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INDIVIDUAL WATER PURIFIER STUDY

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EXECUTIVE SUMMARY

Water supply is a critical requirement for service member sustainment on the battlefield, and emergency individual water purifiers (IWPs) are a critical component of water supply. Emergency IWPs provide microbiologically safe water to keep soldiers mission-ready in cases where they do not have access to an Army-provided water supply. Soldiers are currently procuring and using commercial-off-the-shelf (COTS) IWP devices. However, there is a lack of information on the performance of these devices, and it is unknown whether they provide microbiologically safe drinking water.

To address this problem, the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) conducted a study to assess the performance and suitability of the available devices. A market survey was conducted to identify and collect information on COTS devices, and each device under consideration was procured by CHPPM for the evaluation.

The U.S. Army Edgewood Chemical Biological Center Decision Analysis Team developed a Multi-Criteria Decision Making approach for the evaluation. In this methodology, each COTS IWP was scored against criteria that addressed performance, operational, and logistical factors in a model developed using the software package Logical Decisions for Windows. Each factor in the model was developed with a definition and a performance scale for assessing the devices. The factors were weighted based on their importance to and impact on the evaluation. Four scenarios of use were identified to address the multiple missions in which an IWP could be needed, and each device was evaluated for only those scenarios for which it was appropriate. An overall score was generated for each device, and results were analyzed to develop recommendations for each scenario.

CHPPM developed an online database, which makes the results of this study available. Through the database, users can access information on the performance of each device to aid them in selecting the best device for their mission. This database is found at the following location: <http://usachppm.apgea.army.mil/WPD/Default.aspx>.

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PREFACE

The work described in this report was authorized under Sales Order No. 31-EC-03E0. The work was started in April 2005 and completed in February 2006.

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INDIVIDUAL WATER PURIFIER STUDY

1. INTRODUCTION

This study was performed to evaluate commercially available individual water purifiers (IWPs) that might be taken to the field by deploying military units. The study was sponsored/approved as part of the Headquarters, Department of the Army (HQDA) Army Study Program and performed during FY05 by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM).

In the study, a large number of commercial-off-the-shelf (COTS) IWP devices were identified and procured by CHPPM. Data were gathered on each device and documented in a database. A Multi-Criteria Decision Model (MCDM) was developed, and a panel of experts assessed the devices relative to that model.

This report describes the decision analysis process used to assess the IWP devices and provides the results of that assessment. Recommendations are provided as to which devices are most appropriate for various scenarios of use.

2. BACKGROUND

Water supply is a critical requirement for service member sustainment on the battlefield, and emergency IWPs are a critical component of water supply. Emergency IWPs provide microbiologically safe water to keep soldiers mission-ready in cases where they do not have access to a U.S. Army-provided water supply. Current approved emergency purifiers are time consuming to use and may not produce microbiologically safe water. As a result, units and soldiers today are procuring and using commercial-off-the-shelf water purifiers that may not be adequately tested and are not approved for military use. This presents potential health risks through the ingestion of waterborne contaminants that may render the service member combat ineffective.

CHPPM submitted a proposal to the HQDA Army Study Program to address this problem. The proposal included a three-pronged approach: develop a testing protocol, build a database, and make recommendations concerning use of these COTS IWP devices. The proposal was approved as part of the FY05 program, and the study was initiated in second quarter FY05.

The objective of the study was to evaluate COTS IWP devices and to recommend the best available devices for procurement and use, based on their ability to provide adequate volumes of microbiologically safe drinking water in environments throughout the world where service members are deployed. As part of the study, CHPPM conducted an extensive market survey to identify available IWP devices, and also developed a database that was used to help assess information on the IWP devices.

The U.S. Army Edgewood Chemical Biological Center's (ECBC) Decision Analysis Team (DAT) supported CHPPM by developing and implementing an approach to evaluate the IWP devices. That approach is described in Section 3.

3. EVALUATION PROCESS

The approach used to assess the IWP devices employed a logical, structured decision analysis process, which included thorough documentation of the results and rationale so that final recommendations could be readily explained and defended. This process comprised five phases:

- Form study team and identify participants
- Perform operational and requirements analysis
- Identify and describe IWP devices
- Develop evaluation model
- Assess IWP devices

This section of the report describes each of the five phases in detail. These descriptions are followed by an analysis of the results, and then by the study's conclusions and recommendations.

3.1 Study Team and Participants.

A study team was formed as the first step of the evaluation process. The core study team consisted of CHPPM personnel supporting the Army Study Program project, and decision analysts from ECBC's DAT. The study team identified user representatives and technical experts to participate in subsequent study steps.

The user representatives' primary role was to articulate the needs of the service member. The technical experts were selected for their knowledge and expertise in water purification technologies, which they would use to assess the various IWP devices. The decision analysts were responsible for developing and implementing the evaluation approach, facilitating the study team through the process, and analyzing the results.

The study was performed in a collaborative fashion, using facilitated decision conferences to accomplish most of the project goals. The study participants are listed in Appendix A.

3.2 Operational and Requirements Analysis - User Profile Development.

The user representatives on the study team met to discuss how the IWP device might be used. Based upon those discussions, four user profiles were developed to describe the broad spectrum of military missions (i.e., operational situations) in which an IWP would be needed. The profiles are not intended to be all-encompassing, but they help to define the different requirements that an IWP will likely have to meet to achieve various military missions.

The user profiles are based on and described by three primary attributes (listed below). For each attribute, there are two options that characterize the profile.

Mission: *Stationary or On-the-Move.*

In a *stationary* mission, no movement is required to complete the mission except for initial deployment to the mission location by vehicle. The service member does not have to carry the IWP for more than a short distance daily (e.g., ½ mile or less). Normally, the mission occurs in one location with minimal movement and under generally secure conditions.

In an *on-the-move* mission, the service member must continually move to complete the mission. This mission includes tactical movement, under generally low-security conditions and/or in combat conditions, with little time for the service member to spend on non security-related efforts.

Transportation: *Hand-Carried or Vehicle Transported.*

In the *hand-carried* situation, the IWP is physically carried on/by the service member when the device is moved from location to location. The service member has the burden of carrying the IWP for undetermined distances.

In the *vehicle transported* situation, the IWP is moved with other gear by a vehicle when required. The service member only has to carry the IWP a very short distance to a drop-off site for a vehicle to deliver the IWP to the new mission location.

This attribute is primarily applicable only to the *on-the-move* mission; in the stationary mission, the IWP does not need to be transported (except for the initial transportation to the mission location, which is generally done by vehicle).

Water Sustainment (Length of Use and Daily Water Requirements): *Emergency Use or Augment Planned Use.*

In the *emergency use* situation, the IWP is needed for 1 day or less, and the amount of water required is no more than 5 L. In this situation, the need to purify water is unexpected and short-term.

In the *augment planned use* situation, the length of time the IWP is needed is up to 7 days, and the amount of water required is 15 L per day. In this situation, the ability to make water allows the mission to continue even in situations where the conventional water supply is inadequate.

Each of the three attributes has two options, which results in eight possible combinations (i.e., user profiles). However, as noted above for the transportation attribute, there is no transportation requirement for stationary missions, so the possible combinations are reduced from eight to six. The user representatives were able to further limit the number of user profiles to four by combining all emergency use water sustainment attribute combinations into one user profile. This one emergency use profile covers both mission types (*stationary* and *on-the-move*) and both types of transportation requirements (*hand-carried* and *vehicle transported*).

Table 1 describes and provides brief examples for each of the four IWP user profiles. For Profiles A-C, use of the IWP is generally planned; the service member expects that the conventional water supply will be limited during the mission. Use of the IWP will allow service members to continue and complete their mission. In the most extreme of scenarios that fall into Profiles A-C, the IWP may need to provide up to 15 L of purified water per day for up to 7 days. For the emergency profile (Profile D), there is a short-term, unanticipated need for an IWP. In this case, the IWP must provide only a reasonable minimum amount of water to ensure short-term survival. The mission capability of the service member may degrade in this profile.

The requirements described in the user profiles served as the foundation for the evaluation models described later in Section 3.4.

3.3 Device Descriptions.

CHPPM attempted to evaluate every commercially available device obtainable by soldiers stationed within the continental United States. A survey was performed to identify and include all devices available at retailers within the continental United States or worldwide on the Internet. It did not matter where the device originated; only if it was available. The objective of the survey was to identify all devices that were designed for individual use and marketed for pathogen reduction or inactivation. Devices that were designed solely for reduction of chlorine, lead, and/or taste and odor, etc., were not included in this survey.

To evaluate the pathogen reduction/inactivation ability of the devices, laboratory testing results were critical. Every effort was made to locate and review all available laboratory results showing device efficacy at pathogen reduction/inactivation. Sources of data included, but were not limited to, web searches, direct manufacturer contact (through correspondence or in person), previous market surveys, and contact with other DoD organizations. In the absence of data, the treatment technology used by the device became the primary basis for determining efficacy. All devices evaluated were obtained and personally inspected. The devices were evaluated as commercially packaged and were operated as instructed by manufacturer directions.

The survey of available COTS IWP devices revealed 66 devices produced by 28 manufacturers. Of these, 51 devices used filtration as the primary means of pathogen reduction, and 15 devices used disinfection as the primary means of pathogen inactivation.

Information was collected on each device and recorded in a database developed for this study. The database includes test results and physical properties of the devices. Device evaluation papers were developed based on this information; these papers were used by the technical experts during their evaluation of the devices.

Table 2 lists all devices considered, their manufacturer, the device name abbreviation, and the type of device. For the remainder of this report, the device name abbreviations in this table will be used as the reference for the devices. An "F" or "D" following the abbreviated name indicates whether the device is primarily a filter or disinfectant device, respectively.

Table 1. Characteristics of User Profiles

User Profile A	User Profile B	User Profile C	User Profile D
Mission: stationary* Transportation: hand-carried or vehicle transported (see note below) Water Sustainment: augment planned use Length of Use: up to 7 days Daily Water Requirement: 15 L/day for up to 7 days Description: base camp/fixed location operations Examples: - Initial Base Camp Setup - IWP needed until TWPS or ROWPU becomes operational, or until logistics is set-up to procure potable water (e.g., resupply of bottled water). - Remote Base Camp Frequently Becomes Isolated - Camp operates without a TWPS or ROWPU. Potable water normally brought in. There are known probable (semi-planned) interruptions caused by weather delays, for example, that interrupt the resupply of water to camp. IWP can be used to provide enough water for a week with mission degradation. - Forward Observer - Reconnaissance	Mission: on-the-move Transportation: vehicle transported Water Sustainment: augment planned use Length of Use: up to 7 days Water Requirement: : 15 L/day for up to 7 days Description: vehicle-based operations Examples: - Extended Autonomous Operations/Unit of Action - Sustained Operations (e.g., advance to Baghdad) - Service Member must move continually to locate and engage the enemy. Not enough water is carried to complete operation so IWP needs to augment the difference. - Convoy Operations (Unstable Conditions) - There are known probable (semi-planned) interruptions caused by weather delays, for example, that delay a convoy arriving at its final destination as planned. IWP can be used to provide enough water for a week with mission degradation.	Mission: on-the-move Transportation: hand-carried Water Sustainment: augment planned use Length of Use: up to 7 days Water Requirement: : 15 L/day for up to 7 days Description: dismounted operations Examples: - Special Operations Unit - Because of mission to keep a low profile, the unit cannot be re-supplied with potable water. Mission requires unit to move continually to locate and engage with enemy. Need to make water with IWP from local water source. - Dismounted Patrol - Service member is in a firefight and not able to disengage to resupply. Need to make water with IWP from local water source.	Mission: stationary* or on-the-move Transportation: vehicle transported or hand-carried (see note below) Water Sustainment: emergency use Length of Use: 1 day Water Requirement: 5 L for 1 day Description: short term unexpected emergency use during conditions of otherwise robust water resupply. Includes situations with a loss of mission capability. Examples: - Convoy Operations (Stable Conditions) - Because of an unforeseen delay, the convoy cannot arrive at its final destination before it depletes the potable water it carried for the trip. IWP can supply enough water for 1 day to survive under possible reduced mission capabilities. - Remote Base Camp Becomes Unexpectedly Isolated - Camp operates without a TWPS or ROWPU. Potable water normally resupplied. In this situation, the ability to resupply water has been unexpectedly interrupted. Resupply should occur within 24 hr. IWP can supply enough water for 1 day to survive under possible reduced mission capabilities. - Reconnaissance - Forward Observer - Dismounted Patrol. - Downed pilot

*For stationary missions, the only transportation requirement will be the initial transportation when the IWP is moved by vehicle (typically) to the mission location.

Table 2. Device Names

Manufacturer	Device Name	Device Abbreviation	Device Type
Advance Chemicals Ltd.	Pristine Water Purification System	AC Pristine Water Pur Sys D	chlorine dioxide liquid
Coghlan's	Emergency Drinking Water Germicidal Tablets	Coghlan Iodine tabs D	iodine tablets
Coghlan's	Emergency Drinking Water Germicidal Tablets with Neutralizer	Coghlan IT w/ Neut. D	iodine tablets with neutralizer
Deatrick & Associates, Inc. (distributor)	Chlor-Floc	Chlorfloc D	chlorine tablets with flocculant aid
General Ecology, Inc.	First Need Base Camp	GE Base Camp F	proprietary carbon, microfilter hand pump
General Ecology, Inc.	First Need Deluxe	GE Deluxe F	proprietary carbon, microfilter hand pump
General Ecology, Inc.	First Need Trav-L-Pure	GE TrvLPure F	proprietary carbon, microfilter hand pump
Hydration Technologies, Inc.	HydroWell Expedition	HTI Expedition F	osmotic membrane hydration pack
Hydration Technologies, Inc.	X Pack	HTI Xpack F	osmotic membrane bag
Hydro-Photon, Inc.	SteriPEN	H-P SteriPen D	ultraviolet light generator
Katadyn North America, Inc.	Base Camp	Kat Base Camp F	glass fiber microfilter gravity filter
Katadyn North America, Inc.	Camp	Kat Camp F	ceramic microfilter gravity filter
Katadyn North America, Inc.	Combi	Kat Combi F	ceramic microfilter hand pump
Katadyn North America, Inc.	Exstream Water Bottle	Kat Exstream F	microfilter, iodine resin water bottle
Katadyn North America, Inc.	Exstream XR Water Bottle	Kat Exst XR F	microfilter, iodine resin water bottle
Katadyn North America, Inc.	Guide	Kat Guide F	glass fiber microfilter hand pump
Katadyn North America, Inc.	Hiker	Kat Hiker F	glass fiber microfilter hand pump
Katadyn North America, Inc.	Hiker Pro	Kat Hiker Pro F	glass fiber microfilter hand pump
Katadyn North America, Inc.	Micro Water Bottle	Kat Micro F	glass fiber microfilter water bottle
Katadyn North America, Inc.	MicroPur MP 1 Tablets	Kat MicrPur Tabs D	chlorine dioxide tablets

Table 2. Device Names (continued)

Manufacturer	Device Name	Device Abbreviation	Device Type
Katadyn North America, Inc.	Mini	Kat Mini F	ceramic microfilter hand pump
Katadyn North America, Inc.	Pocket	Kat Pocket F	ceramic microfilter hand pump
McNett Corporation	Aqua Mira Drops	Aqua Mira Drops D	chlorine dioxide liquid
Medentech	Aquatabs	Aquatabs D	chlorine tablets
Mountain Safety Research, Inc.	MiniWorks EX	MSR Miniworks EX F	ceramic microfilter hand pump
Mountain Safety Research, Inc.	MIOX Purifier	MSR MIOX Purifier D	mixed oxidant liquid generator
Mountain Safety Research, Inc.	SweetWater Microfilter	MSR SwtWtr Micfilt F	glass fiber microfilter hand pump
Mountain Safety Research, Inc.	SweetWater Purifier	MSR SwtWtr Purif F	glass fiber microfilter hand pump, chlorine disinfectant liquid
Mountain Safety Research, Inc.	WaterWorks EX	MSR Waterworks EX F	ceramic microfilter, membrane microfilter hand pump
Polar Equipment, Inc.	Polar Pure	PE Polar Pure D	iodine crystals
PRISMedical Corporation	Triton	PRISMed Triton F	microfilter, carbon gravity filter
Sawyer Products	Water Bottle	Sawyer WB F	hollow fiber microfilter water bottle
Wisconsin Pharmacal Company, LLC.	Globaline	Globaline D	iodine tablets
Wisconsin Pharmacal Company, LLC.	Potable Aqua	Potable Aqua IT D	iodine tablets
Wisconsin Pharmacal Company, LLC.	Potable Aqua with Neutralizer	Potable Aqua IT w/ Neut D	iodine tablets with neutralizer
Xinix Disinfection Technologies, Inc.	Xtreme Water Purifier	XDT Xtrem Wtr Pur D	chlorine dioxide liquid

3.4 Evaluation Model.

3.4.1 Model Overview.

A structured decision analysis process was used for the IWP assessment. This process has been used by the ECBC DAT for numerous similar studies over the past several years. Decision analysis is a structured process for decision-making based on established principles of operations research. The decision analysis process is composed of systematic development and examination of alternative courses of action to define and clarify available choices and associated advantages and disadvantages. It also includes thorough

documentation of results and associated rationale so that final recommendations can be readily explained and defended.

This section describes how the evaluation model was developed and presents the primary elements of the model: the evaluation criteria, definitions and performance scales, and weights.

3.4.2 Evaluation Criteria.

The decision analysis methodology used for this study is referred to as MCDM. The identification of evaluation criteria, against which options are assessed, is the core of this methodology. Several factors were considered during development of the evaluation criteria. First, evaluation criteria should differentiate the devices, so the criteria had to be relevant and discriminating. Criteria also had to be independent so that aspects measured in one criterion were not repeated in another criterion. Finally, it was important to focus on the criteria that were the most important to the decision process.

For this study, an initial set of criteria was developed by a subset of the study team. The criteria were primarily based upon a review of several requirements documents, including the U.S. Army Chemical School's draft Joint Initial Capabilities Document (ICD) for the Nuclear, Biological, and Chemical Environment Personal Hydration System (NEPHS), the U.S. Army Infantry School's draft Capabilities Development Document (CDD) for Individual Water Treatment Device (IWTD), and the U.S. Marine Corps' Statement of Need for the Individual Water Purifier. The user profiles (Section 3.2) were also used as a reference to develop the criteria.

On 27-28 July 2005, a panel of user experts (see Appendix A) met with the CHPPM study team and the DAT to review, modify, and finalize the initial criteria and user profiles.

The criteria were structured as a hierarchy, which is referred to as the evaluation model. The highest level of the model consisted of three criteria categories, or goals: Performance, Operational, and Logistics. At the next level of the model, some goals were broken into sub-goals (e.g., Pathogen Removal). The lowest level of the model was formed when each goal or sub-goal was further broken down into evaluation measures (e.g., *Bacteria Removal*). The measures are what the devices were assessed against.

A decision support software tool, Logical Decisions for Windows (LDW), was used to develop and document the evaluation model. Figure 1 depicts the evaluation model, with goals and sub-goals represented by rectangles, and measures represented by ovals. Note that the basic structure of the model (goals and measures) is the same for each of the four user profiles.

The study team decided to exclude cost from the potential evaluation criteria, since each potential IWP user would likely have different cost constraints, resulting in cost-benefit trade-offs that would be unique to each user.

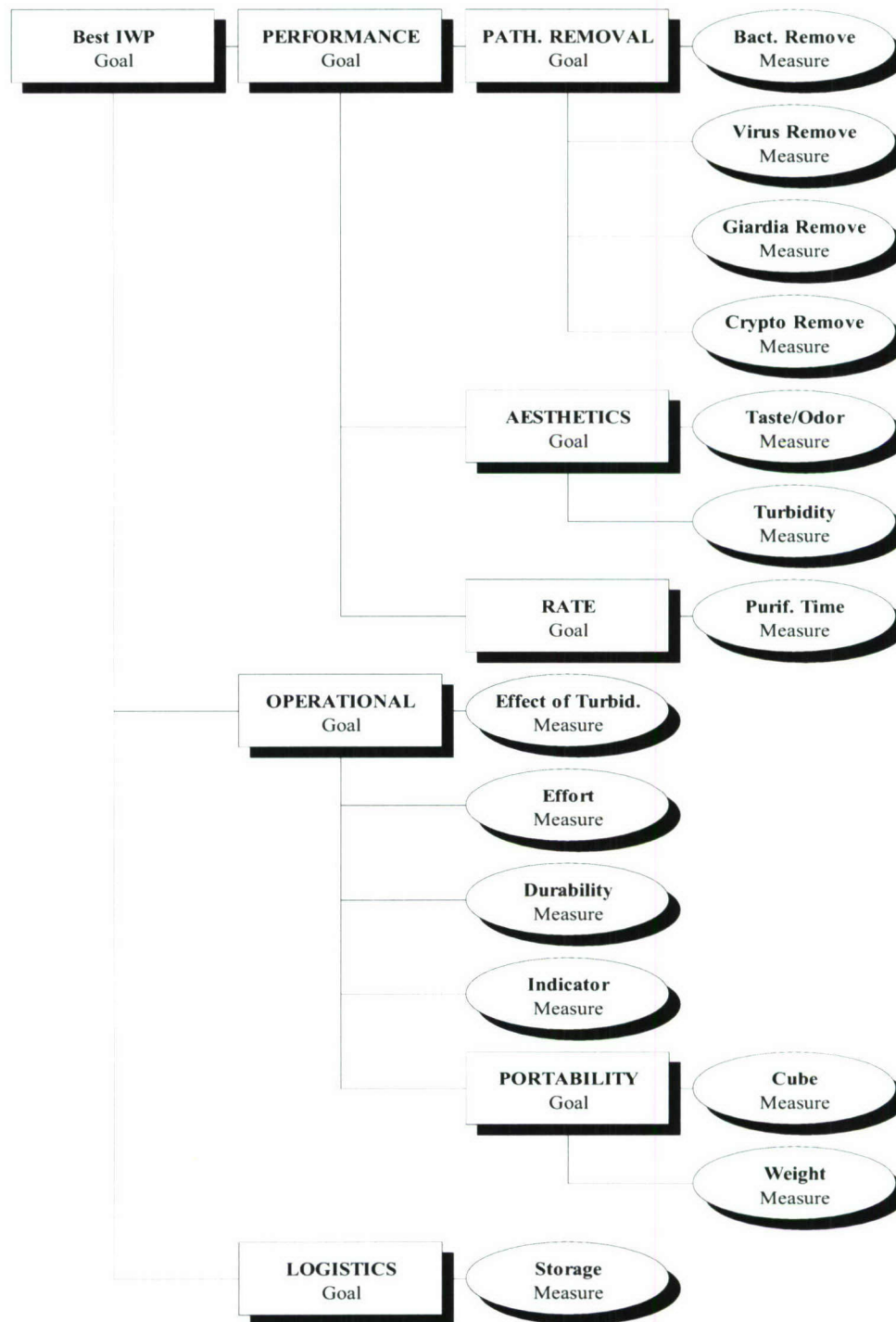


Figure 1. IWP Evaluation Hierarchy

The model is comprised of quantitative and qualitative measures. For example, the Purification Time measure is a quantitative criterion, measured in numerical units (minutes). The Durability measure is an example of a qualitative measure, better assessed in more subjective terms (adjectival descriptors, e.g., high/medium/low).

3.4.3 Definitions and Performance Scales.

Definitions and performance scales were developed for each measure. Measure definitions are narrative descriptions that must be adequately and appropriately stated and clearly understood. The measure definitions and categories (representing the three main model goals) are shown in Table 3.

Table 3. Measure Definitions

#	Criterion Name	Definition
Performance		
1	Bacteria Removal Effectiveness	Ability to achieve a 6-log reduction in bacteria microbial pathogens from worst-case source water (Type 2 water per the EPA protocol standard [cold, turbid]).
2	Virus Removal Effectiveness	Ability to achieve a 4-log reduction in virus microbial pathogens from worst-case source water (Type 2 water per the EPA protocol standard [cold, turbid]).
3	<i>Giardia</i> Cyst Removal Effectiveness	Ability to achieve a 3-log reduction in <i>Giardia</i> cyst microbial pathogens from worst-case source water (Type 2 water per the EPA protocol standard [cold, turbid]).
4	<i>Cryptosporidium</i> Oocyst Removal Effectiveness	Ability to achieve a 3-log reduction in <i>Cryptosporidium</i> oocyst microbial pathogens from worst-case source water (Type 2 water per the EPA protocol standard [cold, turbid]).
5	Aesthetics - Taste and Odor	Reduces objectionable taste and odor in final product. It is ideal for the IWP to reduce taste or odor in source water and to not impart any objectionable taste or odor to product water.
6	Aesthetics - Turbidity	Ability of IWP to reduce turbidity (i.e., cloudiness).
7	Rate - Purification Time	Time it takes to purify 1 L of water. This is not an average. Determining minimum wait time to produce 1 L of water.
Operational		
8	Effect of Turbidity	Impact of turbidity on proper operations of IWP (ability to produce water). (The impact of turbidity on pathogen reduction is included in the pathogen reduction ratings and is not included in this criterion.)
9	Effort Required	Amount of dedicated effort required to purify amount of water needed per user profile. Required effort includes set-up, deployment/use, ease of use, training required, and cleaning and maintenance required (e.g., filter replacement) during maximum length of use (1 day or 7 days based on user profile). Any effort that could occur (e.g., cleaning filter) outside the length of use of the user profile (1 day or 7 days) without affecting the IWP's performance is not included in this criterion.
10	Process Failure Indicator	Indication of failure of IWP to perform as intended due to: unexpected failure, maintenance required, and/or capacities exceeded/end-of-life.

Table 3. Measure Definitions (continued)

#	Criterion Name	Definition
11	Durability	Ability of IWP (including device and all consumables required to complete mission) to withstand drops, rough handling, etc. during transport and use. Includes quality of design, construction, and materials.
12	Cube	Cubic size of IWP (including device and all consumables required to complete mission [for User Profiles A-C, 15 L/day must be produced (105 L in 7 days) and for User Profile D, 5 L must be produced in 1 day]).
13	Weight	Weight of IWP (including device and all consumables required to complete mission as defined by the user profile).
Logistics		
14	Storage	Conditions (e.g., temperature, humidity) required for maximum life (life cycle of the device) of IWP and consumables.

The performance scales served as the “rating scheme” used to evaluate the devices, and represented the different levels of performance that could be expected among all the devices for each measure.

Some performance scales are continuous (e.g., numeric range of *Weight*), while others are discontinuous, or discrete levels referred to as labels (e.g., ability to reduce *Turbidity* (Aesthetics)). These two examples are shown in Table 4.

Table 4. Examples of Continuous and Discontinuous Scales

<i>Weight</i>		
	<u>Utility</u>	<u>Performance Scale</u>
	100	1 g
	0	3,632 g (8 lb)
<i>Aesthetics -Turbidity</i>		
	<u>Utility</u>	<u>Performance Scale</u>
	100	Very high
	75	High
	50	Medium
	25	Low
	0	None

Performance scales are expressed as utility functions, which convert the different units for all the performance scales to common units. To set relevant endpoints and to establish appropriate intermediate utility values, the IWP device characteristics had to be well defined. Utility values of 100 and 0 were assigned to the high and low end of each performance scale. Intermediate level utilities were derived through various elicitation techniques focused on the relative importance of moving to-and-from various points on the utility function. In several

cases, the intermediate points were simply reference points, and allowances were made to score anywhere along the scale.

Figure 2 shows the utility function for the *Purification Time* measure in Profile B. This utility curve is referred to as a “risk seeking” curve; where the rate of utility increases rapidly as the desired end of the scale is approached. Utility can also be defined by risk averse and constant functions.

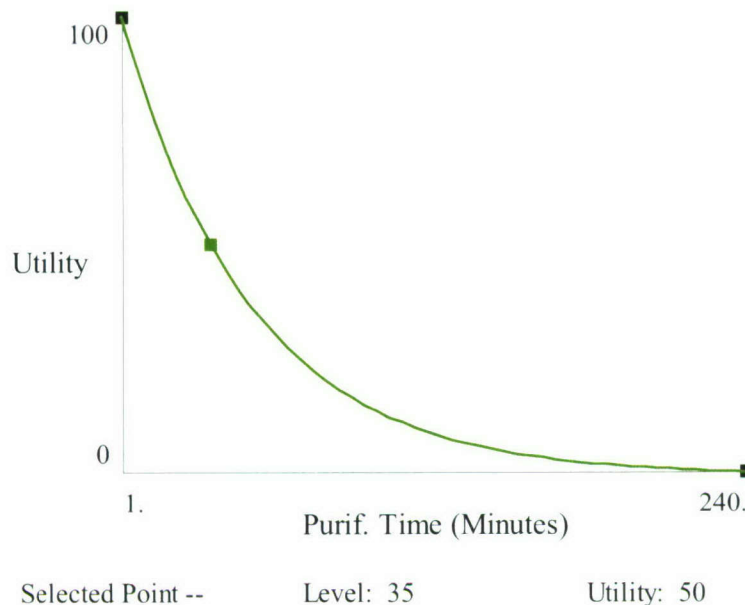


Figure 2. Purification Time Measure Utility Curve Example

The performance scales were the same for most user profiles; however, three measures differed, depending on the profile, described below:

Purification Time – lowest level endpoint was 8 hr for Profile A (longer time is more acceptable in a stationary/base camp situation), and 4 hr for Profiles B-D.

Cube – lowest level endpoint was 8,000 cm³ (8 L) for Profile A, 4,000 cm³ (4 L) for Profile B, 2,000 cm³ (2 L) for Profile C, and 500 cm³ (0.5 L) for Profile D (allowable volumes become more constrictive as need to be mobile with less support increases).

Weight - lowest level endpoint was 3,632 g (8 lb) for Profile A, 1,816 g (4 lb) for Profile B, 908 g (2 lb) for Profile C, and 227 g (0.5 lb) for Profile D (allowable weight becomes more constrictive as need to be mobile with less support increases).

3.4.4 Weights.

The final model development step was to develop weights for the goals and measures, based on the importance of each goal/measure relative to the others. Points (100) were distributed amongst the measures. The weighting process considers relative priority and the concept of swing weighting. Swing weighting compares the effects of moving from the lowest point on the performance scale to the highest for any measure in relation to a similar move for any other measure. An example of this was determining whether it was more important to move from “None” to “Very high” for the *Turbidity* (Aesthetics) measure or to move from “3,632 g” to “1 g” for the *Weight* measure.

Two different techniques were used to establish weights. One method was the Analytic Hierarchy Process (AHP). In this method, AHP weights were derived through pairwise comparisons, in which the user representatives compared each measure to every other measure, and assessed which measure was more important, and by how much.

The Smarter Method weighting technique was also used. In this process, the user representatives rank-ordered the measures, and an algorithm generated a weight for each measure that is dependent on its rank and the number of measures. After generating initial weights via AHP or Smarter, the user representatives adjusted the weights using direct entry.

The weights that were developed were different for each of the four user profiles. The user representatives generated the weights for Profile A first, and then adjusted those weights to account for the different requirements of the other three profiles. The following discussion summarizes the structure of the weights and the differences among the four user profiles.

Profile A: Due to the stationary nature of this profile, pathogen removal and aesthetics are the most important, while operational factors such as size and weight are not as critical.

- Most important to the user was Pathogen Removal (40% of model weight), defined by the four measures of *Bacteria*, *Virus*, *Giardia*, and *Cryptosporidium Removal*. Within Pathogen Removal, *Bacteria* and *Virus* were most important.
- Second most important was Aesthetics (15% of model), defined as *Taste/Odor* and *Turbidity* reduction.
- Next most important was Rate, defined as *Purification Time* (10%) and Portability (10%), defined by the two measures *Cube* and *Weight*.
- Most of the remaining model weight (23%) was distributed amongst the four Operational measures, in order, *Effect of Turbidity*, *Effort Required*, *Durability*, and *Indicator*. The final 2% was allotted to *Storage*.

Profiles B and C: For these profiles, aspects related to transportation and field use of the device became more important.

- Pathogen Removal remained most important to the user; however, the weight was reduced from 40% in Profile A to 36% for Profiles B and C. Within Pathogen Removal, *Bacteria* and *Virus* remained the most important.

- Unlike Profile A, the second most important aspects for Profiles B and C were *Purification Time* (15% of the model) and *Portability* (15%), defined by the two measures *Cube* and *Weight*.

- Next most important for Profiles B and C was *Aesthetics* (9%), defined as *Taste/Odor* and *Turbidity* reduction.

- As in Profile A, most of the remaining model weight (23%) was distributed amongst four of the Operational measures, in order, *Effect of Turbidity*, *Effort Required*, *Durability*, and *Indicator*. The final 2% was allotted to *Storage*.

Profile D: In this profile, aspects related to portability and use in an isolated field environment became more important.

- Pathogen Removal remained most important to the user; however, the weight was reduced to 28%. Within Pathogen Removal, *Bacteria* and *Virus* remained the most important. Some other differences between Profiles D and A are described below.

- Second most important in Profile D was *Portability* (24%), defined by the two measures *Cube* and *Weight*.

- Next most important for Profile D was *Purification Time* (12%), followed by *Effort Required* (10%).

- Most of the remaining model weight (23%) was distributed amongst, in order: *Durability*, *Effect of Turbidity*, *Storage*, and *Indicator*. The final 4% was allotted to the *Aesthetics* measures, *Taste/Odor* and *Turbidity*. This is also different from Profile A, where *Aesthetics* were much more important, and *Storage* was the lowest weighted measure.

The weights and performance scales for the four evaluation models are summarized in Table 5.

Table 5. Criterion Performance Scales and Weights for all Profiles

Measure	Type of Scale	User Profile A		User Profile B		User Profile C		User Profile D	
		Scale	Wgt	Scale	Wgt	Scale	Wgt	Scale	Wgt
Bacteria Removal Effectiveness	Label	100 - 3 Checks*	14	100 - 3 Checks*	12.6	100 - 3 Checks*	12.6	100 - 3 Checks*	9.8
		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks	
		70 - 1 Check		70 - 1 Check		70 - 1 Check		70 - 1 Check	
		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks	
Virus Removal Effectiveness	Label	100 - 3 Checks*	14	100 - 3 Checks*	12.6	100 - 3 Checks*	12.6	100 - 3 Checks*	9.8
		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks	
		70 - 1 Check		70 - 1 Check		70 - 1 Check		70 - 1 Check	
		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks	
Giardia Cyst Removal Effectiveness	Label	100 - 3 Checks*	6	100 - 3 Checks*	5.4	100 - 3 Checks*	5.4	100 - 3 Checks*	4.2
		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks	
		70 - 1 Check		70 - 1 Check		70 - 1 Check		70 - 1 Check	
		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks	
Cryptosporidium Oocyst Removal Effectiveness	Label	100 - 3 Checks*	6	100 - 3 Checks*	5.4	100 - 3 Checks*	5.4	100 - 3 Checks*	4.2
		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks		85 - 2 Checks	
		70 - 1 Check		70 - 1 Check		70 - 1 Check		70 - 1 Check	
		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks		0 - 0 Checks	

Table 5. Criterion Performance Scales and Weights for all Profiles (continued)

Measure	Type of Scale	User Profile A	User Profile B	User Profile C	User Profile D
Aesthetics - Taste and Odor	Continuous	100 - significantly reduces taste and odor of source water; treatment does not impart taste or odor to product water. 70 - no effect on taste or odor (does not remove or impart any taste or odor). 25 - imparts some taste or odor to product water; does not remove taste or odor from source water. 0 - imparts strong taste and/or odor.	100 - significantly reduces taste and odor of source water; treatment does not impart taste or odor to product water. 70 - no effect on taste or odor (does not remove or impart any taste or odor). 25 - imparts some taste or odor to product water; does not remove taste or odor from source water. 0 - imparts strong taste and/or odor.	100 - significantly reduces taste and odor of source water; treatment does not impart taste or odor to product water. 70 - no effect on taste or odor (does not remove or impart any taste or odor). 25 - imparts some taste or odor to product water; does not remove taste or odor from source water. 0 - imparts strong taste and/or odor.	100 - significantly reduces taste and odor of source water; treatment does not impart taste or odor to product water. 70 - no effect on taste or odor (does not remove or impart any taste or odor). 25 - imparts some taste or odor to product water; does not remove taste or odor from source water. 0 - imparts strong taste and/or odor.
		10	7	7	3
Aesthetics - Turbidity	Label	100 - very high 75 - high 50 - medium 25 - low 0 - none	100 - very high 75 - high 50 - medium 25 - low 0 - none	100 - very high 75 - high 50 - medium 25 - low 0 - none	100 - very high 75 - high 50 - medium 25 - low 0 - none
Purification Time	Cont. Label	100 - 1 min 0 - 8 hr	100 - 1 min 0 - 4 hr or more	100 - 1 min 0 - 4 hr or more	100 - 1 min 0 - 4 hr or more
		10	15	15	12

Table 5. Criterion Performance Scales and Weights for all Profiles (continued)

Measure	Type of Scale	User Profile A	User Profile B	User Profile C	User Profile D
Effect of Turbidity		100 - Turbidity has no effect on operation of IWP 70 - IWP has a Pre-filter, primary filter is cleanable 65 - IWP has a Pre-filter, primary filter is less cleanable 60 - IWP does not have a Pre-filter, primary filter is cleanable 50 - IWP has a pre-filter, primary filter is backwashable 40 - IWP has multiple pre-filters, primary filter has small pore size 30 - IWP has multiple pre-filters 20 - IWP has a Pre-filter, primary filter is not cleanable 0 - IWP does not have a pre-filter, primary filter is not cleanable	100 - Turbidity has no effect on operation of IWP 70 - IWP has a Pre-filter, primary filter is cleanable 65 - IWP has a Pre-filter, primary filter is less cleanable 60 - IWP does not have a Pre-filter, primary filter is cleanable 50 - IWP has a pre-filter, primary filter is backwashable 40 - IWP has multiple pre-filters, primary filter has small pore size 30 - IWP has multiple pre-filters 20 - IWP has a Pre-filter, primary filter is not cleanable 0 - IWP does not have a pre-filter, primary filter is not cleanable	100 - Turbidity has no effect on operation of IWP 70 - IWP has a Pre-filter, primary filter is cleanable 65 - IWP has a Pre-filter, primary filter is less cleanable 60 - IWP does not have a Pre-filter, primary filter is cleanable 50 - IWP has a pre-filter, primary filter is backwashable 40 - IWP has multiple pre-filters, primary filter has small pore size 30 - IWP has multiple pre-filters 20 - IWP has a Pre-filter, primary filter is not cleanable 0 - IWP does not have a pre-filter, primary filter is not cleanable	100 - Turbidity has no effect on operation of IWP 70 - IWP has a Pre-filter, primary filter is cleanable 65 - IWP has a Pre-filter, primary filter is less cleanable 60 - IWP does not have a Pre-filter, primary filter is cleanable 50 - IWP has a pre-filter, primary filter is backwashable 40 - IWP has multiple pre-filters, primary filter has small pore size 30 - IWP has multiple pre-filters 20 - IWP has a Pre-filter, primary filter is not cleanable 0 - IWP does not have a pre-filter, primary filter is not cleanable
	Label	8	8	8	6

Table 5. Criterion Performance Scales and Weights for all Profiles (continued)

Measure	Type of Scale	User Profile A		User Profile B		User Profile C		User Profile D	
Effort Required	Continuous	100 - Low effort (comparable to iodine tablets) 75 - Comparable to In-line filter 50 - Comparable to Miox Pen/ ceramic filter 25 - Comparable to General Ecology Deluxe filter 0 - Significant effort	6	100 - Low effort (comparable to iodine tablets) 75 - Comparable to In-line filter 50 - Comparable to Miox Pen/ ceramic filter 25 - Comparable to General Ecology Deluxe filter 0 - Significant effort	6	100 - Low effort (comparable to iodine tablets) 75 - Comparable to In-line filter 50 - Comparable to Miox Pen/ ceramic filter 25 - Comparable to General Ecology Deluxe filter 0 - Significant effort	6	100 - Low effort (comparable to iodine tablets) 75 - Comparable to In-line filter 50 - Comparable to Miox Pen/ ceramic filter 25 - Comparable to General Ecology Deluxe filter 0 - Significant effort	10
Process Failure Indicator	Continuous	100 - multiple engineered 75 - engineered 60 - positive 35 - general knowledge (color change) 0 - None	4	100 - multiple engineered 75 - engineered 60 - positive 35 - general knowledge (color change) 0 - None	4	100 - multiple engineered 75 - engineered 60 - positive 35 - general knowledge (color change) 0 - None	4	100 - multiple engineered 75 - engineered 60 - positive 35 - general knowledge (color change) 0 - None	4
Durability	Continuous	100 - Very durable; able to withstand transport and use (iodine tablets) 0 - Least durable of alternatives evaluated (UV Pen)	5	100 - Very durable; able to withstand transport and use (iodine tablets) 0 - Least durable of alternatives evaluated (UV Pen)	5	100 - Very durable; able to withstand transport and use (iodine tablets) 0 - Least durable of alternatives evaluated (UV Pen)	5	100 - Very durable; able to withstand transport and use (iodine tablets) 0 - Least durable of alternatives evaluated (UV Pen)	7

Table 5. Criterion Performance Scales and Weights for all Profiles (continued)

Measure	Type of Scale	User Profile A		User Profile B		User Profile C		User Profile D	
		100 - 1 cm ³ 0 - 8,000 cm ³	5	100 - 1 cm ³ 0 - 4,000 cm ³	7.5	100 - 1 cm ³ 0 - 2,000 cm ³	7.5	100 - 1 cm ³ 0 - 500 cm ³	12
Cube	Cont.	100 - 28 g (about 1 oz.) or less 0 - 3,632 g (about 8 lb)	5	100 - 28 g (about 1 oz.) or less 0 - 1,816 g (about 4 lb)	7.5	100 - 28 g (about 1 oz.) or less 0 - 908 (about 2 lb)	7.5	100 - 28 g (about 1 oz.) or less 0 - 227 g (about 0.5 lb)	12
	Continuous	100 - Least susceptible to environmental conditions 0 - Most susceptible to environmental conditions	2	100 - Least susceptible to environmental conditions 0 - Most susceptible to environmental conditions	2	100 - Least susceptible to environmental conditions 0 - Most susceptible to environmental conditions	2	100 - Least susceptible to environmental conditions 0 - Most susceptible to environmental conditions	5

*See Appendix B for a definition of the Checks scale.

3.5 Assessment Process.

3.5.1 Screening Process.

CHPPM identified 66 water purifying devices through the market survey. Initial review of the devices indicated that many of them were not feasible candidates for meeting the needs of the service member relative to the four user profiles. To reduce the number of devices that would be evaluated against the detailed evaluation model (described in Section 3.4), an internal study team, composed of representatives from CHPPM and the DAT, conducted a screening phase. In this phase, threshold requirements were determined for each user profile. Each device was then evaluated against those requirements. If the device did not meet the minimum requirements for that profile, it was not assessed against the detailed model for that profile. The minimum standards developed for screening devices are all based on measures from the evaluation model. In most cases, the screening level represents the bottom of the performance scale. The five minimum standards used for the screening are listed below:

Pathogen Removal (this requirement was not user profile dependent):

- All filter devices were required to remove bacteria by 6 log, *Giardia* cyst by 3 log, and *Cryptosporidium* oocyst by 3 log in accordance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers.
- All disinfectant devices were required to inactivate bacteria by 6 log and viruses by 4 log.

Cube:

- For Profile A, all devices must be 8,000 cm³ (8 L) or less in volume.
- For Profile B, all devices must be 4,000 cm³ (4 L) or less in volume.
- For Profile C, all devices must be 2,000 cm³ (2 L) or less in volume.
- For Profile D, all devices must be 500 cm³ (0.5 L) or less in volume.

Weight:

- For Profile A, all devices must weigh 3,632 g (8 lb) or less.
- For Profile B, all devices must weigh 1,816 g (4 lb) or less.
- For Profile C, all devices must weigh 908 g (2 lb) or less.
- For Profile D, all devices must weigh 227 g (0.5 lb) or less.

Purification Time:

- For Profile A, all devices must purify water in 8 hr or less.
- For Profiles B, C, and D, all devices must purify water in 4 hr or less.

Storage:

- All devices must have reasonable storage requirements for the user profile in question.

Some devices did not have enough information available to conduct the evaluation. For these devices, it was noted that more information was needed, and the device was not included in the detailed assessment. In all cases, the manufacturer was contacted and given the opportunity to provide data for their device(s).

For each device screened, rationale was documented to justify which profiles that device was applicable to. Using these requirements, 32 devices were eliminated from all profiles, with rationale documented for why they were not considered further. However, due to the study team's professional interest, three of the screened out devices (HTI Xpack F, HTI Expedition F, and the H-P SteriPen D) were included in all profiles as noted exceptions.

After the screening, 36 of the original 66 devices remained to be evaluated in Profile A, 35 devices in Profile B, 34 devices in Profile C, and 17 devices in Profile D. Appendix C provides the justifications for eliminating some devices from the evaluation.

3.5.2 Detailed Evaluation.

On 24-25 August 2005, a panel of technical experts (see Appendix A) met with the CHPPM study team and the DAT to evaluate the remaining devices against the detailed evaluation model for each user profile. Starting with Profile A, the experts evaluated each device against each measure in the evaluation model. The panel discussed each device, using the data presented in the device evaluation papers as well as their own expertise and judgment. Discussion continued until a consensus was reached, at which point a score was assigned, based on the performance scale in the evaluation model. When required, scoring rationale was documented. This process was repeated until each device had been assessed against each measure for Profile A.

For Profiles B, C, and D, each device was then re-evaluated for those measures that had different performance scales than Profile A.

A consistency check of the scores was performed to ensure that all devices were scored accurately relative to the performance scales and relative to each other. A few corrections were made and approved by the technical experts. The study team also modified the evaluation model in some cases to improve the ability of the model to discriminate between the different devices. For instance, Service Life was a measure that was included in the original model, but was then removed when (1) it became apparent that it provided no discrimination between the devices being evaluated, and (2) the team determined that the main components of Service Life were accounted for in other areas of the model.

The scores assigned to each device for Profile A are shown in Table 6 below. For Profiles B, C, and D, the scores are shown in Appendix D.

Table 6. Assigned Device Scores for Profile A

	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste / Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
AC Pristine Water Pur Sys D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aqua Mira Drops D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aquatabs D	One Check	One Check	Zero Checks	Zero Checks	25	None	30	No effect	85	100	10	120	30	100
Chlorfloc D	Three Checks	Three Checks	Three Checks	Zero Checks	35	Medium	20	No effect	25	10	10	1160	320	100
Coghlan Iodine tabs D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Coghlan IT w/ Neut D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
GE Base Camp F	One Check	One Check	One Check	One Check	90	High	1	Mult prefilters small pore	60	80	60	5120	2800	80
GE Deluxe F	One Check	One Check	One Check	One Check	90	High	1	Prefilter; backwashable	60	65	60	1450	430	80
GE TrvlPure F	One Check	One Check	One Check	One Check	90	High	1	Mult prefilters small pore	70	65	60	1580	630	80
Globaline D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	250	60
H-P SteriPen D	Zero checks	Zero Checks	Zero Checks	Zero Checks	70	None	1.5	No effect	85	0	75	820	1250	100
HTI Xpack F	One Check	One Check	One Check	One Check	100	Very high	480	No effect	70	30	0	8000	3632	60
HTI Expedition F	One Check	One Check	One Check	One Check	100	Very high	130	No effect	60	65	65	8000	3632	60
Kat Base Camp F	One Check	Zero Checks	One Check	One Check	90	High	2	Prefilter; not cleanable	70	70	0	1500	370	80
Kat Camp F	One Check	Zero Checks	One Check	One Check	70	High	12	No prefilter; cleanable	50	30	20	1500	620	40
Kat Combi F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	50	45	20	1360	600	40
Kat Exst XR F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	230	80
Kat Exstream F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat Guide F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	75	0	1250	400	80
Kat Hiker F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; not cleanable	70	70	0	1050	310	80
Kat Hiker Pro F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	70	0	1050	310	80
Kat Micro F	One Check	Zero Checks	One Check	One Check	90	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat MicrPur Tabs D	Three Checks	Three Checks	Three Checks	Three Checks	35	None	240	No effect	100	100	10	440	80	100
Kat Mini F	One Check	Zero Checks	One Check	One Check	70	High	2	Prefilter; cleanable	35	30	20	580	230	40
Kat Pocket F	One Check	Zero Checks	One Check	One Check	70	High	1	Prefilter; cleanable	50	50	20	1250	570	40
MSR Miniworks EX F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	55	40	25	1400	460	40
MSR MIOX Purifier D	Three Checks	Three Checks	Three Checks	Zero Checks	25	None	240	No effect	50	70	100	560	230	100
MSR SwtWtr Micfilt F	Three Checks	Zero Checks	One Check	Three Checks	90	High	1	Prefilter, less cleanable	60	65	25	1260	320	80
MSR SwtWtr Purif F	Three Checks	Three Checks	Three Checks	Three Checks	50	High	6	Prefilter, less cleanable	55	65	25	1400	400	0
MSR WaterWorks EX F	One Check	Zero Checks	One Check	One Check	90	Very high	1	Prefilter; cleanable	55	40	25	1770	540	40
PE Polar Pure D	One Check	One Check	Zero Checks	Zero Checks	25	None	20	No effect	65	80	10	160	250	60
Potable Aqua IT D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Potable Aqua IT w/ Neut D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
PRISMEd Triton F	One Check	One Check	One Check	One Check	90	High	14	Prefilter; not cleanable	75	70	0	1800	500	80
Sawyer WB F	One Check	Zero Checks	One Check	One Check	90	High	2	No prefilter; not cleanable	40	80	0	1040	160	80
XDT Xrem Wtr Pur D	Three Checks	Three Checks	Three Checks	Zero Checks	35	None	15	No effect	100	90	40	700	1400	0

*See Appendix B for a definition of the Checks scale.

4. RESULTS ANALYSIS

Once the scores were finalized, results were generated and analysis was performed. The LDW software translated each assigned score to a converted score on a scale from 0-100. This conversion is based on the assigned score for the device and the associated utility curve for that measure. An overall score was then generated using a linear additive approach, in which the converted score for each measure was multiplied by the measure weight, and then summed across all measures. This resulted in an overall score and a ranking for each device.

The converted and overall scores for Profile A are shown in Table 7, while the converted and overall scores for Profiles B-D can be found in Appendix E. In all four figures, the column titled “Best IWP Goal” represents the overall score calculated for that device.

The results analysis was performed from several perspectives, as described below; the LDW software provides some useful features to aid in these analyses.

- Overall scores and ranking relative to goals and measures (stacked bar charts).
- Includes performance of all devices relative to each measure, to identify areas of technical challenge.
- Performance of individual devices, to identify strengths and weaknesses.
- Sensitivity graphs, to identify how results would be affected by different goal/measure weights.

The remainder of this section describes the analysis of results in detail. One of the most important findings of this analysis is that there are more similarities than differences among the results of the four profiles. Therefore, the results for Profile A are described first and in the greatest detail, while the results for the remaining profiles are described primarily in terms of how they differ from Profile A. Profiles B and C are discussed together because their results are so similar.

4.1 Rankings and Measures Assessment.

4.1.1 User Profile A.

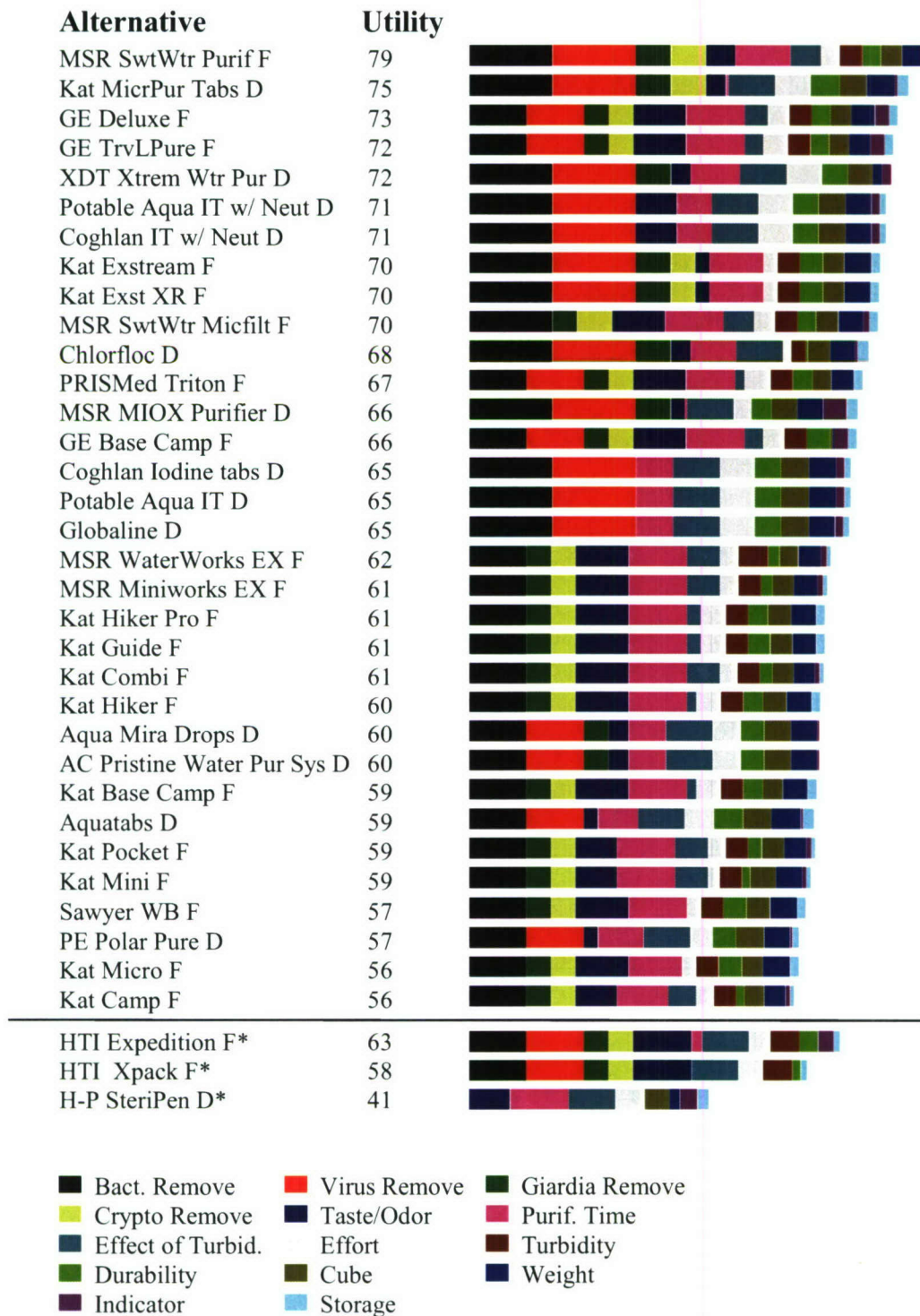
4.1.1.1 Overall Results for Profile A.

Thirty-six devices were evaluated in Profile A. Table 8 shows a stacked bar chart, which displays overall scores and rankings relative to the 14 evaluation measures. The colored bars to the right of each device illustrate the proportion each measure contributed to the overall score for each technology. The width of each sub-bar reflects the weight of the measure and the score a device received. For all profiles, the four Pathogen Removal measures are listed first, followed by the remaining measure in order of decreasing weight (using Profile A weighting).

Table 7. Converted and Overall Device Scores for Profile A

	Best IWP Goal	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste/Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
MSR SwiftWtr Purif F	79	100	100	100	100	50	75	94	65	55	65	25	72	82	0
Kat MicrPur Tabs D	75	100	100	100	100	35	0	4	100	100	100	10	91	96	100
GE Deluxe F	73	70	70	70	70	90	75	100	50	60	65	60	71	81	80
GE TrvLPure F	72	70	70	70	70	90	75	100	40	70	65	60	68	72	80
XDT Xtrem Wtr Pur D	72	100	100	100	0	35	0	83	100	100	90	40	86	32	0
Potable Aqua IT w/ Neut D	71	100	100	0	0	70	0	60	100	95	90	35	94	87	60
Coghlan IT w/ Neut. D	71	100	100	0	0	70	0	60	100	95	90	35	94	87	60
Kat Exstream F	70	100	100	100	70	25	75	91	0	40	80	0	72	91	80
Kat Exst XR F	70	100	100	100	70	25	75	91	0	40	80	0	72	90	80
MSR SwiftWtr Micrfill F	70	100	0	70	100	90	75	100	65	60	65	25	75	86	80
Chlorfloc D	68	100	100	100	0	35	50	78	100	25	10	10	77	86	100
PRISMED Triton F	67	70	70	70	70	90	75	84	20	75	70	0	64	78	80
MSR MIOX Purifier D	66	100	100	100	0	25	0	4	100	50	70	100	89	90	100
GE Base Camp F	66	70	70	70	70	90	75	100	40	60	80	60	9	4	80
Coghlan Iodine tabs D	65	100	100	0	0	0	0	64	100	100	90	35	97	93	60
Potable Aqua IT D	65	100	100	0	0	0	0	64	100	100	90	35	97	93	60
Globaline D	65	100	100	0	0	0	0	64	100	100	90	35	97	89	60
HTI Expedition F	63	70	70	70	70	100	100	18	100	60	65	65	0	0	60
MSR WaterWorks EX F	62	70	0	70	70	90	100	100	70	55	40	25	65	76	40
MSR Miniworks EX F	61	70	0	70	70	90	75	100	70	55	40	25	72	80	40
Kat Hiker Pro F	61	70	0	70	70	90	75	100	30	70	70	0	79	86	80
Kat Guide F	61	70	0	70	70	90	75	100	30	70	75	0	75	82	80
Kat Combl F	61	70	0	70	70	90	75	100	70	50	45	20	73	73	40
Kat Hiker F	60	70	0	70	70	90	75	100	20	70	70	0	79	86	80
Aqua Mira Drops D	60	70	70	70	0	35	0	64	100	80	80	10	93	88	0
AC Pristine Water Pur Sys D	60	70	70	70	0	35	0	64	100	80	80	10	93	88	0
Kat Base Camp F	59	70	0	70	70	90	75	99	20	70	70	0	70	84	80
Aquatabs D	59	70	70	0	0	25	0	68	100	85	100	10	98	99	100
Kat Pocket F	59	70	0	70	70	70	75	100	70	50	50	20	75	75	40
Kat Mini F	59	70	0	70	70	70	75	99	70	35	30	20	88	90	40
HTI Xpack F	58	70	70	70	70	100	100	0	100	70	30	0	0	0	60
Sawyer WB F	57	70	0	70	70	90	75	99	0	40	80	0	79	93	80
PE Polar Pure D	57	70	70	0	0	25	0	78	100	65	80	10	97	89	60
Kat Micro F	56	70	0	70	70	90	75	91	0	40	80	0	72	91	80
Kat Camp F	56	70	0	70	70	70	75	87	60	50	30	20	70	72	40
H-P SteriPen D	41	0	0	0	0	70	0	99	100	85	0	75	84	39	100

Table 8. Stacked Bar Ranking for Profile A



*The HTI Expedition F, HTI Xpack F, and the H-P SteriPen D did not meet the minimum criteria for this scenario. Exceptions were made to allow them to be included in the analysis.

As seen in the figure, no device scored high on all attributes; overall scores for most devices are in the moderate range:

- The top score was 79 (out of 100 possible)
- The spread from best to worst for 35 of 36 devices was only 23 points (56 to 79)

The device scores fall into a “cascading” pattern, with no apparent tiers. The spread of scores among the devices ranked in the top half is fairly narrow, indicating individual tradeoffs will be required to select preferred devices.

The following discussion describes the Profile A results for the Performance goal, and then the results for the Operational and Logistical goals together.

4.1.1.2 Performance Results for Profile A.

Performance addresses how well the device works, and encompasses removal of four pathogens, aesthetics (taste, odor, and turbidity removal), and time to purify. There was a wide range of results in this area, as described below.

Most devices have not undergone independent EPA-protocol testing for pathogen removal, as discussed below:

- Only two devices received a rating of “3 Checks” (see Appendix B for definition of Check scale) for removal of all four pathogens (MSR SwtWtr Purif F and Kat MicrPur Tabs D).
- Two other devices were rated “3 Checks” for removal of three pathogens (*Bacteria*, *Virus*, and *Giardia*), but only “1 Check” for *Cryptosporidium* removal (Kat Exstream F and Kat Exst XR F)
- Three devices were rated “3 Checks” for removal of three pathogens (*Bacteria*, *Virus*, and *Giardia*), but “Zero Checks” for *Cryptosporidium* removal (Chlorfloc D, MSR MIOX Purifier D, XDT Xtrem Wtr Pur D).
- Six devices were rated “1 Check” for all four pathogens (GE Base Camp F, GE Deluxe F, GE TrvLPure F, HTI Xpack F, HTI Expedition F, and PRISMed Triton F). If EPA testing was successful, the GE Deluxe F, GE TrvLPure F would score the highest overall in this profile, and the PRISMed Triton F would rank third.

Bacteria should not be an issue:

- All devices but one (H-P SteriPen D) received at least a “1 Check” rating for *Bacteria Removal* (based on screening criteria, all devices must meet this criterion – the H-P SteriPen D was included as a noted exception).

Aesthetics (taste, odor, and turbidity removal) is not a problem for most filter systems, but is a problem for disinfectants:

- Most filter devices scored 70 or higher for *Taste/Odor* and *Turbidity* [exceptions are Kat Exstream F, Kat Exst XR F, and MSR SwtWtr Purif F (due to disinfectant solution)].
- Most disinfectant devices scored 35 or lower for *Taste/Odor* and *Turbidity*. Exceptions for *Taste/Odor*: Potable Aqua IT w/ Neut D, H-P SteriPen D, Coghlan IT w/ Neut D. Exceptions for *Turbidity*: Chlorfloc D (due to flocculant).

Purification Time should not be an issue for Profile A:

- Most (32) devices were 40 min or less, well within the user constraints. Almost half can purify in 2 min or less.

4.1.1.3 Operational and Logistics Results for Profile A.

Operational and Logistics address how burdensome the devices are to use in the field. They encompass the *Effect of Turbidity*, *Effort*, *Durability*, presence of an *Indicator*, portability (*Cube* and *Weight*), and *Storage*. Overall, most devices should not present a burden for use in the field, given the constraints of Profile A.

Cube and *Weight* should not be an issue for Profile A:

- Most devices scored high (70 or higher) for these measures.
- Two devices did not meet the minimum criteria for *Cube* and *Weight* (HTI Xpack F and HTI Expedition F) but were included in the analysis as noted exceptions.

In general, *Effect of Turbidity*, *Effort*, *Durability*, and *Storage* do not present a significant concern, as most devices scored high (>50) in those areas. However, *Effect of Turbidity* is a concern for most filter devices.

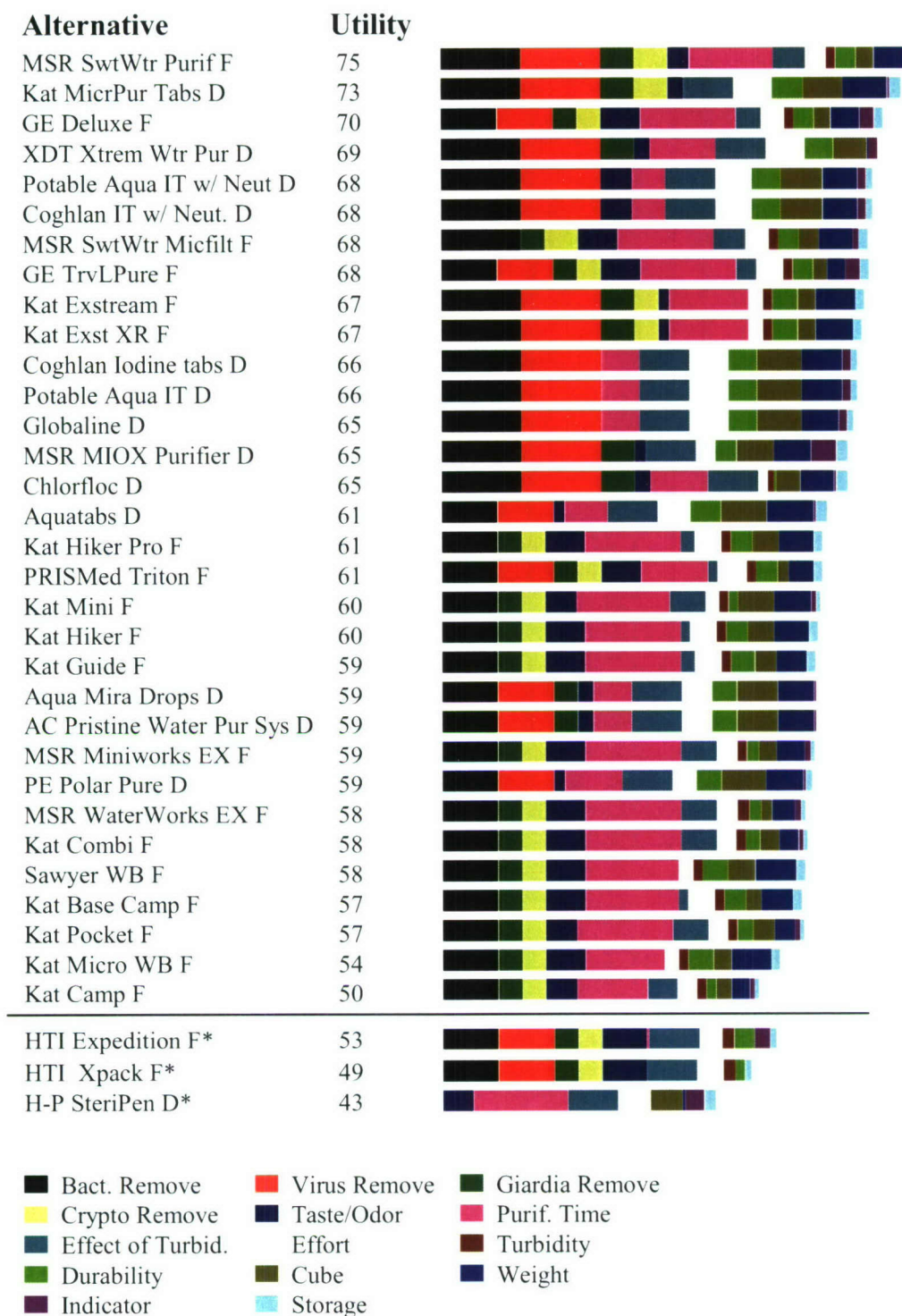
One concern in this area is *Process Failure Indicator*, as most devices (30) scored 40 or lower.

4.1.2 User Profiles B and C.

4.1.2.1 Overall Results for Profiles B and C.

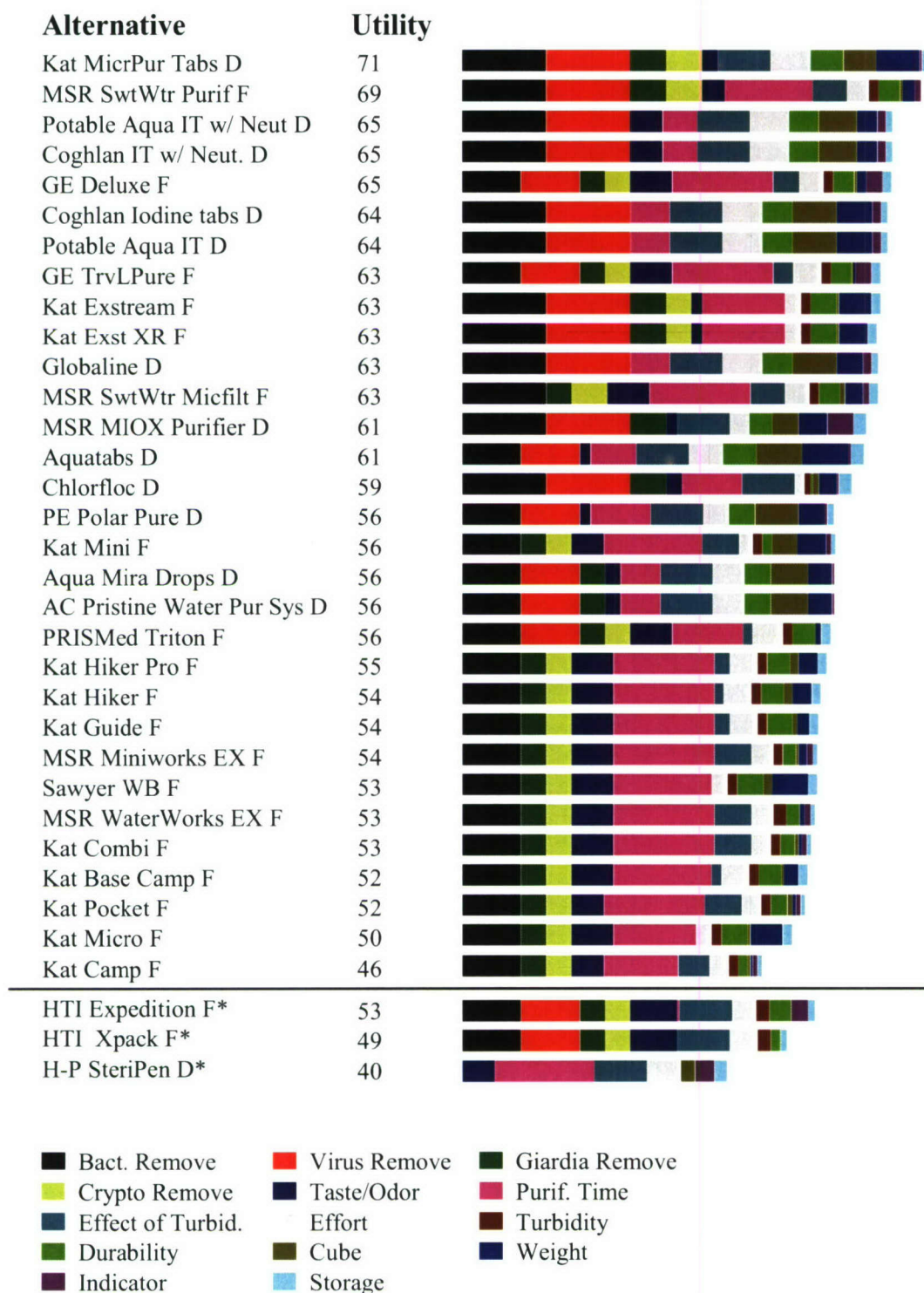
Thirty-five devices were evaluated for Profile B, and 34 devices for Profile C. Tables 9 and 10 show the stacked bar charts for Profiles B and C, respectively. As in Profile A, no device scored high on all attributes; overall scores for most devices are in the moderate range:

Table 9. Stacked Bar Ranking for Profile B



*The HTI Expedition F, HTI Xpack F, and the H-P SteriPen D did not meet the minimum criteria for this scenario. Exceptions were made to allow them to be included in the analysis.

Table 10. Stacked Bar Ranking for Profile C



*The HTI Expedition F, HTI Xpack F, and the H-P SteriPen D did not meet the minimum criteria for this scenario. Exceptions were made to allow them to be included in the analysis.

- The top score was 75 for Profile B (out of 100 possible), and 71 for Profile C.
- The spread from best to worst for Profile B for 32 out of 35 devices was only 21 points (49 to 70), and the spread for 30 out of 34 devices in Profile C is only 16 points (49 to 65).

As in Profile A, the device scores fall into a “cascading” pattern, with no apparent tiers. The spread of scores between the devices ranked in the top half is fairly narrow, indicating individual tradeoffs will be required to select preferred devices.

4.1.2.2 Performance Results for Profiles B and C.

Results for Performance, which encompasses removal of four pathogens, aesthetics (taste, odor, and turbidity removal), and time to purify, were very similar to Profile A (see Section 4.1.1).

The pathogen removal data is the same as in Profile A. The only differences in this area are the result of certain devices being included in Profile A but not in Profiles B and C. The two differences are:

- For Profile C, only two devices (instead of three) were rated “3 Checks” for *Bacteria*, *Virus*, and *Giardia*, but “Zero Checks” for *Cryptosporidium*.
- For Profiles B and C, five devices (instead of six) were rated “1 Check” for all four pathogens. Also, PRISMed Triton F would not score in the top of the ranking even if EPA testing data were available.

As in Profile A, Aesthetics (taste, odor, turbidity removal) is not a problem in Profiles B and C for most filter systems, but is a problem for disinfectants.

Purification Time is slightly more of an issue for Profiles B and C than it was for Profile A:

- 20 devices received a score of 70 or above, which corresponds to a time of 15 min or less. Fourteen of these devices can purify in 2 min or less. All but four devices were within 40 min. The concern is that the 40-min marker was well within user constraints for Profile A; however, in Profiles B and C, a purification time of 40 min corresponds to a score of only 35.
- One device (HTI Xpack F) did not meet the minimum level for *Purification Time*, and its score should be lower than shown.

4.1.2.3 Operational and Logistics Results for Profiles B and C.

These areas encompass the *Effect of Turbidity*, *Effort*, *Durability*, presence of an *Indicator*, portability (*Cube* and *Weight*), and *Storage*. The results for Profiles B and C are mostly similar to Profile A, with the exception of *Cube* and *Weight*.

Cube and *Weight* are slightly more of a concern for Profile B than they were in Profile A:

- Most devices scored high (70 or higher) or mid-range (30-70) for these measures. In Profile A, the majority of the devices scored above 70. In Profile B, less than half the devices scored above 70.

Cube and *Weight* are a concern for Profile C:

- Approximately half the devices scored less than 30 for *Cube* and *Weight*.
- Only nine devices scored high (70 or higher) for *Cube*, and five devices scored high for *Weight* (in Profile A, most devices scored above 70 for *Cube* and *Weight*).

Two devices did not meet the minimum criteria for *Cube* and *Weight* (HTI Xpack F and HTI Expedition F), and their scores should be lower than shown.

As in Profile A, *Effect of Turbidity*, *Effort*, *Durability*, and *Storage* generally do not present a significant concern, as most devices scored high (greater than 50) in those areas. However, *Effect of Turbidity* is a concern for most filter devices.

As in Profile A, *Process Failure Indicator* is a concern for Profiles B and C, as most devices scored 40 or lower.

4.1.3 User Profile D.

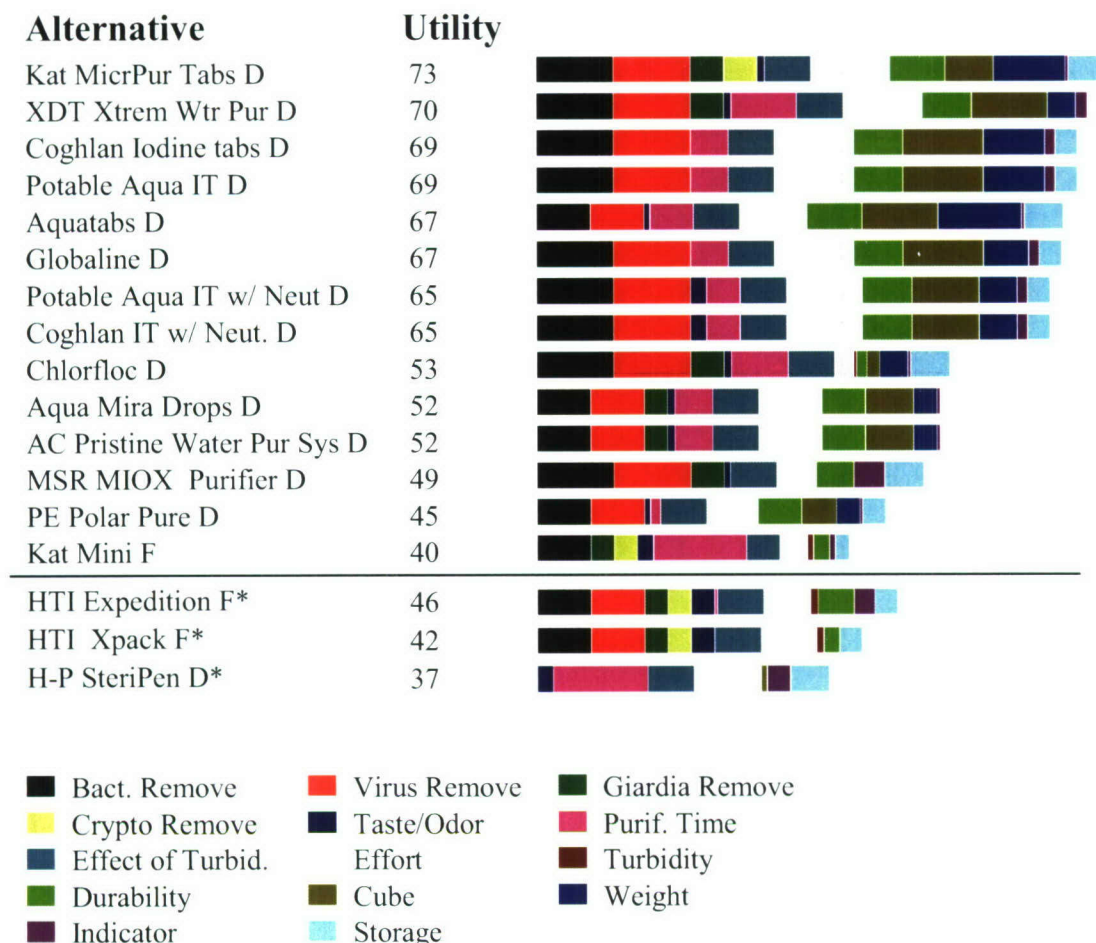
4.1.3.1 Overall Results for Profile D.

Seventeen devices were evaluated for Profile D. Table 11 shows the stacked bar chart for Profile D. As in the other Profiles, no device scored high on all attributes; overall scores for most devices are in the moderate range:

- The top score was 73 (out of 100 possible).
- There is a larger spread from best to worst; for 16 devices the spread is 36 points (37 to 73).

Although the top eight devices have a rather narrow point spread, as a group they score significantly higher than the other 9 devices. The scoring gap is primarily due to their higher scores for *Cube* and *Weight*, which are weighted the highest in this profile, relative to the other profiles.

Table 11. Stacked Bar Ranking for Profile D



*The HTI Expedition F, HTI Xpack F, and the H-P SteriPen D did not meet the minimum criteria for this scenario. Exceptions were made to allow them to be included in the analysis.

4.1.3.2 Performance Results for Profile D.

There was a wide range of results for Performance, which encompasses removal of four pathogens, aesthetics (taste, odor, and turbidity removal), and time to purify, as described below.

Pathogen removal scores remain the same as in Profile A. The differences in Profile D results reflect where a device from Profile A was not evaluated in Profile D, or where the smaller number of devices results in different conclusions. The result is that there are fewer devices in Profile D that receive high scores for Pathogen Removal compared to the other profiles.

Most devices have not undergone independent EPA-protocol testing for all four pathogens:

- Only one device received a rating of “3 Checks” for all four pathogens (Kat MicrPur Tabs D).
- Three devices were rated “3 Checks” for *Bacteria*, *Virus*, and *Giardia*, but “Zero Checks” for *Cryptosporidium* (Chlorfloc D, MSR MIOX Purifier D, XDT Xtrem Wtr Pur D).
- Two devices were rated “1 Check” for all four pathogens (HTI Xpack F, HTI Expedition F); however, having EPA test results for these devices would not significantly alter their performance against the evaluation model.

As in all other profiles, bacteria removal should not be an issue:

- All devices but one received at least a “1 Check” rating for Bacteria (based on screening criteria, all devices must meet this criteria – the H-P SteriPen D was included as a noted exception).

Unlike the other scenarios, Cyst removal may be an issue in Profile D:

- 8 devices received “Zero Checks” for *Giardia* removal.
- 13 devices received “Zero Checks” for *Cryptosporidium* removal.

Again as in Profile A, Aesthetics (taste, odor, turbidity removal) is not a problem in Profile D for most filter based devices, but is for disinfectant devices

- All filter devices score 70 or higher for *Taste/Odor* and *Turbidity*
- Most disinfectant devices score 35 or lower for *Taste/Odor* and *Turbidity*.
Exceptions for *Taste/Odor*: Potable Aqua IT w/ Neut D, H-P SteriPen D, Coghlan IT w/ Neut D.
Exceptions for *Turbidity*: Chlorfloc D

Unlike Profile A, *Purification Time* is a concern for Profile D:

- Only four devices scored above 50 (corresponding to a time of about 28 min). Only two devices can purify in 2 min or less.

One device (HTI Xpack F) did not meet the minimum criterion for *Purification Time*, and its score should be lower than shown.

4.1.3.3 Operational and Logistics Results for Profile D.

Operational and Logistics address how burdensome the devices are to use in the field. It encompasses the *Effect of Turbidity*, *Effort*, *Durability*, presence of an *Indicator*, portability (*Cube* and *Weight*), and *Storage*. Given the constraints of Profile D, some devices will be burdensome to use in the field. This is based on the increased cube and weight constraints of this Profile.

Unlike Profile A, portability (*Cube* and *Weight*) is a concern for Profile D:

- Approximately half the devices scored <30 for *Cube* and *Weight*.
- Only 2 devices scored high (70 or higher) for *Weight*, and 7 devices scored high for *Cube*. In Profile A, the majority of the devices scored above 70.
- Two devices did not meet the minimum criteria for *Cube* and *Weight* (HTI Xpack F, HTI Expedition F), and their scores should be lower than shown.

Effect of Turbidity is not an issue for this profile – all devices scored 100, with the exception of the Kat Mini F, which scored a 70. In Profile A, most devices scored above 50 for this criterion, but the results were not as universally high as they were in Profile D. This is due to the lesser number of filter devices evaluated in Profile D.

Most devices scored high (greater than 50) for *Effort*, *Durability*, and *Storage*. As in all other profiles, *Process Failure Indicator* is a concern. Most devices scored 35 or lower.

4.2 Performance of Individual Devices.

In this part of the analysis, the scores for each device were reviewed relative to each measure to identify where each device scored well and where it scored poorly, i.e., strengths and weaknesses. LDW generates bar charts that help with this analysis. An example chart for the AC Pristine Water Pur Sys D for Profile A is shown in Figure 3. In this chart, the width of each colored bar represents the weight given to that measure, while the height of the bar represents how the device scored for that measure. The chart shows that this device scored fairly high for three of the highest weighted measures (*Virus* and *Bacteria Removal* and *Purification Time*), but fairly low for another important measure (*Taste/Odor*). The device also scores very high for several measures that are not weighted high (e.g., *Cube*), but very low for some low-weighted measures (e.g., *Turbidity*).

Table 12 summarizes the strengths and weaknesses analysis. The table was generated by comparing the score for each evaluated device to the scores of the other evaluated devices, relative to each measure, and noting attributes that stand out, either positively or negatively, for each device. Pathogen Removal was addressed somewhat differently in the table, since that is the most highly weighted area; the performance of every device (not just those that stand out) is summarized relative to the four Pathogen Removal measures.

The analysis also considers the strengths and weaknesses that are common to each of the two classes of devices, filters and disinfectants, as described below.

In general, filters purify water more quickly than disinfectants since most often the user simply pumps the water through the filter without any additional wait time. Disinfectant devices require little or no work on the part of the user, often simply adding tablets or drops to the raw water, but require a wait time for disinfection to occur. Devices that are beyond the common purification time for their class are noted in the table.

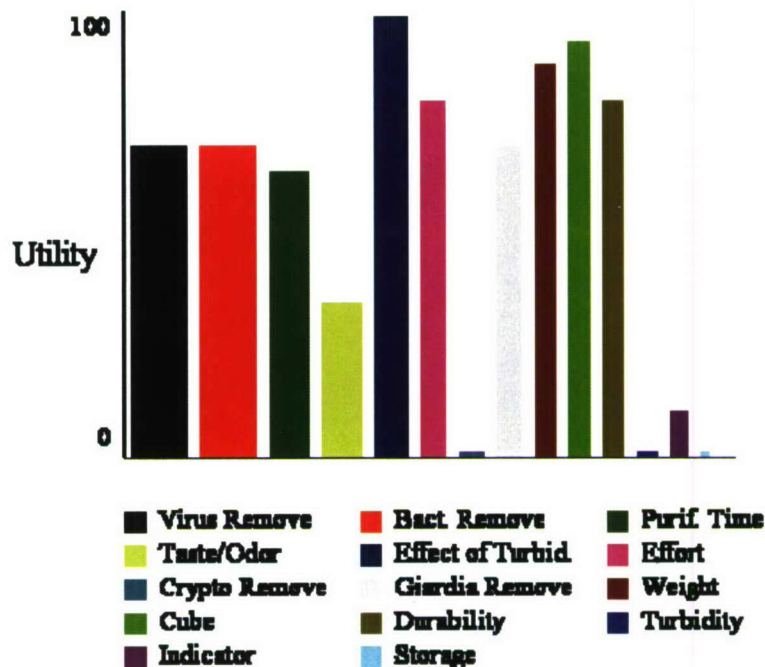


Figure 3. Bar Chart for AC Pristine Water Pur Sys D

Another important attribute of these devices is how turbid water affects their operation and product water aesthetics. In operational terms, turbid waters will eventually clog most filtration devices. The ability of a filter to limit this clogging, and the ability of the device to be restored through cleaning, are attributes of each individual device. Since filters reduce the particulates in turbid water, the purified water will appear clearer than the raw water. Disinfectants are not affected by turbid waters from an operational standpoint (pathogen inactivation is not considered here) but, in contrast to filtration devices, disinfectants do not reduce the turbidity of the raw water. Exceptions exist for devices that do not strictly follow these generalizations, and they are noted in the table as well.

4.3 Sensitivity Analysis.

Sensitivity analysis allows the analyst or decision maker to assess how the results produced by an evaluation model would be affected by varying the weights of the measures or goals. A typical approach is to vary the weights of individual measures by a reasonable amount to see if the overall ranking of the alternatives is affected. A reasonable change in weight might be defined as doubling or halving the weight; if no or few rankings changed among the devices, particularly among the top ranked devices, the measure would not be considered sensitive.

Table 12. Strengths and Weaknesses of Individual Devices

Device	Strengths	Weaknesses
MSR SwtWtr Purif F	• Proven effective against all four pathogens with independent testing • Cleanable filter • Filter reduces taste and odor	• Special storage conditions recommended • Cube and weight increasingly burdensome with on the move profiles • Disinfectant imparts taste and odor
Kat MicrPur Tabs D	• Proven effective against all four pathogens with independent testing • Minimal effort required • Lightweight	• Very slow purification time
GE Deluxe F	• Expected to be effective against all four pathogens • Filter reduces taste and odor	• Potential for cross contamination during cleaning • Cube and weight increasingly burdensome with on the move profiles
GE TrvLPure F	• Expected to be effective against all four pathogens • Filter reduces taste and odor	• Filter not cleanable • Cube and weight increasingly burdensome with on the move profiles
XDT Xtrem Wtr Pur D	• Proven effective against bacteria, viruses, and <i>Giardia</i> cysts with independent testing • Minimal effort	• Not effective against <i>Cryptosporidium</i> oocysts • Multiple bottles required • Special storage conditions recommended
Potable Aqua IT w/ Neut D	• Proven effective against bacteria and viruses with independent data • Minimal effort	• Not effective against <i>Giardia</i> cysts or <i>Cryptosporidium</i> oocysts
Coghlan IT w/ Neut D	• Proven effective against bacteria and viruses with independent data • Minimal effort	• Not effective against <i>Giardia</i> cysts or <i>Cryptosporidium</i> oocysts
Kat Exstream F	• Proven effective against bacteria, viruses, and <i>Giardia</i> cysts with independent testing • Expected to be effective against <i>Cryptosporidium</i> oocysts • Filter reduces taste and odor	• Disinfectant imparts taste and odor • Filter not cleanable • Highly affected by turbid waters • Cube and weight increasingly burdensome with on the move profiles

Table 12. Strengths and Weaknesses of Individual Devices (continued)

Device	Strengths	Weaknesses
Kat Exst XR F	- Proven effective against bacteria, viruses, and <i>Giardia</i> cysts with independent testing - Expected to be effective against <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Disinfectant imparts taste and odor - Filter not cleanable - Highly affected by turbid waters - Cube and weight increasingly burdensome with on the move profiles
MSR SwtWtr Micfilt F	- Proven effective against bacteria and <i>Cryptosporidium</i> oocysts with independent testing - Expected to be effective against <i>Giardia</i> cysts - Cleanable filter - Filter reduces taste and odor	- Not effective against viruses - Cube and weight increasingly burdensome with on the move profiles
Chlorfloc D	- Proven effective against bacteria, viruses, and <i>Giardia</i> cysts with independent testing - Reduces turbidity	- Not effective against <i>Cryptosporidium</i> oocysts - Moderately high effort required - Imparts taste and odor
PRISMed Triton F	- Expected to be effective against all four pathogens - Filter reduces taste and odor	- Filter not cleanable - Slow purification time for a filter
MSR MIOX Purifier D	- Proven effective against bacteria, viruses, and <i>Giardia</i> cysts with independent testing - Engineered process failure indicators	- Not effective against <i>Cryptosporidium</i> oocysts. - Moderate effort required - Very slow purification time - Imparts taste and odor
GE Base Camp F	- Expected to be effective against all four pathogens - Filter reduces taste and odor	- Comparatively large and heavy - Filter not cleanable
Coghlan Iodine tabs D	- Proven effective against bacteria and viruses with independent data - Minimal effort	- Not effective against <i>Giardia</i> cysts or <i>Cryptosporidium</i> oocysts - Imparts strong taste and odor
Potable Aqua IT D	- Proven effective against bacteria and viruses with independent data - Minimal effort	- Not effective against <i>Giardia</i> cysts or <i>Cryptosporidium</i> oocysts - Imparts strong taste and odor

Table 12. Strengths and Weaknesses of Individual Devices (continued)

Device	Strengths	Weaknesses
Globaline D	- Proven effective against bacteria and viruses with independent data - Minimal effort	- Not effective against <i>Giardia</i> cysts or <i>Cryptosporidium</i> oocysts - Slow purification time - Imparts strong taste and odor
MSR Waterworks EX F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Multiple microfilters - Filter reduces taste and odor - Cleanable filter	- Not effective against viruses - Ceramic filter comparatively fragile
MSR Miniworks EX F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor - Cleanable filter	- Not effective against viruses - Ceramic filter comparatively fragile
Kat Hiker Pro F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Filter not cleanable
Kat Guide F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Filter not cleanable
Kat Combi F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Ceramic filter comparatively fragile
Kat Hiker F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Filter not cleanable
Aqua Mira Drops D	Expected to be effective against bacteria, viruses, and <i>Giardia</i> cysts	- Not effective against <i>Cryptosporidium</i> oocyst - Special storage conditions recommended
AC Pristine Water Pur Sys D	Expected to be effective against bacteria, viruses, and <i>Giardia</i> cysts	- Not effective against <i>Cryptosporidium</i> oocysts - Special storage conditions recommended
Kat Base Camp F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Filter not cleanable

Table 12. Strengths and Weaknesses of Individual Devices (continued)

Device	Strengths	Weaknesses
Aquatabs D	- Expected to be effective against bacteria and viruses - Lightweight	- Not effective against <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Imparts taste and odor
Kat Pocket F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Cleanable filter	- Not effective against viruses - Ceramic filter comparatively fragile
Kat Mini F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Cleanable filter	- Not effective against viruses - Ceramic filter comparatively fragile
Sawyer WB F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Reduces taste and odor	- Not effective against viruses - Filter not cleanable - Highly affected by turbid waters - Cube and weight increasingly burdensome with on the move profiles
PE Polar Pure D	- Expected to be effective against bacteria and viruses - Large production capacity	- Not effective against <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Imparts taste and odor
Kat Micro F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Filter reduces taste and odor	- Not effective against viruses - Filter not cleanable - Highly affected by turbid waters - Cube and weight increasingly burdensome with on the move profiles
Kat Camp F	- Expected to be effective against bacteria, <i>Giardia</i> cysts and <i>Cryptosporidium</i> oocysts - Cleanable filter	- Not effective against viruses - Ceramic filter comparatively fragile - Slow purification time for a filter
HTI Expedition F	- Expected to be effective against all four pathogens - Reduces taste and odor - Not affected by turbid water	- Very slow purification time - Very large and heavy

Table 12. Strengths and Weaknesses of Individual Devices (continued)

Device	Strengths	Weaknesses
HTI Xpack F	• Expected to be effective against all four pathogens • Reduces taste and odor • Not affected by turbid water	• Extremely slow purification time • Very large and heavy
H-P SteriPen D	• Fast purification time • Engineered process failure indicator	• Not expected to be effective against any of the four pathogens • Intended for low turbidity waters • Comparatively fragile

Figure 4 shows a sensitivity graph for the *Virus Removal* measure from Profile A. The vertical line represents the weight assigned to this measure, while the colored lines represent the individual devices. The order in which the device lines intersect the weight line represents the overall ranking of the devices. Moving the vertical line to the left or the right represents changes in the weight (decreasing or increasing, respectively) of this measure. For example, the intersection of the current weight line (14%) and the Kat MicroPur Tabs D line shows this device to score 2nd overall. If the weight is increased (weight line moved to the right), Kat MicroPur Tabs D remains 2nd, but if the weight is decreased (weight line moved to the left), this device will rank several places lower.

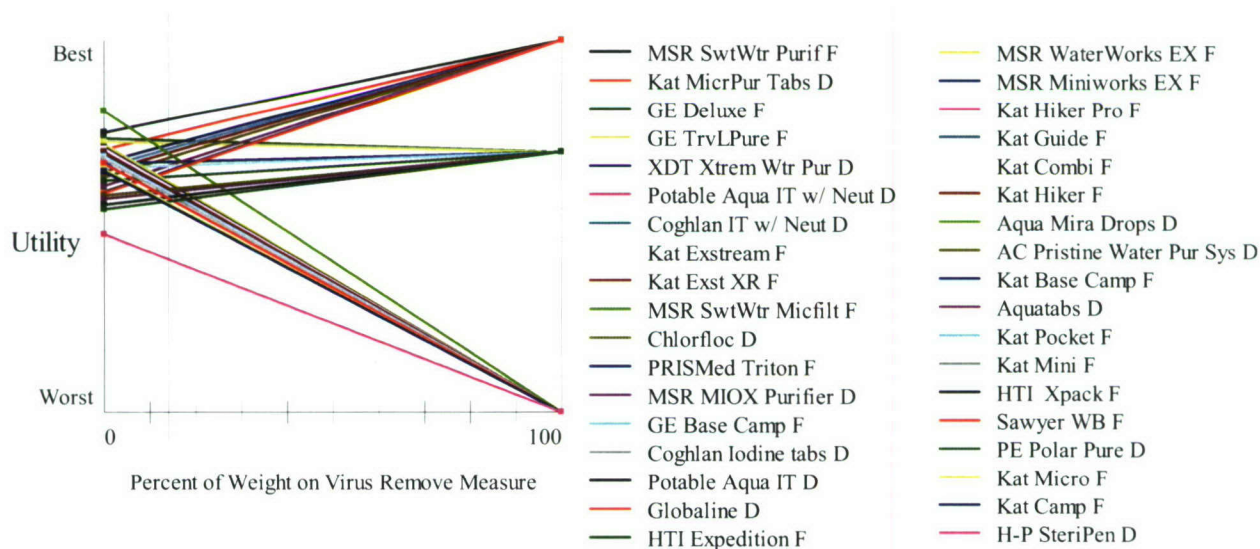


Figure 4. Sensitivity Graph for Virus Removal, Profile A

For this study, only a limited sensitivity analysis was performed. In part, sensitivity analysis was not practical given the number of devices under consideration, as well as the number of measures and profiles. Sensitivity analysis was also not likely to provide much insight into the results and recommendations because of the high weighting for Performance, the closeness in overall scores, and the fact that disinfectant devices and filter devices perform as a class quite differently relative to several measures. For example, filter devices tend to score poorly for *Effect of Turbidity*; so, if that measure is weighted higher, the filter devices will generally rank lower overall, while the converse would be true for the disinfectant devices.

Sensitivity analysis would be useful if a particular user wished to focus on a subset of the devices and had specific interest in particular attributes. This could easily be done using the models developed and documented in this report. As an example of this, if a user was not highly concerned about removal of viruses, he could review the sensitivity graph in Figure 4 (*Virus Removal*) and see that the MSR SwtWtr Micfilt F, which ranks 10th based on the current weight, would actually be the 1st ranked device overall if *Virus Removal* was weighted very low (about 4%).

5. CONCLUSIONS AND RECOMMENDATIONS

This assessment was constrained by data limitations. The expert panel relied heavily on vendor-supplied information. There is a need to perform independent testing to obtain additional performance data. If testing or additional data becomes available, the assessment could be updated and new assessments/recommendations generated.

Given the range of user requirements seen in the four user profiles, it is unlikely a single device will meet all user needs. A potential IWP user could, however, match his mission requirements to the most applicable user profile and review the evaluation results to determine which IWP would be best suited for his needs.

Another option is to consider device combinations. These were not evaluated in this study, but this concept would have the potential to provide a greater range of capabilities. For example, by combining a filter and disinfectant device, the user could have a greater potential to remove all pathogens; however, a combination such as this might have other detrimental effects such as increased size and weight.

Devices were evaluated as packaged/instructed; it is possible individual users could also make modifications/adjustments that might result in increased capabilities. For example, many disinfectants with short contact times of the chemical with the water (per instructions) are only effective against bacteria and viruses; however, some of these devices may have the potential to be effective against cysts if the exposure time is increased. From the perspective of the evaluation, the net change in score would be positive (the increase in the pathogen removal score would be greater than the decrease in the *Purification Time* score).

Very few devices have been proven to remove all four pathogens. There are several others that are likely to, but need to be confirmed by EPA-protocol testing. Given the cube and weight constraints of Profile D, there are significantly fewer acceptable devices for this profile that do well at pathogen removal.

Due to the close range of scores for the devices in all profiles, it was difficult to make recommendations based solely on the overall results generated by the evaluation model. However, there are five devices, which can be distinguished from the other devices due to specific strengths, which are described below.

- MSR SwtWtr Purif F is a combination filter and disinfectant, which results in the best overall performance (ranks 1st or 2nd in Profiles A-C). It is one of two devices proven to remove all four pathogens of interest; however, the filter increases size and weight, which makes it unsuitable for Profile D.
- Kat MicrPur Tabs D is the best disinfectant device (ranked 1st or 2nd in all four profiles). It is one of two devices proven to remove all four pathogens, and is very lightweight. However, it has a detrimental effect on the aesthetics of the water, and has the longest purification time of all devices (4 hr). Both of these weaknesses are common to all disinfectant devices that claim to be able to remove cysts.
- GE Deluxe F is the highest ranked filter-only device in Profiles A-C. The filter increases cube and weight, but overall it performs very well; if EPA testing was successful, this device would rank highest overall. It is very similar to other GE devices (e.g., the GE Base

Camp F and the GE TrvLPure F), but its smaller size and weight makes this device preferred over the other GE devices.

- Aquatabs D is the smallest device, but can only inactivate two pathogens and scores low on several measures.

- Kat Mini F is the only filter device small enough to be used in all four user profiles, but it ranked in the lower half of all profiles (last in Profile D).

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APPENDIX A

STUDY PARTICIPANTS

The table below contains the name, organization, and role of each participant in this IWP study.

Study Participants

Name	Organization	Role
MAJ William Bettin	USACHPPM	Study Team Lead
Art Lundquist	USACHPPM	Study Team
Steve Clarke	USACHPPM	Study Team
Steve Richards	USACHPPM	Study Team
John Walther	ECBC	Decision Analyst
Scott Kooistra	ECBC	Decision Analyst
Lindsey Wurster	ECBC	Decision Analyst
Rochelle Bautista	USA Infantry Center, DCD	User Expert
Jay Dusenbury	TARDEC	User Expert
Wayne Kabat	HQDA – Army G-4	User Expert
Alex Papadopoulos	USMC Combat Developments	User Expert
CDR Jack Beaujon	NAVSEA	Technical Expert
John Brokaw	USACHPPM	Technical Expert
Scott Nielsen	TARDEC	Technical Expert
Christopher Penthany	Natick Soldier Center	Technical Expert
CAPT Joanna Rentes	AFIOH/RSE	Technical Expert
Bill Varnava	NAVFAC	Technical Expert

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APPENDIX B

DEFINITION OF CHECKS SCALE

1, 2, or 3 Checks indicate the Individual Water Purifier (IWP) consistently provides adequate protection from microbial pathogen groups by achieving at least a 6-log reduction in bacteria, 4-log reduction in virus, 3-log reduction in *Giardia* cysts (if information on log reduction for *Giardia* cysts is not available but information for *Cryptosporidium* oocyst is, then a 3-log reduction in *Cryptosporidium* oocyst is equivalent to a 3-log reduction in *Giardia* cysts), or a 3-log reduction in *Cryptosporidium* oocyst.

- 3 Checks: This score is based on independent testing using the EPA test protocol under manufacturer-specified device operating conditions. Independent testing is considered neutral and impartial. These data are the most robust and challenging data and, subsequently, means there is very little uncertainty in the effectiveness of this device. This score means the device poses the lowest risk to the soldier from getting sick.

- 2 Checks: This score is based on in-house/manufacturer testing using the EPA test protocol under manufacturer-specified device operating conditions (e.g., production rate, capacity). These data are more robust and more adequately challenge the device than IWPs that earn 1 Check. However, there is still some uncertainty in the effectiveness of the device because of the concern for the potential lack of impartiality and objectivity of the testing data. This score means the device poses less risk to the soldier.

- 1 Check: The score is based on evaluation of general scientific knowledge of treatment technology (e.g., filtration theory), disinfection/removal studies conducted using general technology (e.g., disinfection study using an iodine solution), device-specific testing not using the EPA test protocol, or device-specific testing (in-house or independent) using the EPA test protocol but not under manufacturer-specified device operating conditions. This evaluation method must be used because there are no device-specific testing data using the EPA test protocol in which the device was tested at the manufacturer's recommended operating conditions (e.g., production rate, capacity). Although expected to consistently provide microbial pathogen protection, the device still poses some level of health risk to the soldier as there is a level of uncertainty in the effectiveness of the device.

- 0 Checks: This score is based on available data, lack of data, or general scientific knowledge of the treatment technology. The IWP is not expected to consistently provide protection through adequate log reductions in pathogens. Using an IWP with this score poses the greatest risk to the soldier from getting sick.

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APPENDIX C

DEVICE SCREENING

The table below shows the rationale for any device that was eliminated from the evaluation during the screening phase of the assessment (reference Section 3.5.1). It also notes those devices for which not enough information was available, and those which were included in the evaluation as noted exceptions.

A red cell in the table indicates that the device was not evaluated for the corresponding profile, while a green cell indicates that the device was evaluated for the corresponding profile. Those devices which have their name cell highlighted in green do not meet the screening criteria, but will be evaluated as the noted exceptions.

Note: the comment "Waiting for more information" in the "Other Reasons and Additional Comments/Rationale" column indicates that at the time of the screening assessment, information on that device was not available. Those devices were not evaluated in the detailed evaluation, as this data was not received in time for consideration in this study.

Device Screening

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
1	H-P SteriPen D	Other	Red	Red	Red	Red	2. Disinfectant IWP not expected to meet disinfectant pathogen removal criteria (i.e., reduce bacteria by 6 log and viruses by 4 log).	Device not expected to meet pathogen log inactivation requirements in turbid water. Does not meet screening criteria; however, this will be evaluated anyway due to professional interest.
2	APT/BW Tech - Aquasak Inline Filter	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Manufacturer provided data does not show 6-log bacterial removal

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
3	APT/BW Tech - Survivor 4i	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Manufacturer provided data does not show 6-log bacterial removal
4	APT/BW Tech - Water Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Manufacturer provided data does not show 6-log bacterial removal
5	Aquamira Water Bottle and Filter	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
6	Bota of Boulder - Sports Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
7	Bottoms-Up Water Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
8	Camelbak - Inline Microfilter	Filter						Waiting for more information.

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
9	CuZn Sport Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on assumption of pore size rating by analogy to other systems (assumed 2-micron filter not expected to reduce bacteria by 6 log). Company verifies 1-micron pore size. Does not change evaluation.
10	DHK - ReFresh Military Canteen	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Limited test data does not support adequate bacteria removal.
11	DHK - ReFresh Water Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Limited test data does not support adequate bacteria removal.
12	DJ Int - PureSip Straw	Filter						Waiting for more information.
13	Flip-Top Straw Filter Bottle	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
14	GE Base Camp F	Filter	Green	Red	Red	Red	7. Weighs 4 lb or more and/or cube is 4 L or more.	7 L in size, weight <8 lb.
15	GE Deluxe F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Weight is 1 lb, cube 1.45 L; requires no consumables

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
16	GE TrvLPure F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Weight is approx 1.5 lb, 1.58 L; requires no consumables
17	HTI - HydroPack	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	Single use, one device only produces 2 L; requires 8 devices for a 15 L day (weighs 3.1 lb for 1 day, or 20.4 lb (53 devices) for 105 L over 7 days). Weight is 4 lb for 5 L in 1 day; some potential use in Profile D Does not meet screening criteria.
18	HTI - HydroWell 24	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	Stationary, designed for a group. Size is 23 L.
19	HTI Expedition F	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	5.1 L volume for 30 L of water; additional charges needed for additional capability. Charges add enough weight to raise total significantly above 8 lb. Profiles A-D device and charges are 16 lb and 10 L size. Profile D weight is 2 lb; size is 3 L. Does not meet screening criteria; however, this will be evaluated anyway due to professional interest.

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
20	HTI Xpack F	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	Requires 4 devices to produce 15 L/day; will need additional electrolyte charges for 7 days of production. 20 lb weight and 8.8 L size for 105 L production capability (Profiles A-C). 2 lb weight and 0.54 L size for 5 L/d (Profile D). Does not meet screening criteria; however, this will be evaluated anyway due to professional interest.
21	Ingram - Survival Straw	Filter						Waiting for more information.
22	Seychelle In-Line Eliminator	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
23	Innova - Heavy Duty Biological Bottle	Filter						Waiting for more information.
24	Innova - Inline Filter	Filter						Waiting for more information.
25	Kat Camp F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	1.5 L size. 0.8 lb
26	Kat Combi F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	1.4 L size. 1.3 lb

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
27	Katadyn - Drip Ceradyn	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	>8 L size. 7.3 lb
28	Katadyn - Drip Gravidyn	Filter	Red	Red	Red	Red	8. Weighs 8 lb or more and/or cube is 8 L or more.	>8 L size. 7.3 lb
29	Kat Exstream F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	After 100 L, virus cartridge requires replacement. Volume of bottle includes holding water; however, device is still a perceptible burden for transporting.
30	Kat Exst XR F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	After 100 L, virus cartridge requires replacement. Volume of bottle includes holding water; however, device is still a perceptible burden for transporting.
31	Kat Guide F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	
32	Kat Hiker F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	
33	Kat Hiker Pro F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	
34	Kat Micro F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	No virus capability. Requires filter replacement after 100 L.
35	Kat Mini F	Filter	Green	Green	Green	Green		Weight <0.5 lb. Size is 0.57 L, just over profile D threshold, but including.
36	Kat Pocket F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	1.3 L size. 1.3 lb

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
37	Kat Base Camp F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	1.5 L size. 1.7 lb
38	McNett - Frontier Straw	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
39	MSR Miniworks EX F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Weight of approx 1 lb and volume approx 1.4 L
40	MSR SwtWtr® Micfilt F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Weight of approx 0.8 lb and volume approx 0.8 L
41	MSR SwtWtr® Purif F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	0.9 lb, 1.3 L
42	MSR Waterworks EX F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Weight of approx 1+ lb and volume approx 1.7 L
43	Clearbrk Portable Water Filtration System	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on assumption of pore size rating by analogy to other systems (assumed 2-micron filter not expected to reduce bacteria by 6 log). No response from company - assume 2-micron pore size

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
44	Pre Mac - Model MWP	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Does not remove cysts
45	Pre Mac - Model PWP	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Does not remove cysts
46	Pre Mac - Model SWP	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Does not remove cysts
47	Pre Mac - Travel Well	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	Does not remove cysts
48	Pres 2 Pure Field Canteen	Filter	Red	Red	Red	Red	1. Filter IWP does not meet filter pathogen removal criteria (i.e., reduce bacteria by 6 log, <i>Giardia</i> cyst by 3 log, and <i>Cryptosporidium</i> oocyst by 3 log).	No data provided; rating based on knowledge of technology (2-micron filter not expected to reduce bacteria by 6 log).
49	PRISMed Triton™ F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Just over 1 lb, just under 2 L
50	Sawyer - In Line Filter	Filter	Red	Red	Red	Red	10. Other.	Device not yet commercially available.

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
51	Sawyer WB F	Filter	Green	Green	Green	Red	5. Weighs 0.5 lb or more and/or cube is 0.5 L or more.	Device volume is 1 L.
52	Seychelle Survivor Water Bottle	Filter						Waiting for more information. Combination filter and chlorine tabs.
53	Aqua Mira Drops D	Disinfectant	Green	Green	Green	Green		
54	Aquatabs D	Disinfectant	Green	Green	Green	Green		Can reduce bacteria and viruses based on knowledge of technology.
55	Chlorfloc D	Disinfectant	Green	Green	Green	Green		
56	Coghlan Iodine tabs D	Disinfectant	Green	Green	Green	Green		Identical to Globaline D and Potable Aqua IT D. Will be evaluated together as COTS version of military iodine tablets for comparison purposes.
57	Coghlan IT w/ Neut. D	Disinfectant	Green	Green	Green	Green		Identical to Coghlan's Iodine tabs D with the additional taste and odor neutralizer tablet.
58	Globaline D	Disinfectant	Green	Green	Green	Green		Identical to Coghlan's Iodine tabs D and Potable Aqua IT D. Will be evaluated together as COTS version of military iodine tablets for comparison purposes.
59	Kat MicrPur Tabs D	Disinfectant	Green	Green	Green	Green		

Device Screening (continued)

#	IWP Device Name	Type	User Profile A Rating	User Profile B Rating	User Profile C Rating	User Profile D Rating	Most Comprehensive Reason to Eliminate	Other Reasons and Additional Comments/ Rationale
60	MSR MIOX Purifier D	Disinfectant	Green	Green	Green	Green		Although device in carrying case is 1 L, separate components total 0.25 L (justification for profile D).
61	PE Polar Pure D	Disinfectant	Green	Green	Green	Green		Crystalline iodine
62	Potable Aqua IT D	Disinfectant	Green	Green	Green	Green		Identical to Globaline D and Coghlan Iodine tabs D. Will be evaluated together as COTS version of military iodine tablets for comparison purposes.
63	Potable Aqua IT w/ Neut. D	Disinfectant	Green	Green	Green	Green		Identical to Potable Aqua IT D with the additional taste and odor neutralizer tablet.
64	AC Pristine Water Pur Sys D	Disinfectant	Green	Green	Green	Green		
65	RediClean	Disinfectant						Waiting for more information.
66	XDT Xtrem Wtr Pur D	Disinfectant	Green	Green	Red	Red	6. Weighs 2 lb or more and/or cube is 2 L or more.	35 g bottles, 35 bottles needed for 105 L equals 2.7 lb

APPENDIX D

ASSIGNED DEVICE SCORES FOR PROFILES B, C, AND D

Table D-1. Assigned Device Scores for Profile B

	Bact. Remove	Virus Remove	Glardia Remove	Crypto Remove	Taste/Odor	Turbidity	Purit. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
AC Pristine Water Pur Sys D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aqua Mira Drops D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aquatabs D	One Check	One Check	Zero Checks	Zero Checks	25	None	30	No effect	85	100	10	120	30	100
Chlorfloc D	Three Checks	Three Checks	Three Checks	Zero Checks	35	Medium	20	No effect	25	10	10	1160	320	100
Coghlan Iodine tabs D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Coghlan IT w/ Neut. D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
GE Deluxe F	One Check	One Check	One Check	One Check	90	High	1	Prefilter, backwashable	60	65	60	1450	430	80
GE TruPure F	One Check	One Check	One Check	One Check	90	High	1	Mult prefilters small pore	70	65	60	1580	630	80
Globaline D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	250	60
H-P SteriPen D	Zero checks	Zero Checks	Zero Checks	Zero Checks	70	None	1.5	No effect	85	0	75	820	1250	100
HTI Xpack F	One Check	One Check	One Check	One Check	100	Very high	480	No effect	70	30	0	4000	1816	60
HTI Expedition F	One Check	One Check	One Check	One Check	100	Very high	130	No effect	60	65	65	4000	1816	60
Kat Base Camp F	One Check	Zero Checks	One Check	One Check	90	High	2	Prefilter; not cleanable	70	70	0	1500	370	80
Kat Camp F	One Check	Zero Checks	One Check	One Check	70	High	12	No prefilter; cleanable	50	30	20	1500	620	40
Kat Kombi F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	50	45	20	1360	600	40
Kat Exst XR F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	230	80
Kat Exstream F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat Guide F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	75	0	1250	400	80
Kat Hiker F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; not cleanable	70	70	0	1050	310	80
Kat Hiker Pro F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	70	0	1050	310	80
Kat Micro WB F	One Check	Zero Checks	One Check	One Check	90	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat MicroPur Tabs D	Three Checks	Three Checks	Three Checks	Three Checks	35	None	240	No effect	100	100	10	440	80	100
Kat Mini F	One Check	Zero Checks	One Check	One Check	70	High	2	Prefilter; cleanable	35	30	20	580	230	40
Kat Pocket F	One Check	Zero Checks	One Check	One Check	70	High	1	Prefilter; cleanable	50	50	20	1250	570	40
MSR MiniWorks EX F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	55	40	25	1400	460	40
MSR MIOX Purifier D	Three Checks	Three Checks	Three Checks	Zero Checks	25	None	240	No effect	50	70	100	560	230	100
MSR SwWtr Micfilt F	Three Checks	Zero Checks	One Check	Three Checks	90	High	1	Prefilter, less cleanable	60	65	25	1260	320	80
MSR SwWtr Purif F	Three Checks	Three Checks	Three Checks	Three Checks	50	High	6	Prefilter, less cleanable	55	65	25	1400	400	0
MSR WaterWorks EX F	One Check	Zero Checks	One Check	One Check	90	Very high	1	Prefilter; cleanable	55	40	25	1770	540	40
PE Polar Pure D	One Check	One Check	Zero Checks	Zero Checks	25	None	20	No effect	65	80	10	160	250	60
Potable Aqua IT D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Potable Aqua IT w/ Neut D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
PRISMED Triton F	One Check	One Check	One Check	One Check	90	High	14	Prefilter; not cleanable	75	70	0	1800	500	80
Sawyer WB F	One Check	Zero Checks	One Check	One Check	90	High	2	No prefilter; not cleanable	40	80	0	1040	160	80
Xtrem Wtr Pur D	Three Checks	Three Checks	Three Checks	Zero Checks	35	None	15	No effect	100	90	40	700	1400	0

Table D-2. Assigned Device Scores for Profile C

	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste/ Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
AC Pristine Water Pur Sys D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aqua Mira Drops D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	330	270	0
Aquatabs D	One Check	One Check	Zero Checks	Zero Checks	25	None	30	No effect	85	100	10	120	30	100
Chlorfloc D	Three Checks	Three Checks	Three Checks	Zero Checks	35	Medium	20	No effect	25	10	10	1160	320	100
Coghlan Iodine tabs D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Coghlan IT w/ Neut. D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
GE Deluxe F	One Check	One Check	One Check	One Check	90	High	1	Prefilter, backwashable	60	65	60	1450	430	80
GE TrvLPure F	One Check	One Check	One Check	One Check	90	High	1	Mult prefilters small pore	70	65	60	1580	630	80
Globaline D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	250	60
H-P SteriPen D	Zero checks	Zero Checks	Zero Checks	Zero Checks	70	None	1.5	No effect	85	0	75	820	909	100
HTI Xpack F	One Check	One Check	One Check	One Check	100	Very high	480	No effect	70	30	0	2000	908	60
HTI Expedition F	One Check	One Check	One Check	One Check	100	Very high	130	No effect	60	65	65	2000	908	60
Kat Base Camp F	One Check	Zero Checks	One Check	One Check	90	High	2	Prefilter, not cleanable	70	70	0	1500	370	80
Kat Camp F	One Check	Zero Checks	One Check	One Check	70	High	12	No prefilter; cleanable	50	30	20	1500	620	40
Kat Combi F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	50	45	20	1360	600	40
Kat Exst XR F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	230	80
Kat Exstream F	Three Checks	Three Checks	Three Checks	One Check	25	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat Guide F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	75	0	1250	400	80
Kat Hiker F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter, not cleanable	70	70	0	1050	310	80
Kat Hiker Pro F	One Check	Zero Checks	One Check	One Check	90	High	1	Multiple prefilters	70	70	0	1050	310	80
Kat Micro F	One Check	Zero Checks	One Check	One Check	90	High	8	No prefilter; not cleanable	40	80	0	1400	200	80
Kat MicPur Tabs D	Three Checks	Three Checks	Three Checks	Three Checks	35	None	240	No effect	100	100	10	440	80	100
Kat Mini F	One Check	Zero Checks	One Check	One Check	70	High	2	Prefilter; cleanable	35	30	20	580	230	40
Kat Pocket F	One Check	Zero Checks	One Check	One Check	70	High	1	Prefilter; cleanable	50	50	20	1250	570	40
MSR Miniworks EX F	One Check	Zero Checks	One Check	One Check	90	High	1	Prefilter; cleanable	55	40	25	1400	460	40
MSR MOX Purifier D	Three Checks	Three Checks	Three Checks	Zero Checks	25	None	240	No effect	50	70	100	560	230	100
MSR SwWtr Micfil F	Three Checks	Zero Checks	One Check	Three Checks	90	High	1	Prefilter, less cleanable	60	65	25	1260	320	80
MSR SwWtr Purif F	Three Checks	Three Checks	Three Checks	Three Checks	50	High	6	Prefilter, less cleanable	55	65	25	1400	400	0
MSR WaterWorks EX F	One Check	Zero Checks	One Check	One Check	90	Very high	1	Prefilter; cleanable	55	40	25	1770	540	40
PE Polar Pure D	One Check	One Check	Zero Checks	Zero Checks	25	None	20	No effect	65	80	10	160	250	60
Potable Aqua IT D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	150	150	60
Potable Aqua IT w/ Neut D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	300	300	60
PRISMed Triton F	One Check	One Check	One Check	One Check	90	High	14	Prefilter, not cleanable	75	70	0	1800	500	80
Sawyer WB F	One Check	Zero Checks	One Check	One Check	90	High	2	No prefilter; not cleanable	40	80	0	1040	160	80

Table D-3. Assigned Device Scores for Profile D

	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste/ Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
AC Pristine Water Pur Sys D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	110	90	0
Aqua Mira Drops D	One Check	One Check	One Check	Zero Checks	35	None	35	No effect	80	80	10	110	90	0
Aquatabs D	One Check	One Check	Zero Checks	Zero Checks	25	None	30	No effect	85	100	10	40	10	100
Chlorfloc D	Three Checks	Three Checks	Three Checks	Zero Checks	35	Medium	20	No effect	25	20	10	290	80	100
Coghlan Iodine tabs D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	30	30	60
Coghlan IT w/ Neut. D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	60	60	60
Globaline D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	30	50	60
H-P SteriPen D	Zero checks	Zero Checks	Zero Checks	Zero Checks	70	None	1.5	No effect	85	0	75	370	230	100
HTI Xpack F	One Check	One Check	One Check	One Check	100	Very high	480	No effect	70	30	0	501	230	60
HTI Expedition F	One Check	One Check	One Check	One Check	100	Very high	130	No effect	60	65	65	501	230	60
Kat MicrPur Tabs D	Three Checks	Three Checks	Three Checks	Three Checks	35	None	240	No effect	100	100	10	110	20	100
Kat Mini F	One Check	Zero Checks	One Check	One Check	70	High	2	Prefilter, cleanable	35	30	20	501	230	40
MSR MIOX Purifier D	Three Checks	Three Checks	Three Checks	Zero Checks	25	None	240	No effect	50	70	100	501	230	100
PE Polar Pure D	One Check	One Check	Zero Checks	Zero Checks	25	None	80	No effect	65	80	10	160	90	60
Potable Aqua IT D	Three Checks	Three Checks	Zero Checks	Zero Checks	0	None	35	No effect	100	90	35	30	30	60
Potable Aqua IT w/ Neut D	Three Checks	Three Checks	Zero Checks	Zero Checks	70	None	40	No effect	95	90	35	60	60	60
XDT Xtrem Wtr Pur D	Three Checks	Three Checks	Three Checks	Zero Checks	35	None	15	No effect	100	90	40	40	80	0

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APPENDIX E

OVERALL AND CONVERTED SCORES FOR PROFILES B, C, AND D

Table E-1. Converted and Overall Device Scores for Profile B

	Best IWP Goal	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste/Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
MSR SwWtr Purif F	75	100	100	100	100	50	75	87	65	55	65	25	38	64	0
Kat MicPur Tabs D	73	100	100	100	100	35	0	0	100	100	100	10	82	93	100
GE Deluxe F	70	70	70	70	70	90	75	100	50	60	65	60	36	62	80
XDT Xtrem Wtr Pur D	69	100	100	100	0	35	0	69	100	100	90	40	72	4	0
Coghlan IT w/ Neut. D	68	100	100	0	0	70	0	35	100	95	90	35	88	73	60
Potable Aqua IT w/ Neut D	68	100	100	0	0	70	0	35	100	95	90	35	88	73	60
MSR SwWtr Micfilt F	68	100	0	70	100	90	75	100	65	60	65	25	45	72	80
GE Trvl Pure F	68	70	70	70	70	90	75	100	40	70	65	60	31	38	80
Kat Exstream F	67	100	100	100	70	25	75	83	0	40	80	0	38	82	80
Kat Exst XR F	67	100	100	100	70	25	75	83	0	40	80	0	38	80	80
Potable Aqua IT D	66	100	100	0	0	0	0	40	100	100	90	35	94	87	60
Coghlan Iodine tabs D	66	100	100	0	0	0	0	40	100	100	90	35	94	87	60
Globaline D	65	100	100	0	0	0	0	40	100	100	90	35	94	78	60
MSR MIOX Purifier D	65	100	100	100	0	25	0	0	100	50	70	100	78	80	100
Chlorfloc D	65	100	100	100	0	35	50	60	100	25	10	10	50	72	100
Aqualabs D	61	70	70	0	0	25	0	46	100	85	100	10	95	97	100
Kat Hiker Pro F	61	70	0	70	70	90	75	100	30	70	70	0	57	72	80
PRISMed Triton F	61	70	70	70	70	90	75	71	20	75	70	0	24	53	80
Kat Mini F	60	70	0	70	70	70	75	97	70	35	30	20	77	80	40
Kat Hiker F	60	70	0	70	70	90	75	100	20	70	70	0	57	72	80
Kat Guide F	59	70	0	70	70	90	75	100	30	70	75	0	45	64	80
Aqua Mira Drops D	59	70	70	70	0	35	0	40	100	80	80	10	87	76	0
AC Pristine Water Pur Sys D	59	70	70	70	0	35	0	40	100	80	80	10	87	76	0
MSR Miniworks EX F	59	70	0	70	70	90	75	100	70	55	40	25	38	59	40
PE Polar Pure D	59	70	70	0	0	25	0	60	100	65	80	10	94	78	60
MSR WaterWorks EX F	58	70	0	70	70	90	100	100	70	55	40	25	25	48	40
Kat Combi F	58	70	0	70	70	90	75	100	70	50	45	20	40	41	40
Sawyer WB F	58	70	0	70	70	90	75	97	0	40	80	0	57	86	80
Kat Base Camp F	57	70	0	70	70	90	75	97	20	70	70	0	34	67	80
Kat Pocket F	57	70	0	70	70	70	75	100	70	50	50	20	45	44	40
Kat Micro WB F	54	70	0	70	70	90	75	83	0	40	80	0	38	82	80
HTI Expedition F	53	70	70	70	70	100	100	3	100	60	65	65	0	0	60
Kat Camp F	50	70	0	70	70	70	75	74	60	50	30	20	34	39	40
HTI Xpack F	49	70	70	70	70	100	100	-0	100	70	30	0	0	0	60
H-P SteriPen D	43	0	0	0	0	70	0	99	100	85	0	75	67	7	100

Table E-2. Converted and Overall Device Scores for Profile C

	Best IWP Goal	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taste/Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
Kat MicrPur Tabs D	71	100	100	100	100	35	0	0	100	100	100	10	65	86	100
MSR SwtWtr Purif F	69	100	100	100	100	50	75	87	65	55	65	25	7	24	0
Potable Aqua IT w/ Neut D	65	100	100	0	0	70	0	35	100	95	90	35	76	41	60
Coghlan IT w/ Neut. D	65	100	100	0	0	70	0	35	100	95	90	35	76	41	60
GE Deluxe F	65	70	70	70	70	90	75	100	50	60	65	60	6	21	80
Potable Aqua IT D	64	100	100	0	0	0	0	40	100	100	90	35	88	73	60
Coghlan Iodine tabs D	64	100	100	0	0	0	0	40	100	100	90	35	88	73	60
GE Trvl Pure F	63	70	70	70	70	90	75	100	40	70	65	60	4	6	80
Kat Exstream F	63	100	100	100	70	25	75	83	0	40	80	0	7	64	80
Kat Exst XR F	63	100	100	100	70	25	75	83	0	40	80	0	7	59	80
Globaline D	63	100	100	0	0	0	0	40	100	100	90	35	88	53	60
MSR SwtWtr Micfltr F	63	100	0	70	100	90	75	100	65	60	65	25	10	37	80
MSR MIOX Purifier D	61	100	100	100	0	25	0	0	100	50	70	100	52	59	100
Aquatabs D	61	70	70	0	0	25	0	46	100	85	100	10	90	95	100
Chlorfloc D	59	100	100	100	0	35	50	60	100	25	10	10	13	37	100
PE Polar Pure D	56	70	70	0	0	25	0	60	100	65	80	10	87	53	60
Kat Mini F	56	70	0	70	70	70	75	97	70	35	30	20	50	59	40
Aqua Mira Drops D	56	70	70	70	0	35	0	40	100	80	80	10	74	48	0
AC Pristine Water Pur Sys D	56	70	70	70	0	35	0	40	100	80	80	10	74	48	0
PRISMED Triton F	56	70	70	70	70	90	75	71	20	75	70	0	1	14	80
Kat Hiker Pro F	55	70	0	70	70	90	75	100	30	70	70	0	17	39	80
Kat Hiker F	54	70	0	70	70	90	75	100	20	70	70	0	17	39	80
Kat Guide F	54	70	0	70	70	90	75	100	30	70	75	0	10	24	80
MSR Miniworks EX F	54	70	0	70	70	90	75	100	70	55	40	25	7	18	40
Sawyer WB F	53	70	0	70	70	90	75	97	0	40	80	0	17	72	80
MSR WaterWorks EX F	53	70	0	70	70	90	100	100	70	55	40	25	2	11	40
HTI Expedition F	53	70	70	70	70	100	100	3	100	60	65	65	0	0	60
Kat Combl F	53	70	0	70	70	90	75	100	70	50	45	20	7	8	40
Kat Base Camp F	52	70	0	70	70	90	75	97	20	70	70	0	5	29	80
Kat Pocket F	52	70	0	70	70	70	75	100	70	50	50	20	10	9	40
Kat Micro F	50	70	0	70	70	90	75	83	0	40	80	0	7	64	80
HTI Xpack F	49	70	70	70	70	100	100	-0	100	70	30	0	0	0	60
Kat Camp F	46	70	0	70	70	70	75	74	60	50	30	20	5	7	40
H-P SteriPen D	40	0	0	0	0	70	0	99	100	85	0	75	29	-0	100

* Although some devices scored beyond the lower limit of the performance scale for some measures, these devices are exceptions, and the study team decided not to alter the performance scale to generate a more precise score. In these cases, the converted score is shown as a "-0" above.

Table E-3. Converted and Overall Device Scores for Profile D

	Best IWP Goal	Bact. Remove	Virus Remove	Giardia Remove	Crypto Remove	Taster/Odor	Turbidity	Purif. Time	Effect of Turbid.	Effort	Durability	Indicator	Cube	Weight	Storage
Kat MicrPur Tabs D	73	100	100	100	100	35	0	0	100	100	100	10	51	75	100
XDT Xtrem Wtr Pur D	70	100	100	100	0	35	0	69	100	100	90	40	79	29	0
Coghlan Iodine tabs D	69	100	100	0	0	0	0	40	100	100	90	35	84	64	60
Potable Aqua IT D	69	100	100	0	0	0	0	40	100	100	90	35	84	64	60
Aquatabs D	67	70	70	0	0	25	0	46	100	85	100	10	79	87	100
Globaline D	67	100	100	0	0	0	0	40	100	100	90	35	84	47	60
Potable Aqua IT w/ Neut D	65	100	100	0	0	70	0	35	100	95	90	35	70	40	60
Coghlan IT w/ Neut. D	65	100	100	0	0	70	0	35	100	95	90	35	70	40	60
Chlorfloc D	53	100	100	100	0	35	50	60	100	25	20	10	15	29	100
Aqua Mira Drops D	52	70	70	70	0	35	0	40	100	80	80	10	51	24	0
AC Pristine Water Pur Sys D	52	70	70	70	0	35	0	40	100	80	80	10	51	24	0
MSR MIOX Purifier D	49	100	100	100	0	25	0	0	100	50	70	100	-0	-0	100
HTI Expedition F	46	70	70	70	70	100	100	3	100	60	65	65	-0	-0	60
PE Polar Pure D	45	70	70	0	0	25	0	12	100	65	80	10	37	24	60
HTI Xpack F	42	70	70	70	70	100	100	-0	100	70	30	0	-0	-0	60
Kat Mini F	40	70	0	70	70	70	75	97	70	35	30	20	-0	-0	40
H-P SteriPen D	37	0	0	0	0	70	0	99	100	85	0	75	7	-0	100

* Although some devices scored beyond the lower limit of the performance scale for some measures, these devices are exceptions, and the study team decided not to alter the performance scale to generate a more precise score. In these cases, the converted score is shown as a "-0" above.