no	no	no	unknown	wet	3.0	300	2.44		7.0	vertical	yes	Lexington Limestone	Mercer series	dripping about 3 ft from bot-tom; "no" listed on report			Records 140 and 141 are on same report.	no

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Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause
143	17-Sep-04	-84.498889	38.044722	293	GL	map	17-Sep-04	Jim Currens	KGS	Fayette	Lexington East	pavement	unknown	unknown	unknown	unknown	wet—Hurricane Ivan	0.0		0.00					Lexington Limestone					Collapse area had been covered with steel roadway plates at time of inspection.	no
144	20-Sep-04	-84.578611	37.851944	268	GL	map	13-Sep-04	Jim Currens & Joe Ray	KGS/DOW	Jessamine	Little Hickman	lawn	yes	no	unknown	unknown	very wet summer	3.7	45	2.44	35	0.2	filled	drain slope—yes	Curdsville Limestone Member or Tyrone Limestone	Huntington series	no	unknown—probably south 220°		5.5 ft in diameter; NRCS said for her to call KGS.	no
145	24-Sep-04	-84.551944	38.080833	284			21-Sep-04	George Crothers	Webb Museum—UK	Fayette	Lexington West			yes				0.0		0.00					Brannon Member	Mercer series					no
146	27-Sep-04	-84.562778	38.091944	277			28-Aug-04	James Rebmann	LFUCG	Fayette	Lexington West	no	no	no	no	no		0.0		0.00				yes	St. Louis Limestone	Mercer series	no		no	Still under excavation for building site.	no
147	7-Oct-04	-84.814167	36.838889	288		GPS		Bart Davidson	KGS	Wayne	Monticello							0.0		0.00					Tanglewood Limestone	Mercer series					no
148	7-Oct-04	-85.724722	36.900000	311		unknown		Bart Davidson	KGS	Russell	Jamestown							0.0		0.00					Tyrone Limestone—High Bridge Group	Newark silt loam				Probably water-filled; couldn't tell.	no
149	29-Jan-05	-86.363333	36.997778	158		unknown	15-Dec-04	James E. Clark Jr.	individual	Warren	Polkville	yes—one wall has fallen and there are numerous holes in the side yard		no	no	yes—after major storms	rainy	0.0		0.00		4.6		no	Lexington Limestone	Baxter—urban land complex	no		no		yes
150	5-Aug-05	-84.477500	37.893889	298		unknown	29-Jul-05	Mary Brinegar	individual	Jessamine	Coletown	yes	yes	no	no	no	some rain to dry	0.0		0.00		1.8		no	Lexington Limestone	Maury series	no		no	Water drains to this area from the neighborhood & revisited 2009.	yes
151	20-Jun-05	-84.615278	37.786111	273		unknown	13-Jun-05	Jim Currens	KGS	Jessamine	Little Hickman	lost goat	no	yes—greater than 50 yr	no	no	wet spring	0.6	45	0.61			vertical	yes	Renault Limestone	McAfee—rock outcrop complex					no
152	3-Aug-04	-84.587222	37.867500	275		unknown	15-Jul-04	Alex Hardy	housing inspector	Jessamine	Little Hickman	yes	yes—damage done 3 yr ago	yes—construction debris & stone fill	possible storm sewer	yes	very wet—wettest June?	0.9		0.91		0.6	filled	no	St. Louis Limestone	Maury series				See record #153.	no
153	22-Feb-05	-84.587222	37.867500	275		unknown	17-Feb-05	Patrick Pinkston	individual	Jessamine	Little Hickman	yes—west half (339) of duplex	yes	unknown	no	yes	very wet	2.4		2.44		1.2	vertical		Calloway Creek Limestone	Maury series				Sinkhole is within the crawlspace and blocked access; see record #152.	yes
154	6-Sep-05	-87.237778	36.833611	184	MSL	map		Paul Inkenbrandt	individual	Todd	Elkton	no	yes	no	no	no	heavy rain (from Hurricane Katrina)	4.9	0	5.18	90			no	Quaternary glacial outwash over Muldraugh Member	Fredonia series	no		no	Husband reported a 30+ ft hole near this sinkhole.	no
155	1-Dec-04	-85.748056	37.580556	230		unknown	1-Nov-04	Sue Kinder	individual	LaRue	Hodgenville	no	no	no	no	no	can't remember	0.9		0.91		1.5		no	Grant Lake Formation	Elk series	no			Are there caves underground on this farm?	no
156	2-Dec-05	-84.332222	37.720556	272		unknown	unknown	Greg & Rhonda Uber	individual	Madison	Richmond South	no—just hole in front yard	no	no	no	no	some rain and freezing weather	1.4		0.91		2.2		yes	Calloway Creek Limestone	Faywood series	no				no
157	16-Dec-05	-85.884870	38.092100	135		unknown		Joe Ray	DOW	Jefferson	Valley Station				yes		wet	0.9		0.61		0.9		no	Tanglewood Limestone over Brannon Member	Weinbach series	no		no	Depression could have been caused by water leak from lines?	yes
158	10-Apr-03	-86.265556	37.347222	180		Google Earth	10-Apr-03	John Blubaugh	City of Oakland	Warren	Bee Spring	no	no	no	no	no	heavy rain	1.5		1.22		1.2	30	no	Drakes Formation	Weikert channery silt loam	no				no
159	3-Sep-03			0		unknown		Larry Simpson		Pulaski								0.0		0.00					St. Louis Limestone						no
160	20-Nov-03	-84.289444	37.759444	#1		GPS	11-Nov-03	Sam Miller	USDA	Madison	Richmond North	lateral lines and lawn		no	septic lateral line	after heavy rain	very wet	1.2	350	0.91	70	1.1	overhanging	no	St. Louis Limestone	Lowell series	no				yes
161	20-Nov-03	-84.324417	37.697222	267		unknown	30-Sep-03	Sam Miller	USDA	Madison	Richmond South	car drove into a hole	no; nearby cover collapse 20 yr ago	no	no; water supply possibly involved	no	wetter than normal	1.1	140	1.07	30	0.6	overhanging	no	Louisville Limestone	Lindside series	no				yes
162	18-Dec-03	-84.695000	38.055833	277		unknown		Rob Blair	DOW-Ground-water Branch	Woodford	Versailles	collapsed under tractor						1.5		1.52		1.2			McAfee series	Maury series					no
163	8-Jun-03	-85.456111	38.050000	207	GL	map	spring 2004	Jim Currens	KGS	Spencer	Taylorville	no	yes	unknown	no	unknown	spring weather	0.9	0	0.61	90	0.2	unknown	no	lower Lexington Limestone	Faywood series	no			On borrow area(?); filled with fieldstone.	no
164	5-Mar-04	-85.687500	36.715000	304		unknown	20-Feb-04	Joe Ray, Sara Sproles	KYTC?	Monroe	Tompkinsville							0.0		0.00					Grier Limestone	Waynesboro series				In existing sinkhole, car lot is on a filled area; probably caused by Division of Highway drainage into sinkhole and runoff from expanding development.	yes
165	24-Apr-04	-84.839167	36.873268	316		unknown	26-May-03	Jim Currens	KGS	Wayne	Monticello	Don Chasteen—broken leg	no	no	no	no	wet	0.9		0.91		0.9		no	St. Louis Limestone	Bewleyville series				See well inspection record.	no
166	24-Jun-04	-85.565556	38.257222	165		unknown	30-May-04	Jim Currens	KGS	Jefferson	Anchorage	deck	yes; filled in adjacent collapse	no	no	no	wet	0.0		0.00		0.3	overhanging	no	Louisville Limestone	urban land—Alic Udarents complex	no	north			no
167	1-Nov-04	-84.610556	38.063056	268		map	fall 2004	Tom Dugan	Blue Grass Consultants	Fayette	Lexington West	no	no	no	no	no	heavy rain—record month and year	0.7		0.64		0.9	89°	no	McAfee series	McAfee very rocky silty clay loam	no				no
168	1-Nov-04	-84.615556	38.059722	271		map	fall 2004	Tom Dugan	BGC	Fayette	Lexington West	no	no	no	no	no	heavy rain—record month and year	0.8		0.91		1.2	88°	no	lower Lexington Limestone	Huntington series	no				no
169	14-Dec-04	-84.610556	38.089444	261		map	1-Nov-04	Tom Dugan	BGC	Woodford	Versailles	no	no	no	no	no	heavy rain—record month and year	2.5		2.47		3.4	85°	no	Grier Limestone	Huntington series	no				no
170	23-Feb-94	-84.449722	38.112500	293		unknown	Feb-94			Fayette	Lexington East							0.0		0.00					Lexington Limestone	Maury series					no

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171	1-Dec-06	-84.660611	37.929972	280	GL	GPS	fall 2006	Jim Currens	KGS	Jessamine	Keene	pasture, wood-chipper trailer	no	no	no	no	very wet fall	1.8	45	1.52	360	8.5	vertical to overhanging	yes	Grier Limestone	Maury silt loam	no	no	no	Discovered when a wood-chipper trailer fell into the collapse; truck passed over it safely.	no	
172	1-Jul-06	-84.714306	38.037167	288	MSL	map	1-Jul-06	Jim Currens	KGS	Woodford	Versailles							0.8	225	1.07	45	0.3			Tanglewood Limestone, Lexington Limestone	Huntington silt loam					no	
173	16-Oct-06	-84.559722	37.976667	302	MSL	map	spring 2006	Jim Currens	KGS	Fayette	Nicholasville		no	no	possibly utility related, but doubtful	unknown	very wet, raining at this time	0.2		0.23		0.3	overarching	no	Brannon Member	Maury silt loam				Possibly utility related, but doubtful, includes detail sketch (epikarst or macropore conduit).	no	
174	12-Oct-06	-85.691583	38.262111	174	MSL	map	18-Sep-06	Jim Currens	KGS	Jefferson	Jeffersonville		no	no	no		very wet	0.9		1.07		1.2	overhanging		Sellersburg-Jeffersonville Limestones	urban land-Alfic Udarents-Crider complex					no	
175	12-Oct-06	-85.731361	38.203389	155	MSL	map	15-Aug-06	Jim Currens	KGS	Jefferson	Louisville East	ornamental landscaping	yes—neighbor reports prior collapse	no	ceramic (terra cotta tile)	no	very wet	3.0		1.83		1.5	vertical to 80°	no	Sellersburg-Jeffersonville Limestones	artificial fill	no	no	no		yes	
176	11-Sep-06	-85.501917	38.295889	243	MSL	map	1-Aug-06	Jim Currens	KGS	Jefferson	Anchorage	no—lawn only	no	no	no		frequent thunderstorms	1.2	295	0.91	225	1.5	overhanging	no	Sellersburg-Jeffersonville Limestones	urban land-Alfic Udarents series					no	
177	1-Sep-06	-86.071333	37.100806	238	MSL	map	15-Jun-06	Jim Currens	KGS	Edmonson	Park City	no	no	no	no		wet	1.5		0.61		1.8	vertical	yes	Big Clifty Member-Girkin Formation	Lily loam	no	no	no		no	
178	11-Sep-06	-85.626389	38.318056	155	GL	map	fall 2003 & summer 2006	Jim Currens	KGS	Jefferson	Jeffersonville	lawn, cracking of cement veneer on interior walls	yes—previously filled with rock	no—but downspouts drain to depression	downspouts drain to depression	yes, briefly	frequent thunderstorms with heavy rain	2.4	310	2.44	270	3.7	former graded surface gently sloping toward northwest	no	Louisville Limestone	Caneyville—rock outcrop	not at the collapse, but run-off was sinking			Fall 2003 & summer 2006; see report #178.	yes	
179	20-Jan-07	-84.765569	37.832619	245	GL	map	fall 2005	David Lutz	KGS	Mercer	Harrodsburg	no—pasture land	no	no	no		unknown	1.2		1.22		1.2	vertical	no	Grier Limestone	McAfee silt—rock outcrop	no	no	no		no	
180	27-Nov-07	-87.407139	36.884472	194		GPS	2004	Jim Currens	KGS	Christian	Kelly	no	yes	no	no		drought	0.0		0.00		0.6	vertical (trimmed back)	no	Bethel Sandstone	Zanesville series	no		no		no	
181	2-Apr-08	-84.448361	38.079472	301		unknown	20-Mar-08	Jim Currens	KGS	Fayette	Lexington East	sod	no	no	no		very wet	1.5	115	0.61	315		overhanging	no	middle Lexington Limestone	Loradale series	no	north	no		no	
182	2-Apr-08	-84.716472	38.072972	281	GL	GPS	13-Feb-08	Jim Currens	KGS	Woodford	Versailles	lawn & trees	no	no	no		wet; adjacent karst valley floods annually	6.1	165	4.57	290	4.6	overhanging	yes	Lexington Limestone	McAfee silt—rock outcrop	no		no		no	
183	15-Apr-08	-84.773500	38.180056	259		unknown	3-Apr-08 or 4-Apr-08	Jim Currens	KGS	Woodford	Frankfort East	driveway pavement	yes—adjacent collapse features predate construction	no	no		100-yr flood	1.2	90	0.91	180	0.6	overhanging	no	upper Lexington Limestone	Maury series					no	
184	11-Jul-07	-85.941044	37.126178	198		Google Earth	4-Jul-07	Jim Currens	KGS	Barren	Horse Cave							4.6		2.44		0.6			St. Louis Limestone	Pembroke series					no	
185	4-Jun-08	-85.596925	38.369850	195		Google Earth		Jim Currens	KGS	Jefferson	Anchorage	no	no	yes	no	no		0.0		0.00					Sellersburg-Jeffersonville Limestones	Crider series				Quarter-acre backyard with 6 to 12 open sinkholes or depressions ranging in size from 1 to 4 ft across and several feet deep. Most depressions formed or expanded in the past year. There are also several spots where the ground is quite spongy, but apparently held in place by tree roots.	no	
186	3-Feb-08	-85.847014	37.205950	195		Google Earth	unknown	Jim Currens	KGS	Hart	Park			no	no	yes	heavy rain	0.6		0.46		1.5	90	no	St. Louis Limestone	Baxter series	no		no	Have been using pasture for hay, so no heavy traffic. Was located at end of cultivated area, near rough.	no	
187	14-Feb-08	-85.688683	38.264344	163		Google Earth	1-Dec-07	Jim Currens	KGS	Jefferson	Jeffersonville	no	yes	no		yes		0.0		0.00					St. Louis Limestone	urban land-Udorthents complex				Problem is only exacerbated by the presence of chipmunks burrowing around the depression.	no	
188	18-Oct-07	-84.526919	38.252411	264		Google Earth		Jim Currens	KGS	Scott	Delaplain							0.0		0.00					Tanglewood Limestone, Lexington Limestone	Huntington series				Near Georgetown Toyota plant.	no	
189	1-May-08	-85.637515	38.191751	158		unknown	30-Apr-08	Jim Currens	KGS	Jefferson	Louisville East						rain	0.0		0.00					Louisville Limestone	urban land-Alfic Udarents-Crider complex					no	
190	3-Jun-08																															
191	3-Jun-08	-86.087000	37.100500	171		unknown	fall 2007	Jim Currens	KGS	Edmonson	Park City	golf course	no	no	no			6.7	30	5.79	100	3.7		no	Ste. Genevieve Limestone	Fredonia-Hagerstown complex	no		no		yes	
192	23-Jul-96	-84.281444	37.990417	293		map	late May, early June 1996	Jim Currens	KGS	Clark	Ford							2.7		2.29		2.7		yes	Tanglewood Limestone	Maury series					no	
193				0				Jim Currens										0.0		0.00										Removed from data set by Jim Currens.		
194	14-Aug-08	-84.566500	38.014167	304		GPS	over the past several years	Jim Currens	KGS	Fayette	Lexington West	no	no	no	no		very dry	0.9		0.91		0.6	80°	no	Tanglewood Limestone	Maury series	no		no		no	
196	19-Nov-08	-85.612323	38.029274	186		unknown	26-Jun-05	Jim Currens	KGS	Bullitt	Mount Washington							2.1		2.13		0.8			Louisville Limestone	Nolin series					no	
197	18-Oct-08	-87.728889	36.723889	171		unknown	relatively old, years	Jim Currens	KGS	Trigg	Roaring Springs							0.0		0.00		4.6			Ste. Genevieve Limestone	Hammack series					no	
198	26-Oct-08	-86.285833	37.497778	228		unknown	1-Oct-08	Jim Currens	KGS	Grayson	Leitchfield	yard and fencing	no	no	no	yes	dry	0.0		0.00					Leitchfield Formation	Zanesville series					no	

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199	21-Nov-08	-85.963350	37.792558	235		Google Earth	unknown	Jim Currens	KGS	Hardin	Vine Grove							0.0		0.00					St. Louis Limestone	Vertrees series				One of the sinkholes located next to the largest one on the property probably happened since the property was purchased about a year ago. Others were pre-existing. Two underground streams start on the property. Possible cave beneath property?	no	
200	19-Mar-09	-87.491667	36.796389	162	66	topo	17-Mar-09	Jim Currens	KGS	Christian	Hopkinsville	road grade	no	no	no	no		1.1		1.07					St. Genevieve Limestone	Crider series					yes	
201	18-Mar-09	-87.494556	36.794611	162	66	topo	10-Mar-09	Jim Currens	KGS	Christian	Hopkinsville	highway construction	no, but nearby collapse	no	no	no, on a slope	occasional rain	1.5		9.15	225	7.5	was overhanging before excavation	no		St. Genevieve Limestone	Vertrees series	no	west	no	Feature was excavated and lined with geotextile when discovered. Second cover collapse 500 ft north was reported, but not observed.	yes
202	summer 2008	-84.297389	37.974028	296		unknown	spring 2007	Jim Currens	KGS	Clark	Ford	no	in a doline	no	no	no	unknown	0.9	360	0.00		1.2	overhanging	no	Brannon Member	Maury series	no	south	no		no	
203	11-May-09	-85.708056	38.224167	161		unknown	several weeks before 11-May-09	Sue Lord		Jefferson	Louisville East							0.5		0.30				Sellersburg-Jeffersonville Limestones	urban land-Udorthents complex				Next to sidewalk, 15 ft in front of house. Filled in a year ago.	no		
204	21-Jan-10	-84.389903	37.932839	240		Google Earth	circa 1997; periodically enlarges	John D. Kiefer	KGS	Fayette	Coletown	farming field	small swallow holes	N/A	N/A	no	heavy rains	7.6		4.57		3.7	vertical to undercut		Tanglewood Limestone, Lexington Limestone	Loradale series					no	
205	22-May-08	-85.645458	38.199667	155		Google Earth	approximately 8-May-08	Jim Currens	KGS	Jefferson	Louisville East							0.0		0.15				Louisville Limestone	urban land-Alfics Udarents-Lawrence complex				Cannot look down hole, but first noticed 2 weeks ago.	no		
206	31-Jul-09	-85.628444	37.986778	171	GL	topo	10-Jul-09	Jim Dinger & Junfeng Zhu	KGS	Bullitt	Shepherdsville	no	no	no	no	no	rain	0.8	90	0.46	180	0.8	overhanging	yes	Sellersburg-Jeffersonville Limestones	Caneyville series					no	
207	31-May-09	-85.644750	38.199444	155		Google Earth		Jim Currens	KGS	Jefferson	Louisville East							0.0		0.00				Ashlock Limestone Formation	urban land-Alfics Udarents-Lawrence complex					no		
208	7-Aug-09	-84.354500	37.787167	277		Google Earth	last 2 yr	Jim Currens	KGS	Madison	Richmond North	no	history extends	no	no	no	very wet	0.0		0.00					Bull Fork Formation	Faywood series					no	
209	3-Aug-09	-84.665642	39.003506	265		Google Earth	18 mo ago (Feb-08)	Jim Currens	KGS	Boone	Burlington	no	no	no	no	no		1.2		0.91		2.4			St. Genevieve Limestone	Rossmoyne series					no	
210	24-Sep-09	-87.515528	36.793444	164		Google Earth	21-Sep-09	Jim Currens	KGS	Christian	Church Hill	lawn only	no	no	no	yes	very rainy	1.2		1.22		6.1	overhanging	yes	Drakes Formation	Pembroke series	yes	toward Louisville Road	no		no	
211	28-Aug-09	-84.223889	37.640000	252		Google Earth	6-Jun-09 & 7-Jun-09	Jim Currens	KGS	Boyle	Moberly	cracked brick on garage						0.6		0.61		2.4			Sellersburg-Jeffersonville Limestones	Lawrence series				Filled with rock and brick, but continued to slump.	yes	
212	30-Jul-09	-85.639511	38.198253	157		Google Earth	unknown	Jim Currens	KGS	Jefferson	Louisville East							0.0		0.00				St. Genevieve Limestone	urban land-Alfics Udarents-Lawrence complex					no		
213	21-Sep-09	-85.909744	37.598444	227		Google Earth	19-Sep-09	owner		Hardin	Sonora	no	no	no	no	yes	heavy rain	0.5		0.46		1.2		no	Tanglewood Limestone	Cumberland series					no	
214	13-Oct-09	-84.475992	37.892169	297		Google Earth	31-Sep-09	Jim Currens	KGS	Jessamine	Coletown	no	no—in larger karst valley	no	no	yes	very wet	0.6	170	0.91	290	1.2		no	Tanglewood Limestone	Faywood series	no		no		no	
215	14-Oct-09	-84.895139	38.022417	244		topo	9-Oct-09	Jim Currens	KGS	Anderson	Lawrenceburg	lawn	no	no	yes, domestic sanitary connect	no	very wet	0.8		1.22	250	1.4	overhanging	no	Salem-Warsaw Limestones	Nicholson series	yes	south	no		yes	
216	14-Oct-09	-84.898917	38.007389	239	GL	ArcGIS	29-Sep-09	Jim Currens	KGS	Anderson	Alton Station	lawn	possible	yes, stump, construction debris, and barbed wire	no	some standing water	1.5 in. of rain	2.4	130	3.35	40	9.1	overhanging	no	Salem-Warsaw Limestones	Faywood series	no		no		yes	
217	14-Oct-09	-85.897750	37.007444	231		Google Earth	1-Jul-98	Jim Currens	KGS	Barren	Glasgow North	under corner of house				yes	flooding	1.2		1.22		7.6	vertical	no	Salem-Warsaw Limestones	Baxter cherty silty clay loam	no		no		no	
218	6-Nov-09	-85.93832778	37.83046111	234		Google Earth	years ago	Jim Currens	KGS	Hardin	Vine Grove	none		dumped in yard debris				3.0		3.05		3.0			St. Louis Limestone	Crider series					yes	
219	2002	-85.90733056	37.68287222	230		Google Earth	unknown	Jim Currens	KGS	Scott	Cecilia	truck fell into cover collapse						0.0		0.00					St. Genevieve Limestone	Sonora series					no	
220	2002	-84.73528611	38.23573056	246		Google Earth	unknown	Jim Currens	KGS	Franklin	Midway	truck caused the drop out						0.0		0.00					upper Lexington Limestone	Lowell series					no	
221	12-Jan-09	-84.1773	37.504932	428		GPS	31-Jan-06	Dan Carey	KGS	Jackson	Bighill			construction debris				3.0		3.05				yes	Slade Formation	Shelocta series					yes	
222	13-Oct-09	-84.475825	37.8922	296		Google Earth	spring 2008	Jim Currens	KGS	Jessamine	Coletown							0.0		0.00					lower Lexington Limestone	Faywood series					no	
223	13-Oct-09	-84.57057222	38.56968333	294		GPS	31-Sep-09	Jim Currens	KGS	Fayette	Mason	major lawn damage						0.0		0.00					Clays Ferry Formation	Eden series					no	
224	6-Feb-03	-84.63215278	39.00186111	285		Google Earth		Jim Currens	KGS	Boone	Burlington							0.0		0.00					Bull Fork Formation	Rossmoyne series					no	
225	10-Dec-09	-83.54211111	38.04430556	247	GL	topo	fall 2009 (Oct-Dec.)	Jim Currens	KGS	Menifee	Salt Lick	no	no	no	no	no	very wet	0.3	90	0.30	360		no	alluvium over Cowbell Member	Renox gravelly fine sandy loam	no	southwest			yes		
226	2-May-77	-86.161075	37.15368056	183		Google Earth	29-Apr-77	James Quinlan	NPS	Edmonson	Rhoda	highway damage	no					3.0		3.05			overhanging		Girkin Formation	Wallen-Bledsoe-Donahue complex					no	
227	31-May-07	-86.12388889	37.88611111	204		Google Earth	1-May-05	Joe Ray	DOW	Meade	Rock Haven	farming field	no	no	no	no	not cited	0.0		0.00					St. Louis Limestone	Hammack-Baxter complex					no	

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228	6-Sep-05	-87.2391	36.83445	183		Google Earth		Jim Currens	KGS	Todd	Elkton	yard	yes	no	no	no	not cited	14.6		3.96		9.1		no	Renault Limestone	Fredonia series	yes, overland flow drains into sinkhole			no		
229	13-May-07	-87.49758611	36.82791944	165		Google Earth		Jim Currens	KGS	Christian	Hopkinsville	driveway pavement						0.0		0.00					Ste. Genevieve Limestone	Fredonia series					no	
230	12-Jul-07	-85.90630556	37.11820833	207		Google Earth		Jim Currens	KGS	Barren	Glasgow North							0.0		0.00					St. Louis Limestone	Pembroke series	yes				no	
231	16-Jul-07	-86.24885	37.03272222	179		Google Earth		Michael May	WKU	Warren	Smiths Grove	road						0.4		0.36					St. Louis Limestone	Hammack series			14-in. hole developed in pavement.	no		
232	8-Apr-04	-87.40582	36.80892	209		Google Earth	2 weeks before 8-Apr-04	Bart Davidson & Glynn Beck	KGS	Christian	Hopkinsville							1.8	105	1.62		1.5			Renault Limestone	Vertrees series					no	
233	8-Apr-04	-87.4078	36.81183	193		Google Earth	9 months before 8-Apr-04	Bart Davidson & Glynn Beck	KGS	Christian	Hopkinsville							2.7	130	2.44		1.5			Renault Limestone	Crider series					no	
234	4-Feb-10	-84.99722222	36.74388889	274		Google Earth	Jan-10	Jim Currens	KGS	Wayne	Powersburg	area near driveway	no				wet to below freezing	1.2	45	1.22	360		overhanging	no	Salem-Warsaw Limestones	Frederick series					Collapse was on private property, 20 ft off right-of-way. Couldn't see the bottom. Diameter and date estimated.	no
235	4-Apr-10	-85.01336111	36.74122222	295		GPS	1-Feb-10	Jim Currens	KGS	Clinton	Savage							0.9	300	0.67	200	2.4			St. Louis Limestone	Allen series					Opened middle of February. Inside a much larger sinkhole.	no
236	28-Mar-10	-87.88591389	37.11122222	146		Google Earth	21-Mar-10	Jim Currens	KGS	Caldwell	Princeton West	parking lot behind old E.W. James grocery store	no	no	yes	no		0.0		0.15		1.8	vertical		Ste. Genevieve Limestone	Crider-urban land complex					Possibly initiated by a heavy truck working on a building nearby.	yes
237	17-Mar-10	-86.05714917	37.88373222	201		Google Earth	unknown	Phillip O'dell		Meade	Rock Haven	field						3.0		6.10		7.6			St. Louis Limestone	Baxter very gravelly silty clay loam					no	
238	3-May-10	-85.57067778	38.29693889	205		Google Earth	15-Mar-10	Jim Currens	KGS	Jefferson	Anchorage							1.1		1.07		0.9			Louisville Limestone	urban land-Allic Udarents complex					yes	
239	17-May-10	-84.59702778	37.97502778	299		topo	16-May-10 & 17-May-10	Jim Currens	KGS	Jessamine	Nicholasville	sidewalk and lawn	no	no	no	no	2 in. rain in approximately 24 hr	3.7	290	3.05	200	1.5	overhanging	no	Grier Limestone	Maury series	no		no		Collapse occurred overnight.	no
240	18-May-10	-84.78722222	36.94286111	232		topo	2-May-10	Jim Currens	KGS	Wayne	Mill Springs	loss of garden area	no	no	no	no	2 in. rain in approximately 24 hr	0.9	90	0.91	360	7.6	overhanging	possibly	Quaternary alluvium (lower terrace) over St. Louis Limestone	Waynesboro series	no	south	possibly		Collapse discovered while mowing.	no
241	3-Jun-10	-84.25827778	36.76337778	279		Google Earth	6-Feb-10	Jim Currens	KGS	Whitley	Cumberland Falls	road collapse						0.0		0.00					Grundy Formation	Captl series					1.5 mi west of Ky. 204.	no
242	3-Jun-10	-87.47563333	37.28227222	140		Google Earth	19-Mar-10	Jim Currens	KGS	Hopkins	Madisonville East	road damage						0.0		0.00					Shelburn, Madisonville, and Providence Limestones, Sturgis Formation	strip mine (Bethesda, Fairpoint series)					no	
243	24-Mar-10	-84.6025	36.99166667	266		topo	17-Mar-10	Bill Walden		Pulaski	Burnside	blacktop pavement has hole					heavy rain	1.2		1.22					Ste. Genevieve Limestone	Frederick series					no	
244	21-Jul-10	-85.51144444	38.034528	296		Google Earth	20-Jul-10	Jim Currens	KGS	Fayette	Lexington West	detention basin	unknown		possible storm sewer	yes, artificial	very rainy	0.8	45	0.61	300	3.0		no	Brannon Member, Lexington Limestone							yes
245	1-Feb-84	-86.470556	36.981667	152		TopoZone	1-Feb-84	George Veni	WKU	Warren	Bowling Green South	none cited	no	no	no	no		4.3		# !		0.3		no	Ste. Genevieve Limestone	urban land-Udorhents complex	yes		no		no	
246	8-Jun-10	-85.88476389	37.45984167	229		Google Earth	1-May-10	Jim Currens	KGS	LaRue	Upton							7.6		7.62		5.5			Ste. Genevieve Limestone	Hagerstown series					no	
247	28-Jul-10	-84.61388889	37.8675	271	GL	GPS	1-Jul-10	Jim Currens	KGS	Jessamine	Little Hickman	alfalfa field—minor loss	yes—verbal report by owner	plastic sheet, PVC waterline, & feedbags	no	unknown	wet	1.4	60	1.37	150	3.0	slightly overhanging	yes	Curdsville Limestone Member	McAfee series	no		yes		yes	
248	1-Nov-10	-87.73998333	36.84454722	152		Google Earth	unknown	Jim Currens	KGS	Trigg	Caledonia	no	no	no	no	yes	unknown	0.0		0.00					Ste. Genevieve Limestone	Hammack-Baxter complex					no	
249	24-Nov-10	-86.18210278	37.79117778	205		Google Earth	unknown	Jim Currens	KGS	Breckinridge	Big Spring	no	no	yes	no	no	dry	0.0		9.15				yes	Ste. Genevieve Limestone	Crider silt loam	no		yes		Purchased the property Nov-09. Sinkhole was present when purchased. Flooded once last year.	no
251	14-Nov-10	-86.48653056	36.97389722	152		Google Earth	12-Nov-10	Jim Currens	KGS	Warren	Bowling Green South	sidewalk collapse	no	no	drainage pipe	no	dry	0.0		1.22		1.2		no	Ste. Genevieve Limestone	Fredonia-Vertrees-urban land complex	no		no		Report of sinkhole at neighbor's house (215 Brookshore) during initial construction. Reports at Karst and Cave Department at WKU.	yes
252	20-Mar-11	-86.13236111	37.01069444	195		topo	28-Feb-11	Jim Currens	KGS	Barren	Smiths Grove	driveway & lateral line	no	no	sanitary sewer lateral line	no	heavy rain	3.4	260	2.13	170	0.9	overhanging	no	St. Louis Limestone	Baxter very rocky silt loam	no				yes	
253	24-Mar-11	-85.92094444	37.81927778	220		Google Earth	1-Dec-10	Jim Currens	KGS	Hardin	Vine Grove	no	yes		no	no	very wet	5.2	30	3.35	120	0.9		no	St. Louis Limestone	Newark silt loam	no				yes	
254	3-Mar-11	-85.35375	38.42283333					owner		Oldham	Smithfield	no	no	no	no	yes	heavy rain	0.0		0.00		0.9			Laurel Dolomite	Beasley silt loam	no				In basic center of gentle bowl-shaped area about 30 yd in diameter.	no
255	2-Mar-11	-85.65833333	37.9444	264		Google Earth	1-Feb-11	Jim Currens	KGS	Bullitt	Shepherdsville	no	no	no	no	no	heavy rain a week or so before	0.0		0.00				no	Beechwood-Sellersberg Limestones	Sensabaugh gravelly loam	no				no	
257	16-May-11	-86.49997222	36.97811111	152		Google Earth	May-10 (first), 15-Apr-11 (latest)	Jim Currens	KGS	Warren	Bowling Green South	lawn	not prior to May-10	one sheet of plywood	no	no	heavy rain	1.5	120	1.22	20	1.8	overhanging	no	Ste. Genevieve Limestone	Fredonia-Vertrees series	no		no		Owner filled in with broken rock and concrete.	yes
258	29-Oct-10	-86.24941944	37.03825556	179		Google Earth		Jim Currens	KGS	Warren	Smiths Grove							0.0		0.00					St. Louis Limestone	Baxter urban land complex					no	

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259	20-Apr-11	-88.33789722	36.99673333	127		Google Earth		Jim Currens	KGS	Marshall	Briensburg	lawn						0.0		0.00					loess/continental deposits	Saffell-Guin complex					no	
260	17-Aug-11	-84.33208333	37.91658333	268	GL	topo	17-Aug-11	Jim Currens	KGS	Fayette	Ford	lawn	no	old board	septic junction box	no	very wet	0.5	115	# 1	300	3.0	overhanging	yes	Grier Limestone	Ashwood series	yes, trickle	northwest	no		yes	
261	25-Jun-11	-86.18782222	37.94816111	194		Google Earth	19-Jun-11	Jim Currens	KGS	Meade	Guston	no	no	no	no	no	heavy rain	0.0		0.00		3.0		no	St. Louis Limestone	Baxter series	no		yes	Possible cave opening.	no	
262	25-Jun-11	-86.08741111	37.89453889	223		Google Earth	2-Jul-05	Jim Currens	KGS	Meade	Rock Haven	no	no	no	no	yes	heavy rain	0.0		0.00				yes	St. Louis Limestone	Hammack-Baxter complex	yes	southeast	maybe	Pond unexpectedly drained, then sinkhole appeared several months later.	yes	
263	12-Jul-11	-85.54081389	37.21002222	248		Google Earth	5-Jul-11	Jim Currens	KGS	Green	Exie	no	yes	no	no	no	heavy rain	3.0		3.05				no	St. Louis Limestone	Mountview silt loam	no		no	Smaller sinkhole noted last year during haying season. Larger sinkhole noted this month during haying offseason.	no	
266	17-Sep-11	-85.42269167	38.21131111	224		Google Earth	17-Sep-11	Jim Currens	KGS	Jefferson	Fisherville	steel beams required to keep basement wall from cracking	yes, neighborhood has many sinkholes	no	no	no	yes, neighbor's pond drains at times	unknown	1.4		1.37				no	Drakes Formation	Beasley silt loam	no		no	Sinkhole is increasing in size.	no
267	25-Oct-11	-84.34083333	38.01888889	316	GL	map	Feb-11	Jim Currens	KGS	Fayette	Clintonville	lawn	yes, owner's parents filled in sinkhole	construction debris	no	no	very wet	0.0		0.00		1.5	vertical	no	Tanglewood Limestone	Lowell series	no		no	Modified by owner: previously filled.	yes	
268	21-Mar-12	-85.77322222	37.24975	218	GL	map	11-Mar-12	Jim Currens	KGS	Hart	Park	waterline and ground	no	no	septic lateral line	no	wet weather	1.5	350	1.22	80	3.0	overhanging	no	Ste. Genevieve Limestone	Baxter gravelly silt loam	trickle		no	Family dog nearly fell into the sink while present.	yes	
269	18-Jan-12	-84.575	37.91666667	318		Google Earth	9-Dec-11	Tom Griswold		Jessamine	Nicholasville	none	no	no	no	no	heavy rain during the previous week	1.8		1.83				no	Brannon Member, Lexington Limestone	Bluegrass-Maury silt loam	no		no	Typical collapse for the area. Depth to bedrock typically ranges from 4 to 10 ft in the area. Located near the headwaters of Jessamine Creek. The property owner backfilled the collapse using approximately 64 yd ³ of material.	yes	
270	30-Sep-12	-84.54441944	38.09063889	279		Google Earth	7-May-11	Dave Peterson		Fayette	Lexington West	unknown	unknown	unknown	unknown	unknown	unknown	0.0		0.00					Tanglewood Limestone, Lexington Limestone	Bluegrass-Maury silt loam				Located on neighbor's property, which has been abandoned or is in the process of being sold.	no	
271	17-Mar-12	-84.61714722	37.06865833	288		Google Earth	1-Mar-12	Bill Mardis	Commonwealth Journal	Pulaski	Somerset	yard	yes	no	no	unknown	unknown	2.4		0.00		1.8			St. Louis Limestone	Cumberland silt loam	no		no	Located near Jehovah's Witness Kingdom Hall.	yes	
272	1-Sep-11	-85.67072222	38.22423333	165		Google Earth	1-Aug-11	Jim Currens	KGS	Jefferson	Louisville East							0.0		0.00					Sellersburg-Jeffersonville Limestones	urban land-Alfic Udarents-Crider complex					no	
273	12-Mar-12	-84.416525	37.97891111	313		Google Earth	1-Jan-12	Jim Currens	KGS	Fayette	Coletown	no	no	no	no	no		2.4		2.44					upper Lexington Limestone	Bluegrass-Maury silt loam	no		no	Filled with small size rock. Dropped 2 ft in a week or two after.	no	
274	7-May-12	-84.48595	38.01295278	317		Google Earth	1-May-11	Jim Currens	KGS	Fayette	Lexington East	lawn	no	no	no	no	dry with scattered thunderstorms	0.6		0.61		0.3	overhanging	no	upper Lexington Limestone	Bluegrass-Maury silt loam	no		no	Plumber's probe went down to a depth of 3 ft in one place.	no	
275	10-Jul-12	-84.38445	37.99374722	310		Google Earth	Jul-12	Jim Currens	KGS	Fayette	Coletown	outbound lane of Todds Road	no	no	no	unknown	drought with intermittent rain	0.9		0.91					no	upper Lexington Limestone	Lowell silt loam	no		no		no
276	12-Mar-12	-85.18121389	38.15118333	238		Google Earth	1-Mar-12	Jim Currens	KGS	Shelby	Shelbyville					unknown		0.8		0.76					Calloway Creek Limestone	Nicholson silt loam			no	Sink located on only good building site on property.	no	
277	5-Feb-12	-85.78155	37.25138056	202		Google Earth	unknown	Jim Currens	KGS	Hart	Canmer							0.9		0.91					St. Louis Limestone	Baxter gravelly silt loam			no		no	
278	4-Oct-11	-86.02740556	37.87711944	208		Google Earth	unknown	Jim Currens	KGS	Meade	Rock Haven							9.1		9.15					St. Louis Limestone	Hammack-Baxter complex					no	
279	11-Jul-12	-85.96488889	37.16515833	186		Google Earth	1-Mar-12	Jim Currens	KGS	Hart	Horse Cave							3.0		3.05					Ste. Genevieve Limestone	Fredonia-Hagerstown-Vertrees silt loam				0.2 mi south of mile marker 55, located on east side of northbound lane. Location based on description and is approximate.	no	
280	16-Aug-12	-84.61616667	37.75475	274		GPS	12-Jul-12	Jim Currens	KGS	Garrard	Little Hickman	lawn; feature is 75 ft from house	no	no	no	no	drought, recent rain	0.4	0	0.37	90	7.6	vertical	yes	lower Lexington Limestone	Faywood-Fairmount complex	no		no		no	
281	21-Sep-12	-84.72597222	38.04436111	276		topo	7-Sep-12	Jim Currens	KGS	Woodford	Versailles	tree fell in	no	no	no	no	rain following drought	1.8	150	0.91	240	1.8	overhanging	flow	Tanglewood Limestone	Bluegrass-Maury silt loam	yes	south	possible	Owner heard water running.	no	
282	30-Sep-12	-84.60994444	37.90305556	287	GL	GPS	29-Sep-12	Jim Currens	KGS	Jessamine	Nicholasville	lawn	possibly	no	no	no	rain	0.2	150	0.23	60	0.6			lower Lexington Limestone	Nicholson silt loam	no				no	
283	25-Apr-13	-84.2	37.96666667	291	GL	GPS	2-Oct-12	Jim Currens	KGS	Scott	Cecilia	none	maybe	yes	no	no	dry	1.0	225	0.53	45	1.0	overhanging	no	Tanglewood Limestone	Salvisa silty clay loam	yes	southwest			no	
284	23-Jul-13	-85.68930556	38.09947222	155		Google Earth		Jim Currens	KGS	Jefferson	Brooks	none	no	no	no	no		0.0		0.00					Louisville Limestone	urban land-Alfic Udarents complex					no	
285	3-Mar-12	-85.60555556	38.02583333	0				Jim Currens	KGS	Bullitt		none	yes	no	no			0.0		0.00					Louisville Limestone					Will not provide location. The address provided here is from reverse telephone look-up.	yes	
286	20-Feb-12	-84.61816111	37.12215556	314		Google Earth		Jim Currens	KGS	Pulaski	Somerset	none	yes	no	no			0.0		0.00					Salem-Warsaw Limestones and St. Louis Limestone	Frederick silt loam				Coordinates are for street address.	yes	
287	13-May-13	-84.03396389	37.86546944	220		Google Earth		Jim Currens	KGS	Scott	Palmer	none	no	no	no	no	rainy	1.2		1.22					Crab Orchard Formation and Brassfield Dolomite	Frederick silt loam				Coordinates are for street address.	no	

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Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause	
288	5-Sep-13	-85.34379444	37.347575	257		Google Earth		Phil Pendleton	WKYT	Taylor	Campbellsville							0.0		0.00		1.8			Salem-Warsaw Limestones	Mountview silt loam			Coordinates are for street address.	no		
289	28-Mar-13	-86.03398333	37.86719444	195	GL	topo	27-Feb-13	Jim Currens	KGS	Meade	Flaherty	none	no	no	no	unknown	wet	2.7	140	2.29	240	0.9	overhanging	no	St. Louis Limestone	Baxter very gravelly silty clay loam	no		no		no	
290	18-Mar-13	-85.89092778	37.44916111	234		Google Earth	18-Mar-13	Jim Currens	KGS	LaRue	Upton	none	no	no	no	no	heavy rain	3.0		3.05		9.1		no	Ste. Genevieve Limestone	Hagerstown silt loam	no		no	Coordinates are for street address.	no	
291	4-Sept-13	-85.63573333	38.2439	160		Google Earth		Jim Currens	KGS	Jefferson	Louisville East	none	yes	no	no	no		0.0		0.00				no	Sellersburg-Jeffersonville Limestones	urban land-Udorthents complex	no		no	Coordinates are for street address. Soil type is for backyard.	yes	
292	16-May-13	-87.872067	36.752636	132		Google Earth	8-May-13	Glynn Beck	KGS	Trigg	Cadiz	none	no	no	no	no	heavy rain	1.2	225	1.22	135	1.1	vertical	no	St. Louis Limestone	Clifty gravelly silt loam	no		no	Hole caved in when a Bobcat tractor was driving over it.	no	
293	22-Mar-13	-85.51667222	38.23892222	217		Google Earth	1-Mar-13	Jim Currens	KGS	Jefferson	Jeffersontown							1.2		1.22					Laurel Dolomite	urban land-Alic Udarents complex			Coordinates originally provided were in Illinois. Coordinates on this spreadsheet are from the street address.	no		
294	13-May-13	-85.81193056	38.19796667	139		Google Earth		Jim Currens	KGS	Jefferson	Louisville West	yes	no	no	no	no		0.0		0.00					Quaternary	urban land-Alic Udarents complex			Coordinates are for street address.	no		
295	13-May-13	-85.42222222	38.33694444	210		GPS		Jim Currens	KGS	Oldham	Crestwood	no	no	no	no	no		0.0		0.00		1.8		no	Drakes Formation	Beasley silt loam	no		no		no	
296	28-Jun-13	-85.61843611	38.206075	174		Google Earth		Jim Currens	KGS	Jefferson	Jeffersontown	no	no	no	no	yes	normal spring weather; some rain	0.0		0.00						Sellersburg-Jeffersonville Limestones	urban land-Alic Udarents-Crider complex	yes			Coordinates are for street address.	no
297	13-Jul-13	-87.93184444	37.11391111	163		Google Earth		Jim Currens	KGS	Caldwell	Princeton West	collapse under I-69; road damage						1.5		1.52					Ste. Genevieve Limestone and upper member of St. Louis Limestone	Udarents, loamy				Coordinates are from mile marker 77.5.	no	
298	13-May-13	-85.652725	38.30396944	169		Google Earth	2 yr prior	Jim Currens	KGS	Jefferson	Jeffersonville	no	yes	no	no	no		0.0		0.00					Sellersburg-Jeffersonville Limestones	urban land-Alic Udarents-Crider complex				Coordinates are for street address. Sinkhole is in backyard.	no	
299	23-Dec-12	-84.53056667	38.00592778	315		Google Earth	unknown	Jim Currens	KGS	Fayette	Lexington West	no	yes	no	no	no		0.0		0.00					Tanglewood Limestone Member (3)	Bluegrass-Maury silt loam				Coordinates are for street address.	no	
300	1-Aug-13	-85.54888889	38.32222222	210	GL	topo	15-Aug-12	Jim Currens	KGS	Jefferson	Jeffersontown	no	yes	no	no	no	heavy rain	3.7		3.05		0.8		no	Louisville Limestone	Beasley silt loam	no		no	Coordinates from aerial photograph for that street address.	no	
301	1-Aug-13	-85.69215833	38.03781944	149		Google Earth	15-Jul-13	Jim Currens	KGS	Bullitt	Brooks	no	no	no	no	no		0.2		0.15		0.6			Louisville Limestone	Caneyville-rock outcrop complex				Coordinates are for street address.	no	
302	1-Aug-13	-84.54845556	38.05478333	272		Google Earth	16-Jul-13	Jim Currens	KGS	Fayette	Lexington West							0.0		0.00					lower Lexington Limestone	Bluegrass-Maury silt loam				Coordinates are for street address.	no	
303	11-Mar-13	-85.59165833	38.31173056	193		Google Earth	unknown	Jim Currens	KGS	Jefferson	Anchorage	no	no	no	no	yes	wet	1.8		0.91					Sellersburg-Jeffersonville Limestones	urban land-Alic Udarents complex				Coordinates are for street address.	no	
304	22-May-13	-85.50361111	38.32538889	220		GPS	2010-2011	Jim Currens	KGS	Oldham	Anchorage	none	no	no	no	no	unknown	0.6	90	0.61	360	1.5		no	Laurel Dolomite	Crider silt loam	no			Collapse filled multiple times.	no	
305	6-Jan-14	-87.89952222	37.09396111	152		Google Earth	unknown	Jim Currens	KGS	Caldwell	Princeton West	no	yes	no	no	no	rain	0.0		0.00					Ste. Genevieve Limestone and St. Louis Limestone	Crider silt loam				Coordinates are for street address.	no	
306	9-Dec-13	-85.65637778	38.11775	180		Google Earth	unknown	Jim Currens	KGS	Jefferson	Brooks	no	no					0.6		0.61					Louisville Limestone	Bedford silt loam					no	
307	8-Mar-13	-84.26666667	37.64194444	302	GL	GPS	2-Mar-13	Jim Currens	KGS	Madison	Richmond South	lawn	no	no	no	no	wet spring	0.8	110	0.46	210	1.2	overhang	no	Drakes Formation	Otway silt loam	no		no		no	
308	16-Oct-12	-84.54305556	38.055	288	GS	topo	12-Oct-12	Jim Currens	KGS	Fayette	Lexington West	curb, pavement	no	no	yes	unknown	rain	0.0		0.00		3.4	overhang	yes	Tanglewood Limestone	Bluegrass-Maury silt loam	no				no	
309	30-Nov-12	-84.81223056	38.11849722	248		topo	15-Jul-12	Jim Currens	KGS	Woodford	Tyrone	lawn	yes	no	no	yes	dry	0.9	270	0.69	360	0.6	overhang	no	Tanglewood Limestone	Bluegrass-Maury silt loam	no				no	
310	9-Nov-12	-84.55055556	38.02333333	300	GL	topo	15-Sep-12	Jim Currens	KGS	Fayette	Lexington West	possible	no	no	no	no	wet	0.6		0.61				no	Tanglewood Limestone	Bluegrass-Maury silt loam	no		no		no	
311	12-Feb-14	-84.83080556	38.01416667	209		Google Earth	unknown	Jim Currens	KGS	Jefferson	Tyrone	unknown	lawn, house	no	no	yes	wet	3.7	45	2.44	315	0.6	70°	no	lower Lexington Limestone	McAfee silt loam	no		no		no	
312	23-Jun-15	-84.76286111	37.66238889	287	GL	topo	15-Sep-14	Jim Currens	KGS	Boyle	Danville	undermining pad at door—threatens	possible	construction debris	no	no	unknown	2.1	135	1.83	80	3.4	vertical to overhanging	no	lower Lexington Limestone	Bluegrass-Maury silt loam	no		no		yes	
313	21-Jul-15	-84.75333333	38.18777778	245	GL	GPS	14-Jul-15	Jim Currens	KGS	Franklin	Frankfort East	pasture	no	no	no	no	very wet	3.0	80	3.05	340	4.3	overhanging	yes	lower Lexington Limestone	Lowell silt loam	no	east	no		no	
314	20-Jul-15	-84.8445278	36.83376667	287		Google Earth	16-Jul-15	Jim Currens	KGS	Wayne	Monticello	damage to Ky. 90X					very wet	0.0		0.00					St. Louis Limestone	Decatur silt				Happened in Monticello on Ky. 90X at mile marker 1.67.	no	
315	21-Jul-15	-84.74495278	38.24170278	239		Google Earth		Jim Currens	KGS	Franklin	Midway						very wet	0.0		0.00		4.6			Tanglewood Limestone	Faywood silt			no		no	
316	24-Jul-15	-84.479225	37.93890833	277		Google Earth	23-Jul-15	Jim Currens	KGS	Jessamine	Coletown	damage to Tates Creek Road					very wet	0.0		0.00						Quaternary	Huntington silt loam					no
317	24-Jul-15	-84.48591667	38.09733056	285		Google Earth	23-Jul-15	Jim Currens	KGS	Fayette	Lexington East	damage to Newtown Pike					very wet	0.0		0.00						Tanglewood Limestone	Bluegrass-Maury silt loam					no
318	21-Jul-15	-84.65424722	37.73573889	286		Google Earth	22-Jul-15	Jim Currens	KGS	Garrard	Bryantsville	loss of the family's pond	no			yes	very wet	0.0		0.00						lower Lexington Limestone	Bluegrass-Maury silt loam					yes
319	7-Jul-15	-84.34722222	38.27777778	299		KGS online map	1-Aug-13	Jim Currens	KGS	Scott	Centerville	damage to lawn	no	no	no	no	very wet	1.8	0	1.07	189	0.8	vertical to overhanging	no	Drakes Formation	Lowell silt loam	no	unknown	no		no	
320	20-May-14	-85.68388889	38.20833333	152	GL	KGS online map	1-Feb-14	Patti Evans	owner	Jefferson	Louisville East	lawn	yes	no	no	yes	very wet	0.0		0.00						Sellersburg-Jeffersonville Limestones	Crider complex	no		no		no

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Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause	
321	13-Dec-14	-87.59388889	36.86388889	152	GL	KGS online map	2-Jul-14	Tamara Williams	owner	Christian	Church Hill	pasture	yes	no	no	unknown	very wet	0.0		0.00					Ste. Genevieve Limestone	Pembroke silt loam	no		no		no	
322	12-Jan-14	-85.643333	38.304722	174	GL	KGS online map	20-Dec-13	Jim Currens	KGS	Jefferson	Jeffersonville	lawn	no	no	no	no	very wet	0.9		0.91		1.2	vertical to overhanging	no	Sellersburg-Jeffersonville Limestones	Crider complex	yes	south	no		no	
323	6-Mar-14	-84.356008	38.355080	341	GL	KGS online map	1-Feb-14	Buzz Carlotis, Jim Currens	KGS	Rockcastle	Mount Vernon	lawn, very near a secondary building	no	no	no	no	very wet	0.8	300	0.61	90	3.7	overhanging	no	Ste. Genevieve Limestone	Faywood silty clay loam	sewage	north	possibly		no	
324	18-Feb-14	-85.630000	38.303333	175	GL	KGS online map	18-Jan-14	Ralph Boone	owner	Jefferson	Jeffersonville	lawn; the house is threatened	yes	no	no	no	very wet	1.8		1.52				no	Sellersburg-Jeffersonville Limestones	Crider complex	no		no	Reconstructed from an email.	no	
325	24-Feb-14	-86.375278	37.087500	177	GL	KGS online map	12-Feb-14	Jim Currens	KGS	Warren	Bowling Green South	museum gallery and six Corvettes; cost \$3 million, not including the cars	no	no	no	no	although the weather had been wet, the terra rosa and other unconsolidated material was all very dry	12.2	300	10.98	90	8.2	vertical to overhanging	yes	St. Louis Limestone	Ramsay-Frondorf complex	no		yes		The collapse involved bedrock too. The drainage around the building was so efficient that the terra rosa was dried out until it lost the cohesiveness to support itself. This was a preserved segment of trunk passage that the sky dome was serendipitously built directly over.	yes
326	19-Mar-14	-84.673056	37.845556	285	GL	map	9-Mar-14	Jim Currens & Pattie Witt	KGS	Jessamine	Wilmore	garden plot	no	no	no	no	cold and wet	1.2		0.76		5.2	vertical to overhanging	yes	Curdsville Limestone Member	Lowell silt loam	no		yes	Collapse occurred while owner was tilling his garden. The small tractor fell in.	no	
327	11-Feb-14	-85.850596	37.249444	210	GL	KGS online map	4-Feb-14	Mike Cundiff	owner	Hart	Canmer	near garage (less than 30 ft)	no	no	no	no	unknown	2.4		2.13				yes	Ste. Genevieve Limestone	Crider silt loam	can hear flowing water		no	Collapse occurred when neighbor was using heavy equipment to remove a tree trunk.	no	
328	19-Mar-14	-84.329250	37.375833	341	GL	map	1-Feb-13	Buzz Carlotis	mayor	Rockcastle	Mount Vernon	lawn	yes	no	no	unknown	2.4	220	1.83	40		vertical	no	Renfro Member	Caneyville-Shelock rocky silt	no	northeast	no	Has been partly filled with crushed stone. Nearby swallow hole.	no		
329	29-Jul-14	-86.093611	37.901111	262	GL	KGS online map	27-Jul-14	Dale Jones	owner	Meade	Rock Haven	pasture	no	no	no	no	appeared after the storm on 26-Jul-14	0.0		0.00				yes	Ste. Genevieve Limestone	Fredonia-Crider complex	yes	northeast	no		no	
330	22-Apr-14	-84.945000	37.656667	268	GL	KGS online map	3-Apr-14	Susan Mallette	DOW Watershed Management	Boyle	Perryville	pasture	no	no	no	no	no warning	2.4		1.83			steep slope into opening in bedrock	yes	upper member Lexington Limestone	McAfee silt loam	no	west-northwest	yes, but too small to enter		no	
331	1-May-14	-84.447500	38.280000	305	GL	KGS online map	1-Feb-14	Jason Mullins	owner	Scott	Leesburgh	lawn	no	no	no	no	wet	1.5		1.22			overhanging	no	Clays Ferry Formation	Lowell silt loam	no		no	Some of these data were recovered from my recollection of the site.	no	
332	6-Jun-14	-84.683889	38.181389	250	GL	GPS	1-Jun-14	Jim Currens	KGS	Woodford	Midway	pasture	no	no	no	no	wet	1.2	110	1.30	320	5.5	overhanging in top 2 ft	yes	Grier Limestone	Bluegrass-Maury silt loam	yes	southeast	yes	Farm manager is Tammy.	no	
333	4-Jun-14	-84.937222	38.140000	262	GL	KGS online map	July 2002	Marcella Mullings	owner	Franklin	Frankfort West	lawn	yes	yes	no	yes	wet	0.0		0.00				no	Tanglewood Limestone	Elk silt loam	no		no	Can hear water rushing beneath the surface.	no	
334	16-Jul-14	-85.645833	38.184167	155	GL	KGS online map	5-Jun-14	Kamae Dixon	owner	Jefferson	Louisville East	lawn	no	no	no	no	dry	0.0		0.00		0.5		no	Sellersburg-Jeffersonville Limestones	Crider complex	no		no		no	
335	16-Sep-14	-85.244167	38.363056	259	GL	KGS online map	2-Sep-14	Harriet Botner	owner	Henry	Eminence	pasture	unknown	unknown	unknown	unknown	unknown	0.0		0.00					Bull Fork Formation	Lowell silt loam	unknown		unknown		no	
336	24-Sep-14	-84.908056	38.168056	262	GL	KGS online map	9-Sep-14	Kris Churchman	renter	Franklin	Frankfort West	lawn	no	no	no	no		1.8		1.37		0.5		no	Clays Ferry Formation	Lowell silt loam	no		no	The owner of the property is named as Clint Martin.	no	
337	6-Sep-14	-84.407500	37.951667	320	GL	KGS online map	1-Apr-14	Kathy Rupp	owner	Fayette	Coletown	lawn	no	no	no	no	rain and freezing rain	1.4		1.37		1.5		no	Tanglewood Limestone	McAfee silty clay loam	no		no		no	
338	26-Sep-14	-84.668833	37.933528	258	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	1.2		1.04		0.6	90°	no	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		no	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
339	26-Sep-14	-84.668056	37.937639	262	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	3.4	320	2.74		0.9	70°	no	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		no	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
340	26-Sep-14	-84.668056	37.937611	263	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	4.0		2.13	320	0.9	90°	yes	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		no	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
341	26-Sep-14	-84.667778	37.937417	263	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	1.4		1.22	320	0.9	70°	yes	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		no	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	

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Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azimuth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause	
342	26-Sep-14	-84.665333	37.934306	257	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	2.4		2.44	320	0.9	70°	no	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		yes	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
343	26-Sep-14	-84.665500	37.934528	258	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	0.6		0.58	320	0.9	70°	no	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		yes	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
344	26-Sep-14	-84.666056	37.934778	259	GL	KGS online map	20-Aug-14	Richard Smath	KGS	Jessamine	Keene	pasture	no	no	no	no	above normal precipitation	0.6		0.40	320	0.9	90°	no	lower Lexington Limestone (Grier Limestone)	McAfee-Maury-Fairmount series	no		yes	Date of occurrence is estimated as between the report date and prospective buyer's previous visit to the property. The transaction involved here was never completed.	no	
345	29-Oct-14	-85.556667	38.068056	203	GL	KGS online map	1-Oct-14	Tracey	unknown	Bullitt	Mount Washington	lawn	no	unknown	unknown	unknown	unknown	1.2		0.91		0.6			Laurel Dolomite	Crider complex	no		no	House is built on a slab. The owner denies visible cracking or sticking doors.	no	
346	20-Nov-14	-85.516111	38.065278	285	GL	KGS online map	19-Nov-14	Jim Currens	KGS	Fayette	Lexington East	parking lot	no	no	no	no	heavy rain three days prior	0.6	220	0.49	160	1.5	overhanging	no	lower Lexington Limestone (Grier Limestone)	Beasley silt clay loam					no	
347	14-Apr-15	-84.531111	38.163889	220	GL	KGS online map	12-Apr-15	Jim Currens	KGS	Fayette	Georgetown	pasture and board fence	no	no	no	no	heavy rain past week	6.7	310	5.18	20	4.0	overhanging to vertical	no	Tanglewood Limestone, middle member	Huntington silt clay loam	yes	northwest	no, flooded	This cover collapse was within 500 ft of the groundwater monitoring station.	no	
348	6-Apr-15	-87.192500	37.070833	197	GL	KGS online map	1-Feb-15	Sandy Davis	owner	Muhlenburg	Kirkmansville	pasture	no	no	no	no	frozen ground followed by heavy rain	0.9		0.91				no	Kinkaid Limestone with Caseyville Formation cap	Frondorf-Lenberg series	no		no, flooded	Lovell Cave (entrance physically closed) is reported nearby.	no	
349	4-Mar-15	-86.225194	37.853250	193	GL	topo	1-Feb-15	John Nevitt	contractor	Meade	Big Spring	made it too costly to move building; was on the right side, 15 ft in front and 25 ft to the right	no	no	no	no	wet	3.0		2.74		2.4			no	St. Louis Limestone	Baxter very gravely silt loam	no		no, flooded	This building was acquired to move it to a historic village. The development of the cover collapse made it too expensive to complete the project.	no
350	31-Mar-15	-85.606333	38.160278	209	GL	KGS online map	15-Mar-15	Mark Bonn	owner	Jefferson	Jeffersontown	date of collapse is estimated; lawn, 20 ft from house	no	no	no	no	wet	2.7		2.44		0.3			no	Louisville Limestone	Affic Udarents complex	unknown	unknown	no, flooded	Owner has lived there 13 yr, and the house was six years old when he bought it.	no
351	30-Apr-15	-86.563889	36.645000	229	GL	KGS online map	1-Apr-14	Sid Monroe	manager	Simpson	Franklin	expanding toward the horse racing track	no	no	no	yes, sinkhole pond as a landscape feature	wet	0.0		0.00					no	St. Louis Limestone	Baxter cherty silt loam	yes	unknown	no	The initial cover collapse a year ago was the "size of a dinner plate."	no
352	15-Jun-15	-84.840278	38.208611	213	GL	KGS online map	1-Feb-15	Jim Currens	KGS	Franklin	Frankfort East	is in the crawl space; severe damage to house is possible	no	no	no	unknown	wet	0.9	10	0.73	100	1.2	vertical	no	Tanglewood Limestone	Elk silt loam	no	unknown	no	The feature was created by the runoff from the neighboring homes being directed into the crawl space.	no	
353	15-Jun-15	-84.338611	38.129722	287	GL	KGS online map	10-Apr-15	Jim Currens	KGS	Fayette	Centerville	adjacent to drive from the main entrance	unsure	gravel	stormwater culvert was directed into the depression	no	wet	4.0	180	3.96	270	3.0	vertical	no	Tanglewood Limestone	Lowell silt loam	no	unknown	no		yes	
354	21-Aug-15	-84.376944	37.892778	243	GL	5-ft digital elevation model	1-Mar-15	Matt Crawford	KGS	Madison	Richmond North	development accelerated during the summer	possible	no	yes	yes	wet	5.2		3.05		2.4	90°	no	Tyrone Limestone-Oregon Formation	Cynthiana rock outcrop complex	prior to first infilling		no	Cover collapse has been filled more than once before. Collapse exposed drain tile or some other water-carrying pipe. No leak in the tile was noted.	yes	
355	25-May-16	-84.681139	37.665917	0			16-May-16			Garrard	Bryantsville	lawn and drive of adjacent house	no	no	no	unknown	rain, heavy at times	11.3	south-south-west(?)	3.51	east	6.1	90°	yes	Lexington Limestone	Faywood-Fairmount complex	prior to infil	southwest		Dimensions are extent of excavation.		
356	26-Oct-15	-84.527889	38.023917	290	GL	GPS	15-Oct-14			Fayette	Lexington West	lawn	unknown	no	no	no	unknown	0.5	170	0.15	70	0.5	90°	no	lower Lexington Limestone	made land, over silty materials	no	unknown				
357	14-Oct-15	-84.684444	37.676944	245	GL	topo	31-Aug-15			Boyle	Bryantsville	pasture	no	no	no	no	rainy	1.7	115	1.68	70	4.1	overhanging	yes	Camp Nelson Limestone	Caleast silt loam	no	unknown		Opening into bedrock may be visible.		
358	5-Oct-15	-84.539235	38.100801	293	GL	KGS online map	4-Oct-15			Fayette	Lexington West	no	no	unknown	no	no	unknown	1.5		0.30		0.6	unknown	no	upper Lexington Limestone	Bluegrass-Maury silt loam	no	unknown	no	Indication of soil loss over time (sod laid several times); opened during mowing.		
359	9-Nov-15	-84.474389	38.018778	315	GL	GPS	8-Nov-15			Fayette	Lexington East	no	no	no	no	unknown	1-in. rain	0.5	300	0.30	350		unknown	no	Tanglewood Limestone	Bluegrass-Maury silt loams	no	unknown	no			
360	3-Mar-16	-84.534917	38.211833	259	GL	Google Earth				Scott	Georgetown	lawn	no	no	no	adjacent	rain and snow	1.7	285	1.52	100	4.0	90	maybe	Tanglewood Limestone	McAfee silt loam	no	unknown	yes	Opening into bedrock visible.		
361	10-Mar-16	-84.583139	38.161861	273	GL	topo	29-Feb-16			Scott	Georgetown	pasture	no	no	no	no	moderate rainfall	1.0	280	0.91	335	6.1	90	yes	Tanglewood Limestone	Bluegrass-Maury silt loam	yes	300-345	yes	Water cascading from soil approximately 10 ft below ground level; farm pond nearby.		
362	6-Apr-16	-84.638917	38.280306	256	GL	Google Earth	1-Mar-16			Scott	Stamping Ground	no	no	yes	no	unknown	unknown	0.9		0.61		1.5		no	Tanglewood Limestone	Lowell-Faywood silt loam	no		no			
363	7-Jan-11	-85.593775	38.302653	200	GL	Google Earth	6-Jan-11			Jefferson	Anchorage	no		yes	no	no	unknown	1.8		1.22				no	Louisville Limestone	Crider silt loam	no		no			
364	21-Jun-16	-84.699545	37.677920	248	GL	Google Earth	21-Jun-16			Boyle	Bryantsville	pond drained	no	unknown	unknown	yes	unknown	1.1	unknown	1.07	unknown	6.1	unknown	unknown	no	Tyrone Limestone	Nolin silt	unknown	unknown	unknown	Pond drained; soil likely altered.	

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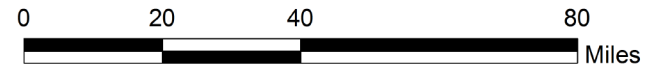
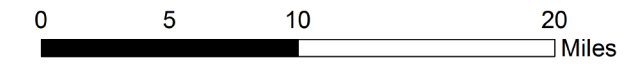
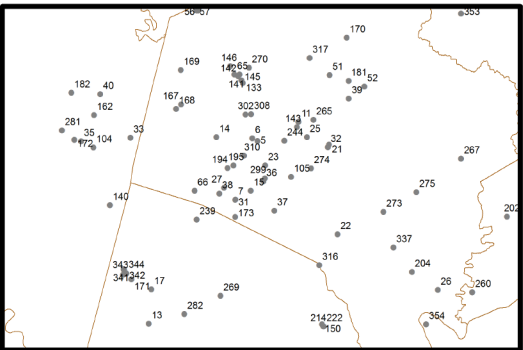
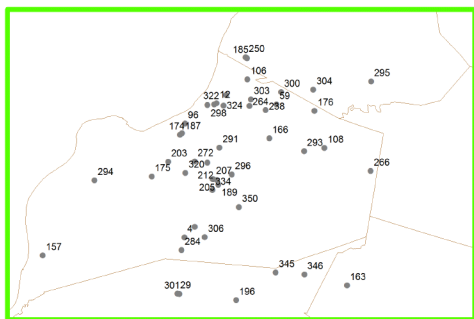
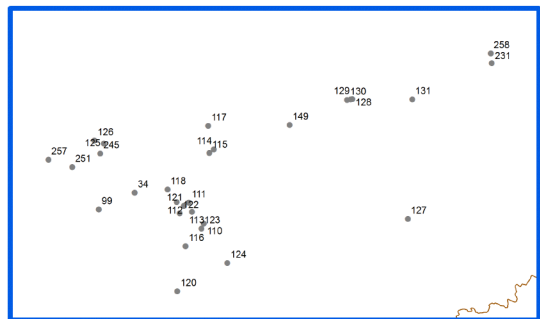
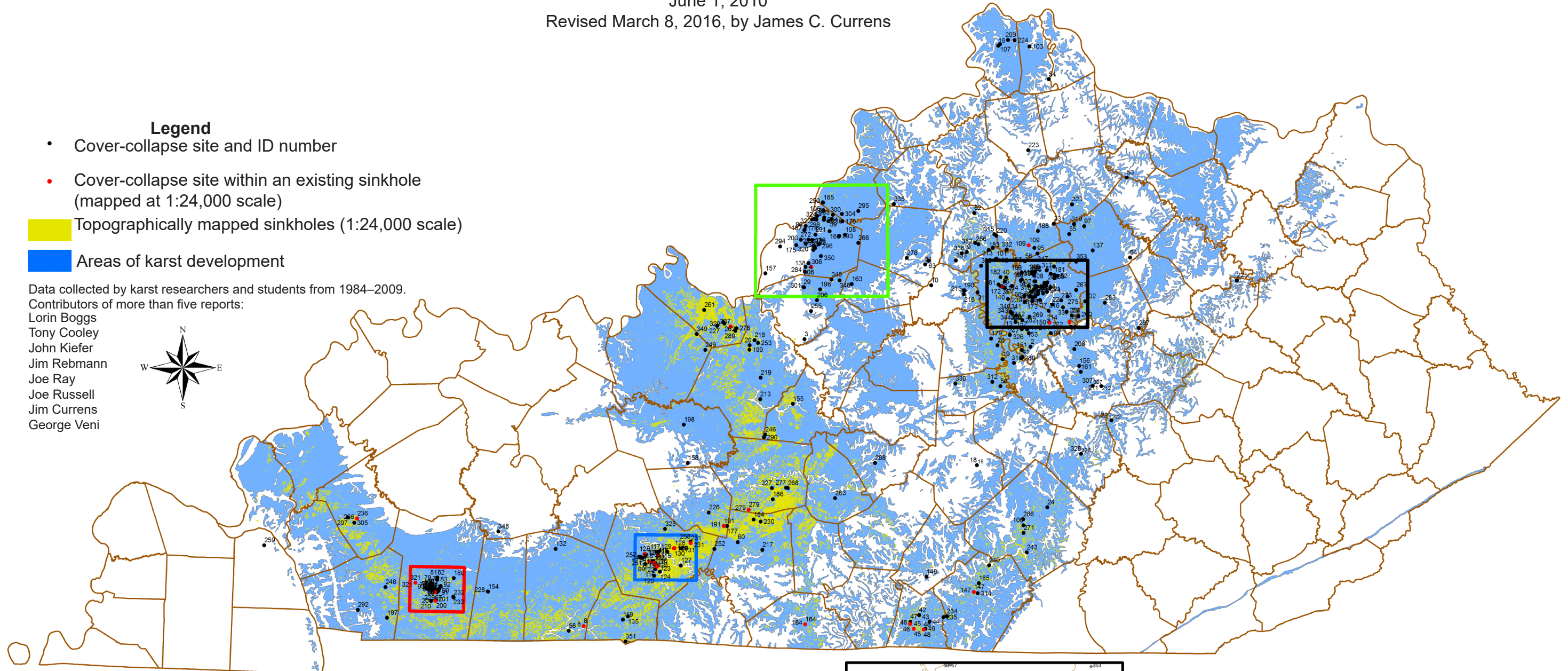
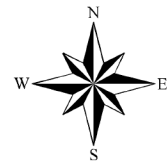
Site ID (Corresponds to Number on Plate)	Report Date	GIS Spherical X	GIS Spherical Y	Elevation (m)	Datum	Elevation Method	Collapse Date	Reporting Person	Agency	County	Quadrangle	Property Damage	Evidence of Prior Collapse	Buried Trash Exposed	Utility Lines Exposed	Preexisting Depression Holds Water	Weather Previous 30 Days	Long Axis (m)	Long Axis (azi- muth)	Short Axis (m)	Short Axis (azimuth)	Depth (m)	Wall Slope	Bedrock Visible	Geologic Formation	Soil	Water Visible	Direction Water Is Flowing	Cave Entrance Visible	Comment	Anthropomorphic Cause
365	27-Apr-16	-84.424944	38.266444	280	GL	Google Earth	23-Apr-16			Scott	Leesburgh	lawn	no	unknown	no	unknown	rainy	# !	un- known		unknown	2.0	unknown	unknown	upper Lexington Limestone	Faywood silty clay loam	yes	unknown	unknown	Series of sinks, farm pond directly across road.	
366	17-Aug-15	-84.480764	38.052394	298	GL	Google Earth	17-Aug-15			Fayette	Lexington East	roadway	unknown	unknown	unknown	unknown	unknown	# !	un- known		unknown		unknown	unknown	Tanglewood Limestone	not available	unknown				
367	12-Mar-16	-87.662876	36.876164	154	GL	Google Earth	6-Mar-16			Christian	Gracey	roadway	unknown	unknown	unknown	unknown	unknown	# !	un- known		unknown		unknown	unknown	Ste. Genevieve Limestone	Lawrence silt loam	unknown	unknown	unknown	Collapse occurred between 1-Mar and 11-Mar.	
368	1-Jul-16	-84.691782	37.723493	243	GL	Google Earth	14-Jun-16			Garrard	Bryantsville	pasture	no	unknown	no	unknown	wet	1.5		1.52		2.4	overhanging	yes	Tyrone Limestone	Faywood-Fair- mount complex	no	unknown	unknown		

Plate 1. Distribution of Documented Cover-Collapse Sinkholes Across Kentucky.

James C. Currens, Randall L. Paylor, and Michael Farwell
June 1, 2010
Revised March 8, 2016, by James C. Currens

- Legend**
- Cover-collapse site and ID number
 - Cover-collapse site within an existing sinkhole (mapped at 1:24,000 scale)
 - Topographically mapped sinkholes (1:24,000 scale)
 - Areas of karst development

Data collected by karst researchers and students from 1984–2009.
Contributors of more than five reports:
Lorin Boggs
Tony Cooley
John Kiefer
Jim Rebmann
Joe Ray
Joe Russell
Jim Currens
George Veni



Inset Scale

Map Scale