SL1000 - PPA

DRINKING WATER FIELD TESTING: CURRENT STATE

Step 1: Collect Materials/Route at Lab

Step 2: Drive to Stop on Route & Collect Samples

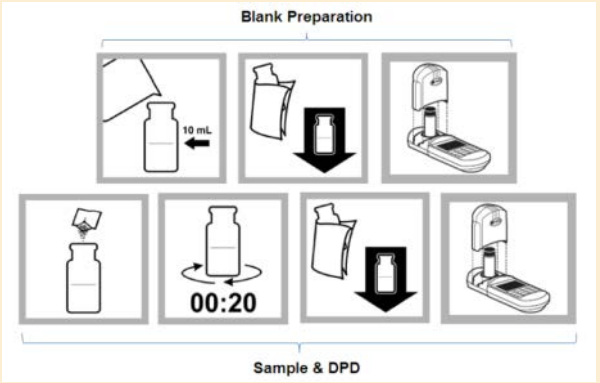
Step 3: Perform Testing

Typical Colorimetric Testing Process

a. Measure sample volume
b. Blank sample
c. Mix reagent
d. Wait (reaction time)
e. Reading complete
f. Log values

→ Repeat for other tests (typically 2-5)

→ Also run pH and often conductivity



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FIELD TESTING APPLICATION OVERVIEW (CONT.)

Step 4: Handoff Samples to Lab

Step 5: Lab Testing

Common Lab Tests

- Nitrite (reaction time)
- Monochloramine (multiple steps)
- Free Ammonia (multiple steps)

Step 6: Manually Collate & Transcribe Data

Step 7: Analyze Data and Take Action

VOICE OF CUSTOMER:
WE CAN IMPROVE FIELD TESTING

ISSUE	IMPROVEMENT AREA	DESIRE
Testing of multiple parameters at multiple sites (10+ sites) is very time consuming – cannot test a high number of parameters nor parameters with lengthy time requirements in the field.	72% of utilities want to add the "ability to test multiple parameters in the field simultaneously in less than 10 minutes." Ideally, want "ability to test in parallel with chlorine".	**Test more parameters in the field in less time.**
Data is most useful in the field where action takes place, but confidence in results is low because the test sophistication is difficult to manage in the field environment.	66% want to add the "ability to easily make field measurements on parameters that traditionally are tested in the lab."	**Eliminate testing errors, variability.**
Currently measurement data is recorded manually leading to transcription errors and missing data. User must spend time and effort going back though data to correct mistakes or risk reporting an abnormal value.	61% want better data management & storage than their current system provides.	**Eliminate transcription errors.**
The amount of equipment required (instruments, chemistries, logs, SOPs, manual) to complete tests physically limits how much testing can be completed in the field.	44% want to take less equipment into the field to take that same measurement.	**Carry less equipment into the field.**

FUTURE “PPA” STATE

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SL1000 ~ PORTABLE PARALLEL ANALYZER (PPA)

PPA value communicated in a "3 Pillar approach"

1.) "Faster Time to Results"

2.) "Less Variability in results"

3.) "Less *hassle* to get results"

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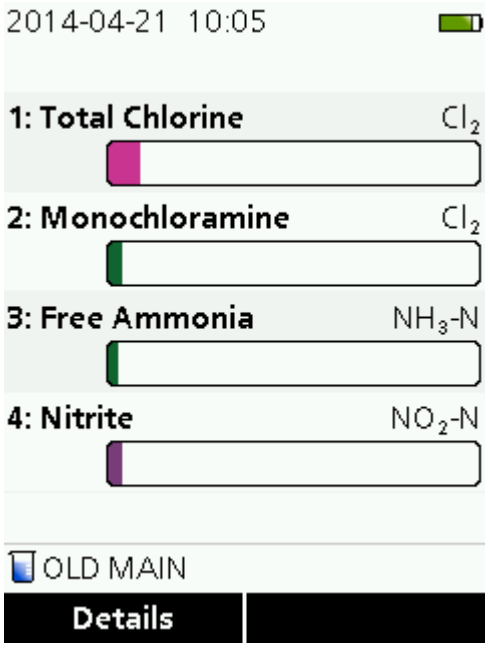
1.) FASTER TIME TO RESULTS

Nitrification Current State

Total CL: 3 minutes
Free Ammonia/Monochloramine: 12 minutes
Nitrite: 20 Minutes
pH/Conductivity (additional meter): 1-2 minutes

Total time: **30 + minutes**



Nitrification PPA State

Total CL: 3 minutes
Free Ammonia/Monochloramine: 8 minutes
Nitrite: 7 Minutes
pH/Conductivity (same instrument): 1 minute

Total time using **one** instrument: **8 minutes**

One instrument, 6 parameters, tested simultaneously… in UNDER 10 minutes

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2.) LESS VARIABILITY

Current State Opportunity for Errors/Variation		Future State Correction
Scratched sample cells		Sample cells eliminated
Improper reaction time		All reaction time automated/standardized
Different mixing method		Mixing automated/standardized
Different mixing time		Mixing automated/standardized
Improper/lack of zeroing		Multiple "Blanks" processed automatically
Sample degradation		Ability to test on site (reduction of lab samples)
Improper sample volume		Sample volume automated/standardized
Improper reagent amount (spill)		Reagent amount automated/standardized
Incorrect program selected		Barcode allows for automatic method selection
Improper sample temperature		Individual slot heaters compensate for temperature
Single readings (outlier)		10+ readings per test, average taken, outliers discarded
Transcription errors		USB port allows for easy data transfer

PPA removes 90%+ of human/testing variability; delivering a more accurate result

3.) LESS “HASSLE”

One meter for colorimetric and electrochemistry testing organized in a portable workstation with room for reagents, probes and sample cups

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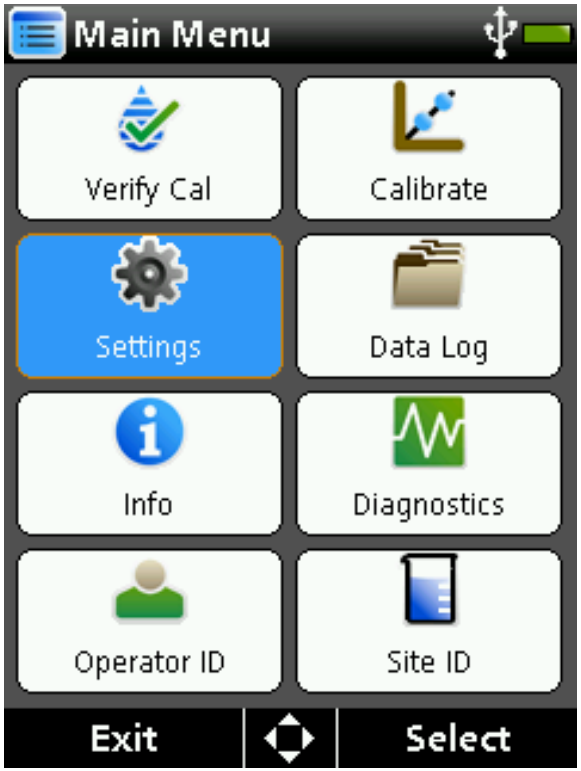
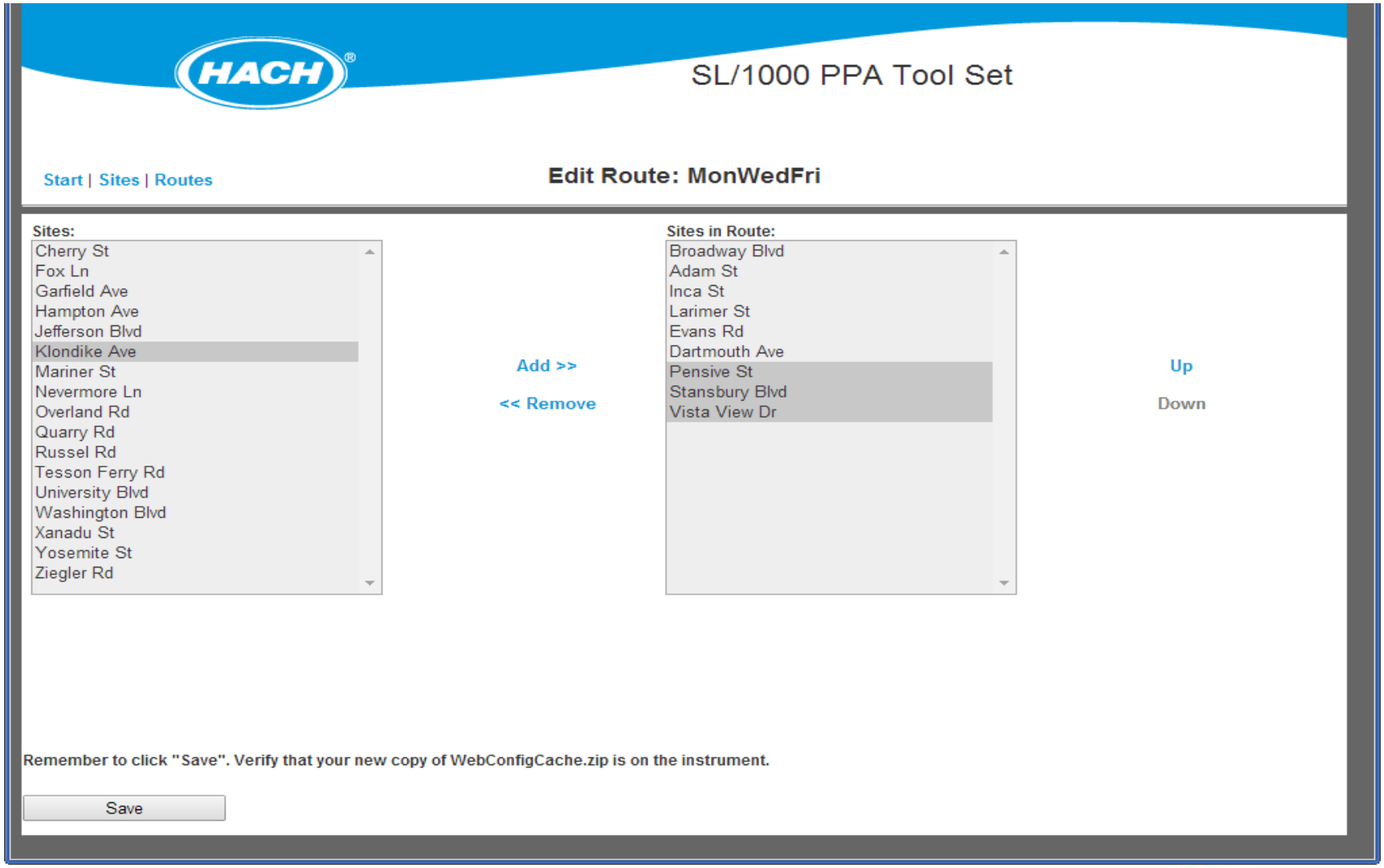
MAIN MENU STRUCTURE



Verify Cal		Uses Verification Chemkeys - Validates light throughput, barcode reader and optical quality
Settings		Basic meter settings (date/time, sounds, display etc.) Also probe and chemkey settings
Info		Instrument information (battery life, software version, serial #, etc.)
Operator ID		Used for Operator designations and password capabilities
Calibrate		Used for calibrating probes
Data Log		View data log by date
Diagnostics		Disk space, Method versions etc. (primary for troubleshooting)
Site ID		Used for designating Site IDs and Routes. Also used for Notes feature

SITE ID AND ROUTES



CHEMISTRY SPECIFICATIONS

Parameter		Range
Free CL		0.12 mg/L - 4.6 mg/L ~ EPA Approved
Total CL		0.12 mg/L - 4.6 mg/L ~ EPA Approved
Monochloramine		0.12 mg/L - 4.6 mg/L
Nitrite		0.005 mg/L - 0.600 mg/L
Copper		0.06 mg/L - 5.75 mg/L
Free Ammonia		0.05 mg/L - 0.5 mg/L
Total Ammonia		0.05 mg/L - 1.5 mg/L

Chemkeys sold in boxes of 25. Free/Total CL will be offered in a KTO of 300 keys

INSTRUMENT SPECIFICATIONS

Specification	Details
Dimensions (W x D x H)	5.02in x 2.32in x 10.17in
Enclosure Rating	IP64
Weight	2.7lbs
Power Source	Lithium Ion Rechargable Battery
Operating Temperature	5 to 50*C (41 to 122* F)
Storage Temperature	-20 to 60*C (-4 to 140* F)
Interface	USB mini
Data Memory	1000 measured values
Warranty	1 year

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INSTRUMENT OPERATION

- No restrictions on port/parameter - only requirement is MonoCL in combination with Free Ammonia
- Two prongs on bottom sense when instrument is placed in sample, immediately activate individual pumps (pump life is > 25,000 cycles ~ roughly 3x instrument life)

NITRIFICATION & CHLORAMINES

Where & How Nitrification Occurs

- Free ammonia is present in distribution system
  - Not all is tied up in chloramination disinfection process
  - Released from the monochloramine formation as the disinfectant attacks bacteria or reacts with organics
- Free ammonia oxidizes to nitrite, then nitrate
- Over 2/3 of DW systems report experiencing issues with nitrification, and all systems have potential for issues
- Nitrification is accepted by many utilities as a "fact of life", although it is painful and can be avoided.

Nitrification is Costly & Disruptive to Utilities

- Wasted water and labor cost of flushing lines
- Compliance Risk
  - Negative health effects of nitrite/nitrate
  - Increase in heterotrophic plate count (HPC)
  - Rapid loss of disinfection residual and possible microbiological contaminant growth
  - Reduction in alkalinity & pH → corrosion, Lead & Copper Rule issues, & reduced effectiveness of disinfectant
- Taste & Odor Complaints
  - Nitrification events themselves
  - Free chlorine "burn" used to kill nitrification process

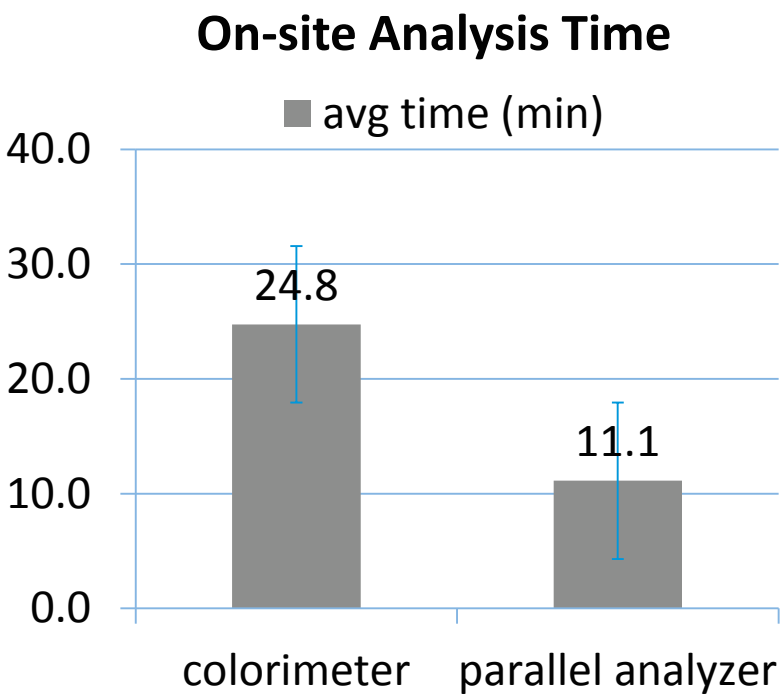
Controlling Nitrification

- Nitrification can be avoided by taking action (adding chlorine, mixing water, or localized flushes) once leading indicators are identified in the distribution system.
- Leading Indicators:
  - ✓ Presence of Free Ammonia
  - ✓ Loss of Monochloramine Residual
  - ✓ Decrease in pH
  - ✓ Increase in Nitrite

Limitations Today

- Testing Capacity
  - Not enough time for additional parameters in field
  - Too complex in field environment and/or field tech skill set
- Gap between data in the lab and action in the field

VALIDATION IN THE FIELD



Parallel analysis solving utility and environmental challenges

- Reduction of analysis time via automation:
  1.5 hours saved on a 4 hour route

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