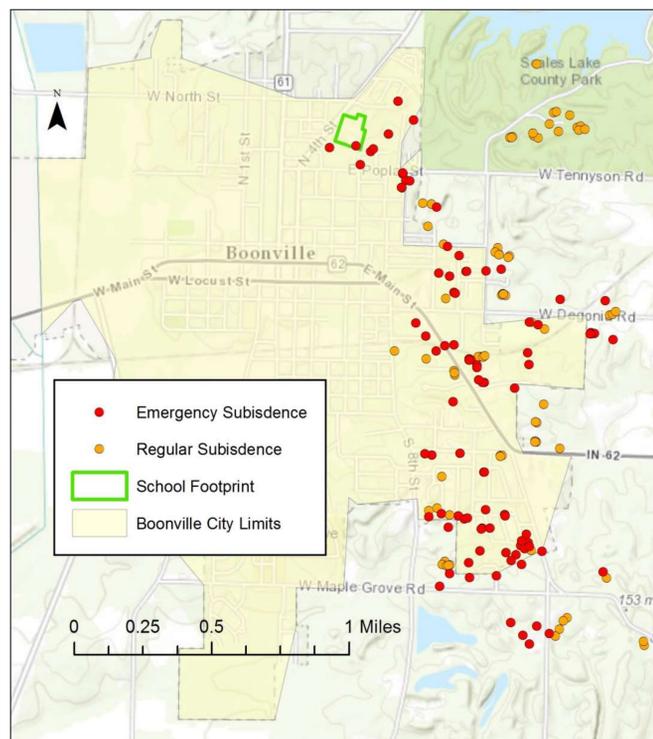


Indiana Department of Natural Resources Division of Reclamation, Abandoned Mine Lands Section

Site 2147, Loge School Grouting

A Dangerous Situation

This project addressed the unstable mine void at Loge Elementary School in northeast Boonville. Eastern Boonville is highly prone to subsidence because the mine void is less than 50 feet from the surface and the overlying strata are weak. There have been five emergency subsidences on the school grounds since 1995. To alleviate the safety hazard and prevent the community disruption that would be caused by closing the school, the AML program decided to stabilize the mine void underneath the building.



There have been 85 subsidences within the city limits in the past 35 years, and 75% were declared emergencies.

A Challenging Design

Due to the shallow void and large building footprint, the design required careful study of the building plans and foundation structure in three dimensions. While the central open courtyard provided additional access points, some of the boreholes were drilled at less than a 30 degree angle. Casing was required to ensure that the grout reached the mine void. Boreholes also had to avoid water supply, sanitary sewer, gas, electricity, and fiber optic lines serving the building.



To utilize the central courtyard, the drilling equipment was lifted over the building using a large crane.

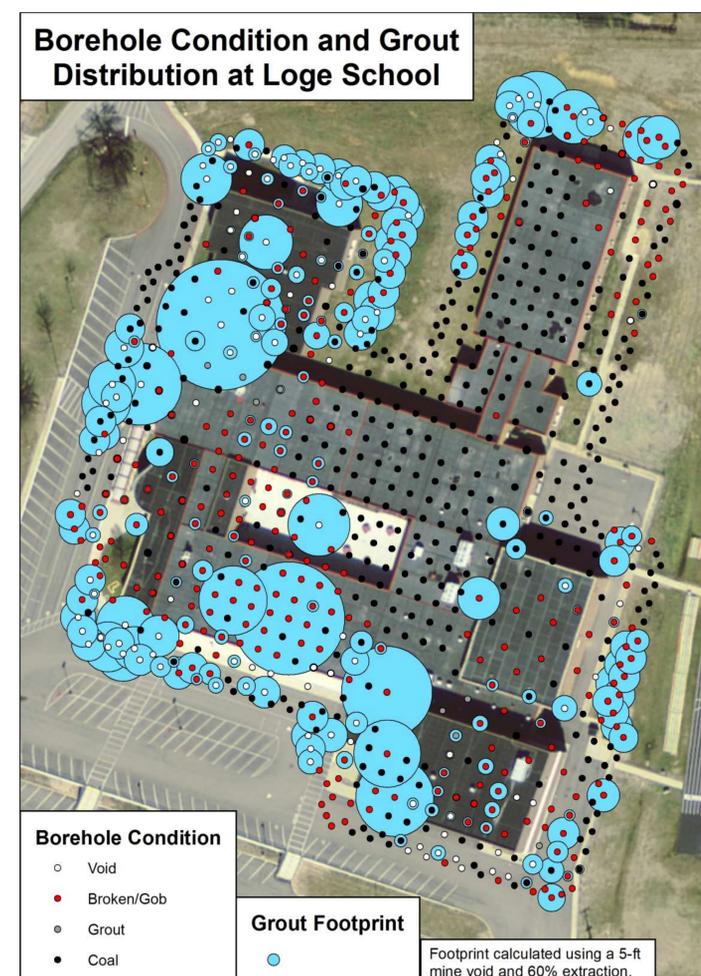


Grout was pumped from the building perimeter using a pump truck with large articulated pumping booms.

The design included barrier grouting, which involves establishing a perimeter and injecting a lower slump grout mixture to restrict flow outside the target area. The borehole pattern was laid out to target the building's column footers, which are structural load points throughout the building interior. An engineering study revealed that a subsidence event affecting four columns would cause major structural failure.

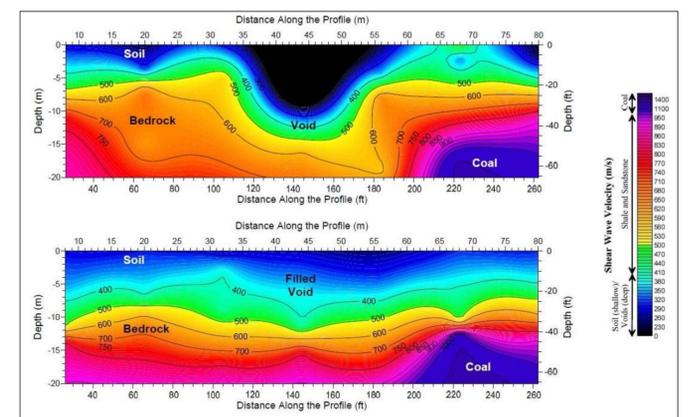
On-Site Effectiveness

A total of 10,177 cubic yards of grout were injected into the mine void. There were 144 barrier holes, 301 vertical holes on the perimeter and in the courtyard, and 400 angled boreholes targeting the building itself. Grout takes were very high in some areas, indicating large void spaces highly vulnerable to subsidence.



The size of the blue circles represents the area of grout coverage if dried into a cylindrical column.

The success of both the drilling and the grouting were evaluated using independent analyses. A gyroscopic instrument was used to survey select boreholes, and they were not more than 2 feet off target. Eight confirmation boreholes were drilled, and they all encountered grout. Refraction Microtremor surveys were performed both before and after grouting to confirm its effectiveness. This technology utilizes the dispersive property of surface vibrations to detect anomalies in the bedrock.



The pre-injection (top) and post-injection (bottom) profile lines indicate that the existing mine void was filled during grouting. This survey ran southwest to northeast.

Logistics and Impact

An aggressive schedule to complete the project during summer break was facilitated by a dedicated contractor and assistance from the school. Contractor Howard Concrete deployed three drill rigs to the site, including the small one that was lifted into the courtyard. Grout was mixed on-site in a batch plant, so there were no delays waiting for concrete trucks to arrive. School staff assisted by providing access to the courtyard, running electricity to the job trailer, and helping repair a sewer line that was damaged during drilling.

This project was a proactive effort to alleviate a serious safety hazard. By choosing to act prior to any mine void collapse, the reclamation work could be scheduled during the period of lowest activity. Damage occurring during the school year would not only endanger students and staff but might also have forced the school to close, which would cause a major disruption to many families and the community as a whole.



Loge students pose after a Thanksgiving food drive.