# A CLOSER LOOK AT SOUTHEAST REGIONAL DRINKING WATER WELLS: IDENTIFYING PROBLEMS USING A DOWN WELL CAMERA

Paul Vendrell[1], Tina Pagan[2], Mark Risse[3], and William Thom[4]

AUTHORS: [1]Program Coordinator, Feed and Environmental Water Lab, University of Georgia, 2300 College Station Rd., Athens, GA 30602-4356. 2 Extension Program Specialist – Georgia Farm*A*Syst Coordinator, University of Georgia, Cooperative Extension Service, Driftmier Engineering Center, Athens, Georgia 30602. [3]Associate Professor, Department of Biological and Agricultural Engineering, University of Georgia, Driftmier Engineering Center, Athens, Georgia 30602. [4]Professor, Department of Agronomy, University of Kentucky, Lexington, Kentucky, 40506.

REFERENCE: *Proceedings of the 2005 Georgia Water Resources Conference*, held April 25-27, 2005, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, The University of Georgia, Athens, Georgia

**Abstract.** A majority of Georgia's rural residents have their drinking water supplied by private water wells. It is critical these wells function properly and are free of pollutants. Over the past year, the University of Georgia Cooperative Extension Service has been using a down well camera to gain a better understanding of private drinking water wells with concerns identified by a drinking water well test. The down well camera captures footage that allows a specialist to check a well's casing, depth of casing, presence of seepage at joints, and depth to water level that might lead to contamination. Images obtained with the camera identify problems and provide individuals with information necessary to encourage them to repair their well and remove the presence of any potential surface pollutants. The down well camera offers Cooperative Extension Services a way to target the needs of their clientele and educate the public. This presentation will showcase selected video frames captured by the camera.

## INTRODUCTION

Often very localized groundwater pollution is discovered in individual private drinking water wells, which leads to an assumption that the cause was related to process that occurred as a result of contaminants entering through the well itself. The objective of this study was to determine avenues for groundwater contamination due to inadequate construction or deteriorated materials that would remain undiscovered during a routine wellhead inspection.

Over the past year, the University of Georgia Cooperative Extension Service has used a down-well camera to look for the source of problems identified by a drinking water well test. This camera captures video images that allow a specialist to inspect the integrity of the well casing, depth of casing, seepage at joints, corrosion problems, leaks, foreign material, insects, invertebrates, tree roots, and water depth. Images obtained with this camera can identify avenues for entry of contaminants and provide well owners or their driller with information that encourages them to take action by repairing their well and removing surface pollutants. The down-well camera offers Cooperative Extension Services a way to target the needs of their clientele and educate the public.

## RELATED WORK

In Georgia, the principals of wellhead protection have been thoroughly prepared and presented in many Georgia Extension programs (Tyson, 1993). Essentially every State in the U.S. has some version of these basic principals. Wellhead protection is essential for protecting groundwater resources and drinking water supplies. Contaminants could enter groundwater through the well bore without an obvious pathway being visible above ground at the wellhead. In the past, the wellhead was the only practical part of a well that could be inspected with reasonable effort. Due to advancements in video technology, down-well video cameras are relatively inexpensive and easy to operate. These cameras allow inspection of the entire well bore in addition to the traditional wellhead inspection. As an example, a down well camera can be obtained from distributors listed in the following website, http://www.wellvu.com/.

## METHODS

From an archive of over 37 down well videos, still frames were selected that depict plausible reasons for the water quality problems that initially led the video team to these wells. Wells were located either in Georgia or the Jackson Purchase area of Kentucky. Table 1 lists the county or region the wells were located,

**Table 1. Well Location, Water Quality Problems, Well Type, and Aquifer Type for Photos in Figures 3, 4, and 5.**

| Fig. | Location | Problem | Type | Aquifer |
|---|---|---|---|---|
| 3a | White Co., GA | Bacteria | Bored | Alluvial |
| 3b | White Co., GA | Bacteria | Bored | Alluvial |
| 3c | Oconee Co., GA | Bacteria | Bored | Alluvial |
| 3d | Oglethorpe Co., GA | Bacteria | Bored | Alluvial |
| 3e | Oconee Co., GA | Bacteria | Bored | Alluvial |
| 3f | Thomas Co., GA | Severe corrosion | Drilled | Confined Carbonate |
| 3g | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 3h | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 4a | White Co., GA | Bacteria | Bored | Alluvial |
| 4b | Madison Co., GA | Bacteria | Bored | Alluvial |
| 4c | Putnam Co., GA | Organic matter | Drilled | Crystalline rock |
| 4d | Glynn Co., GA | Tannin and lignin | Drilled | Confined carbonate |
| 4e | Thomas Co., GA | Severe corrosion | Drilled | Confined carbonate |
| 4f | Chatham Co., GA | BTEX | Drilled | Confined carbonate |
| 4g | Chatham Co., GA | BTEX | Drilled | Confined carbonate |
| 4h | Monroe Co., GA | Nitrate | Drilled | Crystalline rock |
| 5a | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5.b | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5c | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5d | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5e | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5f | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5g | Jackson Purchase, KY | Bacteria | Bored | Alluvial |
| 5h | Chatham Co., GA | BTEX | Drilled | Confined carbonate |

identifying water quality problems, the type of well (bored or drilled), and type of aquifer the well was cased into. Figure 1 describes the distribution of these locations across Georgia and Figure 2 shows the location of the Jackson Purchase area.

The still frames captured from the video footage have been sorted into three general categories, organisms, leaks, and foreign material. Photographs of organisms (arthropod, insect, annelid, mollusk, plant part, and bacteria/fungi colony) are shown in Figure 3, consisting of: 3a) centipede, 3b) grub, 3c) microbial colony on pump intake, 3d) peach tree roots, 3e) plant roots, 3f) root growing down old steel casing into a deep confined aquifer (Floridan), 3g) slug, 3h) earthworm living in a mat of plant roots.

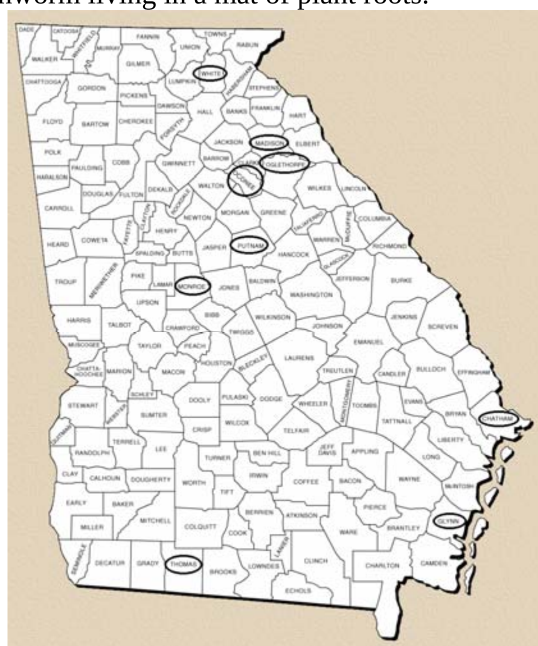

**Figure 1. Locations of the study wells in Georgia**

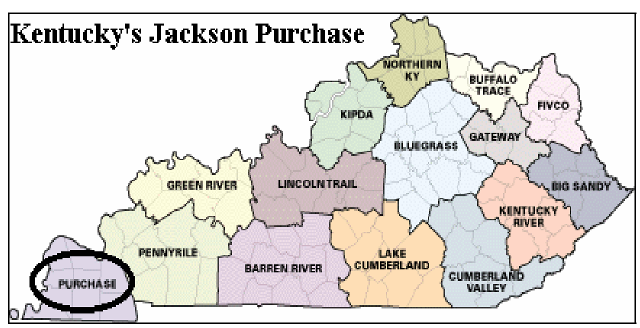


**Figure 2. Location of the Jackson Purchase area in Kentucky**

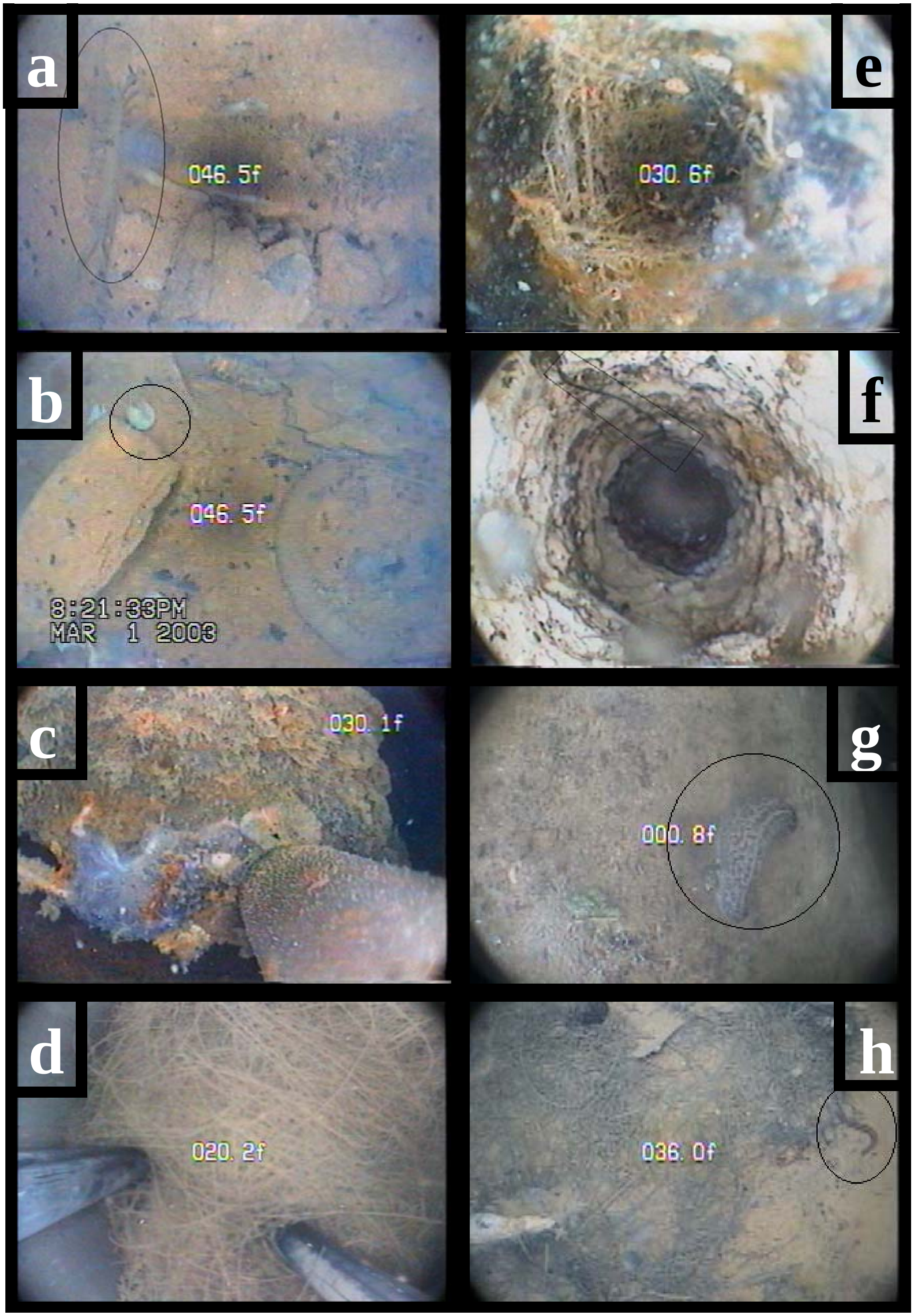


**Figure 3. Organisms observed in wells: a) centipede, b) grub, c) microbial colony on pump intake, d) peach tree roots, e) plant roots, f) root growing down old steel casing into a deep confined aquifer (Floridan), g) slug, h) earthworm living in a mat of plant roots**.

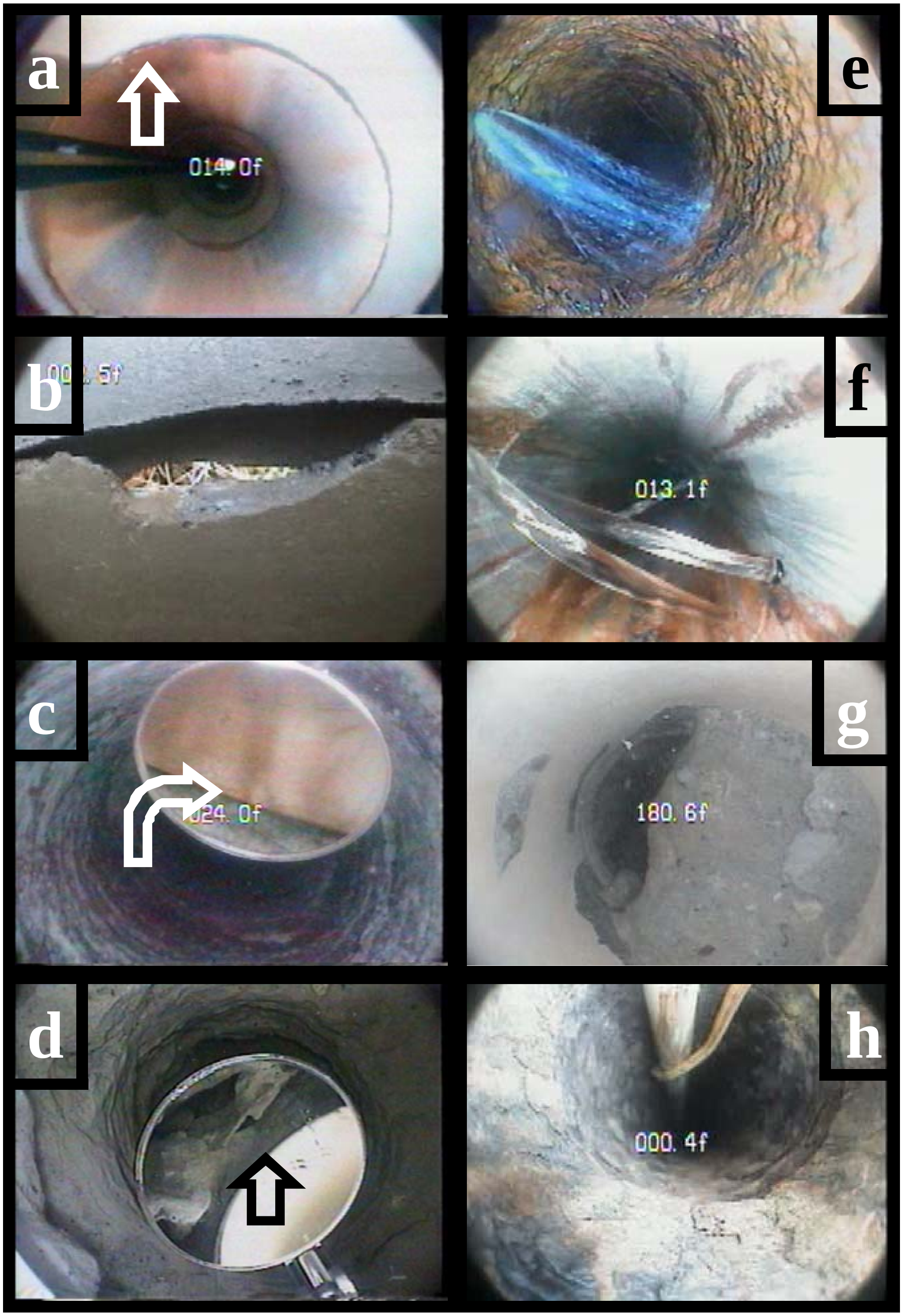


**Figure 4. Leaks, seepage, and holes observed in wells: a) iron staining due to shallow seepage through a casing joint, b) hole in the casing at ground level, c) mirror image of a leak at the junction of the casing with bedrock, d) mirror image of a leak at the junction of the casing with the confining unit , e) hole through old steel at the alluvial aquifer zone in a confined aquifer well, f) holes in galvanized steel in the alluvial aquifer zone in a confined aquifer well, g) encrustation caused by a leak at a casing joint, h) severely corroded steel.**

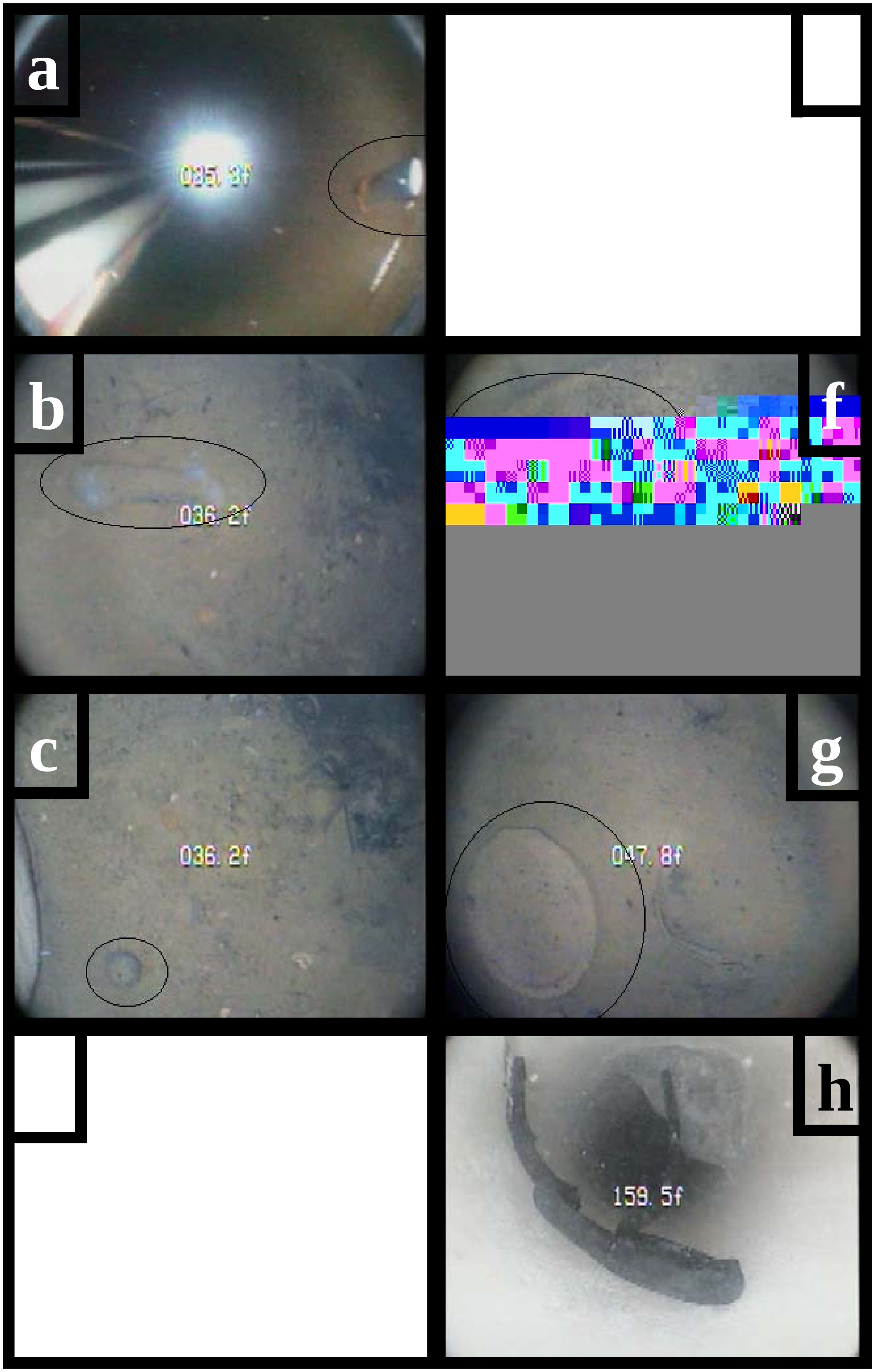


**Figure 5. Foreign material observed in wells: a) plastic disposable lighter, b) nylon dog chew bone, c) ball, d) leaves, e) nail, f) hair dryer, g) pie pan, h) electrical wire.**

Figure 4 contains the pictures of leaks, holes, and seepage that are specifically described as: 4a) iron staining due to shallow seepage through a casing joint, 4b) hole in the casing at ground level, 4c) leak at the junction of the casing with bedrock, 4d) leak at the junction of the casing with the confining unit, 4e) hole through old steel at the alluvial aquifer zone in a confined aquifer well, 4f) holes in galvanized steel in the alluvial aquifer zone in a confined aquifer well, 4g) encrustation caused by a leak at a casing joint, 4h) severely corroded steel. Foreign materials seen in wells are revealed in Figure 5 and consist of: 5a) plastic disposable lighter, 5b) nylon dog chew bone, 5c) ball, 5d) leaves, 5e) nail, 5f) hair dryer, 5g) pie pan, 5h) electrical wire.

## CONCLUSIONS

Video inspection of well bores effectively explained the presence of pollution in groundwater in cases where simple wellhead inspection would not. Plant and animal organisms indicated that the shallow groundwater in many bored wells is under direct influence from surface-water (Figures 3a, 3b, 3c, 3d, 3e, 3g, and 3h). In Figure 3f, a plant root was seen growing into a deep confined Floridan aquifer. This well was over 50 years old and the steel casing was leaking and almost completely corroded (Figure 4e). Wells or groundwater that harbor these organisms cannot be expected to be free of coliform bacteria. This study was unable to determine if these organisms were indigenous in these aquifers or present only because these wells had introduced surface-water.

Identifying inadequacies in well construction such as leaks, holes, and shallow seepage explained the pathways for both bacterial and chemical contaminants (Figures 4a, 4b, 4c, 4d, 4e, 4f, and 4g). In most cases grouting would have prevented or appreciably reduced these problems.

Deterioration of construction materials was identified in Figures 4e, 4f, 4g, and 4h, which were corrosion of steel casing in all instances. The inability to achieve a watertight seal of casing with rock or the confining unit was observed in two wells (Figures 4c and 4d, a crystalline rock and a confined aquifer well, respectively). Grouting the lower portion of the entire length of casing would have prevented this.

Over the years wells can accumulate foreign material that may not cause problems as seen in Figures 5a, 5b, 5c, 5d, 5e, 5f, 5g, and 5h. However, this serves as a warning or indicator that if it will fit, it can enter a drinking water well.

## DISCUSSION

Down-well video inspection of water wells is an effective step beyond traditional wellhead inspections. This visual information has an application to Extension programs designed to educate private water well owners. Complex hydrogeology and water well engineering principals can be easily conveyed with a photograph.

## LITERATURE CITED

Tyson, T., 1993. Wellhead protection for private domestic wells. University of Georgia, Cooperative Extension Service. Circular 819-12.