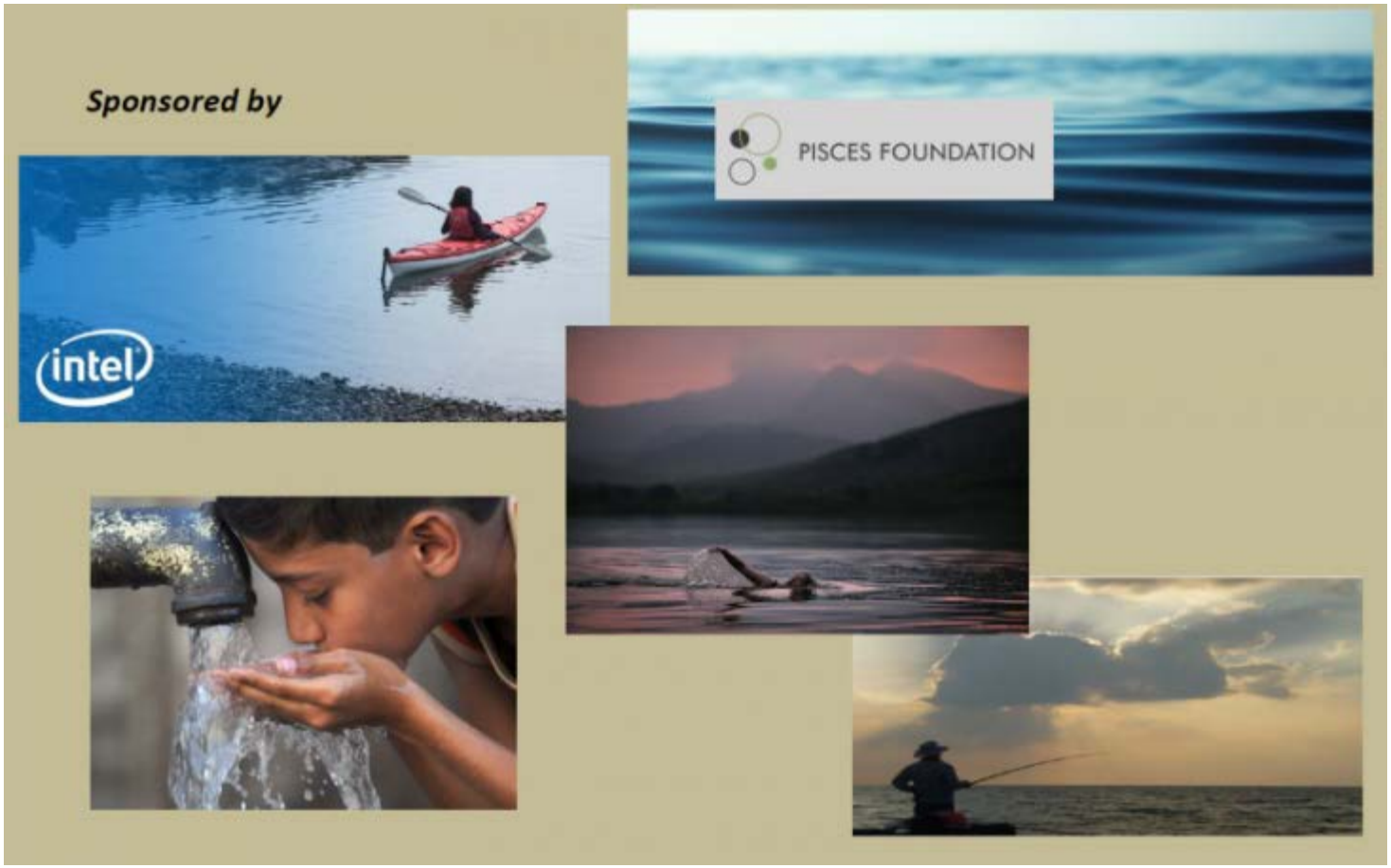
# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

## Background

- 2015: Pisces Foundation & Intel Corporation project leaders agree to survey groups doing water resource monitoring to better understand gaps between their current and desired:
  - ✓ **Water monitoring practices**
  - ✓ **Reporting**
  - ✓ **Information sharing technologies**

- Goal was to empower engaged members of the public to protect their water through information gained or managed with *the use of low-cost technologies*

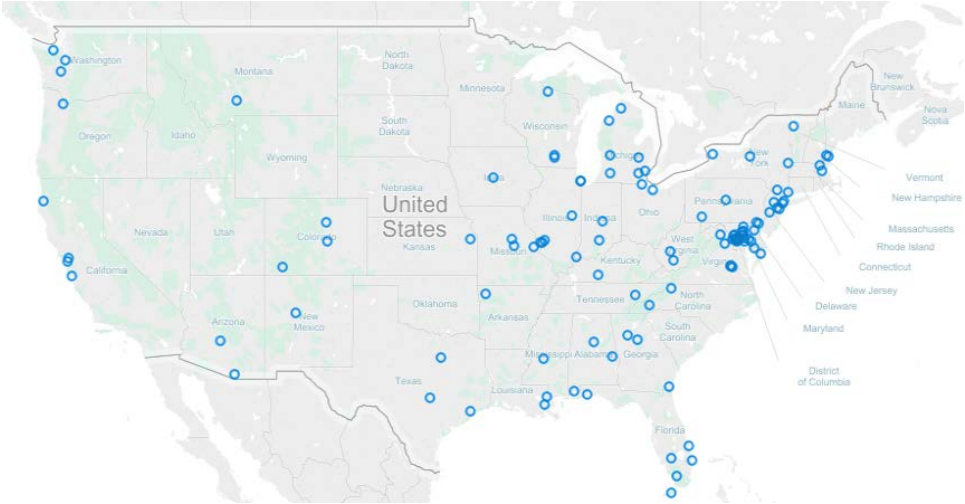
- National Steering Committee of non-profit, business, academic and government experts guided survey development & distribution

Water Quality

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

## Survey Audience Profile

- Key Characteristics:
  - ✓ **130 respondents—all but 3 in U.S.**
  - ✓ ***Very knowledgeable*—50% monitoring program leads & 78% were either staff, volunteers, or had strong program knowledge**




  - ✓ **Several respondents represented their regional/national staff network**
  - ✓ ***Geographically broad* representation—42 states**
  - ✓ **Mostly non-profits (72%) & govt. (16%) respondents**
  - ✓ **50% answered a *watershed* was their service area**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY

## Monitoring Program Profile

- Rivers and streams (89%) are monitored most, followed by a distant (32%) for stormwater or wastewater discharges. Yet, only a few monitored drinking water supplies (6%)

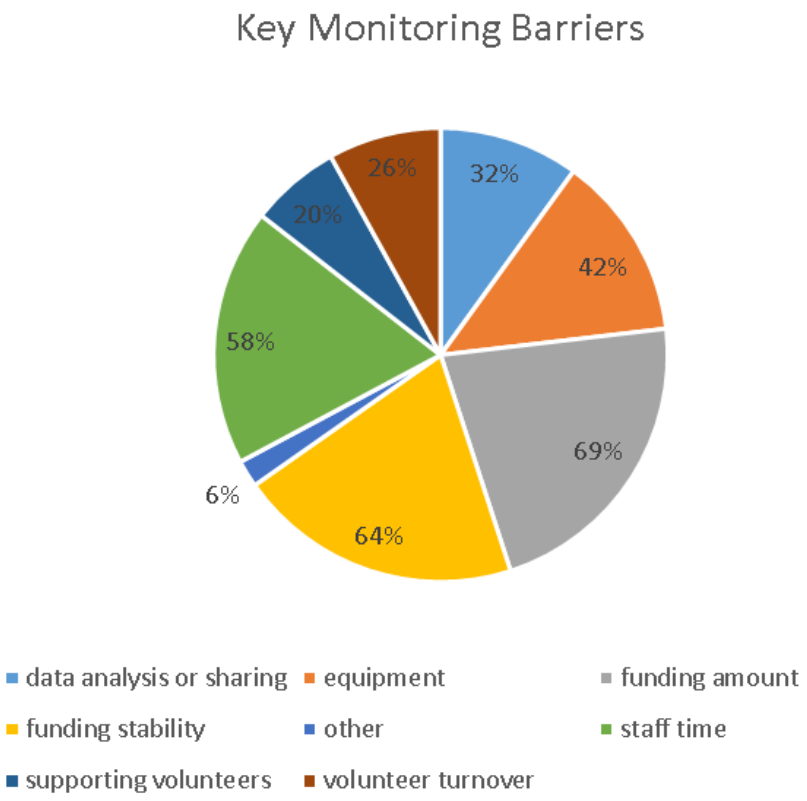
- Top 5 of 15 monitoring program objective areas were:
  - ✓ **Create long term data sets (77%)**
  - ✓ **Education (75%)**
  - ✓ **Target problem areas (59%)**
  - ✓ **Report pollution incidents (51%)**
  - ✓ **Change community behavior (50%)**
- **Remaining program objective areas scored below 50%**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- Monitoring Program Profile

- Top 4 of 8 program barriers
  - ✓ **Funding amount (69%)**
  - ✓ **Funding stability (64%)**
  - ✓ **Staff time (58%)**
  - ✓ **Equipment (41%)**

- Considering funding and people resources are the top two barriers, it is significant to note that ***equipment*** emerges as the third leading barrier.

- 30% monitor water volume, 64% do not and 6% are unsure



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- Monitoring Program Profile

## Data collection

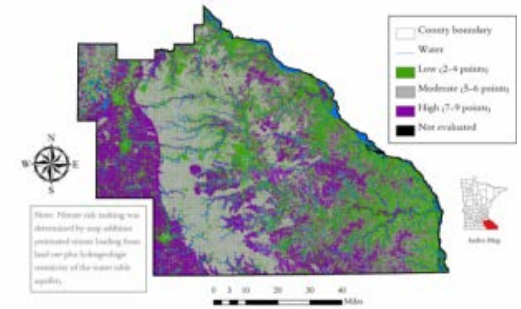
- Of the 13 possible answers for data collection methods--2 are deployed by most organizations:
  - ✓ **Field test kits** **74% (59)**
  - ✓ **Grab samples & lab analysis** **69% (55)**

- Notably, only a few organizations make use of various types of unattended monitoring stations or cell phone monitoring

| | | |
|---|---|---|
| grab samples and lab analysis | 68.75% | 55 |
| prepared samples and lab analysis | 23.75% | 19 |
| field test kits | 73.75% | 59 |
| lab test kits | 16.25% | 13 |
| single parameter electronic meters or sensors | 28.75% | 23 |
| multi-parameter meters or sensors | 48.75% | 39 |
| other | 8.75% | 7 |
| custom assembled sensors | 7.50% | 6 |
| unattended monitoring stations without telemetry | 13.75% | 11 |
| unattended monitoring stations with telemetry | 5.00% | 4 |
| long term fixed stations with flow controls without telemetry | 1.25% | 1 |
| long term fixed stations with flow controls with telemetry | 3.75% | 3 |
| cell phone reporting | 13.75% | 11 |

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- Monitoring Program Profile

## Data Sharing

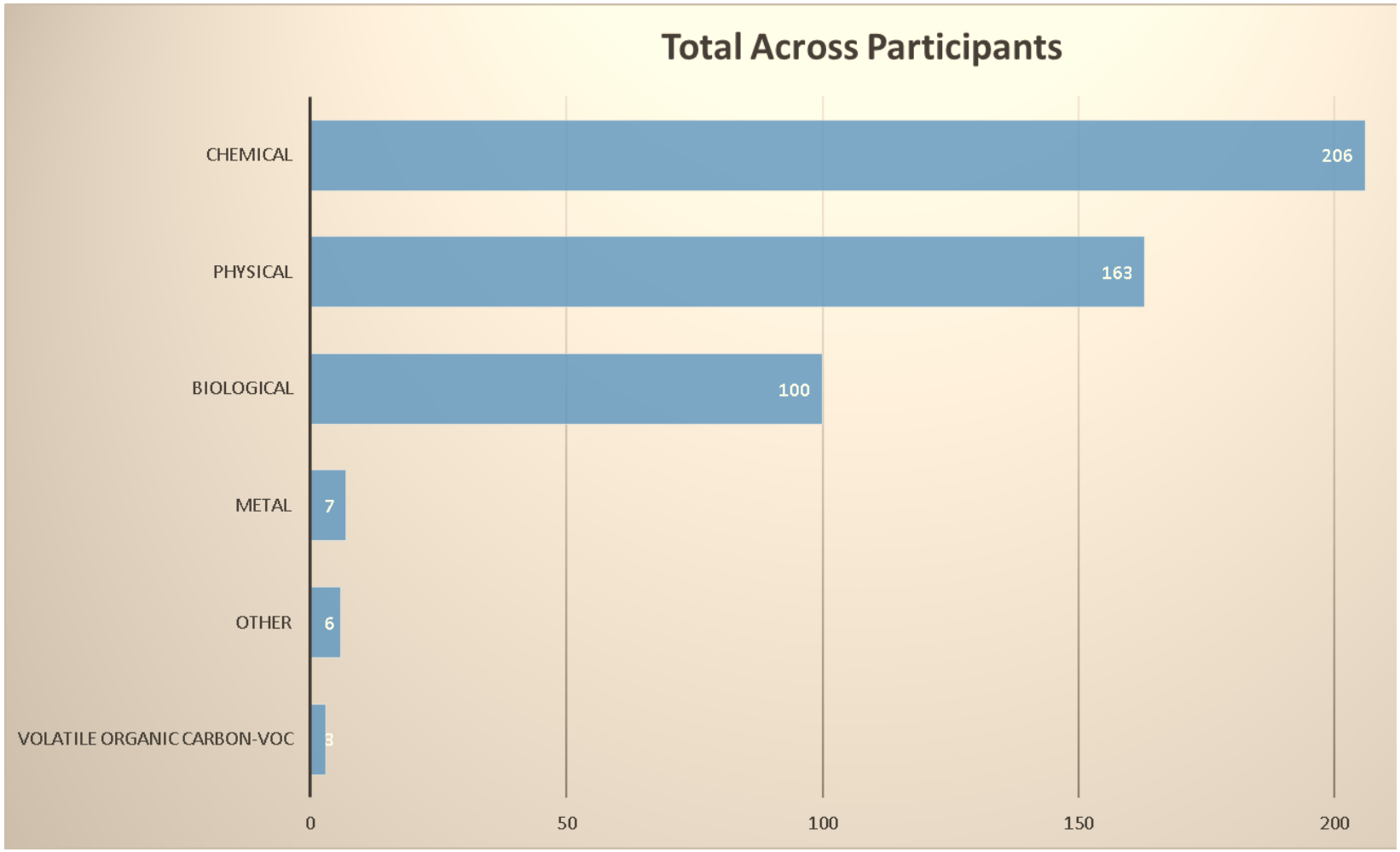



- Data sharing is largely accomplished through:
  - ✓ **Annual or periodic reports** **61% (48)**
  - ✓ **Community outreach** **58% (46)**
  - ✓ **Online database** **56% (44)**
  - ✓ **Online map with results** **42% (33)**

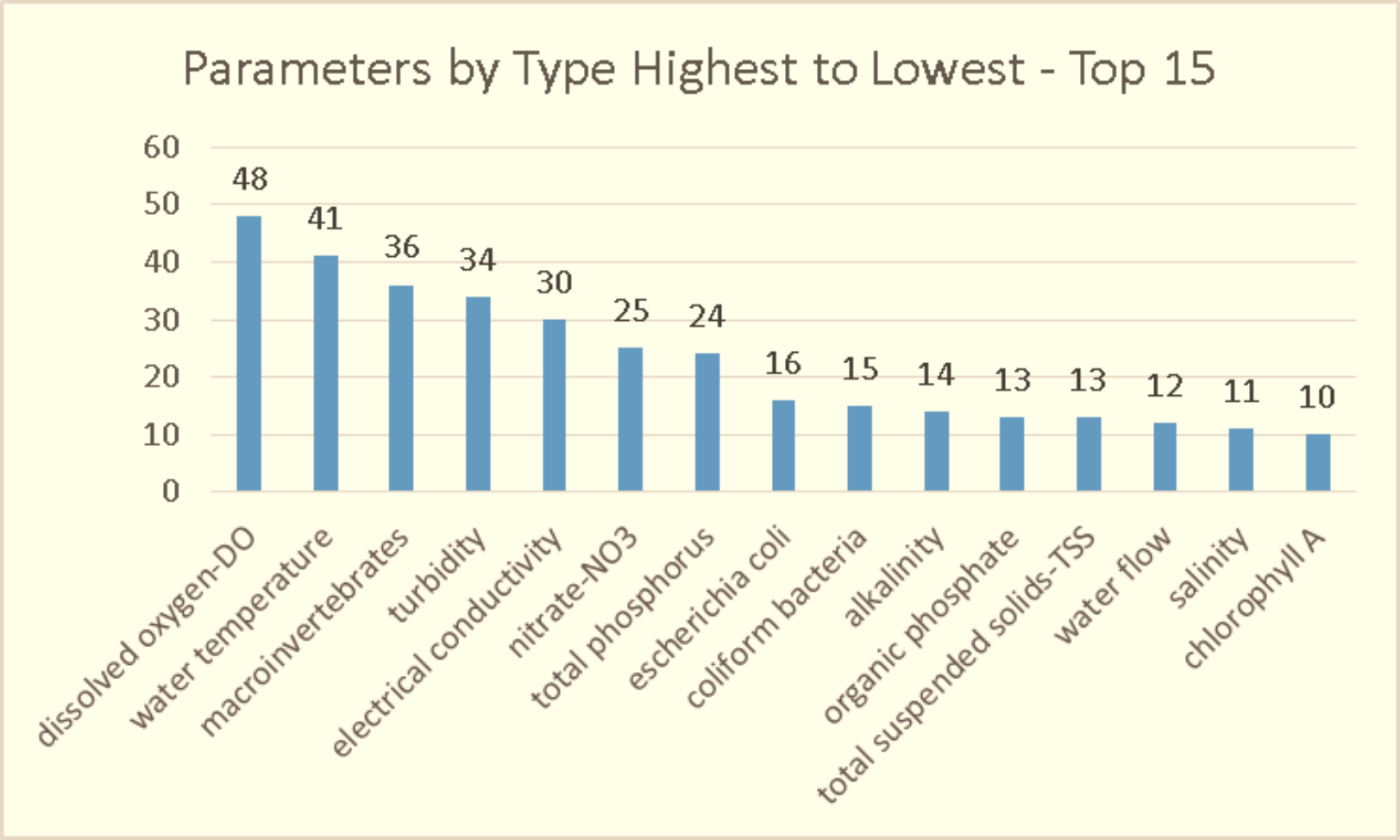
- Alternative water monitoring & information sharing technologies are principally:
  - ✓ **GIS mapping** **74% (39)**
  - ✓ **Phone apps** **38% (20)**

- Data is shared with:
  - ✓ **Govt. water quality, wildlife & natural resource agencies at federal, state, & local levels**
  - ✓ **General public, news agencies**
  - ✓ **Stakeholders like farmers, watershed groups, families, board members, funders**
  - ✓ **Academic sectors including universities, schools, teachers, students**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Parameters

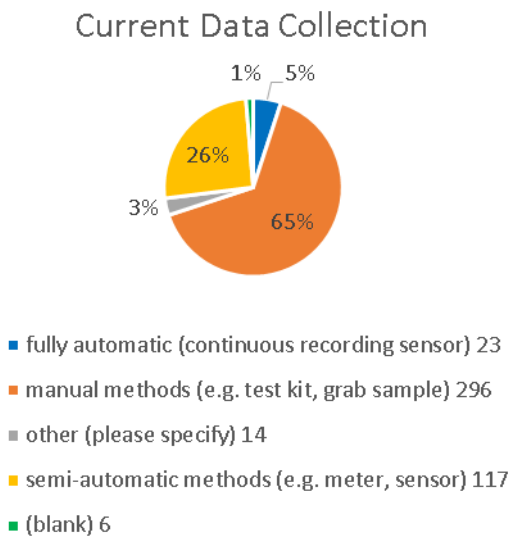


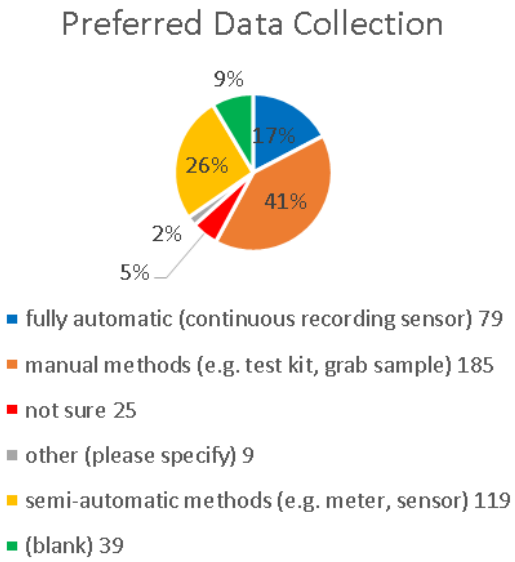
# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Parameters



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- All Monitoring Parameters

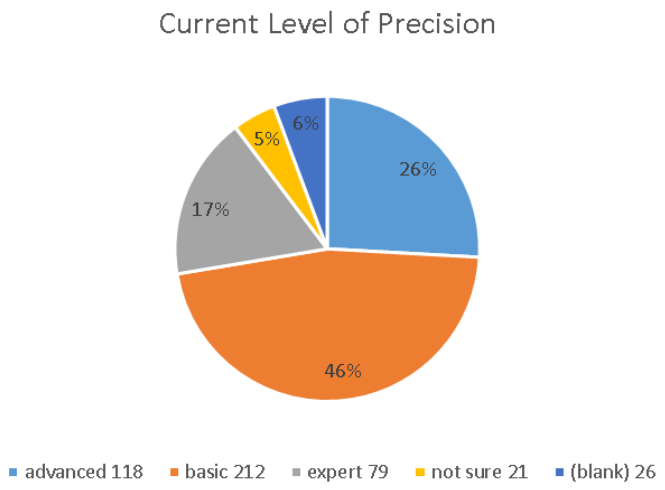
- most use manual data collection methods, yet fewer prefer this approach
- Some are unsure what they prefer, while more want a fully automatic approach
- Differences become more apparent with some individual parameters

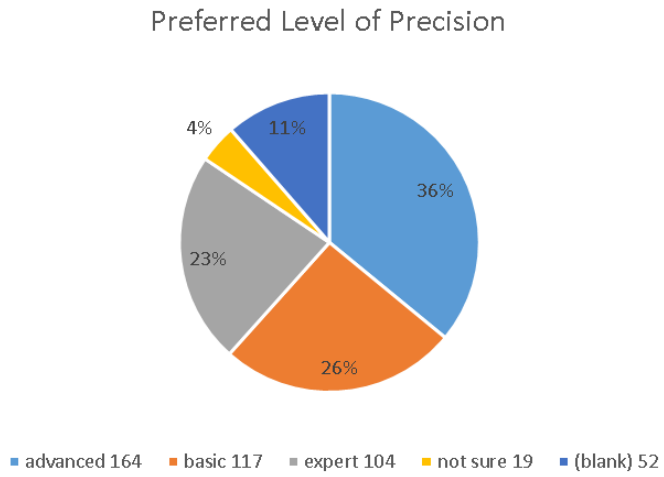


# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- All Monitoring Parameters

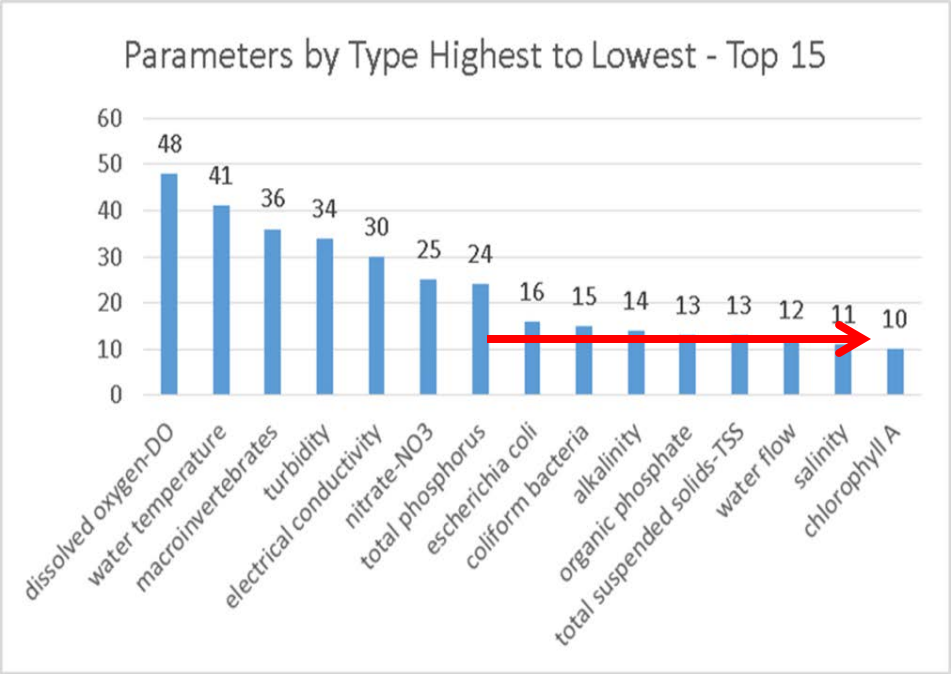
- most are engaged with basic levels of precision
- More prefer to transition into advanced and expert precision levels



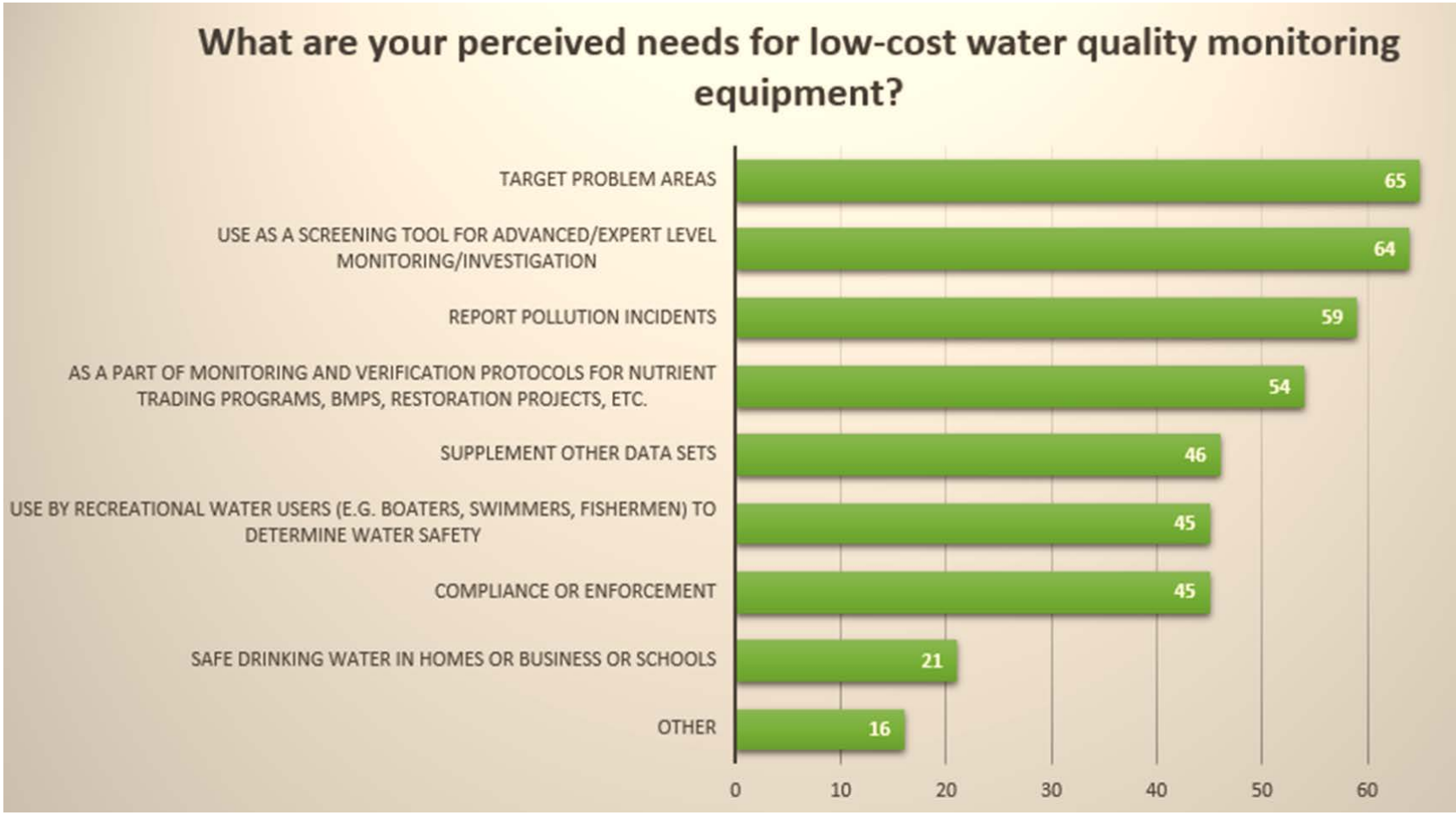



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Analysis: Data Collection & Precision

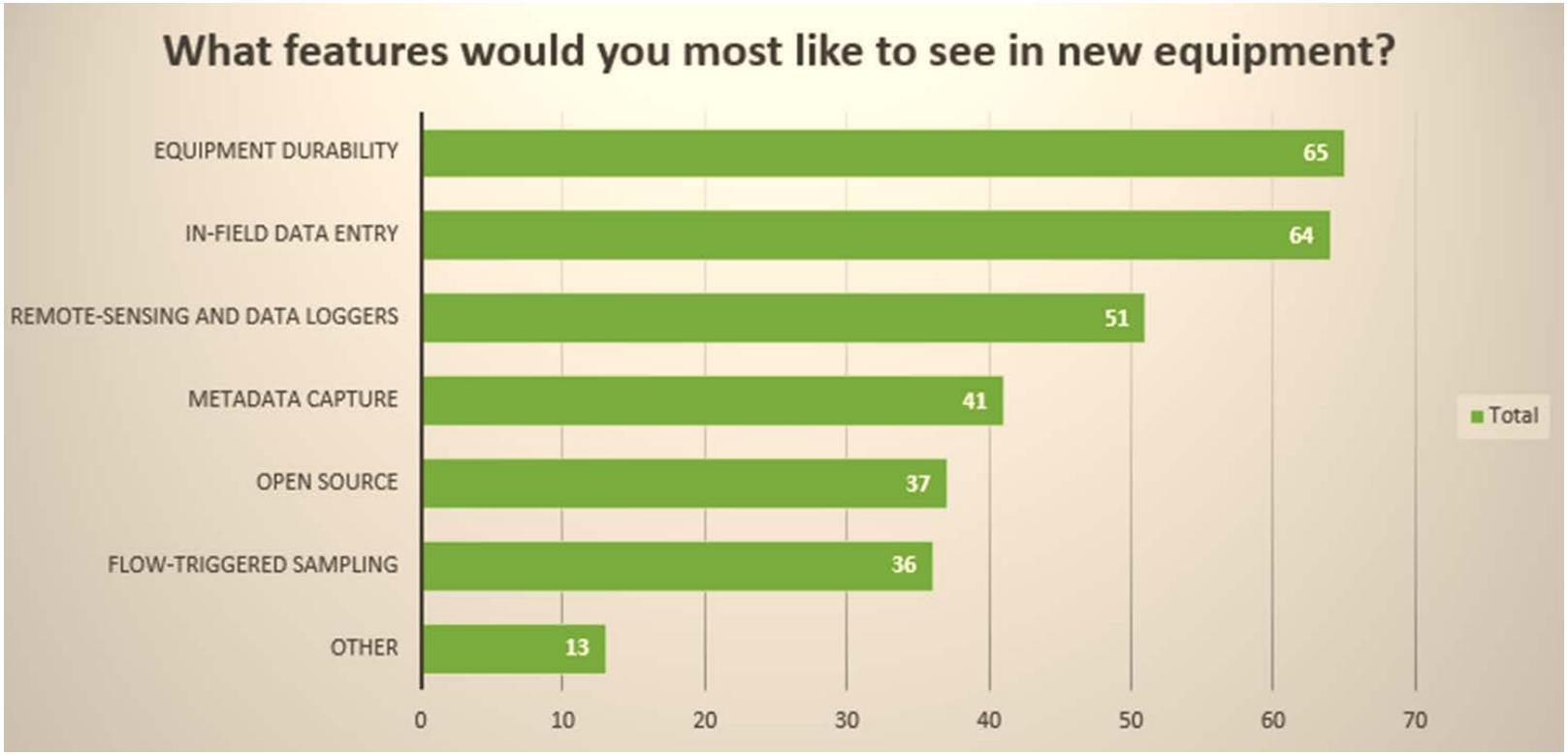
- Respondents say parameters that are *most useful to monitor but can't now, are* *<u>nutrients e.g. nitrogen & phosphorus</u>* in various forms, especially:
  - ✓ **in real time**
  - ✓ **with sensors and;**
  - ✓ **continuous monitoring**
- Parameters ranked below total phosphorus were briefly examined. Note that E. coli & coliform bacteria are used as contamination indicators
- Nutrients & bacteria are among the top 5 parameters in need of low-cost monitoring improvement



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Equipment



# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Equipment




Other examples of features needed:

- ✓ **simple intuitive interface and use**
- ✓ **be easy to calibrate and store**
- ✓ **user-friendly for volunteers**
- ✓ **small, and easy to carry in field**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Equipment

**Most respondents had little knowledge of promising low cost equipment:**

- ✓ No knowledge =74%

**Price ranges of "low cost " equipment:**

- ✓ Low range—75% of the respondents were clustered between 0-$100
- ✓ High range great variability—a majority (57%) clustered between $500-$5,000

**Equipment borrowing participation:**

- 64% don't participate, 36% do. Examples why they do:
  - ✓ **equipment is loaned to volunteers, schools, monitoring partners**
  - ✓ **equipment is borrowed from EPA, State organizations, non-profit organizations**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Equipment

**Equipment availability:**

- 84% of respondents believe widespread availability of low cost equipment could affect major improvements in water quality
- These themes emerged:
  - ✓ **greater affordability, more group/individual participation possible**
  - ✓ **more data can be collected in more places to fill gaps in knowledge & needed action**
  - ✓ **better public awareness and engagement about the nature & scale of the problem**
  - ✓ **may help catalyze broader action**

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Key Findings

## GOAL

- We wanted to survey select groups doing water resource monitoring to better understand gaps between their current and desired:
  - ✓ **Water monitoring practices**
  - ✓ **Reporting**
  - ✓ **Information sharing technologies**

- Our goal was to help empower citizens to protect their water through information gained or managed with the use of **low-cost technologies**

- The following key findings will assist our efforts to move forward in partnership with other interested parties to help expand the role that low-cost technologies play in protecting and enhancing water quality

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Key Findings

- **84% of respondents believe widespread availability of low-cost equipment could affect major improvements in water quality**

- **Top 4 perceived needs for low-cost monitoring equipment:**
  - ✓ target problem areas
  - ✓ use as a screening tool for advanced/expert level monitoring/investigation
  - ✓ report pollution incidents
  - ✓ as part of monitoring & verification protocols for nutrient trading programs, BMPs, restoration projects, etc.

- **Top parameters for low-cost** (under $100) **monitoring improvements:**
  - ✓ nutrients (N and/P forms)
  - ✓ bacteria (fecal coliform, E. coli, etc.)
  - ✓ dissolved oxygen
  - ✓ turbidity
  - ✓ temperature

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY -- Key Findings

- **Top 4 most desired features in new equipment:**
  - ✓ equipment durability
  - ✓ in-field data entry
  - ✓ remote sensing & data loggers
  - ✓ automatic metadata capture

- **78% of respondents lack knowledge of beneficial low-cost data access & sharing technologies that could benefit their program**

- **Top 4 perceived needs for low-cost** (less than $50) **data access and sharing technologies:**
  - ✓ quality and reliability of the data
  - ✓ low unit cost of the data
  - ✓ sharing of water quality information with environmental advocates
  - ✓ sharing of water quality information with local government officials

# LOW COST WATER QUALITY MONITORING NATIONAL SURVEY-- Implications and Potential Next Steps

- **Identify available low cost water quality monitoring technologies meeting identified priorities from the survey**
- **Use education and technical assistance to expand access to those technologies**
- **Share best practices and promote the use of peer supported tools for analyzing and sharing water quality information.**
- **Demonstrate how improved technology to collect and share information can empower organizations to protect and restore their rivers, lakes and streams.**
- **Promote improvements in technology and explore market incentives through collaborative efforts with NGOs, academics, and technology providers to ensure that the market is meeting the needs of the public for clean water.**