Use of the FlexiGrid system for processing of physical habitat data collected per multiple protocols, including SWAMP

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Today's Topics

Background

Why "FlexiGrid", and how it works

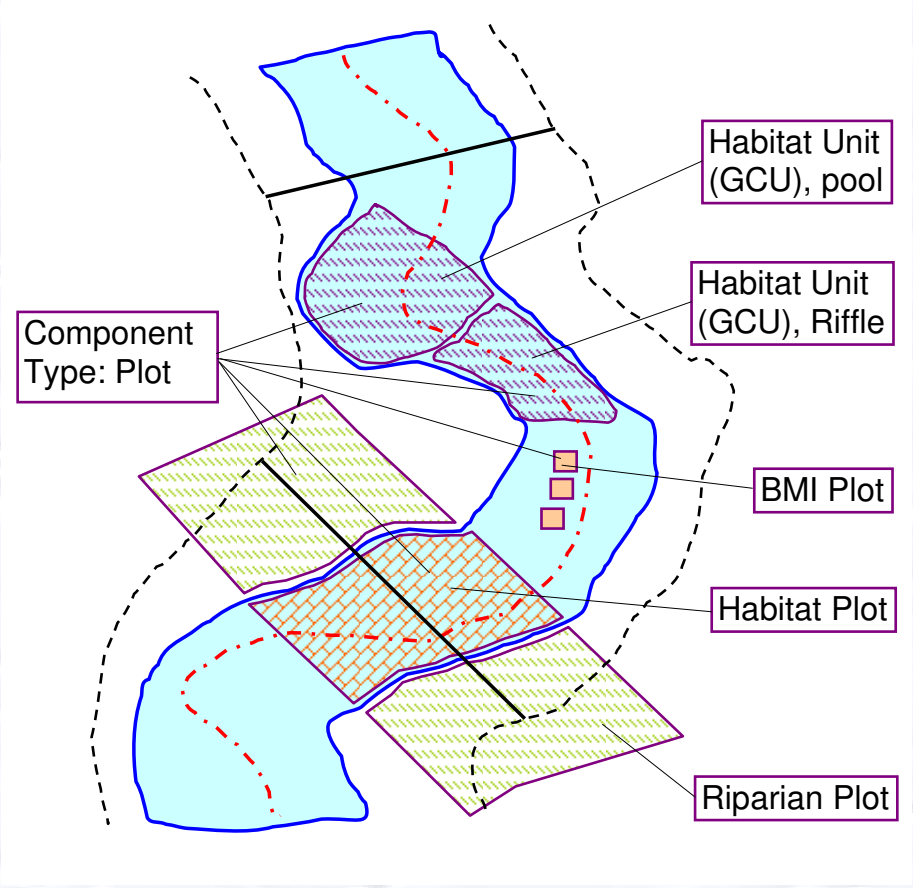
The FlexiGrid `System:` spreadsheet and associated Templates

- Data Entry
- Endpoint Calculation
- Crosswalk to SWAMP

Upload of raw data to SWAMP

The FlexiGrid is a Concept

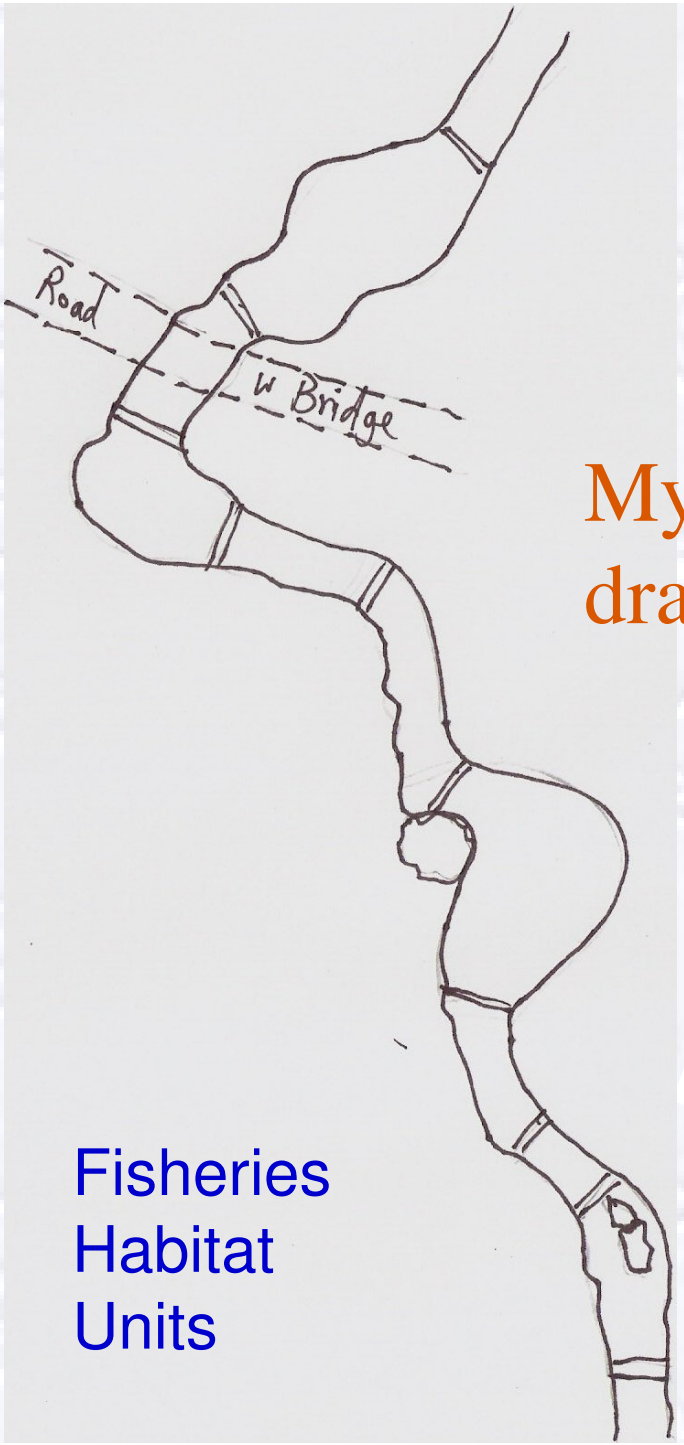
It is a way of organizing information about spatial components of complex sampling frames to enable:



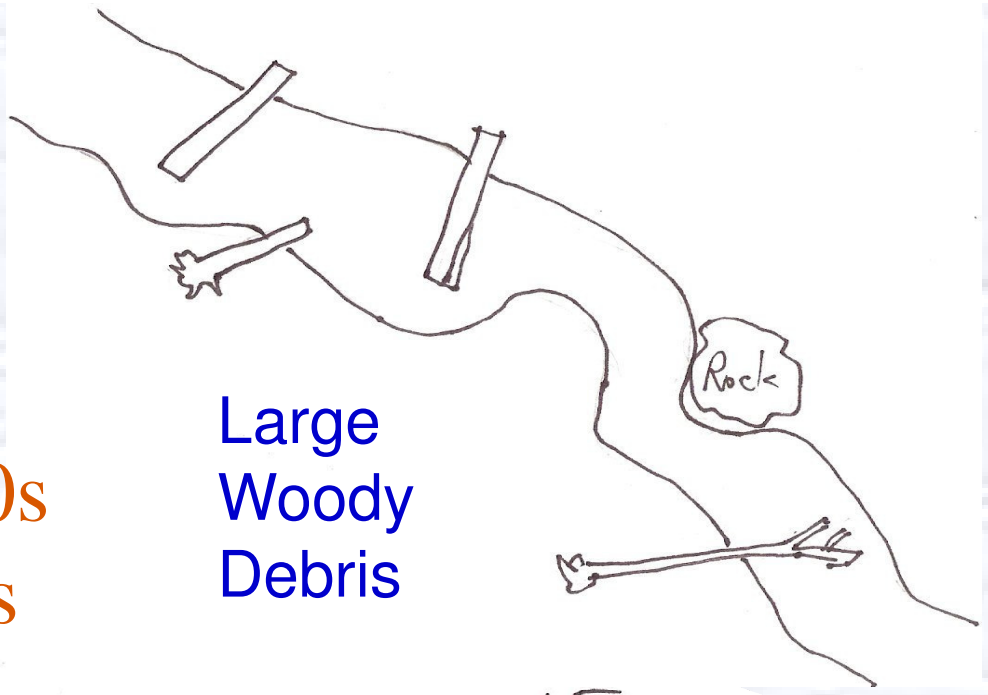
(a) Description and mapping of the Frame and each component within the frame

(b) Linking each assessment Result to the component in which it was collected.

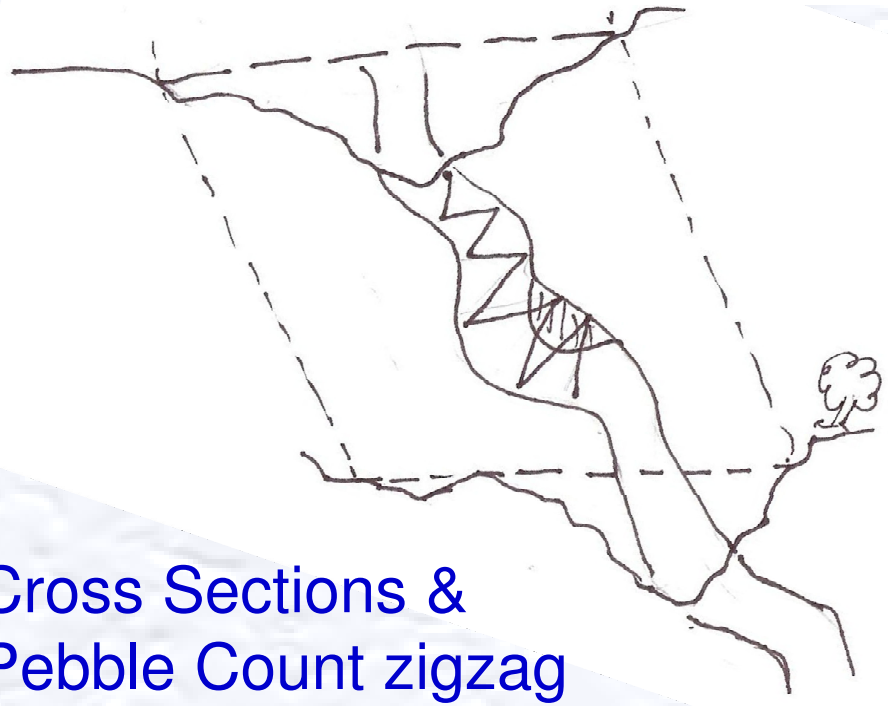
My 1990s drawings



Fisheries Habitat Units



Large Woody Debris



Cross Sections & Pebble Count zigzag

Some of the protocols I encountered

Fisheries habitat assessments DFG style (Flossi&Reynolds…)
Thalweg profile & cross section surveys
Pebble counts
Large Woody Debris assessments
Riparian plots & canopy density
Residual pool volume (V*)
Collection of vertical composite samples in water column
Sampling storm runoff in outfall & creek networks
Bird point-counts in a 50m-radius circle
Flow discharge measurements
Physical Habitat assessments RBP style
Physical Habitat assessments EMAP style
Physical Habitat assessments NAWQA style
(more)

My 2000s drawings

Transects
Transect points
Intertransects
Transect Plots
Riparian plots
Stream segments
…
…
…

Lots of “Crosslines”, and “Plots”
…and the internal hierarchy gets more and more complicated

The Challenges:

Multiple Protocols: Identify the common elements and components among diverse protocols and spatial Sampling Frames

Links: Find a universal way to connect each monitoring Result to the specific spatial component it represents, in a flexible data structure

Hierarchy: Find a way to map multi-dimensional sampling frames with internal hierarchy

Endpoints: Find a simple way to generate assessment Endpoints from desirable aggregates of components

Spatial Sampling Frames

Can share the following properties:

- A 'Grid' made of a number of components
- Flexible (variable angles)
- Multi-dimensional
- A structure with internal hierarchy

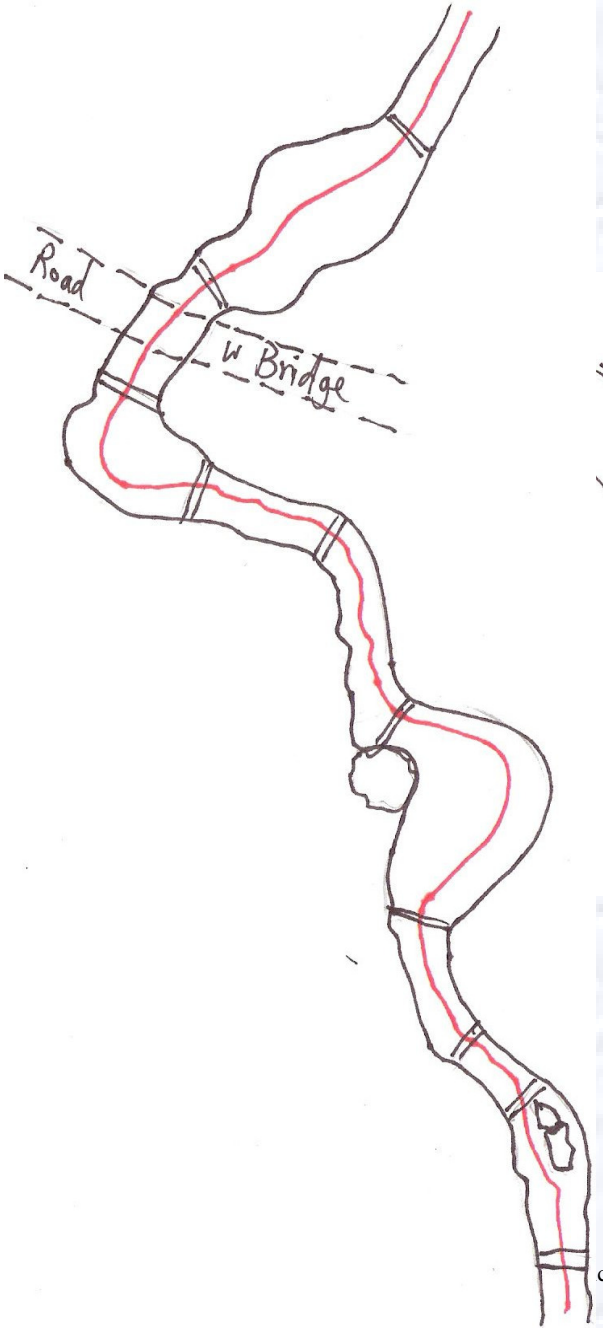
They can easily be defined in neutral terms: each Frame has

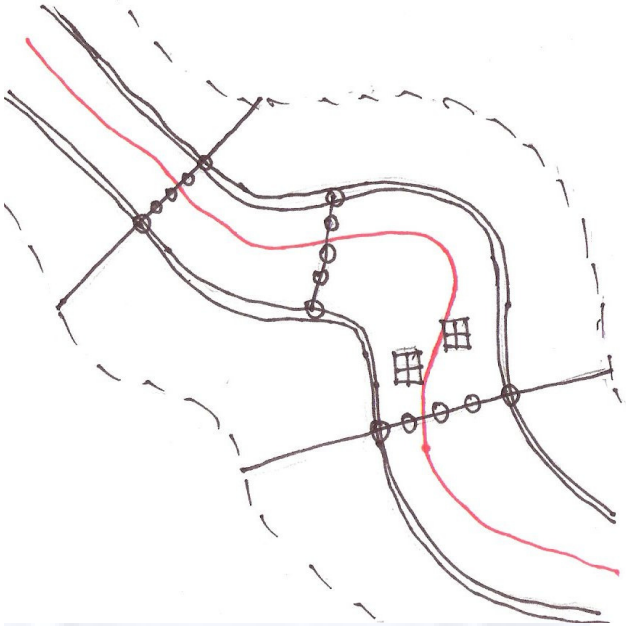
- An origin
- A direction (upstream or downstream)
- A known curvilinear distance.

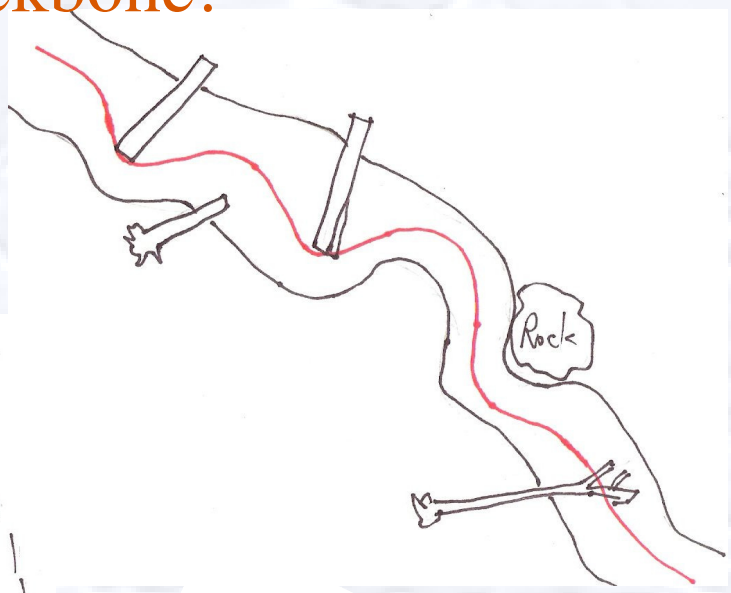
The **Origin** can be mapped to a Permanent Station and/or Monument

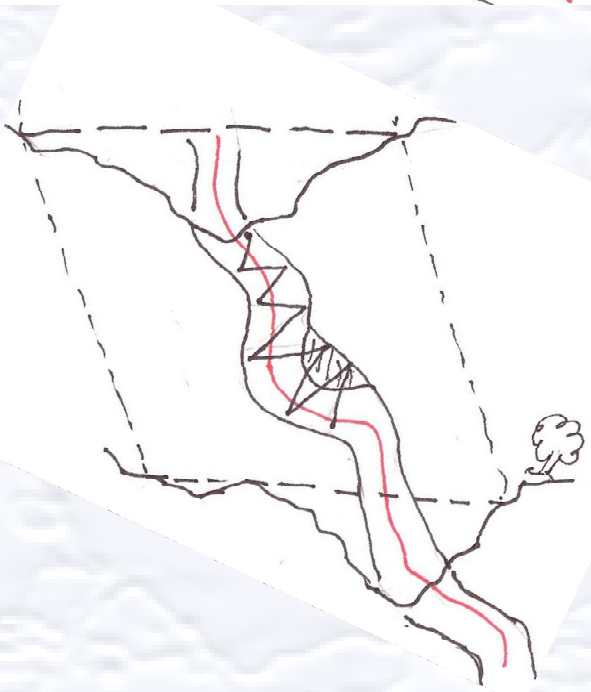
Curvilinear distances can be measured on a tape placed on the thalweg, or the centerline, or the centroid…. Every Frame or grid has a **"backbone"** of sorts

Mapping is so much easier with a Backbone!









ctions

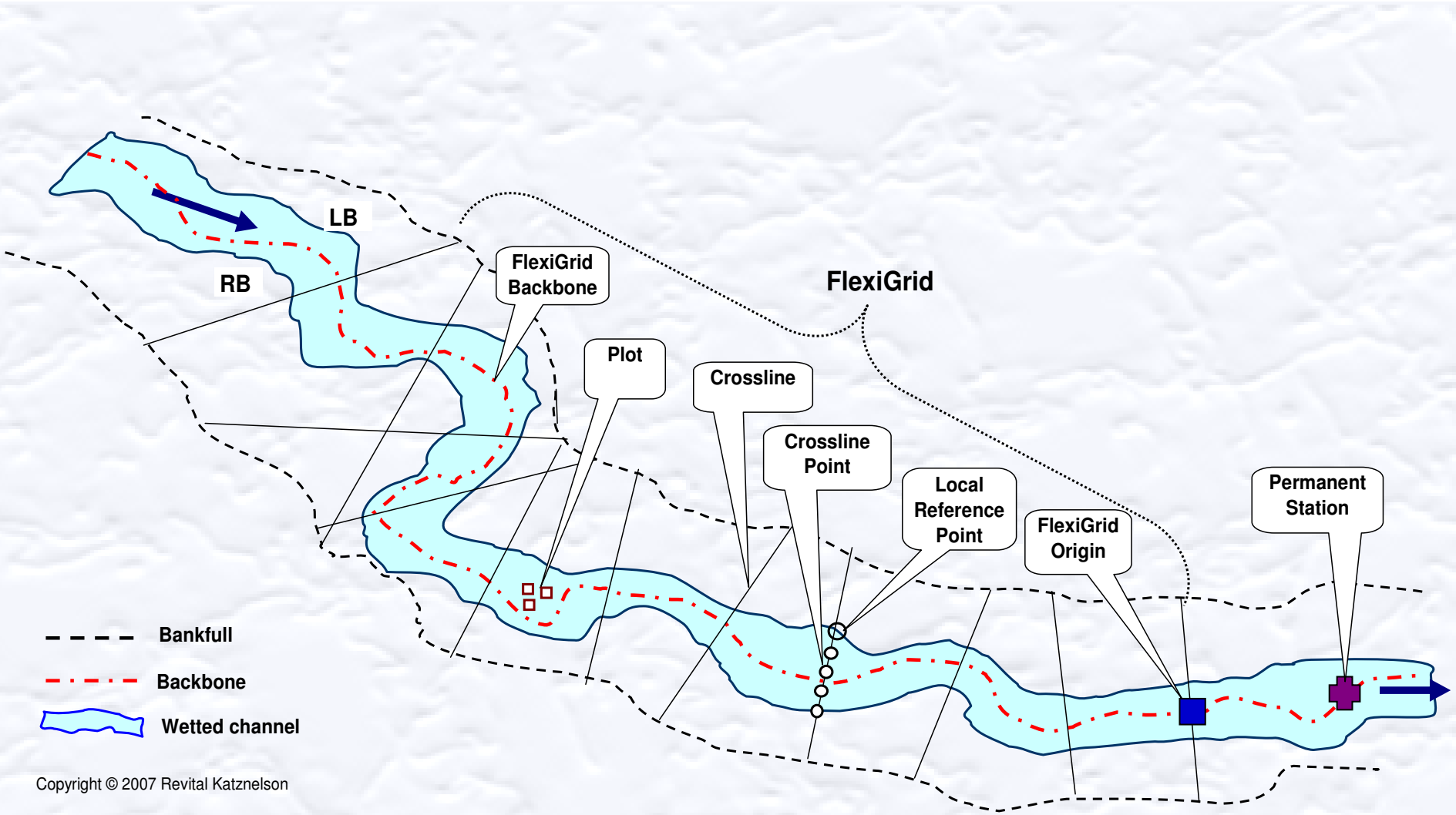
We are talking about “a spatial multi-dimensional flexible sampling frame with a variety of components, some organized with an internal hierarchy” (in short, SMDFAFWVCIH).

I called it “A FlexiGrid”

A FlexiGrid with a unique ID is laid out on a stream channel by one Team in one Station Visit. A Team can lay out one or more FlexiGrids in one Visit, each with its own unique ID.

The FlexiGrid refers to permanent locations, but is not permanent itself (FlexiGrids may be laid out differently at different times).

The FlexiGrid concept can be applied to different scales.



The secret: use of neutral terms

Common Data Elements

(These are added to the 'generic' Station-Visit descriptors:
Project, Trip, Team, Date, Time, Station, Station-Visit ID, etc.)

List 1: FlexiGrid Descriptors

FlexiGrid **Origin ID**
FlexiGrid distance **units** (m, ft)
FlexiGrid Origin **distance from permanent Station** [/monument]
FlexiGrid **Type** (transects&points, right-angle grid, string of hab units, etc.)
FlexiGrid **Backbone** (Thalweg, midstream, centerline, centroid)
FlexiGrid Positive-distance **direction** (Upstream, downstream)

List 2: FlexiGrid component descriptors

FlexiGrid Component **ID** [naming conventions can reflect hierarchy]
FlexiGrid Component **Type** (e.g., Stream-fragment, Crossline, Plot, Point, Vertical, River-Parallel, Crossline-point, etc.)

FlexiGrid Component **Name in Protocol** (e.g., Reach, Transect, Transect-point, BMI Plot, etc.); [these are protocol-specific]

FlexiGrid Component Pre-determined **size [/shape, /boundaries]**
FlexiGrid Component **backbone-distance from Origin**
FlexiGrid Component place in series
FlexiGrid Component **distance from Local Reference Point**
Local Reference Point type (e.g., Left-bank)
FlexiGrid Component **depth from surface**

FlexiGrid and FlexiGrid component descriptors

Remember: Any of the spatial components you have defined can be included in the FlexiGrid; you do not HAVE TO snap them to the grid (i.e., to map them) with distances or depth measurements

But if you want to, you CAN!

All you need is … a spreadsheet.

And I already had a spreadsheet. Actually, I had more than one

The Data Quality Management (DQM) System

Developed for field measurements, 1998-2001, and implemented by the SWRCB Clean Water Team (Citizen Monitoring Program)

http://www.waterboards.ca.gov/water_issues/programs/swamp/cwt_toolbox.shtml

Station Visit Information

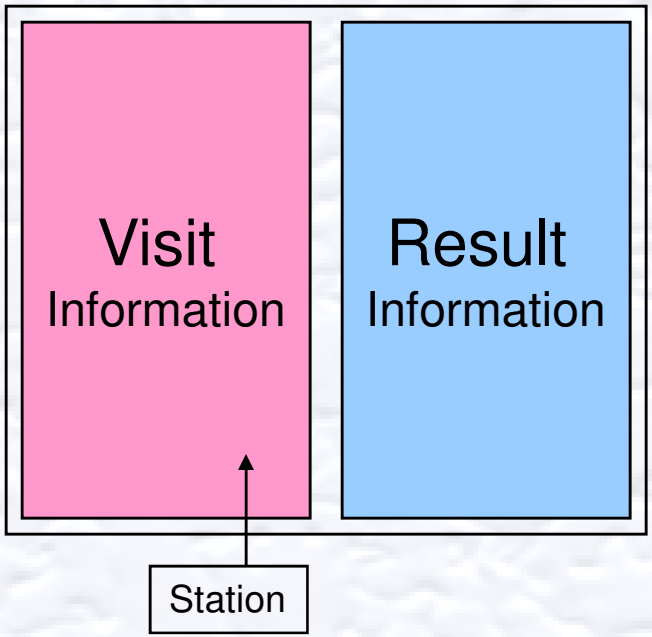
Project ID	Team Name	Date	Station Visit ID	Station Visit start time	Permanent Station ID
WIL03	Rkcrew	6/22/2003	T1V1	10:47	WIL070
WIL03	Rkcrew	6/22/2003	T1V1	10:47	WIL070
WIL03	Rkcrew	6/22/2003	T1V1	10:47	WIL070
WIL03	Rkcrew	6/22/2003	T1V1	10:47	WIL070
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116

Result Information

Instrument ID	Characteristic	Result	Result unit	Accuracy		Precision	
TTP-STB01	Temperature, water	14.57	C	-1.44	%	0.06	%, RPD
ECP-STB01	Specific conductance	758.7	uS/cm	-0.14	%	0.40	%, RPD
DOP-STB01	Dissolved oxygen (DO)	11.08	mg/l	-5.00	%	6.92	%, RPD
PHP-STB01	pH	8.34	pH	0.71	%	0.12	%, RPD
EC-2SLC02	Specific conductance	780	uS				
FLO-SLC01	Velocity	0.67	ft/sec				

The Field Result Table is linked to everything else: Location, Instrument, Organization, etc.

The basic Results spreadsheet: a schematic



Everything was simple when the Station was a point.

Station Visit Information

Project ID	Team Name	Date	Station Visit ID	Station Visit start time	Permanent Station ID
SYCM09	PW crew	6/15/2010	PW05-v1	9:50	SYC050
SYCM09	PW crew	6/15/2010	PW05-v1	9:50	SYC050
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116
SYCM09	PW crew	6/15/2009	PW05-v1	9:50	SYC050
WL-yr3	MD crew	5/12/2009	MD02-v2	13:50	WL32

FlexiGrid Information

FlexiGrid Origin ID	FlexiGrid distance units	FlexiGrid Origin distance from permanent Station	FlexiGrid type	FlexiGrid backbone	FlexiGrid positive distance Direction
FG35	m	23	transects &points	Thalweg	Upstream
FG35	m	23	transects &points	Thalweg	Upstream
FG-RD05	m	35	String of habitat units	Thalweg	Upstream
FG-RD05	m	35	String of habitat units	Thalweg	Upstream
FG35	m	23	transects &points	Thalweg	Upstream
FGW32	m	-48	transects &points	midstream	Upstream

FlexiGrid Component Information

FlexiGrid Component ID	FlexiGrid Component Type	FlexiGrid Component Name in Protocol	PHAB Protocol Used	FlexiGrid Component backbone-distance from Origin	FlexiGrid Component place in series	FlexiGrid Component distance from Local ref point	Local ref point type	Local ref point distance from Backbone	FlexiGrid Components Aggregate
FG35-R1	Stream-Fragment	Reach	Jones 2010	0	n/ap	n/ap	n/ap	n/ap	BMI plots
FG35-R1	Stream-Fragment	Reach	Jones 2010	0	n/ap	n/ap	n/ap	n/ap	Slope Segments
FG-RD05-P3-CS2	Crossline	Cross-Section	CCRS 1993	20	2	n/ap	n/ap	n/ap	n/ap
FG-RD05	Stream-Fragment	Reach	CCRS 1993	n/ap	n/ap	n/ap	n/ap	n/ap	Cross Sections
FG35-R1-PL08	Plot	BMI Plot	Smith 2003	67	6	5.8	LB	3.9	n/ap
FGW32-R1-RP2	Plot	Riparian plot	(EMAP)	18	2	n/ap	n/ap	n/ap	n/ap

Result Information

Characteristic	Result	Result unit	Result type	Endpoint type
Index of biological integrity (IBI)	67	(none)	Calculated endpoint	Compound endpoint
Average slope	4.5	%	Calculated endpoint	Simple endpoint
Stream width	4.8	m	Individual measurement	n/ap
Average Stream Width	5.3	m	Calculated endpoint	Simple endpoint
Estimated percent Cobble	10	%	Estimated number or numeric range	n/ap
Big Tree Canopy cover	10-40	%	Estimated number or numeric range	n/ap

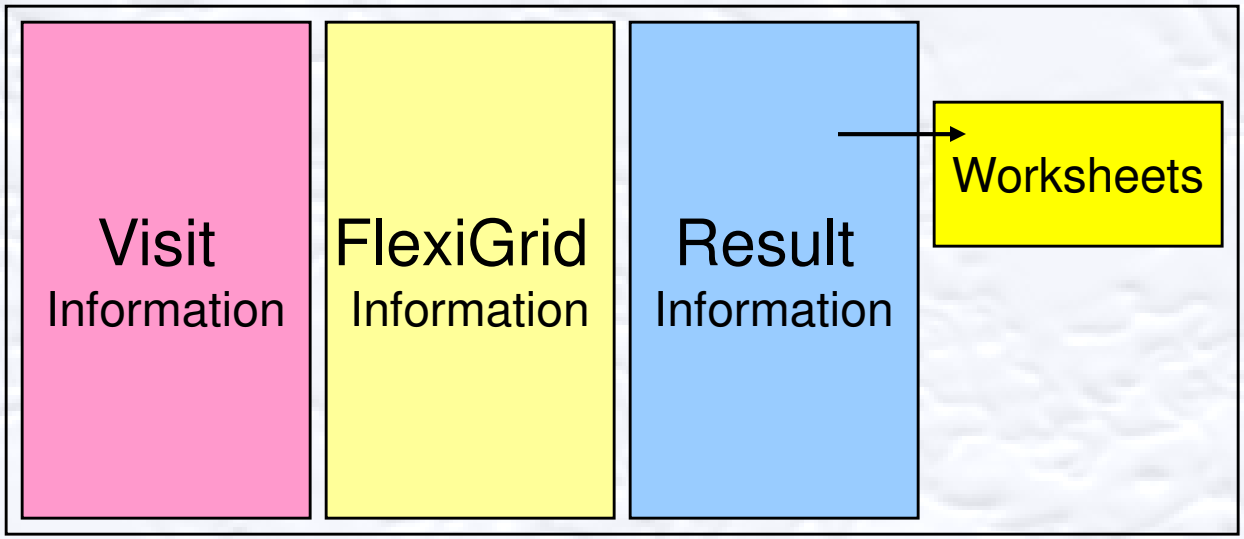
Project ID	Team Name	Date	Station Visit ID	Station Visit start time	Permanent Station ID
SYCM09	PW crew	6/15/2010	PW05-v1	9:50	SYC050
SYCM09	PW crew	6/15/2010	PW05-v1	9:50	SYC050
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116
SLC95	RD crew	5/3/1995	RD05-v1	10:10	SLC116
SYCM09	PW crew	6/15/2009	PW05-v1	9:50	SYC050
WL-yr3	MD crew	5/12/2009	MD02-v2	13:50	WL32
SUIS06	LM crew	4/7/2009	LM21-v1	13:40	SUI085
WL-yr3	MD crew	5/12/2009	MD02-v2	13:50	WL32
WL-yr3	MD crew	5/12/2009	MD02-v2	13:50	WL32

FlexiGrid ID, Component ID, and everything you need to know about them

Characteristic	Result	Result unit	Result type	Endpoint type
Index of biological integrity (IBI)	67	(none)	Calculated endpoint	Compound endpoint
Average slope	4.5	%	Calculated endpoint	Simple endpoint
Stream width	4.8	m	Individual measurement	n/ap
Average Stream Width	5.3	m	Calculated endpoint	Simple endpoint
Estimated percent Cobble	10	%	Estimated number or numeric range	n/ap
Big Tree Canopy cover	10-40	%	Estimated number or numeric range	n/ap
Particle d50	34	mm	Calculated endpoint	Quantile
Stream width	13.5	m	Individual measurement	n/ap
Water depth	0.43	m	Individual measurement	n/ap

The FlexiGrid Results spreadsheet, Part 1

(Data Entry Template)



This spreadsheet has been customized several times.
Each version served as a **data entry template** for a specific SOP

Assessment Endpoints

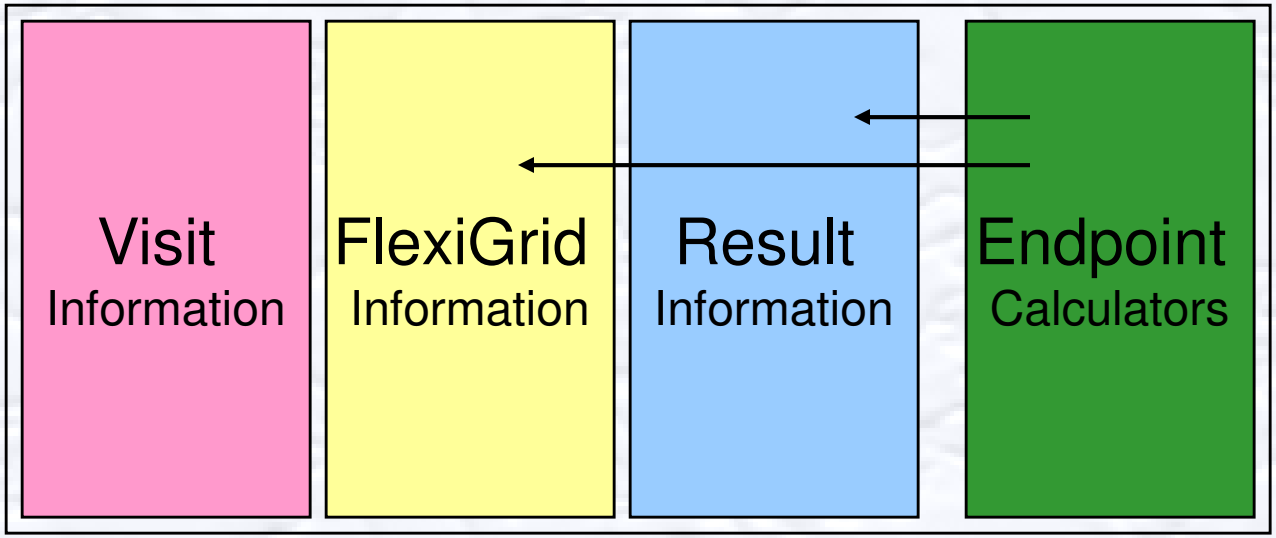
Descriptive statistics (Average, Frequency), Metrics, Indices, and any other Endpoint calculated for an aggregate of raw data.

Examples: Average wetted channel width, Percent cobble, Landfill/Trash Human Influence Index

Trip start date	SV start time	Permanent Station ID	FlexiGrid Component place in series	**Characteristic**	**Result**	Result unit	**Processed Result (Formula!)**		**Result [Endpoint]**	**Unit**	**Characteristic [Endpoint]**	Components Aggregate for Endpoint	Number of observations in aggregate (n)
4/13/2005	8:45	201EAS050	1	Boulders cover	1	(code)	5		11	%	Average Boulders cover	Habitat Plots	11
4/13/2005	8:45	201EAS050	2	Boulders cover	1	(code)	5						
4/13/2005	8:45	201EAS050	3	Boulders cover	0	(code)	0						
4/13/2005	8:45	201EAS050	4	Boulders cover	1	(code)	5						
4/13/2005	8:45	201EAS050	5	Boulders cover	0	(code)	0						
4/13/2005	8:45	201EAS050	6	Boulders cover	1	(code)	5						
4/13/2005	8:45	201EAS050	7	Boulders cover	2	(code)	25						
4/13/2005	8:45	201EAS050	8	Boulders cover	0	(code)	0						
4/13/2005	8:45	201EAS050	9	Boulders cover	2	(code)	25						
4/13/2005	8:45	201EAS050	10	Boulders cover	2	(code)	25						
4/13/2005	8:45	201EAS050	11	Boulders cover	2	(code)	25						

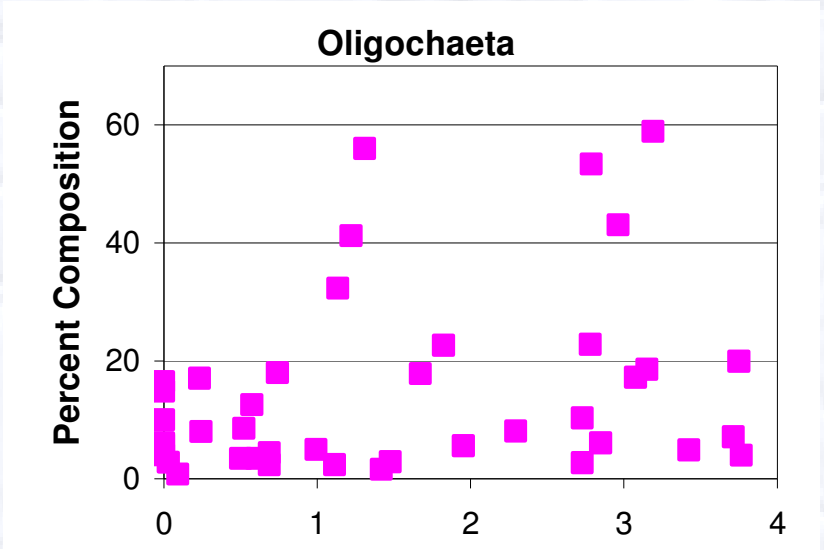
The FlexiGrid Results spreadsheet , Part 2

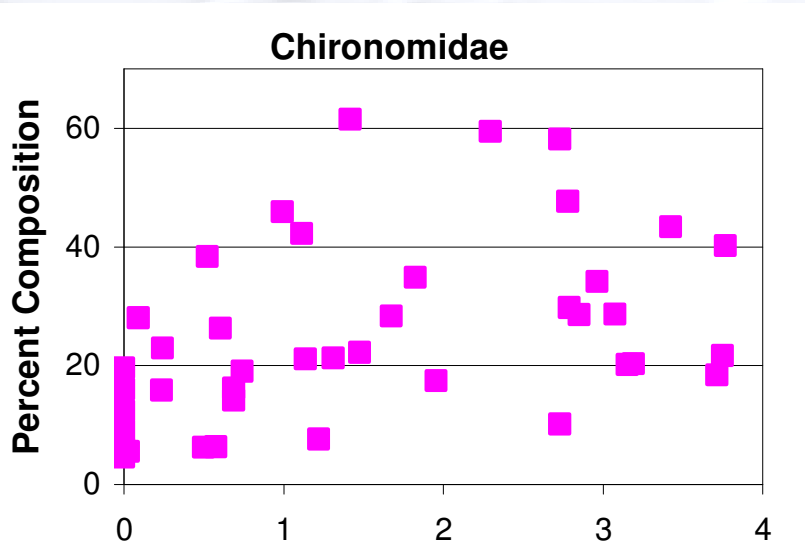
(with Endpoint Template pasted on the right)

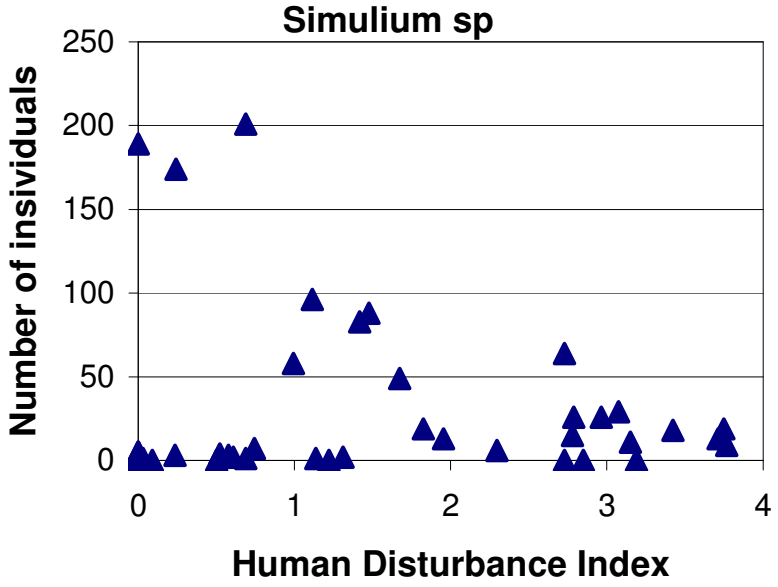


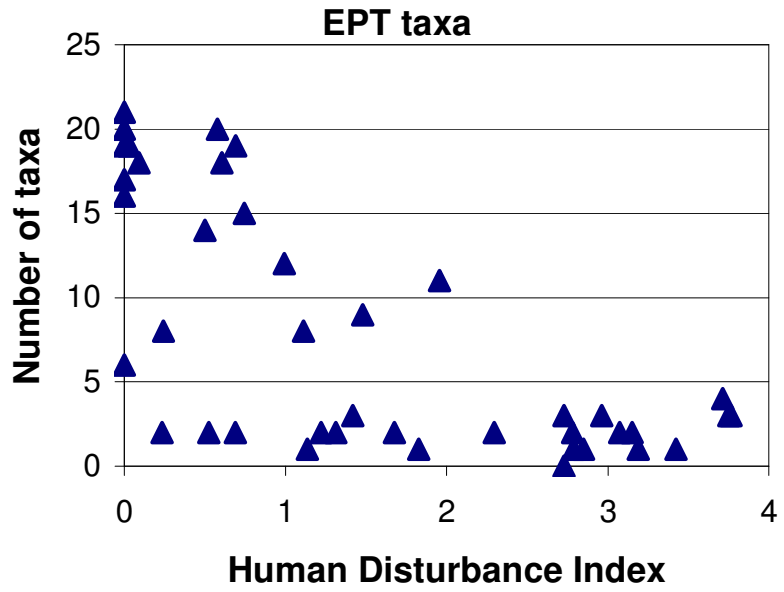
The Endpoint Calculation Template has been customized to calculate an array of Endpoint, mostly per the EMAP protocol (Kaufmann et al 1999)

Years 4&5 data, plotted in 2007









Implementation of the FlexiGrid system

Data Entry and Endpoint Derivation completed:

SWAMP RB2 years 4&5 - Physical habitat (PHAB) data
[interim protocol, the customized FlexiGrid is the only data entry option]

SWAMP RB2 Year 8 - PHAB and algae cover data
[4 version of the SWAMP data sheets were accommodated as they kept changing; some data capture in the field, using FlexiGrid template on a field computer]

SWAMP RB2 Year 9 - PHAB and algae cover data
[all data capture in the field, using FlexiGrid template on a field computer]

SWAMP RB2 Year 10 - PHAB and algae cover data (6 visits)

Alameda County Clean Water Program - PHAB pilot 2008 (4 visits)

Implementation, Part 2

Transfer of raw PHAB data to SWAMP:

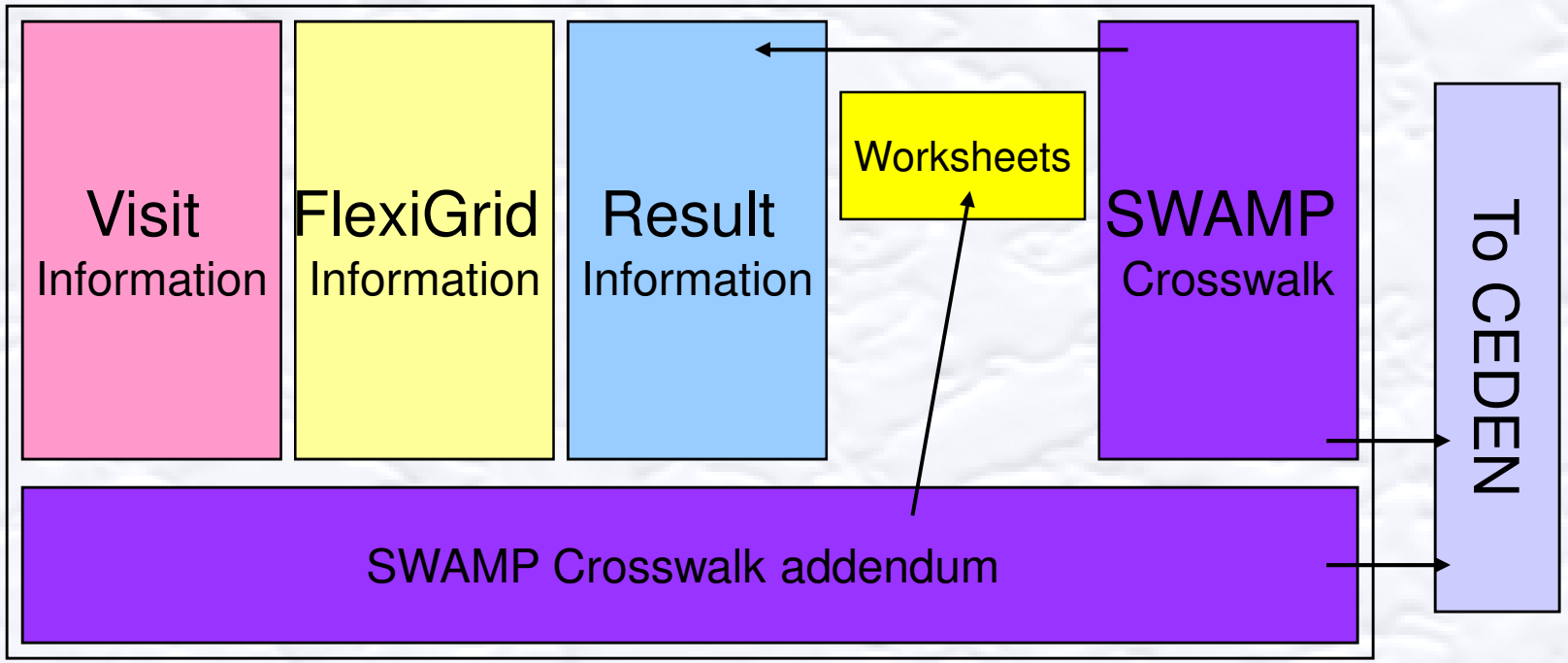
FlexiGrid-to-SWAMP Crosswalk developed and tested

All SWAMP RB2 Years 8&9 data have been transferred via the SWAMP/CEDEN template (Thanks, Marco!)

Year 10 data are in the works

The FlexiGrid Results spreadsheet, Part 3

(With SWAMP Crosswalk pasted or Built-in)



This spreadsheet has been used as a Data Entry Template in 2010., and can be used (in the office or in the Field) for future work

Summary Part 1: The FlexiGrid concept supports a data structure that can do the following:

-- Connect each monitoring Result to the exact spatial component it was measured in (or to aggregate thereof);

-- Stage the raw data for easy, streamlined derivation of descriptive statistics, metrics, indices, and any other Endpoint;

-- Place every spatial component on a 'virtual map' as an independent entity while preserving the internal hierarchy and its order in a series;

-- Enable reconstruction of the Frame from the virtual map that is stored in database cells; and allow information transfer into a GIS system;

Summary Part 2: More good things FG can do

-- Integrate physical habitat (PHAB) results and descriptors with results and descriptors from any other area of inquiry (e.g., chemistry, toxicity, bioassessment, etc.);

-- Enable reporting of any type of Result and Endpoint, generated for any Characteristic in any spatial component and at any scale, on the 'same page'; and

-- Accommodate data generated by any Protocol that has multiple spatial components, including PHAB protocols used by different Agencies and Programs (e.g., NAWQA, EMAP, EPA RBP), DFG Fisheries habitat, etc.

Currently available: All FG templates for SWAMP, plus all SOPs for streamlined data processing and transfer

Summary Part 3: Drawbacks

-- Tailoring the FlexiGrid spreadsheet to a given protocol requires real understanding of that protocol

-- Development and customizing of the templates requires focused thinking and advanced Excel skills

-- Although data entry and streamlined endpoint derivation can be done by anyone, the Excel Data Entry Template cannot support as many 'fool-proof' safeguards against erroneous entries as some other database systems, and it is harder to protect

-- Users need training and technical support

Thanks for Listening!

SWAMP & FlexiGrid PHAB Entry Only

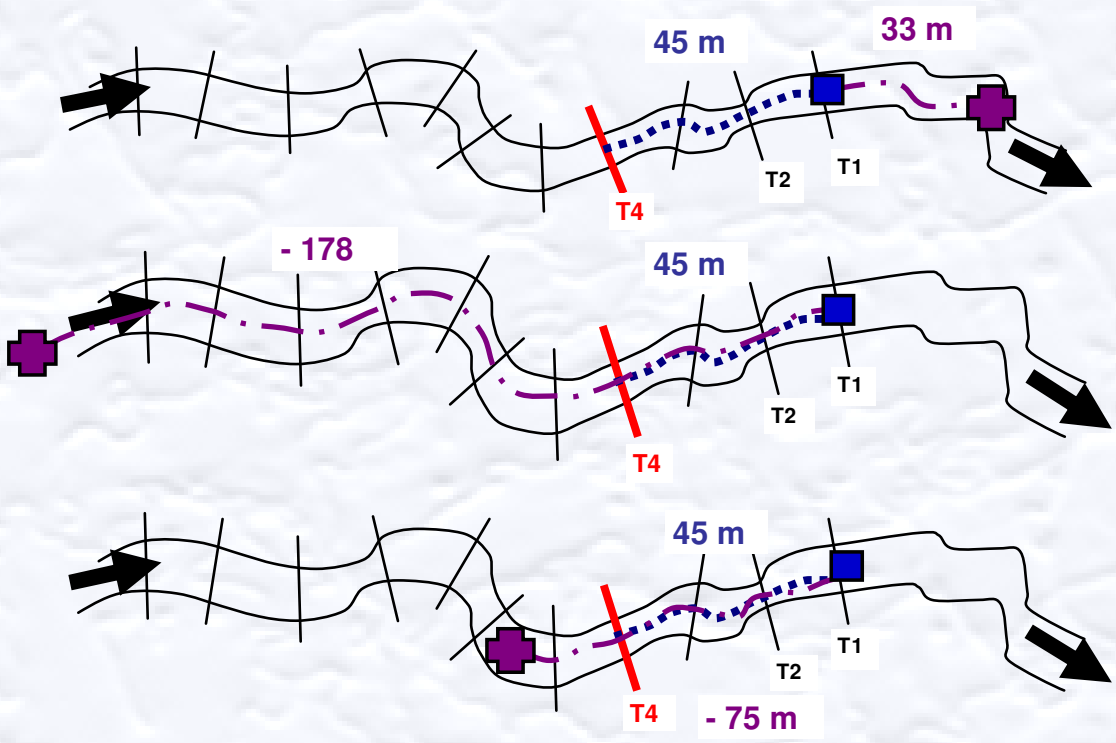
- Software
  - SWAMP = MS Access
  - FlexiGrid = MS Excel
- Data Entry
  - SWAMP = PHAB, Water Quality
    - Automated and manual data entry checks against erroneous entries
  - FlexiGrid = PHAB, Water Quality
    - Only manual data entry checks
  - Both field and desktop entry available
    - FlexiGrid allows data entry between/among sheets; SWAMP requires completion of each sheet before proceeding
    - FlexiGrid allows immediate corrections; SWAMP requires use of queries for corrections
- Data Output
  - Both require exporting data to MS Excel Template Upload file
    - SWAMP uses MS Access application to automatically create upload file
    - FlexiGrid uses crosswalk to create upload file with minor tweaking
- Metric Calculations
  - SWAMP = PHAB Reporting Module
    - Time lag between data entry and metric calculations
    - Process multiple samples across projects
  - FlexiGrid = PHAB metrics
    - Potentially instant output with minor processing of individual samples/visits
  - Both = Metrics are organized in database ready format as well as in tabular format for reporting and plotting
- Technical Support
  - CEDEN = Help Desk including some IT support, tutorials, supporting documentation; no costs (currently)
  - FlexiGrid = Initial training, data processing SOPs, and ongoing support by Revital; associated minimal costs

Three mapping scenarios: different relationships between the permanent Station and the FlexiGrid Origin

Permanent Station is downstream of Origin

Permanent Station is Upstream of Origin and the entire FlexiGrid

Permanent Station is upstream of Origin and within the FlexiGrid



FlexiGrid Origin. FlexiGrid direction = upstream

Distances within FlexiGrid (e.g., to T4)

Permanent Station (USGS Reference Location; EMAP X-site)

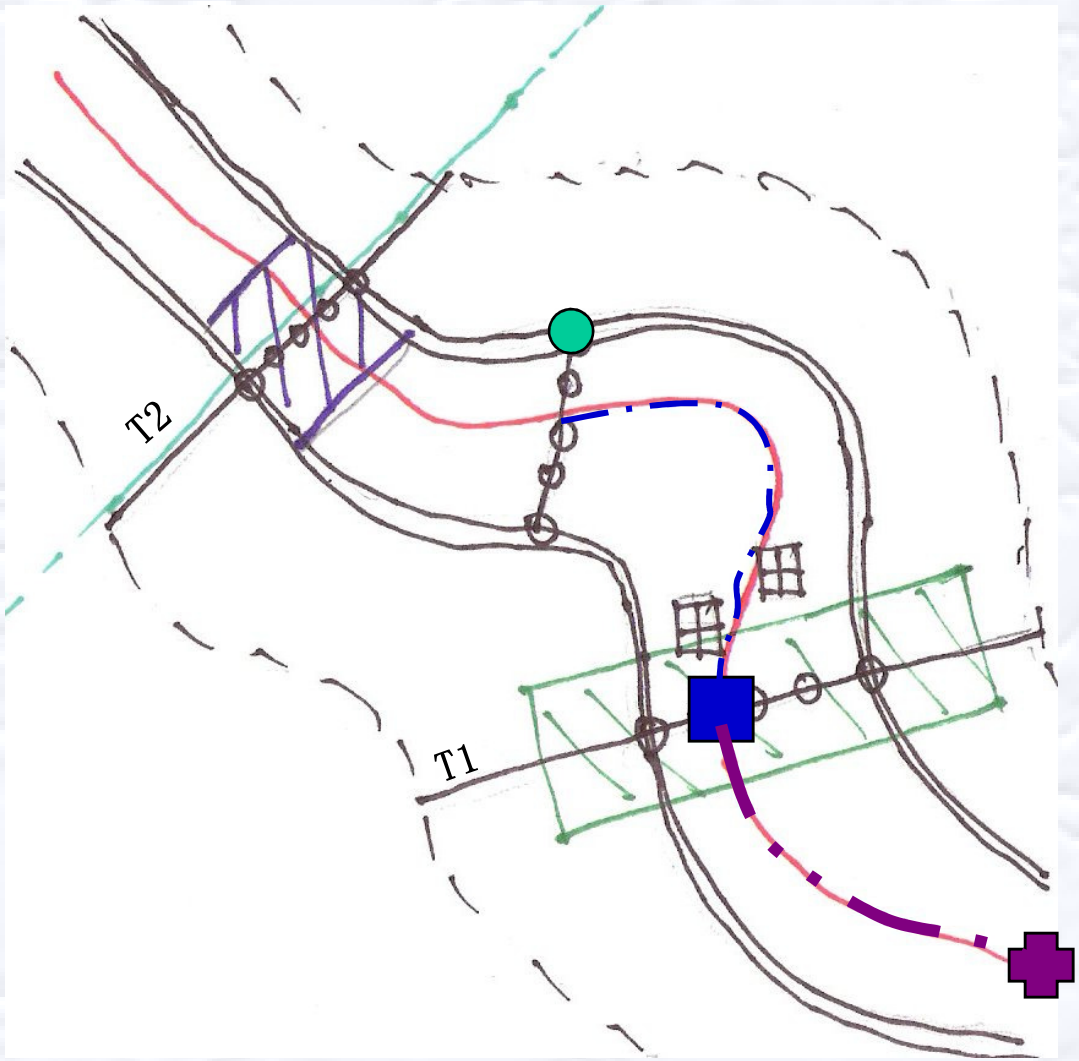
Distance Origin to Permanent Station

Flow direction

Snap FlexiGrid to the globe, then map components onto it

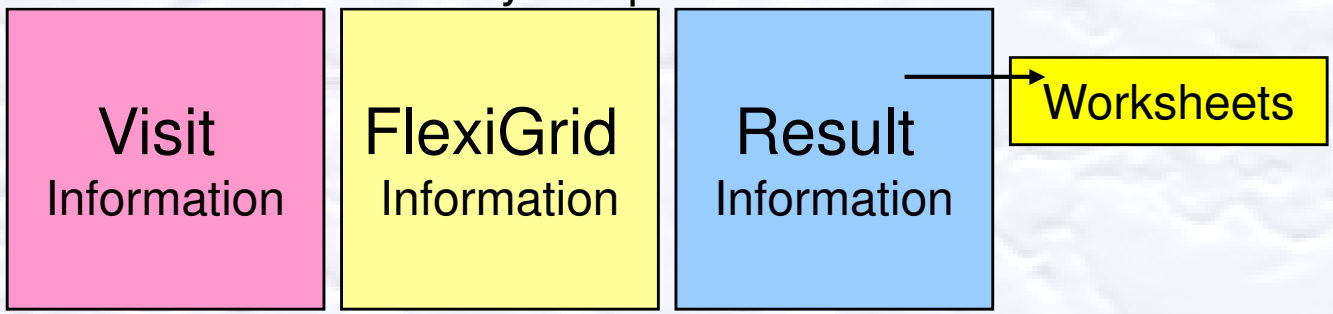
You can measure the Frame Origin's ■ backbone-distance from the Permanent Station, ✚ and snap the entire Frame to the globe

You can measure the backbone-distance from a Frame component (e.g., Crossline) to the Origin, ■ Then add a Local Reference Point (e.g., Left Bank), ● And map any point within the Frame.

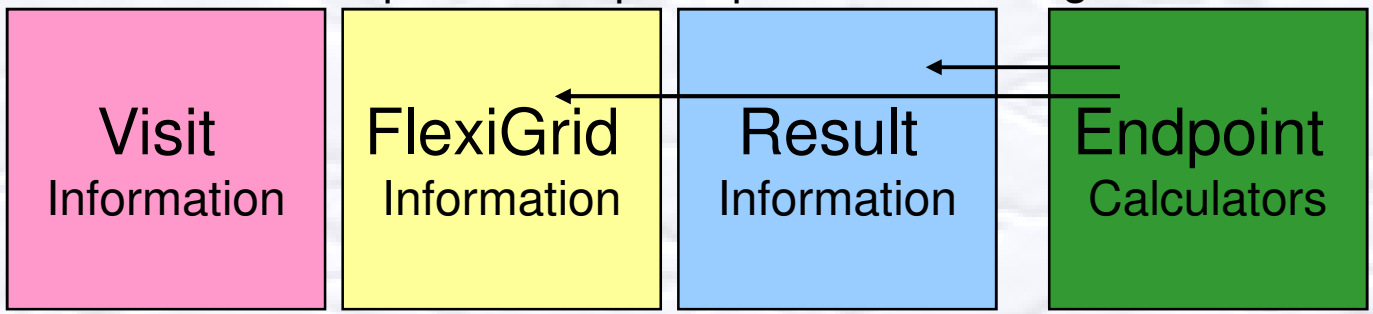


You can have many types of components: Crosslines, Points, Plots, etc; all can be snapped to the same grid.

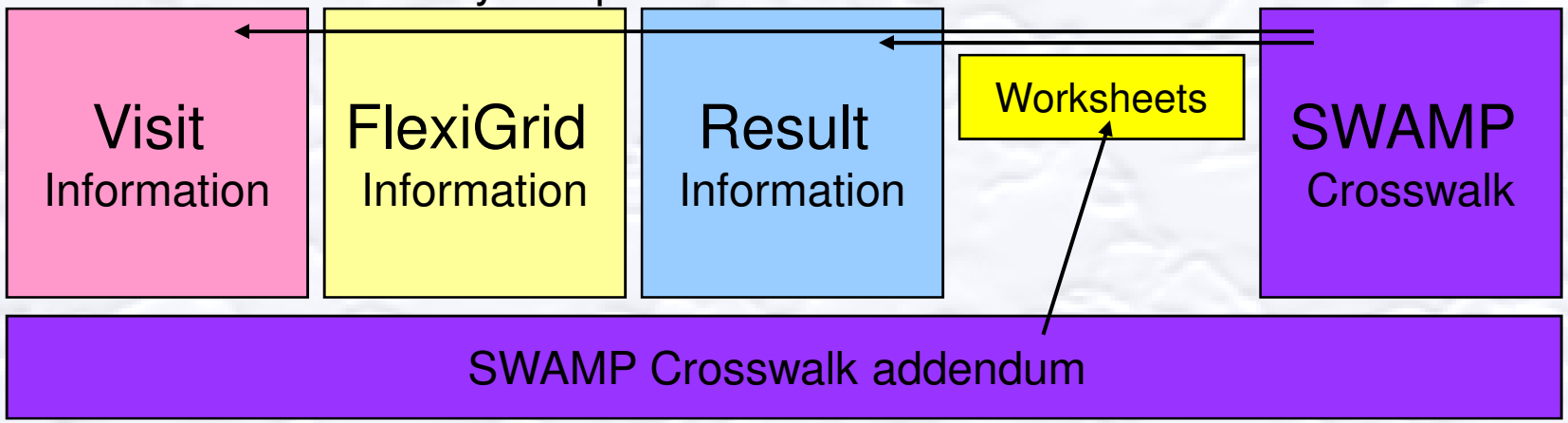
1. FlexiGrid Data Entry Template



2. FlexiGrid Endpoints Template pasted on the right



3. FlexiGrid Data Entry Template with SWAMP Crosswalk



USGS - NAWQA - data setup

Reach

Descriptors and Results --->

<--- Reach

Reach Sample ID	STAID	Reach	Reach Collection Date	Sample Type	REFLOC	Collector	STAGE	DISCH	DISCH MD	REACH LEN
29302	04062085	A	5/27/1994 9:15	REACH		(Sullivan, D	.			227
29304	04063700	A	6/16/1993 8:30	REACH	upstream s	(Fitzpatrick	.			210
29306	04063700	A	5/24/1995 9:30	REACH		(Stewart, J	.			334
161206	04063700	A	8/29/2006 13:00	REACH	Bridge at M	Lutz, Stens	1.38	56	Gage	300
110625	04063700	B	9/13/2002 9:00	REACH	Bridge at M	(J. Stewart	1.34	61	Gage	290
110771	04063700	C	9/12/2002 13:00	REACH	Bridge at M	(J.Stewart)	1.35	62	Gage	300

Transect

Descriptors and Results --->

<--- Transects

Reach SampleID	STAID	Reach	Tran Num	Collection Date	Sample Type	Review Status	CHWIDTH	LBANGLE	RBANGLE
29301	04062085	A	1	6/15/1993	TRANSECT	R	14.5	50	90
29301	04062085	A	2	6/15/1993	TRANSECT	R	16.1	90	40
29301	04062085	A	3	6/15/1993	TRANSECT	R	11	35	45
29302	04062085	A	1	5/27/1994	TRANSECT	R	14.3	45	90
29302	04062085	A	2	5/27/1994	TRANSECT	R	17.6	65	45
29302	04062085	A	3	5/27/1994	TRANSECT	R	11.6	35	90

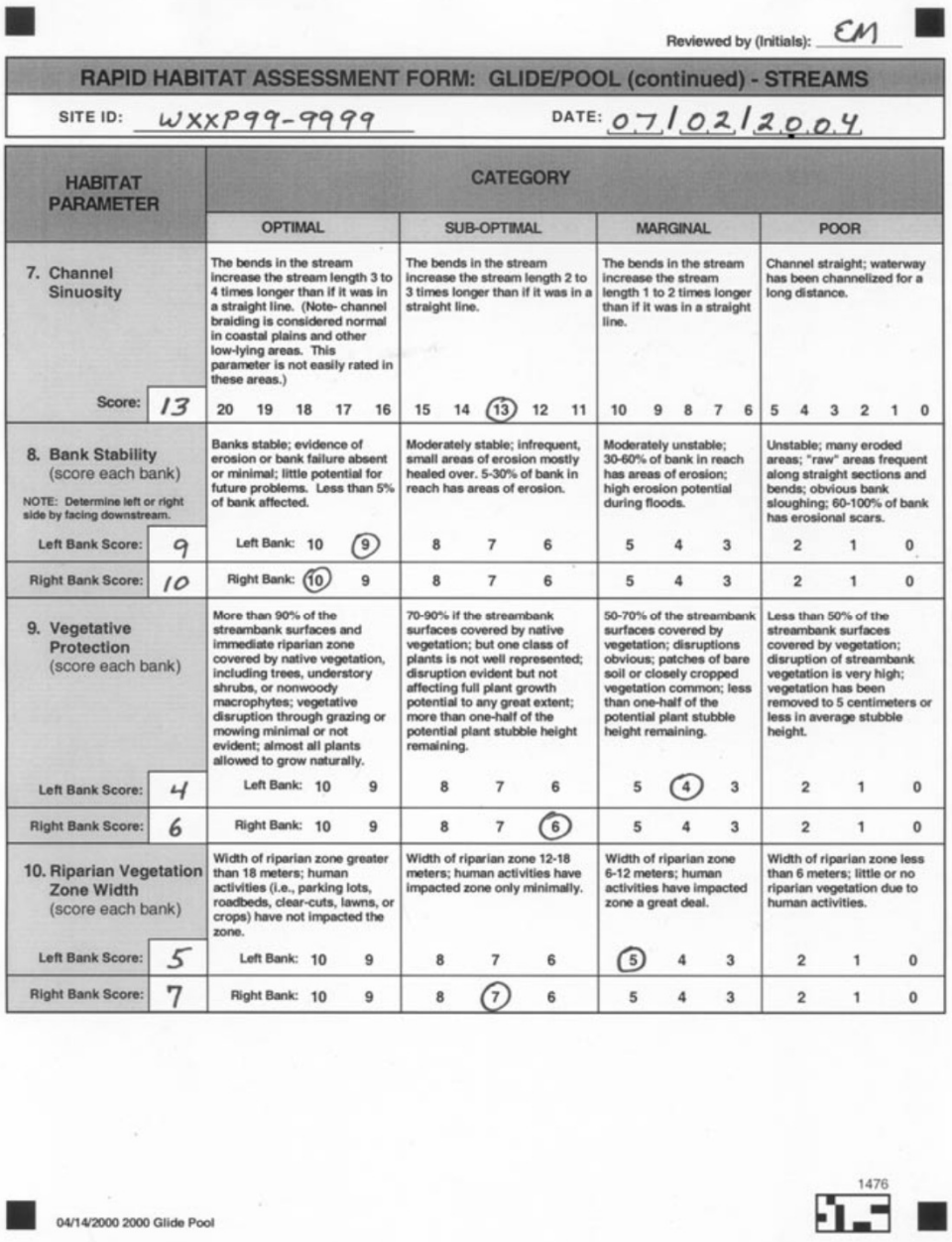
Transect-Points

Channel Features

Geomorphic Channel Units (flow-habitat units)

Calculated Endpoints

Other systems: Western EMAP: OCR and SAS



Reviewed by (Initials): EM

RAPID HABITAT ASSESSMENT FORM: GLIDE/POOL (continued) - STREAMS

SITE ID: WXXP99-9999 DATE: 07/02/2004

HABITAT PARAMETER	CATEGORY			
	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
7. Channel Sinuosity Score: 13	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note- channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.) 20 19 18 17 16	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line. 15 14 (13) 12 11	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 10 9 8 7 6	Channel straight; waterway has been channelized for a long distance. 5 4 3 2 1 0
8. Bank Stability (score each bank) NOTE: Determine left or right side by facing downstream. Left Bank Score: 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. Less than 5% of bank affected. Left Bank: 10 (9)	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. 8 7 6	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. 5 4 3	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. 2 1 0
Right Bank Score: 10	Right Bank: (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Left Bank Score: 4	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Left Bank: 10 9	70-90% if the streambank surfaces covered by native vegetation; but one class of plants is not well represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. 8 7 6	50-70% of the streambank surfaces covered by vegetation; disruptions obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. 5 (4) 3	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. 2 1 0
Right Bank Score: 6	Right Bank: 10 9	8 7 (6)	5 4 3	2 1 0
10. Riparian Vegetation Zone Width (score each bank) Left Bank Score: 5	Width of riparian zone greater than 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted the zone. Left Bank: 10 9	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. 8 7 6	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. (5) 4 3	Width of riparian zone less than 6 meters; little or no riparian vegetation due to human activities. 2 1 0
Right Bank Score: 7	Right Bank: 10 9	8 (7) 6	5 4 3	2 1 0

1476

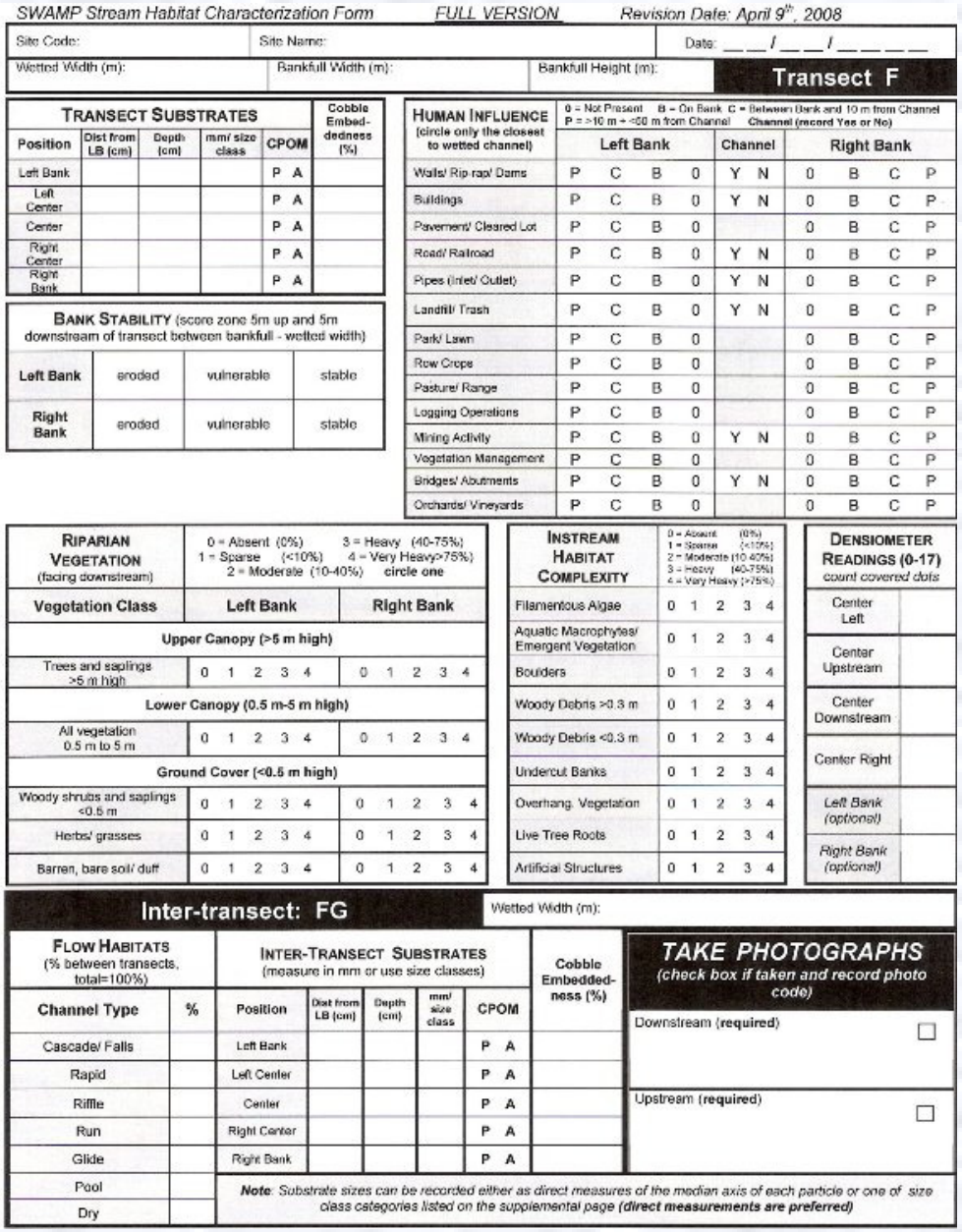
04/14/2000 2000 Glide Pool

Data Sheets are filled out by the field operators and then scanned by an OCR machine that ‘reads’ the numbers and puts them in a data file.

The data file is fed into SAS, which calculated Endpoints.

Extremely rigid

Other systems: SWAMP: MS Access



SWAMP Stream Habitat Characterization Form — FULL VERSION — Revision Date: April 9th, 2008

Site Code: | Site Name: | Date: ___/___/____

Wetted Width (m): | Bankfull Width (m): | Bankfull Height (m): | **Transect F**

TRANSECT SUBSTRATES

Position	Dist from LB (cm)	Depth (cm)	mm/ size class	CPOM	Cobble Embed-dedness (%)
Left Bank				P A	
Left Center				P A	
Center				P A	
Right Center				P A	
Right Bank				P A	

BANK STABILITY (score zone 5m up and 5m downstream of transect between bankfull - wetted width)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

HUMAN INFLUENCE (circle only the closest to wetted channel) — 0 = Not Present B = On Bank C = Between Bank and 10 m from Channel P = >10 m - <50 m from Channel; Channel (record Yes or No)

	Left Bank				Channel	Right Bank			
Walls/ Rip-rap/ Dams	P	C	B	0	Y N	0	B	C	P
Buildings	P	C	B	0	Y N	0	B	C	P
Pavement/ Cleared Lot	P	C	B	0		0	B	C	P
Road/ Railroad	P	C	B	0	Y N	0	B	C	P
Pipes (Inlet/ Outlet)	P	C	B	0	Y N	0	B	C	P
Landfill/ Trash	P	C	B	0	Y N	0	B	C	P
Park/ Lawn	P	C	B	0		0	B	C	P
Row Crops	P	C	B	0		0	B	C	P
Pasture/ Range	P	C	B	0		0	B	C	P
Logging Operations	P	C	B	0		0	B	C	P
Mining Activity	P	C	B	0	Y N	0	B	C	P
Vegetation Management	P	C	B	0		0	B	C	P
Bridges/ Abutments	P	C	B	0	Y N	0	B	C	P
Orchards/ Vineyards	P	C	B	0		0	B	C	P

RIPARIAN VEGETATION (facing downstream) — 0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%) 3 = Heavy (40-75%) 4 = Very Heavy>75%) circle one

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs and saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY — 0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-40%) 3 = Heavy (40-75%) 4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17) count covered dots

Center Left	
Center Upstream	
Center Downstream	
Center Right	
Left Bank (optional)	
Right Bank (optional)	

Inter-transect: FG | Wetted Width (m):

FLOW HABITATS (% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

INTER-TRANSECT SUBSTRATES (measure in mm or use size classes)

Position	Dist from LB (cm)	Depth (cm)	mm/ size class	CPOM	Cobble Embedded-ness (%)
Left Bank				P A	
Left Center				P A	
Center				P A	
Right Center				P A	
Right Bank				P A	

Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of size class categories listed on the supplemental page **(direct measurements are preferred)**

TAKE PHOTOGRAPHS *(check box if taken and record photo code)*

Downstream **(required)** ☐

Upstream **(required)** ☐

Data Sheets are filled out by the field operators; the data is then entered into a set of MS Access Data Entry Forms which look very much like the field data sheets.

An Endpoint Calculation module will be developed in the future.