Considerations and Costs for Water, Sanitation, & Hygiene System Improvements for Health Care Facilities

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Introduction

This paper is designed to give the reader a universal view of critical Water, Sanitation, and Hygiene (WASH) assets and how they serve Health Care Facilities (HCFs) in the developing world. We added Education and Capacity Development as a final section because they are the foundation of sustainable WASH resources for HCFs. For each WASH asset we provide insight into issues and components to consider when attempting to improve the WASH status of an HCF. The insights are further broken down into cost estimates for consideration purposes. The cost estimates are provided in basic ranges based on assumptions from recent project experience in Latin America and Africa. **The reader/potential donor is advised to look to site-specific evaluations and analysis for actual cost for WASH improvements at specific HCFs.**

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Quick Glance: WASH Assets and Estimated Cost

WASH Asset Type	Cost (labor & materials)
Water (Source to Tap)	
Source of Supply	
▪ Rainwater catchment systems	$1,000-$5,000
▪ Springwater catchment	$3,000-$10,000
▪ Groundwater wells	- A drilled groundwater well with submersible pump - $50,000 to $200,000 - Handpumps $50 to $500
▪ Surface water diversions	$5,000-$20,000.
▪ Physical connections	$25,000 to $100,000
Transmission	$5/meter up to $100/meter
Treatment	
▪ Rainwater catchment	- Filtration - $750 to $2,500 - Chlorination - $50-$100/month - Boiling - $30-$100 - SODIS – practically free
▪ Springwater and groundwater	- In-line tablet - $25-$50 per unit - In-line liquid - $500-$1,250 - On-site chlorine generation - $2,500-$10,000
▪ Surface water	$80,000-$200,000
Storage	- Plastic - $500-$2,500 - Ferrocement - $250-$1,250 up to 3,000 liters - Concrete/Block - $1,000-$10,000 - Steel - $3,000-$30,000
Distribution to Taps/Connections	- Network - $10/meter-$50/meter - Tap stands - $50-$150
Sanitation	
Human Waste Disposal	
▪ POU Latrines	- Pit - $200-$600 - Composting - $400-$600 - Bucket Flush w/septic - $2,000-$5,000
▪ Wastewater Collection Systems and Treatment	$20,000-$100,000
Grey Water Disposal	- Single sink - $200-$500 - Multiple sinks & showers - $500-$2,500
Site Drainage	Site - $1,000-$5,000
Solid Waste Disposal	Complete - $2,500-$10,000
Hygiene	- Tippy Tap – practically free - Sink & Shower - $300-$500
Education/Capacity Development	- Add education and Cap Dev to WASH asset add 15% to project cost. - Circuit Rider Program - $200 and $1,000 per year per HCF, assuming that a circuit rider would cover 12-15 HCFs per month.

Water (Source to Tap)

Water as it pertains to WASH systems in HCFs is made up of 5 main components: source of supply, transmission from source to treatment, treatment, storage, and distribution to taps/connections. Water systems vary in size based on the geographic area of the service population and the water demand of the service population. The scale, location, sourcewater quality, age, and operation & maintenance of the system adds complexity to the cost to build, repair, renovate, expand and/or improve. For water systems serving HCFs these variations and complexities follow a similar trend based on size and service population of the facility. We have broken down the system components below with further discussion and basic labor and material cost estimates.

Source of Supply:

Water supply to HCFs can either be self-supplied infrastructure or a physical connection to an external system. Both types of supply bring their own challenges. Self-supplied systems fall into four main categories of water systems: Rainwater catchment, Springwater catchment, Groundwater wells, and Surface water diversions. When a HCF has a physical connection to an external system, the source of supply is that of the external system. Both self-supplied sources and physical connections to an existing distribution system have water quality and quantity issues that will need to be addressed with treatment technologies and storage capacity, respectively.

Considerations:

- Rainwater catchment systems for HCFs are relatively inexpensive to construct but only provide a reliable source of supply in areas where there is adequate rainfall year-round. Often rainwater systems are built to complement other sources and/or systems. Rainwater can be treated and used for drinking, wash, and flush water. Rainwater systems utilize HCF roofs and gutters or a constructed catchment area to capture the rain and deliver it to tanks. Rainwater systems are dependent on large storage tanks to adequately supply water during dry times.
    - Rainwater systems include catchment, gutters, piping, treatment, storage, and distribution to a tap stand. Labor and materials for Rainwater catchment range from $1,000-$5,000. Considerations and costs for treatment and storage tanks will be addressed below.
- Springwater catchments take spring water from geologic features like mountainsides, canyons, gulches, etc. The water is piped to the HCF site, treated, and put into a storage tank or directly into the distribution system (these costs will be addressed in the transmission, treatment, storage, and distribution sections below). Spring sources can provide adequate quality and quantity in some areas and be particularly challenging in quality and quantity in other areas. Local knowledge is key to understand the source reliability.
    - Springwater catchment refers to the development of a spring area and the construction of the spring box to capture the water and send it into transmission. Labor and materials costs for spring development and spring box construction range from $3,000-$10,000.
- Groundwater wells require extensive knowledge and investment on the construction side but can be a significant source of quality supply for HCFs. Wells are developed on-site within the HCF compound or nearby where the borehole will produce the required amount of water. In some cases, groundwater wells can be hand dug, but where water is close to the surface there are water quality considerations (i.e. contamination). After well development and protection a hand pump or submersible pump is placed on/in the well below the water table level. For hand pumped wells the water is captured at the outlet of the hand pump and then carried to the location for use. Drilled

wells with submersible pumps the water is typically pumped through a treatment system then stored in elevated storage tanks on the HCF site. Knowledge of the local groundwater hydrology and an experienced well driller is critical to project success.

  - A drilled groundwater well requires a hydrological analysis, drilling technology (drill rig), well development, pump tests, well casing, well screens, sounding tube, drop pipe, submersible pump, wellhead, and wellhead piping. Labor and materials for a groundwater well range from $50,000 to $200,000.
  - Handpumps can be installed on a drilled well or a hand dug well but are limited to well depths of 100 meter for installation and ability to access the water. Handpumps can be produced locally with PVC or can be purchased. Their costs range from $50 to $500.

- Surface water diversions require a constructed structure to divert water naturally from a ditch, stream, river, or lake. Surface water is diverted into holding ponds at the top of a treatment train (surface water treatment will be addressed in the treatment section below). The diversion structure is built to capture water while letting debris flow over or past the structure. Some diversion structures are built to add a primary filtration process to the captured water.
  - Surface water diversion structures that could be used in HCFs would be in areas where ditches, streams, rivers and or lakes are the only source of supply. The diversion would be smaller in scale than a ubiquitous municipal surface water system. Small scale-surface water diversion structures including labor and materials range from $5,000-$20,000.
- Physical connections to an external system require that the HCF is within the service area of an existing water system. The HCF typically owns and manages its own treatment, storage, and distribution to tap stands. This internal system is connected to the existing system at the street entrance to the HCF. The HCF then pays a monthly rate for the water use whether metered amounts or agreed upon amount. The HCF is then reliant on the external system to provide adequate quantity and quality. As many of the external systems in the developing world have inconsistent service, inadequate water quality, and regular outages, the HCF will need its own treatment system and storage adequate to survive outages.
  - Master connection systems range from $25,000 to $100,000 for the internal treatment, storage tank, and distribution system including labor and materials. In addition, the HCF will need to pay the monthly fee billed by the external system.

Transmission:

The transmission component of a water system refers to the piping from the source to the storage facility. Transmission lines can be short when the HCF is close to the source. For example, when a well is drilled on-site or nearby, the transmission line runs from the well through a treatment system and into the storage tank. In the case of a spring capture, the transmission line runs from the spring to the HCF – which could nearby or far away. Transmission lines are designed to carry the maximum flow from the source(s) and can either be gravity-flow or pumped. Most transmission lines are built using PVC or HDPE pipe, or in some cases galvanized steel pipe is used where pressures are high, stream/gulch crossings, or when burial is not an option.

Considerations:

- As with all underground piping, transmission lines require adequate burial to be protected from frost and vehicle, or animal traffic on the surface. They also require proper bedding below the piping, so the line is not damaged by hard edges in the sub-surface. Transmission lines vary in length and diameter depending on source location and source quantity. Geology of the transmission line route will affect cost as will land tenure on the route and the need to acquire rights of way (ROW).

- Transmission line cost is measured in $/meter which includes labor & materials, additional cost such as geologic analysis, ROW, sub-surface boring are not included in the estimate. Transmission line cost can range from $5/meter up to $100/meter depending on the route that the line has to take.

Treatment: The treatment components of a water system is designed to eliminate, inactivate, or neutralize contaminants that could be harmful for human health. Waters sources have different types of contamination thus there are a few basic kinds of water treatment to highlight for the sources of supply discussed above. In general water treatment for HCFs can be broken down into 5 categories: Filtration, Aeration, Chemical Disinfection (Chlorination), Ultraviolet Disinfection (SODIS), and Boiling.

Considerations:

- Rainwater catchments are subject to contamination from the atmosphere and the catchment surfaces. Dust in the atmosphere where the rain falls or dust and dirt that collect on the catchment surfaces contaminate the rainwater and thus pose a contamination risk. Rainwater if stored for a long time without treatment will foul and develop taste, odor and potability issues related to the breakdown of organics and other particles. Treatment for rainwater begins by purging/wasting the first few minutes of rainfall to eliminate surface contamination of the catchment area. Basic filtration after the purge can help eliminate smaller particles. Chlorination or boiling after filtration will make the rainwater potable for immediate consumption or for a small time in storage. Chlorination of unfiltered rainwater is not recommended. Once the filtered rainwater is in storage it will need aeration if kept for long periods and will need chlorination or boiling at the time of human consumption.
  - Rainwater treatment systems that could be used in HCFs need to be self-cleaning and functional as not to burden HCF staff with extra tasks. There are self-purging and primary filtration units that fit on existing downspouts or fit onto outlets of other catchment area types. These units (materials and labor) range from $500 to $1000. Storage tank aeration units (dependent upon either electrical or solar power) range from $750 to $2,500 help keep the rainwater fresh by oxidizing/settling organic compounds.
  - Chlorination for rainwater systems would most likely either be by tablets or liquid placed in the storage tank (for larger systems), or point-of-use liquid bleach addition to containers used to collect the water at the tap for use in the HCF. Chlorination of rainwater would inactivate any biological contamination present and make the water potable for drinking and safe for use. Cost of either chloring tablets or liquid chlorine vary by location and availability but a broad estimate for chlorinating a rainwater system would be $50-100/month.
  - Boiling rainwater for potability is another form of contaminant inactivation and is effective for making water safe to drink and use. Cost estimates for boiling rainwater vary by location and fuel availability, a broad estimate for boiling rainwater for drinking and HCF use would be $30-100/month.
  - Ultraviolet disinfection, aka solar disinfection or SODIS is a process that uses 1-liter clear glass or clear plastic bottle capped containers left in the sun for more than 24 hours to inactivate any biological contaminants. This method is practically free, but time consuming, only provides as much water as you have containers for, and dependent upon full sun.

- Springwater and groundwater quality both depend upon what the aquifer quality is in the area. These sources tend to be relatively contaminant free compared to surface water, but if the aquifer is contaminated either from surface sources or breakdown of aquifer materials, the water may be unfit for consumption and use. It is imperative to test the water quality of a spring or groundwater source before putting it into a water system. Most groundwater and spring water sources can be treated with chlorination to maintain potability in storage and distribution.
    - There are two types of in-line chlorination systems that work well for groundwater wells and spring fed systems: tablet chlorinator and liquid injection chlorinator. Because both water systems use a transmission line from source to storage tank, it is ideal to place an in-line chlorinator on the transmission line before it reaches the storage tank. Once the chlorine is fed into the water it has contact time in the storage tank to inactive biological contaminants before it runs into the distribution system. In-line tablet chlorinators can be produced locally from PVC parts and range from $25-$50 per unit. Liquid injection chlorinators are more complex, manufactured off-site, require a power source, and require liquid chlorine. They range from $500-$1,250 per unit. Both in-line systems require personnel to operate and maintain the units on a daily/weekly basis. It is imperative to have a consistent supply of chlorine liquid or tablets.
    - On-site generation of chlorine from salt, water and electricity would be an option for larger HCFs where disinfection is critical for water supply and the facility. These units range from $2,500 to $10,000.
- Surface water sources require robust treatment technology to eliminate contaminants found naturally in stream, rivers, lakes. Surface water is diverted into holding ponds at the top of a treatment train. A basic treatment train consists of screens, coagulation, flocculation, sedimentation, chlorination, and filtration. There are multiple variations of surface water treatment depending on the source water quality. Treated water is then piped to storage and delivered to taps by way of the distribution system (these costs will be addressed below in transmission, storage, and distribution).
    - Surface water treatment systems (package plants or constructed on-site) that could be used in HCFs would be in areas where streams, rivers and or lakes are the only source of supply. The system would be smaller in scale than a ubiquitous municipal surface water system. Small scale-surface water systems range from $80,000-$200,000 including labor and materials. It should be noted that these small-scale systems require personnel to operate and maintain the system daily (see the Education and Capacity Development Section below).

Storage: Storage tanks (ground level and elevated), reservoirs, cisterns, etc. are critical components of water systems as they add additional supply capacity to the system, provide additional pressure to the system, and allow any chemical treatment (i.e. chlorine) to have contact time before entering the distribution system. Storage tanks vary in size based on the type of water system, and the water supply/demand analysis of the HCF. They also vary in materials and construction methods. The main types of storage tanks are plastic, ferrocement, concrete/block, and steel.

Considerations:

- The sizing and location of the storage tank(s) for a HCF is the most important consideration. For sizing and value, the HCF needs to know what their daily water demand would be for operations (washing, sanitizing, cooking, cleaning, drinking, etc.). The World Health Organization has minimum requirements that can be used to understand the HCF needs. In addition, the HCF needs to know whether it will grow in services or facilities in the coming years to understand a projected future water use. The location of the storage tank has multiple considerations. Three key considerations are elevation above the HCF for pressure, land tenure of the tank site for security of the asset, and seismic activity in the area for tank material selection and elevated location.

- One of most cost-effective solutions for water storage at HCFs are plastic tanks. Plastic tanks can be found almost everywhere and are easy to transport to site. Plastic tanks can be placed between the source and the HCF to allow for treatment and elevation to attain adequate pressure in the distribution system whether by placing on a tower or nearby hill. Plastic tanks range from $500 for a 1,500-liter tank up to $2,500 for a 15,000-liter tank.
- In some areas where plastic tanks are unavailable/inaccessible or local skilled labor is at a level to construct ferrocement tanks, these tanks are constructed with chicken wire, cement and sand, and cost half the amount of a plastic tank. Ferrocement tanks max out at 3,000 liters.
- Concrete/block tanks are effective storage facilities for larger water systems and require skilled labor and the necessary materials for construction. Concrete/block tanks are desirable in hot climates as they keep the source water cool. Smaller concrete/block tanks can be elevated for on-site use and to build adequate pressure in the distribution system. Concrete/block tank costs vary by area, availability of skilled labor and materials. A general estimate for a concrete/block tank is $1,000 for a 2,000-liter tank up to $10,000 for a 30,000-liter tank including labor and materials.
- Steel storage tanks are expensive but are durable beyond any of the previous mentioned tanks if they are taken care of. Access to steel storage tanks in the developing world is low if not non-existent. In general steel storage tanks cost double or triple that of the concrete/block storage tanks.

Distribution to Taps/Connections:

The distribution network begins after the storage tank and runs to outdoor tap stands, and/or other interior plumbing connections such as boilers, toilets, hose bibs, and/or fire hydrants. As mentioned above these systems can be complex in the municipal setting, but for the purposes of HCFs, distribution networks could be as simple as one central tap stand for use, or based on the size of the HCF the network could have multiple internal and external connections for multiple uses. Some basic HCFs will have a distribution network where the source is piped directly to the network and thus the tap stands continue to flow at the rate of the source input. In other, more common cases, the distribution network starts after the storage facility and is under pressure due to the elevation of the storage tank. Most distribution networks are built with PVC or HDPE pipe and buried below ground level. The user accesses the distribution network through interior taps/faucets or exterior protected tap stands. In larger HCF such as hospitals, the distribution network feeds interior connections that are then plumbed to taps, boilers, toilets, hydrants, etc.

Considerations:

- Like transmission lines, distribution networks require adequate burial to be protected from frost and vehicle, or animal traffic on the surface. They also require proper bedding below the piping, so the line is not damaged by hard edges in the sub-surface. Distribution networks for HCFs tend to be small in diameter due to the supply/demand analysis (ranging from 21.5mm to 60mm)
  - Distribution network cost is measured in $/meter which includes labor & materials. Distribution network cost can range from $10/meter up to $50/meter.

- Exterior tap stands in the HCF compound require galvanized steel pipe and fitting to protect the asset. Some tap stands are also encased in concrete with multiple faucets and a splash pad to direct the overflow into a drainage feature. Tap stands range in cost from $50 to $150 depending on complexity and need for security.
- We do not address interior plumbing cost estimates in this paper.

Sanitation

Sanitation as it pertains to WASH in HCFs consist of four main components: human waste disposal, greywater disposal, solid waste disposal and site drainage. Sanitation requirements of HCFs vary by facility size, geographic location, age, and operation & maintenance of the system and add complexity to the cost to build, repair, renovate, expand and/or improve. We have broken down the components below for further consideration, and basic labor and material cost estimates.

Human Waste Disposal:

There are proper human waste disposal methods at HCFs to eliminate contamination and eliminate the spread of disease. When human waste is adequately disposed of or treated the sanitation system itself becomes a barrier to disease transmission. A critical component of human waste disposal discussed below in the Hygiene Section is hand washing after the sanitation system use. All human waste disposal methods must be pared with hand washing stations to strengthen the barrier to contamination pathways. Human waste disposal has two main components: Point of Use (POU) latrines and Wastewater Collection/Treatment Systems.

Considerations:

- POU Latrines can be divided into three categories: dry pit, composting, and bucket flush toilet to an on-site septic system. Dry pit latrines are hand dug holes (typically many meters deep) covered with a surface structure (wood, bamboo, concrete slab, etc.) to allow the user to access a hole (i.e. SanPlat) or toilet structure over the hole for defecation. Composting latrines typically are built on two enclosed boxes where one box is in use and the other box is in compost mode. Composting latrines require a separation of liquid and sold waste. Liquid waste is piped to an infiltration pit and solids are collected in the enclosed box. Dry material such as ash, lime, sawdust is necessary for application on top of each defecation in the composting box. The bucket flush toilet to on-site septic systems require a toilet, septic tank, and leach field into permeable soils. All these latrine types require a secure house-like structure around the toilet areas and should be out of flood zones.
  - Basic cost estimate for a dry pit latrine including labor and materials is $200 to $600. Note that pit latrines fill up and need to be moved, incurring a future cost.
  - Basic cost estimate for a composting latrine including labor and materials is $400 to $800. Note that composting latrines require the user knows how to use them and will require monthly maintenance to operate effectively.
  - Basic cost estimates for a bucket flush toilet to on-site septic system range from $2,000 to $5,000. Note that a bucket flush toilet requires an external source of water for flushing, and the septic tank will need to be pumped every 3-5 years.
- Wastewater Collection Systems/Treatment are broken into two categories: multiple flush toilets collected to one on-site septic system, and multiple flush toilets collected to one active wastewater treatment system. Multiple flush toilets to an on-site septic system are typically plumbed into the

water supply for flushing and are set up in banks of multiple toilet rooms in a row. Wastewater is collected from the bank of toilets and sent to a primary septic tank where solids are settled and the remaining effluent is sent to infiltration pits or fields depending on the permeability of the accepting soils. Multiple flush toilets collected to on active wastewater treatment plant can be in banks of toilets or can be from multiple building on the HCF site. Like a wastewater collection system of a municipality, an active wastewater treatment plant can accept all the HCF wastewater from toilets, sinks, showers, etc. The wastewater treatment plant, whether built on site or installed as a package plant, use a basic treatment train that includes screening and griding, primary sedimentation, active biological treatment, secondary sedimentation, sludge treatment & removal, effluent treatment, discharge to waterway or injection well.

- Wastewater treatment systems (package plants or constructed on-site) that could be used in HCFs would be for larger facilities where there is interior plumbing and enough water supply to have multiple toilets, sinks, showers, etc. The system would be smaller in scale than a municipal wastewater system. Small scale wastewater systems range from $20,000-$100,000 including labor and materials. It should be noted that these small-scale systems require personnel to operate and maintain the system daily (see the Education and Capacity Development Section below).

Greywater Disposal:

Greywater for HCFs refers to water that is used for washing whether handwashing, showers, or kitchen sink use that is collected and neutralized. Greywater disposal systems are not plumbed to a wastewater facility (human waste disposal system), especially when wastewater systems are not available. In smaller HCFs where there is limited access to piped water there is often a separation of wash water from human waste disposal. Thus, sinks and showers are piped to leach pits or fields depending on the quantity of grey water flow and soil permeability.

Considerations:

- Greywater system are easy to construct and serve to eliminate wash water contamination of the HCF surroundings. In arid regions greywater systems outfall to a leach pit or field where the soil can easily absorb the water input. Occasionally these pits/field need to be renovated based on the type of solids carried in the greywater. In areas that receive more rainfall or where soil permeability is low, greywater can flow to fenced constructed wetlands for treatment that use plants and biological media to eliminate any vector transmission (i.e. mosquito transmission).
    - Greywater systems range in size and thus in cost, a simple greywater system for a bank of sinks could cost between $200-$500 including labor and materials, where a larger more elaborate system with multiple sinks & showers collected to one point would range from $500 to $2,500 including labor and materials.

Site Drainage:

Site Drainage for HCF refers to the site design that allows rainwater to flow off the site without creating stagnant water and thus potential for vector transmission. General grading of the site will allow for rainwater to flow off the site into receiving streams or lakes. When rainfall events are high or when the site needs additional design for drainage, swales and constructed drainage canals will help eliminate stagnant water.

Considerations:

- Site drainage considerations should be built into the design of a new HCF. To renovate an existing HCF for drainage considerations will depend on the size and geographic location of the site.

    - Cost estimates for grading, swales, canals could range from $1,000 to $5,000 including labor and materials.

Solid Waste Disposal:

Solid Waste Disposal for a HCF refers to collection of organics, non-organics, medical waste, and durable goods (i.e. Electronics). Proper disposal of all contaminated waste is critical to the health of the HCF and the people connected to the facility. The waste stream of a HCF depends on the types of services provided, geographic location, and service population. In many cases, the medical waste will be separated and treated by itself either in an incinerator and/or burial on site.

Considerations:

- Proper solid waste disposal at HCFs is critical so the cost estimate includes incinerators for medical waste and burial for the incinerated waste and remaining waste items.
    - Costs including labor and materials for a complete solid waste disposal site range from $2,500 to $10,000 depending on size.

Hygiene

Hygiene as it pertains to WASH in HCFs consist of the ability of either HCF personnel or clients of the HCFs to maintain their hygiene while at the facility. In basic terms this means that sinks and showers are available to people and there is soap for washing. Internal WASH components for the HCF are better captured in the CASH (Clean and Safe Health Care) methodology and are not discussed here. We have broken down the hygiene components below for further consideration and basic labor and material cost estimates.

Considerations:

- Access to sinks, showers and soap is critical for basic hygiene and the elimination of contamination and disease. As mentioned above, placement of a sink and shower adjacent to a latrine or bathroom allows the user to complete the task of personal hygiene. It is proven to be even more effective if these hygiene stations are private. And in the case of the HCF staff it is critical to have separate facilities for staff and clients.
    - The main cost consideration for sinks and showers is discussed above in the water and sanitation sections. If there is no running water to the HCF and there is no sanitation in the HCF, sinks and showers are a challenge. The most basic of hand washing station is a tippy-tap constructed of a 1-liter bottle with soap tied to it. And the most basic shower is an enclosed space with a bucket of water, soap, and a towel.
    - Where there is access to piped water and either a grey water or wastewater collection system, sinks and shower combinations can be placed in and/or outside the facility for $300-$500 including labor and materials.

Education/Capacity Development

Education and Capacity Development are intrinsic in the WASH paradigm, and they are critical for improving/managing WASH in HCFs. Both HCF staff, users/clients/patients should be adequately educated on the WASH system requirements, functions, and use. HCF staff will need to be trained to operate and maintain the WASH systems. Or the HCF staff will need to be involved in some capacity when a WASH-HCF circuit rider arrives for the routine system check-up. Users/clients/patients of the HCF will need direction and education on how to use the WASH systems appropriately. Because the WASH systems of HCFs are for collective users, proper use of the systems is critical for contamination and disease prevention as well as effective operation and maintenance of the systems.

Considerations:

- Education and capacity development programs for WASH systems in HCFs are key to protecting the health of the users and protecting the investment in the system infrastructure. Education programs are aimed at the users/clients/patients of the facilities to ensure proper use and hygiene after facility use. Capacity development refers more to training of HCF staff to have the technical, managerial, and financial understanding to operate and maintain the WASH systems.
    - Cost of education and capacity development programs for the HCF should be built into the cost of the improvements or installation of the WASH assets. It is recommended to add an additional 15% to the costs discussed above to implement an education/capacity develop program for each asset.
    - If the HCF will utilize a circuit rider program to ensure adequate education, capacity development, and operation & maintenance of the WASH resources, our basic cost estimate for a circuit rider program is between $200 and $1,000 per year per HCF, assuming that a circuit rider would cover 12-15 HCFs per month.