

## **What's Up With All the Sinkholes?**

By: Clint Kromhout, P.G.

To help answer this question we need to define what sinkhole is and in what geologic terrain they form in. The bulk of Florida's peninsula is made up carbonate rock (limestone and dolostone) overlain by variable thicknesses and mixtures of sand and clay (i.e., overburden). Carbonate rocks store and transmit groundwater. Through a slow chemical process these carbonate rocks may dissolve, resulting in karst terrain (topography). Karst terrains are characterized by sinkholes, caves (wet and dry), springs, disappearing/reappearing streams, and other land surface depressions all of which are commonly found throughout Florida. Sinkholes are karst-terrain landforms created when the overburden subsides or collapses into voids which have formed by dissolution of the underlying carbonate rocks. Florida has two basic types of sinkholes: cover-subsidence sinkholes and cover-collapse sinkholes. I will further define these two types of sinkholes later on in the article.

At the end of February, 2013, the collapse of a sinkhole in Seffner, Florida tragically took the life of a young man.. From a public perspective, sinkholes seem to be occurring more frequently in Florida. Although there is usually some credence to the old saying "perception is reality," that isn't the case with sinkholes. Under standard geologic time and processes, sinkholes are likely forming at the same rate they always have in Florida.

There are three factors that influence the perception that sinkholes are occurring more frequently in Florida now than in the past:

1. Population Growth
2. Sinkhole Insurance Claims
3. Triggering Events

### **Population growth**

Population growth has likely played the largest role in the perception that sinkholes are occurring more frequently. "If a tree falls in a forest and no one is around to hear it, does it make a sound?" Figuratively, sinkholes fall under that same quandary. In order for us to know a sinkhole has occurred, someone has to observe it. As we know, the population of our state is always growing, more people means more eyes and ears, and more media reporting outlets to document things. As Florida's population grows it expands into areas which may be potentially more susceptible to sinkhole formation. Therefore, as our population grows, covering more areas of the state, more sinkholes are being witnessed and reported. In this digital age news travels as fast as the telephone, television, and internet can distribute it, especially when an event is tragic (Seffner sinkhole tragedy) or novel (sinkhole forms in a lake and drains it).

The unfortunate event in Seffner is prime example of how quickly news can travel and create heightened awareness within the public. Rightly so, people were concerned about their safety following the Seffner event, and as such, a significant increase in potential sinkhole reportings was experienced. The Florida Geological Survey maintains a database of subsidence incident reports which documents occurrences of subsidence which may or may not be sinkhole related. From December 2012 to end of February 2013 only four subsidence incidents were reported, generally a few are reported each month under normal climatic conditions. After the Seffner tragedy, end of February 2013 to beginning of April 2013, twenty-three subsidence incidents were reported.

What is a subsidence incident?

In addition to potentially being a sinkhole, a subsidence incident can also be the result of other subterranean events which can cause holes, depressions or subsidence of the land surface and mimic sinkhole activity. These include subsurface expansive clay or organic layers which compress as water is removed, collapsed or broken sewer and drain pipes or broken septic tanks, improperly compacted soil after excavation work, and even buried trash, logs and other debris.

Often a depression is not verified by a licensed professional geologist or engineer to be a true sinkhole and the cause of subsidence is not known.

## **Sinkhole Insurance Claims**

There are three forces of nature someone living in Florida will likely experience to some degree: sunshine, tropical storms, and sinkholes. Two of those three are required to be covered by insurance under Florida law. Beginning in 1981 Florida law required insurers to offer sinkhole damage insurance in the form of an optional rider policy. Later a law requiring insurance coverage in a standard homeowner's policy for "catastrophic ground cover collapse" was added. Sinkhole-related claims have risen by nearly an exponential rate since 1981<sup>1</sup>. The main catalysts for that rise are as Florida's population increases it sprawls and covers more area and that it also inhabits more areas which may be geologically susceptible to sinkhole formation. The population increase and sprawl equates to more people making claims on their homeowner's policies, and as more people make claims more people become aware of sinkholes and potential sinkhole damage related issues leading to more claims, a circular cycle of awareness. That awareness developed by people's interaction with sinkhole insurance has certainly led to perceived increase in sinkhole occurrences.

A lot of that perceived increase can likely be attributed to the sinkhole insurance laws and peoples' misunderstanding of the terms *sinkhole*, *sinkhole activity*, and *catastrophic ground cover collapse* and the circumstances to which they apply. Two out of the three of those terms are legal definitions as they pertain to insurance, *sinkhole activity* and *catastrophic ground cover collapse*. *Sinkhole* is a geologic term. Chapter 627, Section 706<sup>2</sup> of the Florida Statutes defines these terms as:

### sinkhole -

(h) "*Sinkhole*" means a landform created by subsidence of soil, sediment, or rock as underlying strata are dissolved by groundwater. A sinkhole forms by collapse into subterranean voids created by dissolution of limestone or dolostone or by subsidence as these strata are dissolved.

### sinkhole activity -

(i) "*Sinkhole activity*" means settlement or systematic weakening of the earth supporting the covered building only if the settlement or systematic weakening results from contemporaneous movement or raveling of soils, sediments, or rock materials into subterranean voids created by the effect of water on a limestone or similar rock formation.

### catastrophic ground cover collapse -

(a) "*Catastrophic ground cover collapse*" means geological activity that results in all the following:

1. The abrupt collapse of the ground cover;
2. A depression in the ground cover clearly visible to the naked eye;
3. Structural damage to the covered building, including the foundation; and
4. The insured structure being condemned and ordered to be vacated by the governmental agency authorized by law to issue such an order for that structure.

To further help understand these terms one needs to know the two basic types of sinkholes that form in Florida, cover-subsidence sinkholes and cover-collapse sinkholes. Cover-subsidence sinkholes form when the overburden slowly migrates into the cracks and fissures in the underlying rock. The result of a cover-subsidence sinkhole is often an apparent depression in the land surface. Cover-collapse sinkholes form when the roof of an underground void can no longer support the weight of the overburden causing a sudden collapse of the overburden into the void. The result of a cover-collapse sinkhole is often a very apparent and rapidly-formed hole at land surface. It's not uncommon for geologic conditions to exist below ground that result in a sinkhole formed by a combination of collapse and subsidence mechanisms. In general cover-subsidence sinkholes are

more plentiful than cover-collapse sinkholes simply due to the mechanism under which each forms, but the dramatic nature of cover-collapse sinkholes makes for better news.

*Catastrophic ground cover collapse* involves the formation of a cover-collapse sinkhole which has formed under a building causing severe structural damage. Cover-collapse sinkholes are the type often reported on by the news media and most people envision when they hear the word sinkhole. Damage assessments and investigations associated with an occurrence of a *catastrophic ground cover collapse* are generally more cut-and-dry. Conversely, *sinkhole activity* involves the degradation of the underlying sediments which may be the result of or lead to the formation of either a cover-subsidence sinkhole or a cover-collapse sinkhole. *Sinkhole activity* is only covered only by an optional sinkhole insurance rider which covers a *sinkhole loss*.

Chapter 627, Section 706<sup>2</sup> of the Florida Statutes defines *sinkhole loss* as:

(j) “*Sinkhole loss*” means structural damage to the covered building, including the foundation, caused by sinkhole activity. Contents coverage and additional living expenses apply only if there is structural damage to the covered building caused by ***sinkhole activity***.

A claim against a sinkhole insurance rider is invoked in circumstances where a built structure may be experiencing minor persistent yet structural damage, which may be indicated by popping floor tiles, warped roof lines, cracking walls, or sticking doors and windows. Damage assessments and investigations associated with potential *sinkhole activity* can be tenuous and difficult to prove. Far more situations involving investigations of *sinkhole activity* versus *catastrophic ground cover collapse* end up disputed in a court of law. In large part, the instances of investigation for *sinkhole activity* outnumber those of *catastrophic ground cover collapse*.

The industry that has grown-up around the sinkhole insurance claims business has also significantly aided in peoples’ awareness of sinkholes. Everyday people across the state are exposed to commercials on the television or receive advertisements through the mail, by flyer, or through internet searches. These companies offer services to either help an insurance policy holder file a sinkhole claim, investigate a sinkhole insurance claim for *sinkhole activity*, remediate sinkhole damage, or provide legal representation specializing in sinkhole insurance claims.

### **Triggering Events**

Sinkholes form naturally under standard geologic and hydrogeologic conditions throughout much of Florida. Additional stresses beyond those standard conditions can be catalysts inducing formation of single or multiple sinkholes. Those additional stress conditions are referred to as triggers. Triggers can be climatic or seasonal as natural variations in precipitation from wet to dry periods (or vice versa) occur. Other triggers are anthropogenic (human influenced) in character and can be caused by alteration of the land surface and hydrology. Examples include rapid depletion of groundwater resources such as consumptive use for agricultural or power production, and terraforming by removing protective “bridging” overburden sediments. These activities may concentrate large quantities of water or otherwise load the land surface beyond its weight carrying capacity over subsurface cavities. It’s not uncommon for triggers to occur in combinations, such as extreme groundwater pumping to protect agricultural crops from freezing temperatures or excavation of protective overburden sediments to create a stormwater drainage retention area. Depending on the scale of the mechanism that acts as the trigger, either a single sinkhole may form, many sinkholes may form together in a small area, or many new sinkholes may form over a large region.

Triggers fall into two categories, natural and anthropogenic (result from human influence)

Natural trigger events include, but are not limited to:

- Heavy rainfall
- Drought, followed by heavy rain

- Tropical storms (heavy rain, flooding)
- Animal burrowing and digging

Anthropogenic trigger events include, but are not limited to:

- Heavy pumping of groundwater for agricultural freeze protection
- Well or investigative drilling
- Excavation of protective or weight-bearing sediments over an unknown void
- Overloading of sediments over an unknown void (ex: landfill)
- Broken waterline leaking and causing a point of dissolution
- Pounding / driving in of foundation support structures (ex: piles)
- Blasting
- Excessive vibration (ex: vibratory compaction rolling )

Sometimes the large numbers of sinkholes will form when one or more triggering events occur. Below are two examples of events that triggered sinkholes to form which were observed in Florida recently.

Example #1 –

In January of 2010, an unprecedented eleven consecutive days of freezing temperatures (trigger #1) were experienced in the strawberry growing region of Hillsborough County. In order to protect their crops from freezing, area farmers used their irrigation wells to continuously spray pumped groundwater over their crops effectively insulating them from the freezing temperatures. Tremendous volumes of groundwater were pumped in that effort, dramatically lowering local aquifer levels in a short period of time (trigger #2). The unintentional side effect was that scores of sinkholes starting forming around the region in which both the freezing temperatures and freeze protection groundwater pumping occurred. Those sinkholes created significant damage which in turn generated lots of press. Understandably, the region's residents developed a heightened awareness/wariness regarding sinkholes.

Example #2 –

In June of 2012, Tropical Storm Debby dumped record amounts of rain over a three day period across the state. Florida had been experiencing an extended drought at the time during which local aquifer levels were abnormally low. The added weight of the rain water added to the surficial sediments combined with the lowered aquifer levels exceeded the weight-bearing capacity of the sediments over many unknown voids causing hundreds of sinkholes to form all over Florida. State Emergency Response officials were nearly overwhelmed by citizens' requests for assistance involving sinkholes. News camera crews visited and reported on dozens of sinkholes at that time helping to heighten people's awareness/wariness.

The somewhat unpredictable nature of sinkholes to potentially threaten people's lives and possessions is likely why they garner so much attention. Florida's population will continue to increase, there will always be a need for insurance, and triggers will continue to play a role in sinkhole formation. That's why it's important for scientists to study Florida's complex karst topography and the sinkholes that form in it.

References:

- 1) 2010, Issues Relating to Sinkhole Insurance, Interim Report 2011-104, Committee on Banking and Insurance, The Florida Senate, 47p.
- 2) 2012, Sinkhole Insurance; catastrophic ground cover collapse; definitions., §627.706, Florida Statutes.