

Hillsborough County Wet Well Dilemma: Fall Protection Evaluation and Implementation at Its Pump Stations

Brian J. Lewis, David D. Fox Sr., and Nicholas Eckhardt

Founded in 1834 and boasting a population of approximately 1.4 million, Hillsborough County (county) is the fourth most populous county in Florida. The Hillsborough County Water Resources Department (HCWRD) provides drinking water and wastewater treatment services to the unincorporated portions of the county.

The HCWRD operates four water treatment plants, eight wastewater treatment plants, a biosolids facility, and administrative and field support facilities. The sewer system serves an area of 294 sq mi, with 171,009 sewer connections, and includes 826 collection system sewage pump stations.

Each pump station receives routine cleaning and maintenance services performed by HCWRD personnel. The HCWRD promotes a strong safety culture and is continuously looking for opportunities to improve safety for its staff. Currently, the relevant standard operating procedures (SOPs) for maintenance at the pump stations include fall hazard protection and tie-off points. These points are typically located on existing pump station features, such as:

- ◆ Control panel supports
- ◆ Fence posts
- ◆ Maintenance trucks

The availability and location of tie-off points vary greatly between stations, since there are many different station configurations, and over the years, HCWRD built the stations to varying standards.

In 2018, HCWRD investigated standardizing the safety equipment used. It retained Black & Veatch, a consulting engineering firm, to review available safety options for working in or around openings; specifically, the HCWRD pump stations wet wells. Black & Veatch worked with HCWRD to review the various station configurations and examine representative sites containing various tie-off point configurations. The goal is to develop a safety solution that covers various station sizes and layouts.

Part of the safety solution was defining the type of safety coverage. The primary concern is employee safety; therefore, fall protection and fall prevention are defined as follows:

- ◆ *Fall protection systems* use tie-off locations and fall arresters to limit the distance and force on the user's body during a fall.
- ◆ *Fall prevention systems* prevent the user from being able to proceed past the edge of the fall hazard by employing either a physical barrier (such as a railing) or fall

Brian J. Lewis, E.I., is an engineer intern, and David D. Fox Sr. is assistant section manager, with Hillsborough County Water Resources Department in Tampa. Nicholas Eckhardt, P.E., is a project manager—water, with Black & Veatch in Tampa.

restraint system (such as lanyards with tie-offs) designed to prevent the employee from passing the edge of the wet well.

A fall may still result in injury or death, even though a fall protection system fall arrester prevents an employee from falling to the bottom of the wet well. The fall may result in an employee being trapped in the wet well, unable to climb out, unconscious as a result of the fall, and/or overcome with toxic fumes.

Some sites are remote (with no cellphone service) and a single employee performs most maintenance work. Reducing or eliminating these risks drives the county forward in its safety goals with fall prevention procedures.

Continued on page 10



Figure 1. Existing station tie-off to electrical panel supports.

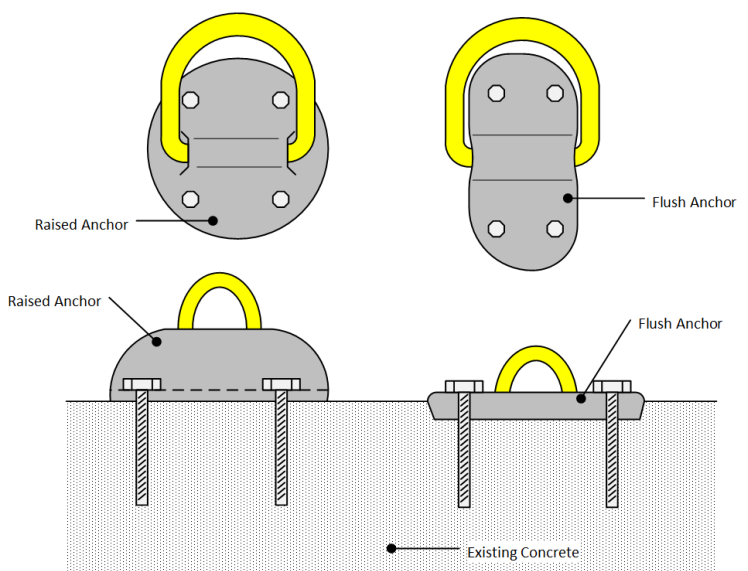


Figure 2. Ground anchor connections.

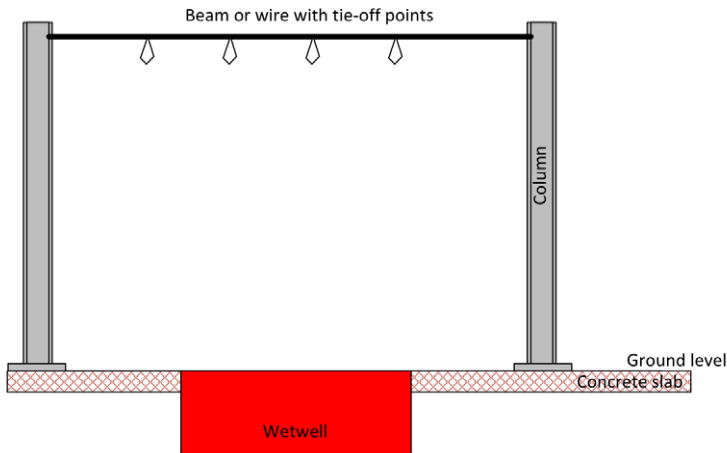


Figure 3. Representation of an overhead system.



Figure 4. Existing site with permanent railing.



Figure 5. Staff demonstrating use of portable railings.



Figure 6. Current pump station with safety grate.

Continued from page 8

Safety Options

There are many different safety options, and Black & Veatch's engineers and safety experts examined fall prevention methods specific to HCWRD's needs.

The HCWRD has recently purchased self-retracting lifelines/lanyards with fall arresters. These lanyards are 9 ft long and used to tie off electrical panels, fence posts, or service trucks. These anchor points are at various locations around the site, and they aren't positioned well for equipment use, wet well access, and work efficiency.

The following safety options were explored, which include a brief explanation of their use.

1. *Continue Tie-Offs to Existing Infrastructure.* Per Occupational Safety and Health Administration (OSHA) requirements, each tie-off point for fall protection must be able to withstand 5,000 lb per person. The structural design of the existing infrastructure (Figure 1) was analyzed and it was determined that the infrastructure was

of varying standards and not strong enough to use as tie-off points. Tying off to existing infrastructure is a low-cost option, since the infrastructure and lanyards already exist; however, since the infrastructure strength is insufficient, it does not present a viable option.

2. *Add Tie-Offs to Ground Anchors.* This includes adding multiple ground anchors around the site to provide tie-off locations that allow access to each part of the station. This option may require removal of existing concrete to install the anchors (Figure 2), but is, overall, a lower-cost option. The main disadvantage is that the tie-off points are installed at ground level, and for the fall prevention to be effective, tie-off points need to be overhead (above the personnel attachment point of the harness).
3. *Install Overhead Beams or Cables for Anchor Points.* This option puts the tie-off locations overhead, which meets proper tie-off requirements; however, this option can be quite costly, will not include full coverage at all sites, and is unsightly for neighbors adjacent to the pump station (Figure 3).
4. *Permanent Railings.* Permanently installed railings

are in use at some HCWRD pump stations (Figure 4), and the railings, with access gates, were evaluated. The railings provide full fall prevention; however, when the gate needs to be opened for certain maintenance activities, there is a fall risk.

5. *Portable Railings.* Similar to the permanent railings, this option is for portable-type railings with gates (Figure 5). These railings are adjustable for each unique site layout where installing permanent railings isn't feasible due to space constraints or station configuration.
6. *Safety Grates.* This option includes installing a grating that covers the wet well opening when the hatch is open (Figure 6); the grating then folds upward to serve as protective barriers similar to railings. The grating is removable when necessary for access, but doing so removes the fall prevention. This option was deemed to be cost-prohibitive.
7. *Vehicle Hitch Mount.* The HCWRD could outfit every maintenance truck with a hitch-mount system to eliminate the fall hazard when accessing wet wells. The operator can place the hitch-mount system as needed to access the site

to provide an overhead tie-off location (Figure 7). The only limitation is that there may be some sites where truck access is not available. The system has the advantages of being portable, useful for most sites, and available from multiple locations on a single site when used in conjunction with floor-mount davit bases.

8. *Fall Arrest Anchor Post.* This option utilizes a fall arrest anchor post with permanently installed anchor points (Figure 8). This system is similar to the hitch-mount hoist in functionality, but instead uses permanent anchor points. The operator can move the single unit as needed to each anchor point. These provide adequate tie-off locations for multiple users, but are difficult for a single employee to move around at the site.
9. *Safety Alert System.* There are several devices available that can send a manual or automatic emergency request and track employees when in use (Figure 9). The systems detect falls and can be programmed to automatically call a designated person when an event occurs. They use cellphone service, which could be an issue at a remote site. Another disadvantage is that the unit may not be easily accessible during an emergency, could have a low or dead battery, and is not proactive as a fall prevention measure by itself.

Design Options

After reviewing and discussing the safety options, HCWRD decided to move forward employing a mix of them. These options would be standardized and allow for full coverage for each existing station configuration, as well as new stations.

1. *Railings.* The HCWRD will provide a certain amount of portable railings to be used as needed. These will be set up to provide fall prevention when there are multiple employees or visitors present at the site. The railings could limit certain maintenance activities, but will allow flexibility for routine inspection activities and provide a solution for smaller sites. For some larger sites, HCWRD can install permanent railings if the specific layout, and where the station design, calls for it.
2. *Hitch-Mount Hoists.* Each maintenance truck is supplied with a hitch-mount hoist. Operators can position a single truck or multiple trucks to provide tie-off points around the station. At some sites, multiple trucks (or even a single truck) will have difficulty with positioning to allow adequate tie-off locations. To account for this, the installation of floor- or flush-mount davit bases in multiple locations around the site will provide additional anchor points for situations where multiple employees are onsite. These anchors allow moving the hitch-mount hoist from the hitch mount to these ground anchors.
3. *Portable Anchor Post.* For certain stations when there is limited truck access to the site for

hitch-mount hoists, anchor posts will be used to provide tie-off locations. This post system is specifically designed to allow for multiple employees to simultaneously connect and can be moved around to different anchor points

located around the site. This post system is currently installed in two stations and provides adequate fall protection, but is not compatible with the hitch-mount system.

Continued on page 13

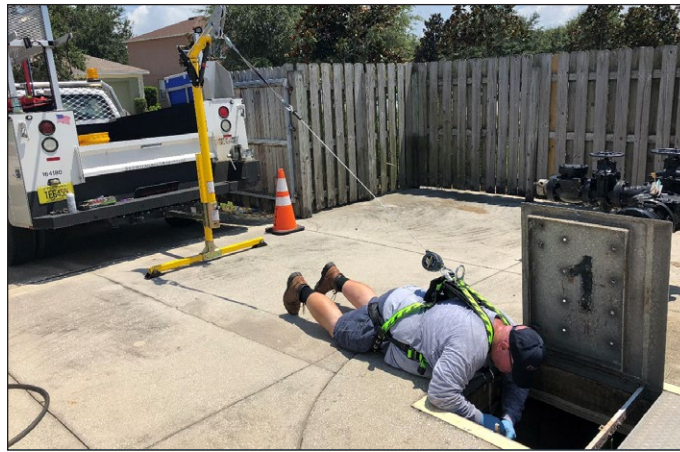


Figure 7. Staff demonstrating use of a hitch-mount system.



Figure 8. Fall arrest anchor post (left) and post ground anchors (right).

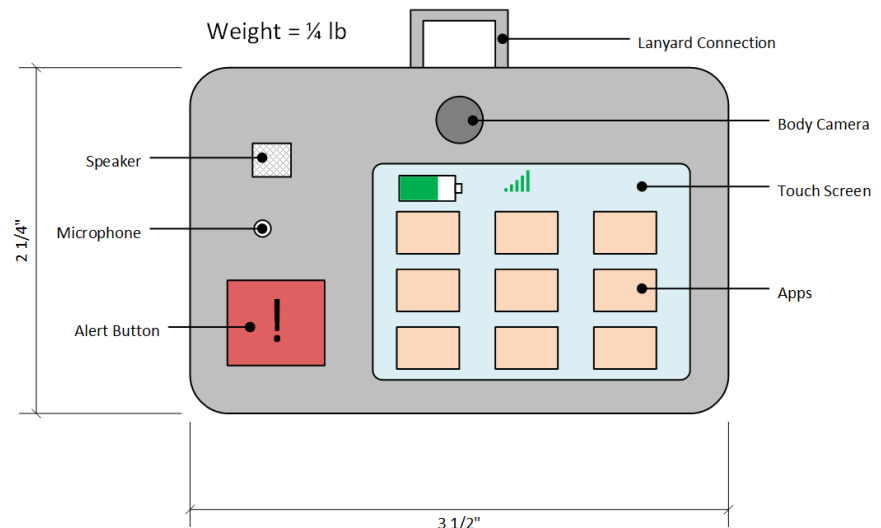


Figure 9. Representation of a safety alert system.

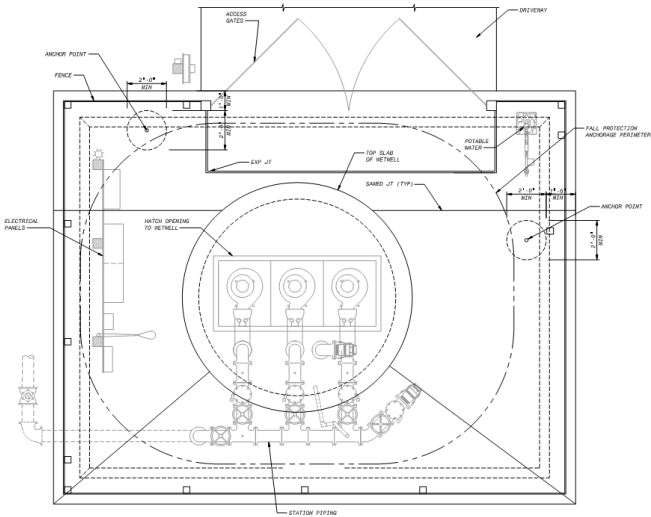


Figure 10. Existing pump station standard layout/configuration with new anchor points.

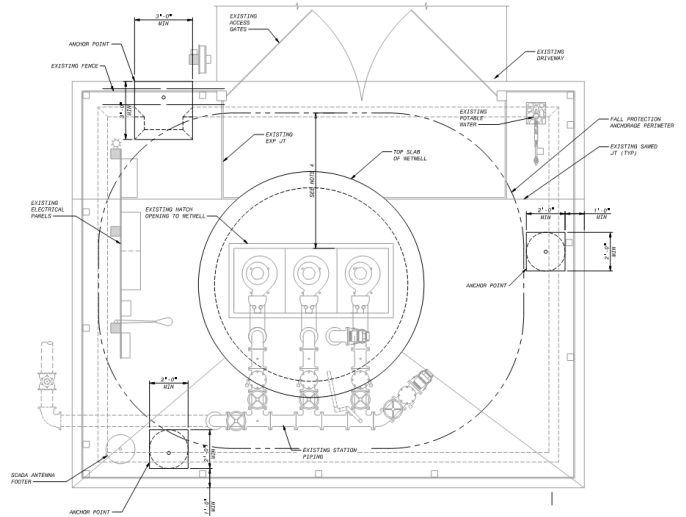


Figure 11. New pump station with anchor points.

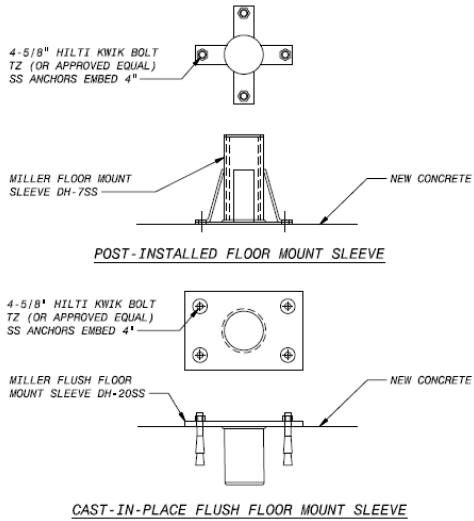


Figure 12. New flush-mount floor sleeve with thickened slab.

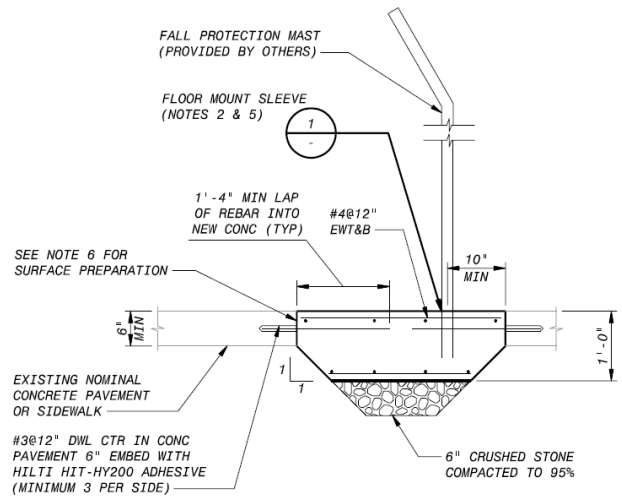


Figure 13. New raised pedestal floor sleeve.

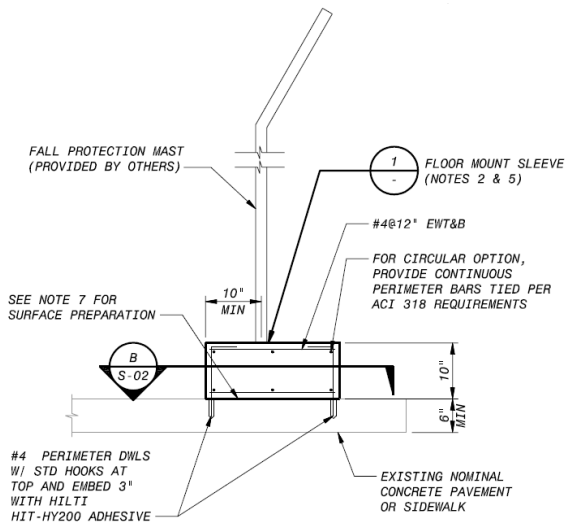


Figure 14. Free-standing base.

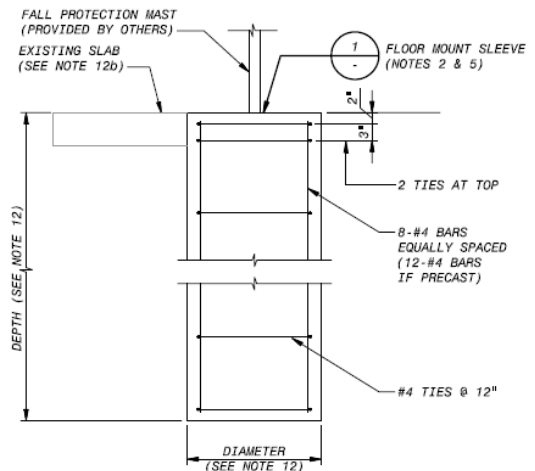


Figure 15. Anchor types.

Implementation

Part of implementing the fall prevention plan is to cover both existing and new sites. The HCWRD asked for a site layout design for existing sites. For typical site activities, a maintenance truck accesses the site and uses the hitch-mount system. The site layout design provides for multiple points to install floor- and flush-mount davit bases that accept the hitch-mount hoist. The site design also identifies the locations for the davit base system.

Site visits help determine the locations around the site, with an estimated two anchor points per station. Anchor points are located to account for access to the electrical panel and wet well, while including structural limitations, such as the edges of concrete, slab expansion joints, and distance from other anchor points.

Site layout design structural considerations account for the forces on the davit bases in the event of a fall. Multiple base footing options were designed as follows:

- ◆ Slab thickening
- ◆ Raised pedestal
- ◆ Free-standing base

These foundation designs, combined with the hoist receiver options of a flush- and floor-mount sleeve, allow for flexibility in retrofitting various existing site layouts and structural conditions. Each existing station will be examined for wet well access and safety connection requirements. For new (future) pump stations, HCWRD will implement “safety by design” by incorporating a fall protection system into the standard configuration (Figure 10).

Retrofitting the 826 existing pump stations will be a significant challenge. A new station site layout provides for safety in future stations. The overall layout and options are similar to the retrofit design, but with a few key differences. Options for installation can be simplified and standardized, since new stations will adhere to the updated HCWRD standards (Figures 11-15).

The HCWRD’s existing SOPs must be updated to implement these fall prevention safety systems and station-specific uses, along with employee training.

Components, such as lanyards and hitch-mount hoists, have been purchased by HCWRD. The systems will be installed in the future at existing stations, and new stations will incorporate the safety systems by design.

Conclusions

The HCWRD considers it very important to involve its employees in the process of selecting a new fall protection system and to get their input

into what systems are the easiest to use and will best integrate into the SOPs. This encourages employee buy-in and the likelihood that they will use the equipment after installation.

After the initial safety option recommendations were made, HCWRD purchased small quantities of the preferred equipment (Figures 16 and 17) and had maintenance teams use the equipment and provide feedback, which went into the final determination of which options to use. It was found, however, that no single solution could accommodate all situations

due to the large variation of design standards and layouts for pump stations over the years.

It’s very important to have multiple solutions covering all the different designs. The HCWRD estimates that approximately \$4 million will be needed to purchase and install the equipment needed to retrofit its 826 pump stations, which is approximately \$4,500 per station. The work is scheduled to be complete by the end of 2022. The county is adding the new floor-mount davit

Continued on page 14

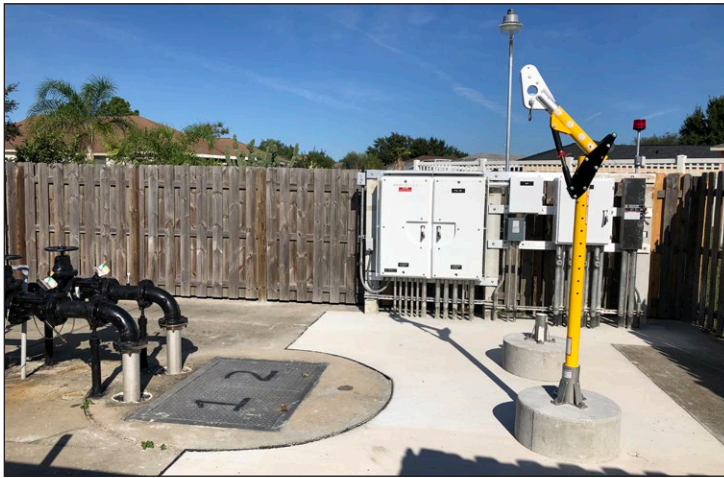


Figure 16. Recently installed flush-mount anchor does not block access or introduce a trip hazard.



Figure 17. Recently installed pedestal mount anchor.

Continued from page 13

receptacles to its standards and estimates an additional \$3,500 per station for new pump stations.

The vehicle hitch-mount system was installed by HCWRD on its fleet of maintenance trucks and its use is now incorporated in the SOPs. It's effectively being used on a daily basis and employee feedback has been positive. Floor- and flush-mount

davit bases that accept the hitch-mount hoist have been installed in 41 pump stations to date, and there is a contract to complete a total of 90 stations by early 2021 with a continuing services contractor.

Portable railing systems have been purchased and are in use at pump stations that are too small or have access issues to preclude the use of the vehicle hitch-mount system. The portable anchor post

system is in use at two pump stations and has been purchased for installation at another eight stations.

Floor- and flush-mount davit bases have been purchased for installation at another 250 pump stations. Once scoping is completed, additional contracts with continuing services contractors will be set up for installation. ◊