Beneath the Surface: Sustainable Solutions for Culvert Challenges and Water Management in a Community Garden

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Project summary and goals

The Reclamation Garden in Jubilee House organization in Parrish, Alabama, which is designed to produce agricultural goods for local consumption, is currently facing a critical issue due to neglected culvert systems that lead to sinkholes, excessive water runoff, and subsequent land collapses. Through this project (website), we aim to map the existing culvert infrastructure, assess its condition, and formulate a management plan to handle water and culvert systems sustainably.

Figure 1. Site map overview. (a): The aerial view of the site. The proposed reclamation garden is shown in dark brown. The mapped culvert from site visit is shown as the red line. Exact location of the culvert can be found in the Past Work and Milestone section. (b) - (e): photo examples of sinkholes and land collapses.

Project Background

Jubilee House was established three years ago in partnership with the Town of Parrish. The primary initiative of Jubilee House is the Reclamation Garden. The goal of the garden is to transform vacant land in the town into a community farm, promoting regenerative agricultural practices, food production, and community learning and play spaces.

The proposed garden is situated on a former football field (see Fig. 1) associated with a closed high school. This area lies in a basin surrounded by several houses and trees, with a vertical distance of about 10 meters (33 feet) between the bottom and the top.

The plan was to establish a community garden at the front end of the property and gradually develop the larger sections of the overall farm project. However, when planting began in 2023, a major sinkhole was discovered on the garden land, revealing a long-neglected culvert system beneath the surface. They are not currently maintained by any individuals or organizations. The project had to be halted due to these sinkholes and land collapses.

Past Work and Milestones

Site Visit October 24, 2024

Objective:
Initial field investigation and site mapping of the suspected culvert system at the Parrish property.

Activities Completed:
Prof. Jack Montgomery and his team conducted the first on-site assessment. The team deployed a drone for aerial documentation and collected ground measurements around multiple holes observed on site. Using these data, the team produced the first draft map of the culvert and surrounding terrain (see Fig. 2).

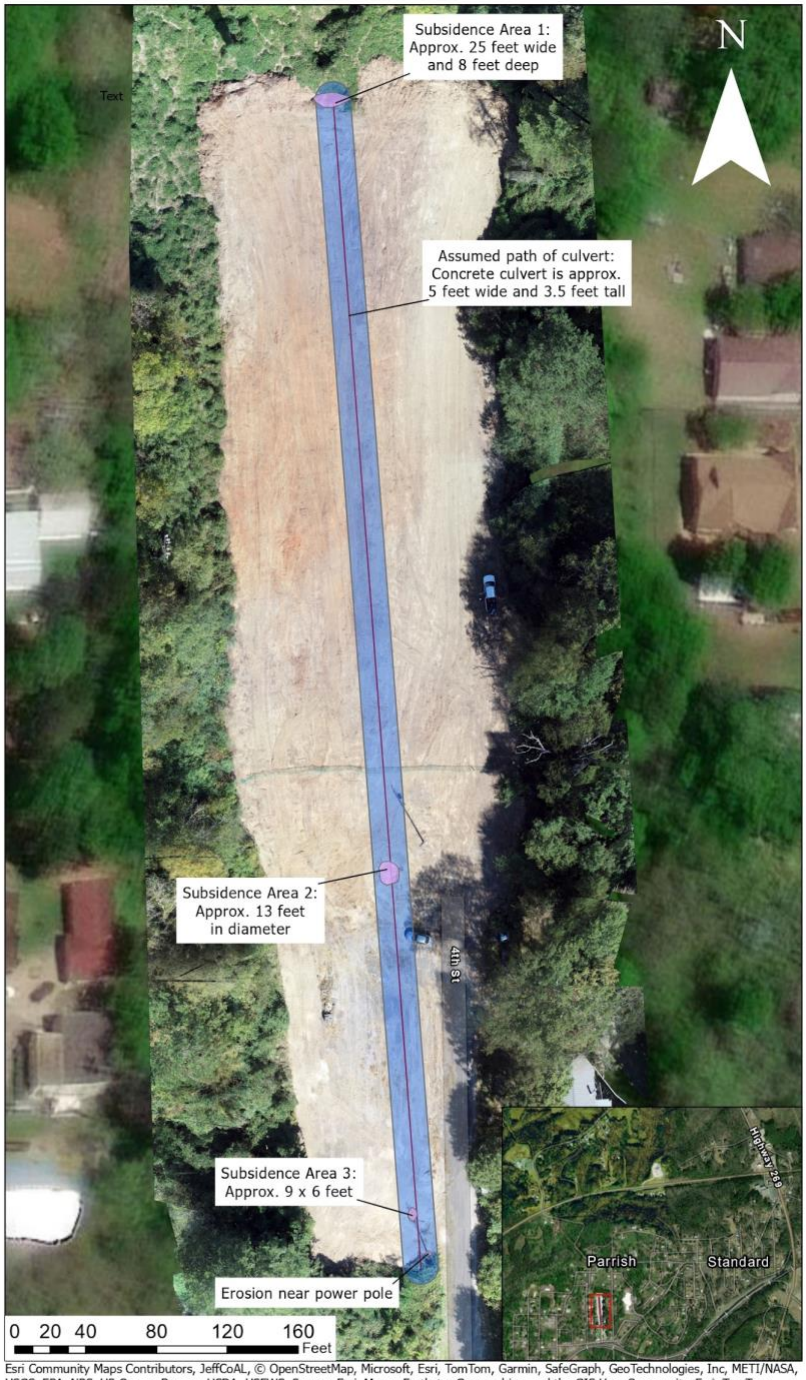
Findings:

- A **rectangular culvert**, approximately **5 ft wide** and **4 ft tall** at the entrance, was identified running through the center of the site (marked in red in Fig. 2).
- No evidence of any other culvert.
- Three **main subsidence areas** (shaded in purple in Fig. 2) were noted, ranging in surface area from ~ **54 ft²** to **176 ft²**.
- An additional **erosion spot** was identified near the power pole located at the downstream end of the site.

Analysis:
Water continues to flow through the culvert from the rear opening toward the parking lot, indicating that it remains at least partially functional. However, the observed subsidence suggests potential **internal collapses** or **soil washout** within the culvert. Vegetation growing

near the holes may exacerbate these issues and should be cleared to allow further inspection and prevent additional root intrusion.

Figure 2. Site map of the culvert produced after the site visit on October 24, 2024



Visual Inspection May 12, 2025

Objective:
Detailed visual inspection of the interior of the culvert to assess structural integrity and locate internal failures.

Activities Completed:
Video Industrial conducted a robotic camera inspection of the culvert from both ends. The inspection vehicle advanced approximately 5 ft from the upper side and 30 ft from the lower side before being obstructed by debris.

Figure 3. Overview of the video inspection. (a): map of the two inspections from the upper and lower sides of the culvert (red line). (b) - (c): images from the stacked stone section. The hinging stone from the ceiling of the culvert is circled in red. (d) - (f): images from the concrete section. The hole between the side and the bottom wall is highlighted in red.

Findings:

- The culvert consists of **two construction sections**:
  - A **concrete section** on the lower side of the garden.
  - A **stacked-stone section** near the large hole on the upper side of the garden.
- A **hinging stone** in the stacked-stone section was observed to be dislodging downward, shown in Fig. 3 (c).
- A **hole ~ 23 ft** into the concrete section (between the side wall and bottom slab) allows **active water infiltration** into surrounding soils, shown in Fig 3. (e) - (f).
- Continuous water flow confirms that the culvert remains in active use.

Analysis:
The upper stacked-rock portion is likely older and more structurally compromised, while the concrete section may represent a partial replacement of an earlier failed culvert. Although the top of the concrete segment appeared intact, the hole along the wall joint is allowing water to undermine adjacent soil, contributing to gradual surface subsidence. This internal failure correlates spatially with the surface subsidence documented during the October 2024 site visit (Fig. 2). The stacked-rock section shows failure risk due to the loose hinging stone. A full replacement of the entire culvert is recommended.

Next Steps

Hydrology Assessment:

Engage a hydrologist to calculate surface runoff rates and determine appropriate culvert dimensions for potential replacement. Excavation and replacement should be scheduled during the dry season to minimize risks.

Stormwater Facilities Project Evaluation:
Professors Jack Montgomery, Mike Perez, and Wesley Donald will conduct a follow-up site visit in November 21, 2025 to assess whether the Parrish project qualifies for federal stormwater funding at Alabama Department of Environmental Management (ADEM). If eligible, the project could receive engineering and hydrological support through federal programs focused on stormwater infrastructure and impaired waterway restoration.
Because the site is privately owned by Jubilee House, implementation logistics will be relatively straightforward.

Budget Status

Funding Source	Date Awarded	Amount	Purpose
Thriving Earth Neighborhood & Community Funds	2024-25	$8,000	Land clearing, community outreach and engagement, community leads time & effort
Take It Further Grant	2025	$4,000	Site evaluation and mapping
Documentary Production Fund	2025	$3,000	Educational media and public awareness

Media Coverage

News Article: *"Fight for It to Be Better"* – Southern Science (November 13, 2024)
https://southern-science.com/2024/11/13/fight-for-it-to-be-better/

AGU Documentary Film: *YouTube – Parrish Stormwater Story*
https://www.youtube.com/watch?v=UD_CZeeeYs4