

**Targeted Sampling with
Enterococcus faecalis to Identify
Sources of Human Fecal Contamination**

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For Poor Communities, the Biggest Problem with BST...

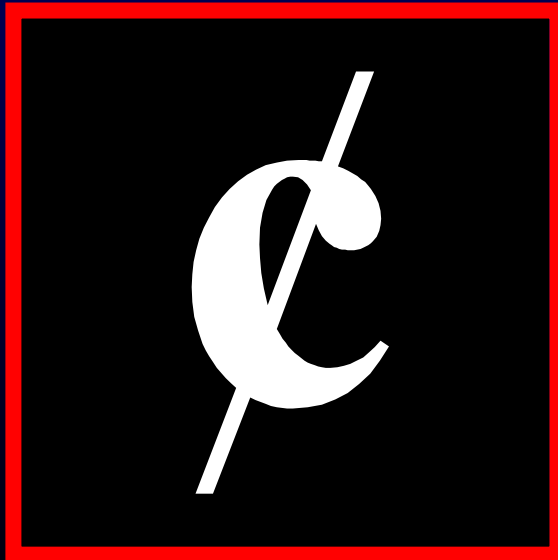


Example of Cost Problem

- **Northeast Georgia RDC wanted to do bacterial source tracking on five watersheds on the 303(d) list:**
 - **Anne Court Branch: 1.1 miles**
 - **Brooklyn Creek: 1.9 miles**
 - **Fortson's Creek: 3.8 miles**
 - **Richland Creek: 25.0 miles**
 - **Sugar Creek: 16.0 miles**
- **Total funds allotted: \$15,000**

Peter Hartel's Objective for BST

- Do sound science
- Use volunteers
- If any microbiology required, then easy to do
- Cost



A Two-Pronged Approach

- **Emphasize sampling as prelude to BST**
- **Find bacteria with host range limited to only one or two host animal species**

Prelude to Bacterial Source Tracking: Targeted Sampling

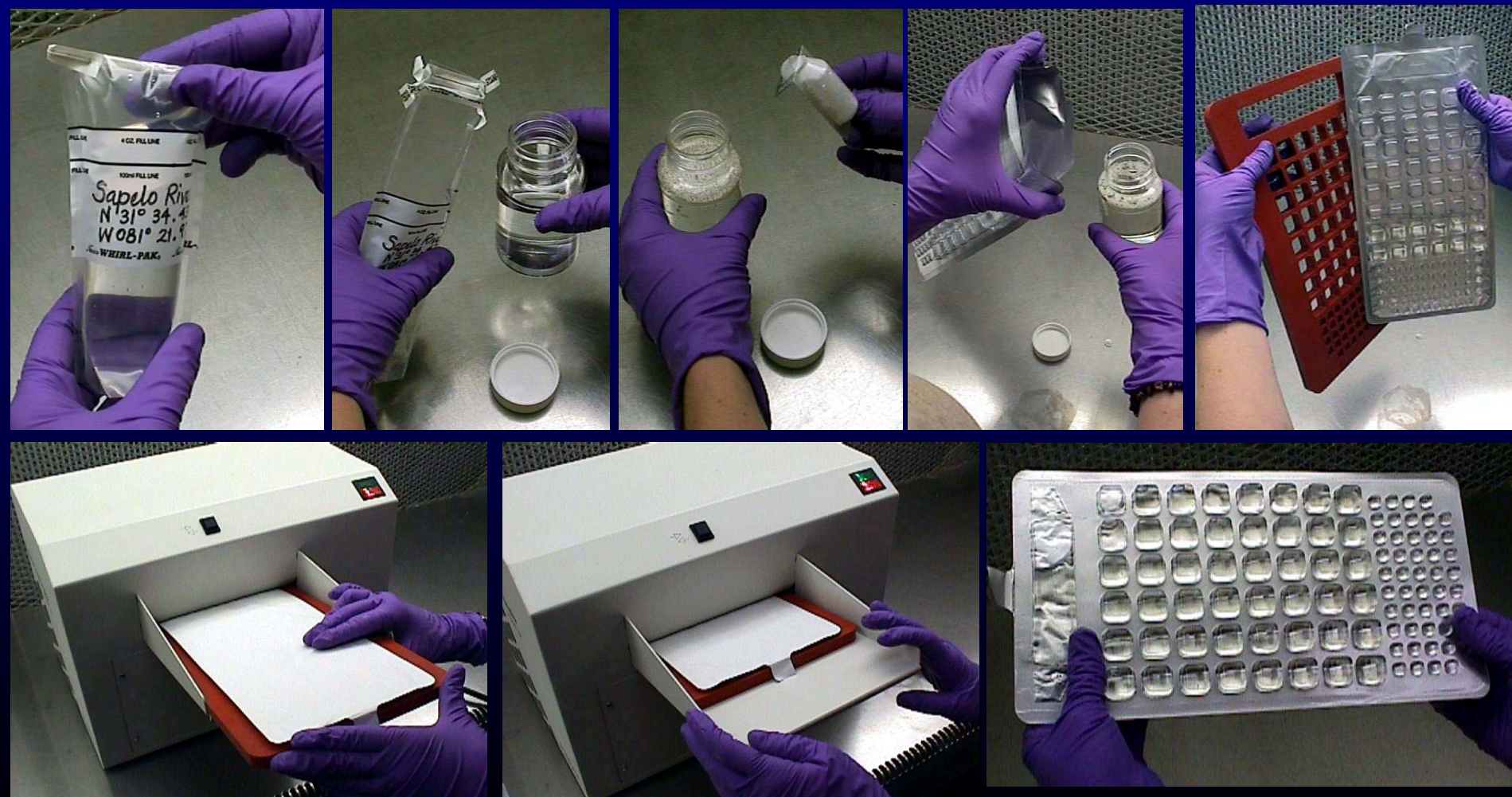
- Children's game of "hot" and "cold" (as you go away from the goal you get "colder;" as you get closer to the goal, you get "hotter")
- Avoid bacterial subspecies change with:
 - host
 - time
 - intra-host (e.g., age, diet)
 - sediment
 - habitat
 - flow
 - geography

To Reduce Subspecies Change with Flow

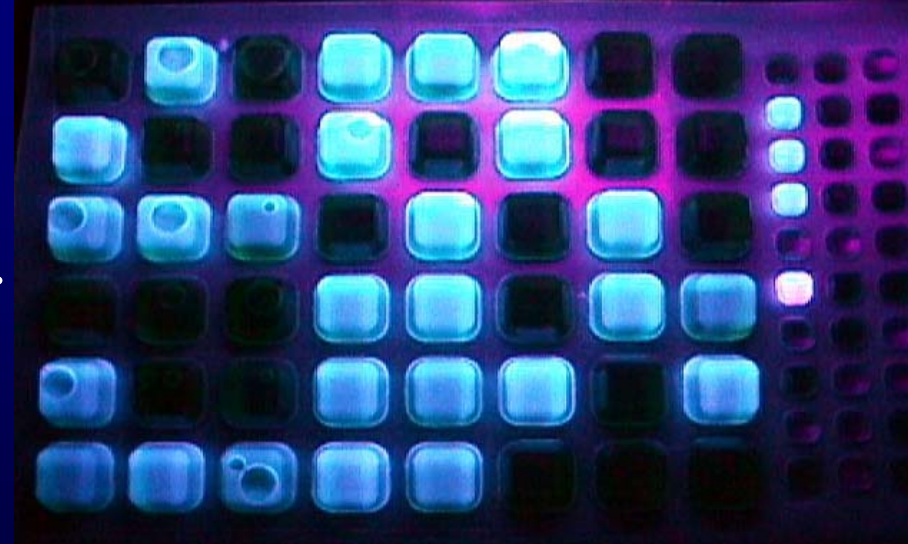
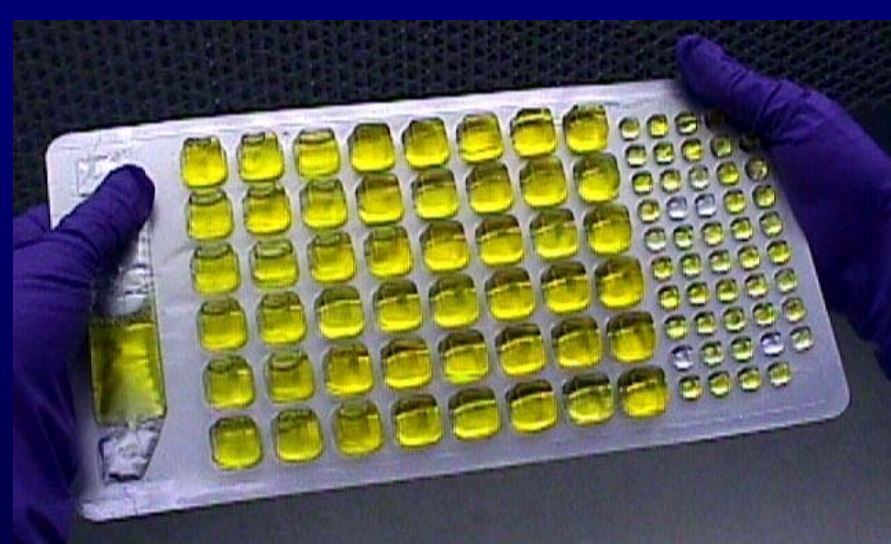
- **Separate baseflow from stormflow conditions**
- **Why? Because typically, fecal bacterial counts increase 10- to 100-fold because of runoff and sediment disruption**

To Reduce Subspecies Change in Time

- Conduct all sampling in one day (e.g., IDEXX)



Subspecies Change in Time (cont'd)



= 26 large wells
4 small wells
= 44 *E. coli*
per 100 mL

To Reduce Subspecies Change in Geography

- **Conduct multiple samplings over an ever-decreasing area**
- ***Note:* number of samplings will depend on reach. If the reach is short (a few km), then one sampling is sufficient; if the reach is long (more than a few km), then multiple samplings are necessary**

Example

- Sapelo River
- Targeted sampling
- McIntosh County (per capita income of \$16,214; 153 of 159 counties)

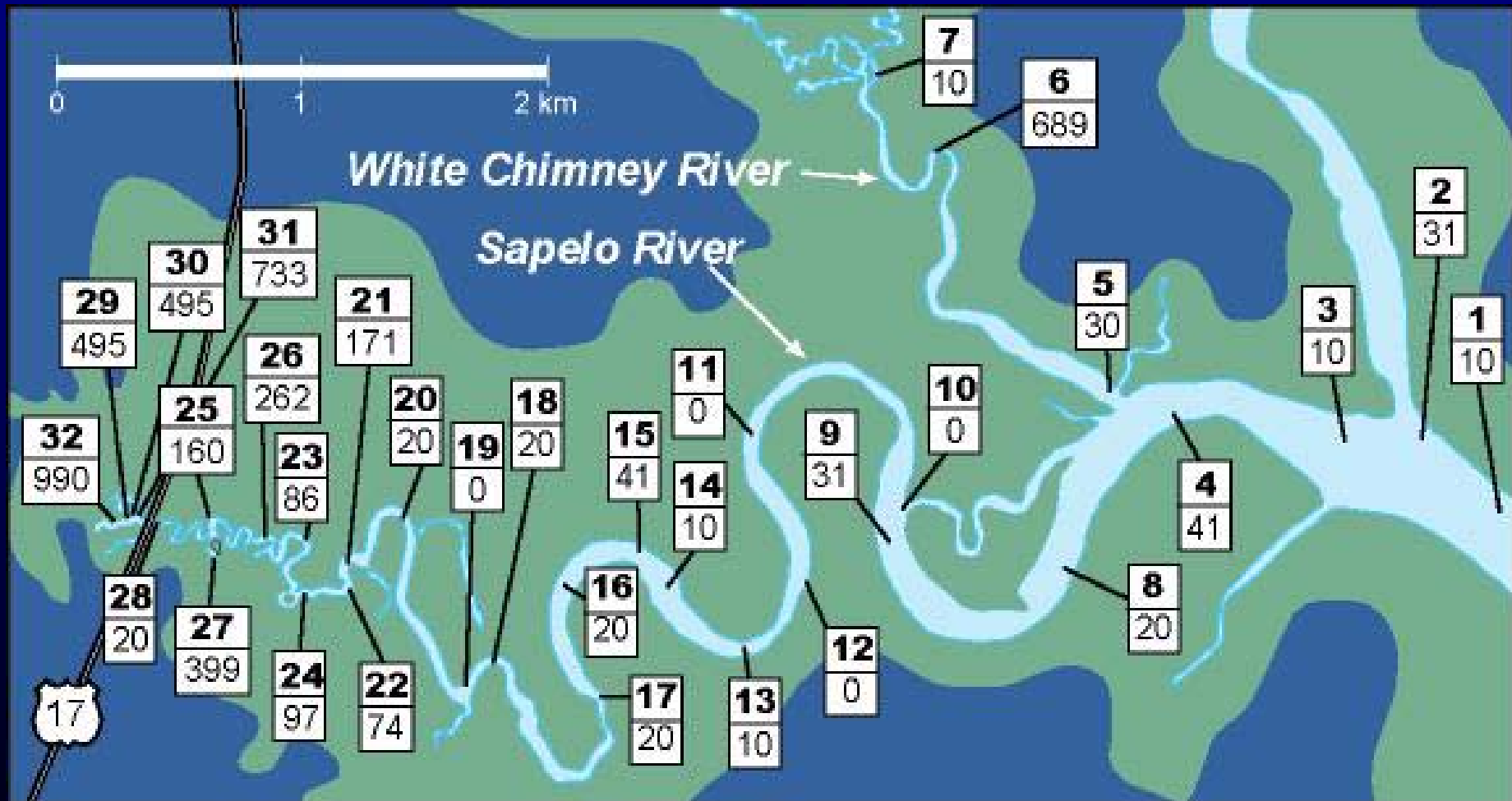


General Sampling: Sample all Tributaries, River Bends, River Cuts, and Pipes*



* Confusing terrain like salt marsh? Use GPS system

General Sampling (cont'd): Take a Boat or Walk the River



Select Areas for Targeted Sampling



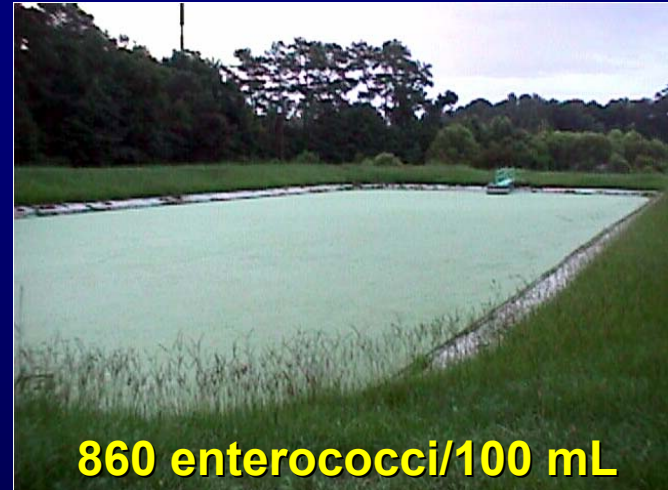
Targeted Sampling (the dumb way)



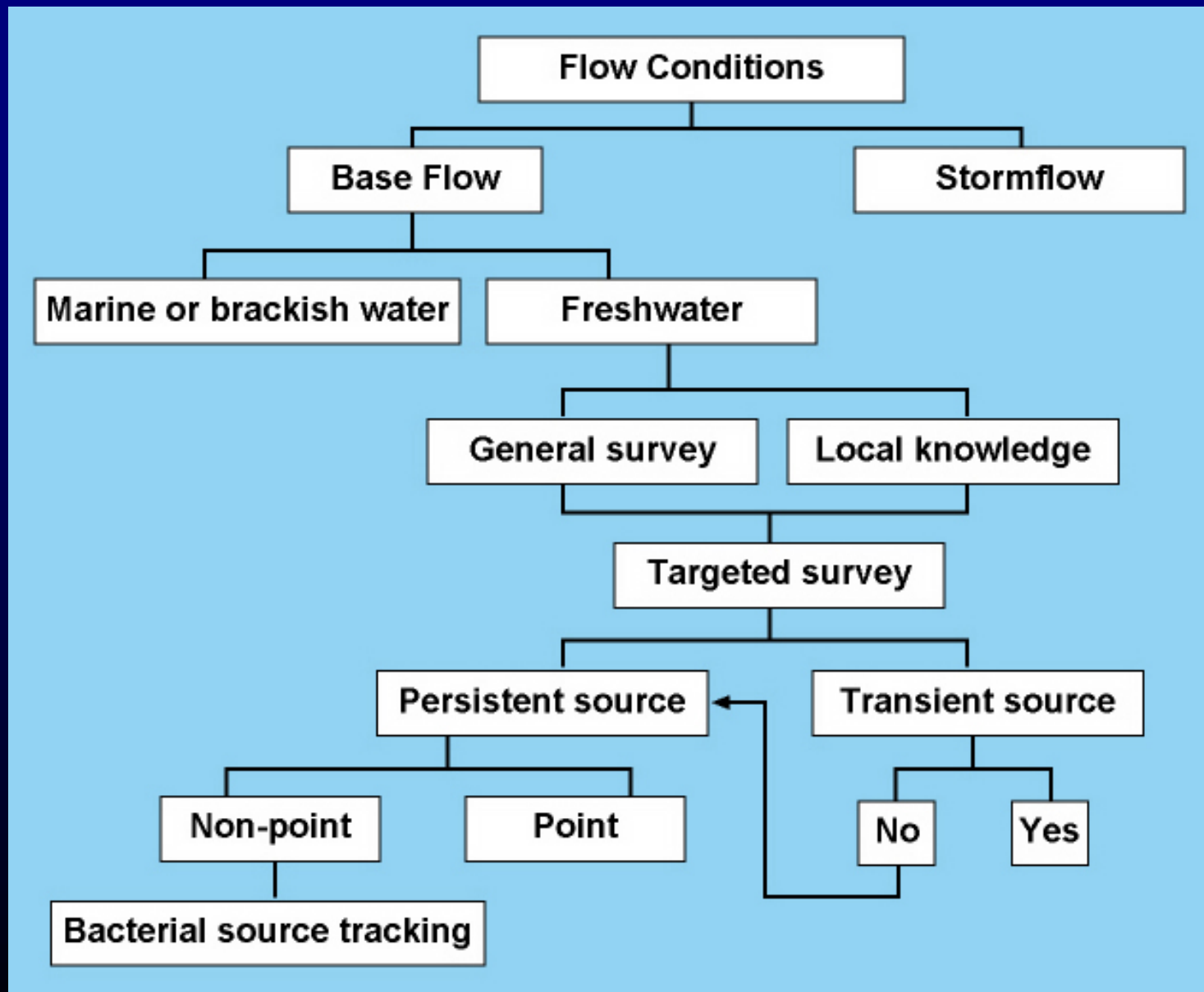
Targeted Sampling with Local Knowledge



Third Sampling: Down to 50 meters



Flowchart for Targeted Sampling



Advantages of Targeted Sampling

- Reduces subspecies change by flow by sampling either during baseflow or stormflow
- Reduces subspecies change in time by sampling all in one day
- Reduces subspecies change in space by sampling in a limited area
- Requires no host origin database

Advantages of Targeted Sampling (cont'd)

- Identifies persistent sources of fecal contamination with a high “duh” factor



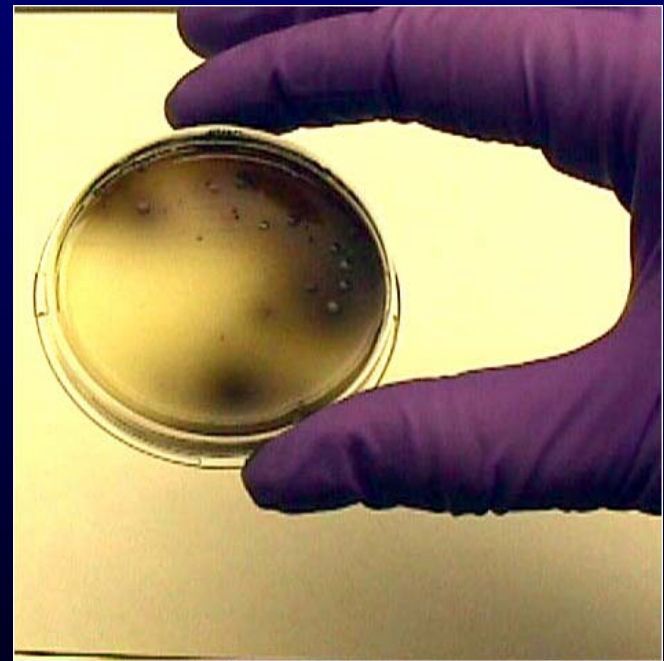
- Low 800-lb. gorilla factor: Cost for Northeast Georgia RDC to do five watersheds: \$6,000; cost for Sapelo River (no boat or tech): \$800

Disadvantages of Targeted Sampling

- **Won't work well for transient conditions**
- **Won't work for sources with high background (e.g., Gulf of Mexico)**
- **Hasn't been tried under stormflow or other complex conditions**
- **Only a prelude to BST (still need to conduct BST under certain conditions)**

So What Do I Do If I Have To Do BST?

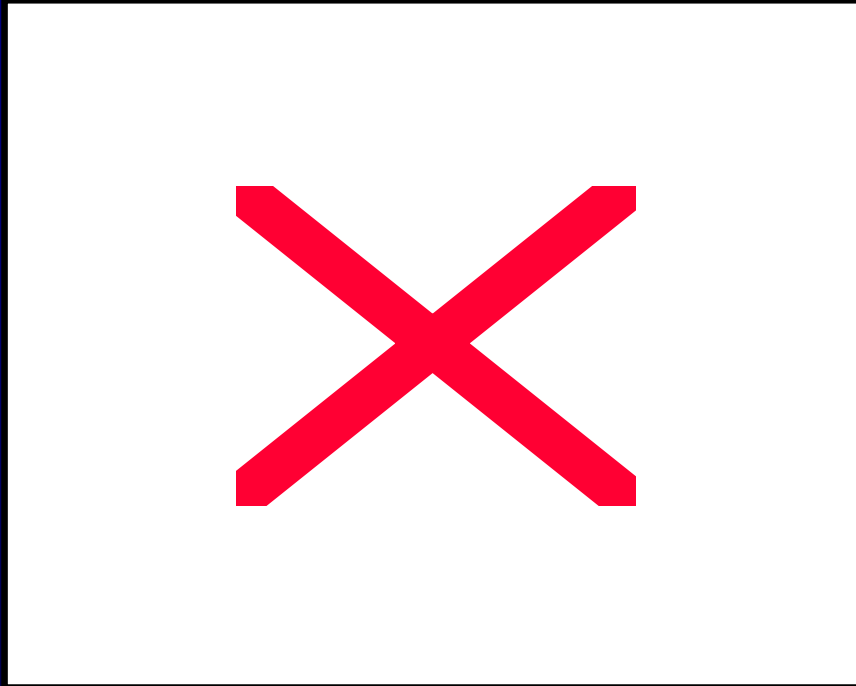
- Are there species of fecal bacteria associated with one host species or a group of species?
- *Escherichia coli* has a broad host range
- Some fecal enterococci may have a limited host range, especially when isolated with certain biochemical tests



Limited Host Range for *Enterococcus faecalis*

Source	Pourcher et al. (1991)		Wheeler et al. (2002)	
	Total isolates	<i>Ent. faecalis</i>	Total isolates	<i>Ent. faecalis</i>
Cattle	56	0	69	0
Chicken	42	8	35	12
Deer	ND	ND	131	0
Dog	ND	ND	56	0
Human	72	27	47	19
Horses	28	1	ND	ND
Rabbits	5	0	ND	ND
Sheep	12	0	ND	ND
Swine	45	3	48	0
Wild birds	10	7	ND	ND

Fecal Contamination in Rock Creek, Idaho



	Isolates	<i>Ent. faecalis</i>	Other enterococci
Septic tanks	180	99 (55%)	81 (45%)
Seeps	172	7 (4%)	165 (96%)

Summary

- Use targeted sampling to identify persistent sources of fecal contamination
- If BST is needed, use *Ent. faecalis* isolation as one way to identify human fecal contamination
- **Important note:** targeted sampling makes other BST methods better (e.g., antibiotic resistance analysis)
- Approach is a lot less expensive and good for communities that could otherwise not afford BST technology