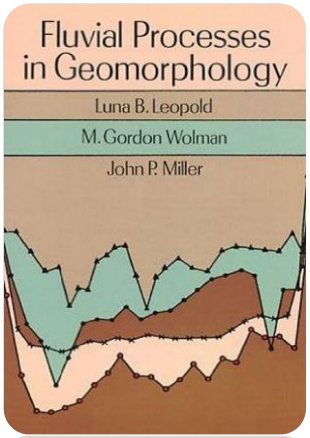
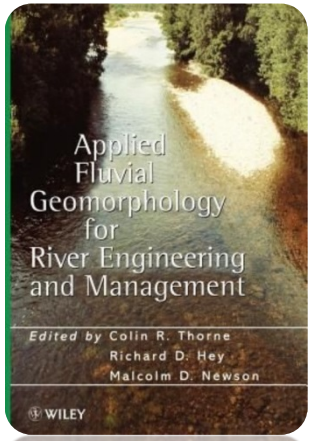
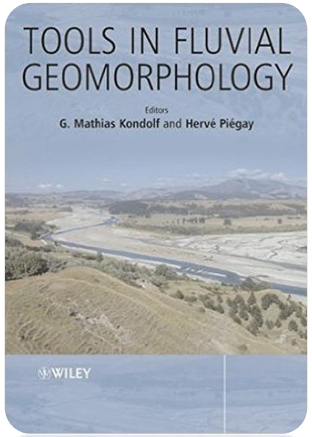
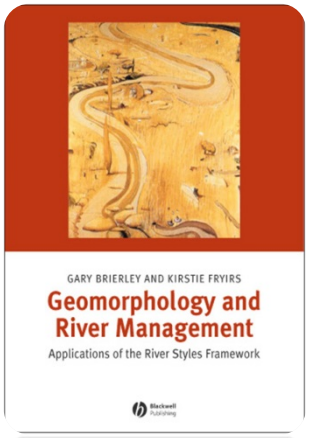
APPLIED FLUVIAL GEOMORPHOLOGY

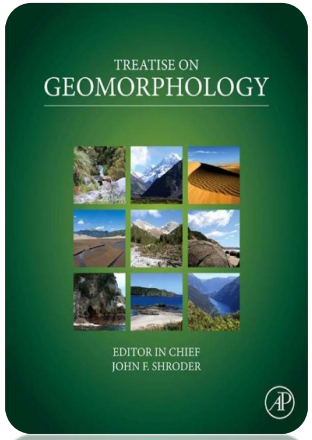
Where have we come from, where do we go?











Roger TJ Phillips

Mariëtte Pushkar and Peter Ashmore

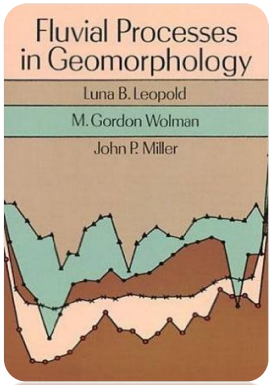
Aquafor Beech Limited

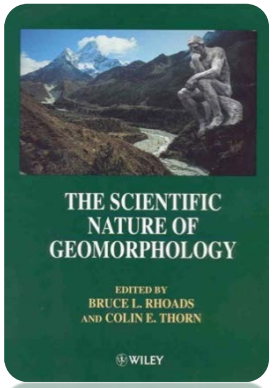
ecosystem recovery inc. PROFESSIONAL ENGINEERS

Western

MITACS

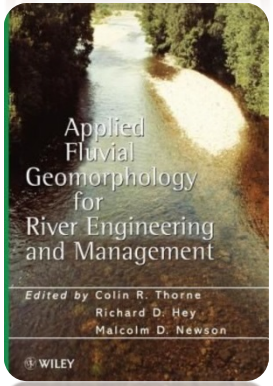
Value of Geomorphologists in River Management

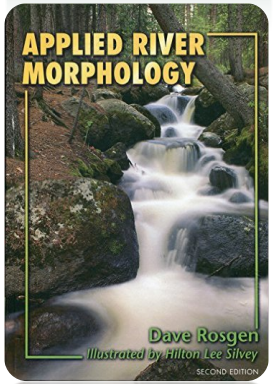


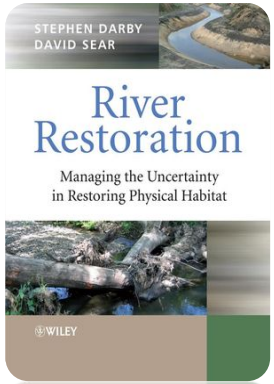


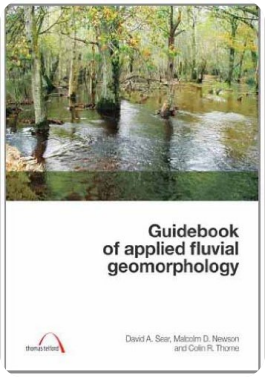
Start with Historical **Geology** and Scientific Roots

Placed in Context of **Interdisciplinary** Applications







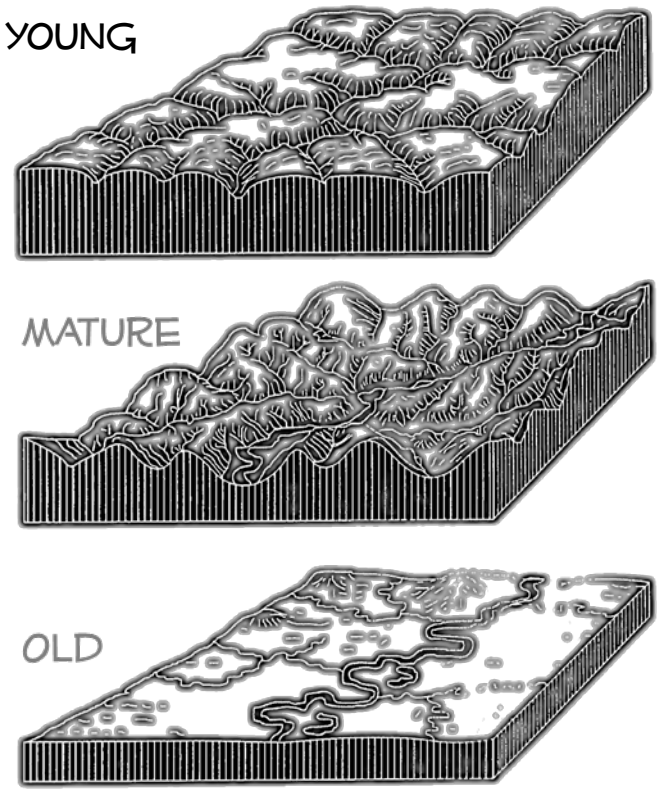


What are your views?

Natural Channels **Geomorphology** Survey

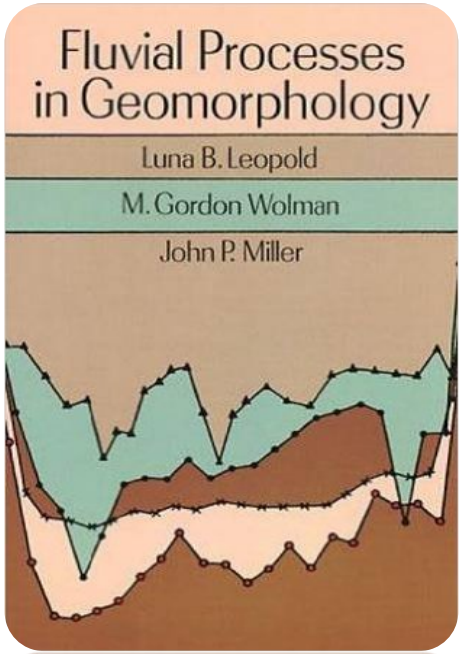
HISTORICAL ROOTS

W.M. DAVIS GEOGRAPHICAL CYCLE



- ✓ Descriptive
- ✓ Geology
- ✓ Geography

The Quantitative Revolution



- ✓ Scientific
- ✓ Physics
- ✓ Engineering

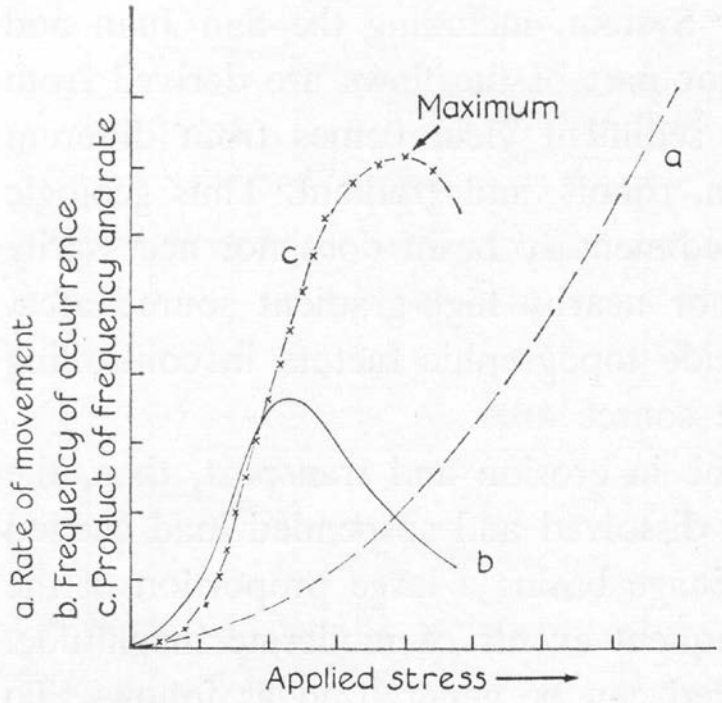


Figure 3-23.

Generalized relation of effective work done by events of different magnitude.

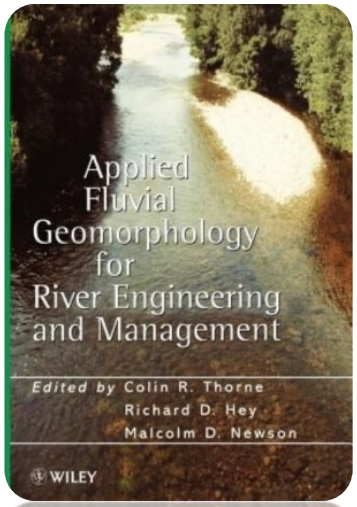
20th Century Quantitative Revolution

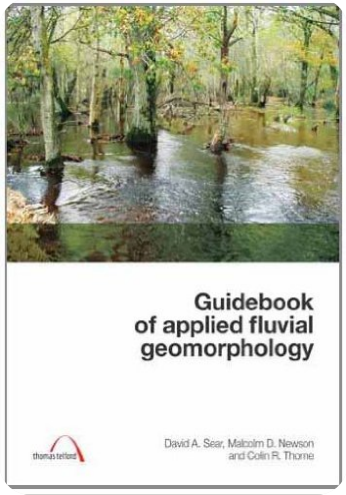
Six components, Orme (2013)

1. Quantitative, statistical
2. Process geomorphology
3. Theory (equilibrium, thresholds)
4. Plate tectonics
5. Climate change
6. Geochronology


precision down to
grains of sand.

Applied Fluvial Geomorphology





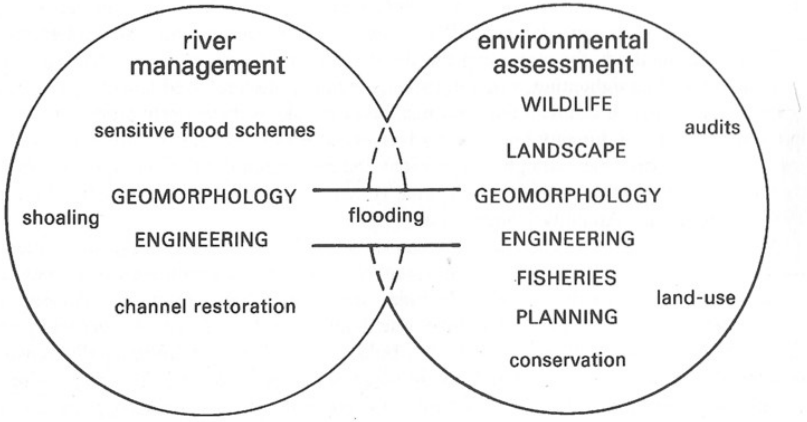
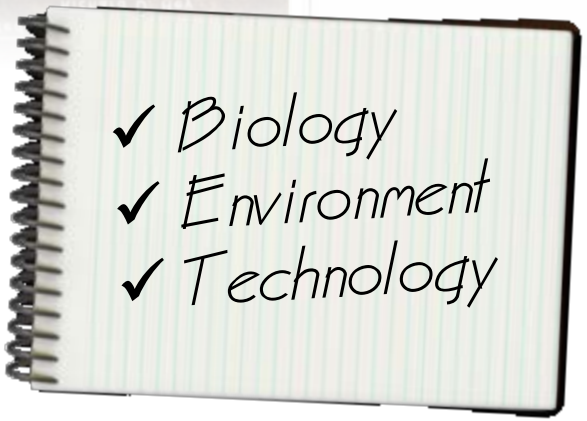
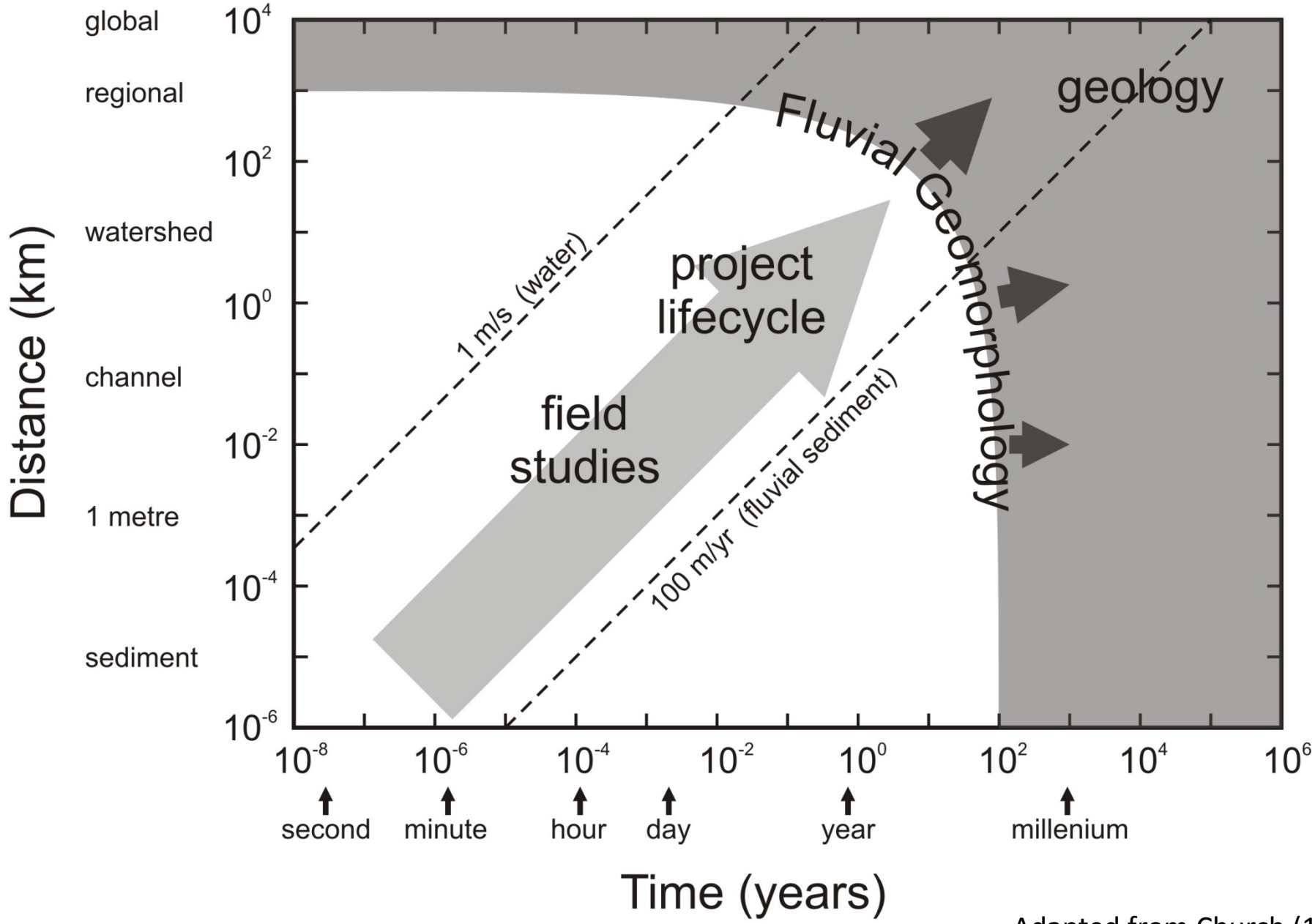


Figure 12.1 Situations in which engineers, geomorphologists and other disciplines work jointly on problems of river management



Recognizing geomorphologists?

"…obsession with longer time scales"



Adapted from Church (1996)

Natural Channels GEOMORPHOLOGY Survey

2016 Natural Channels Conference Presentation – Niagara Falls

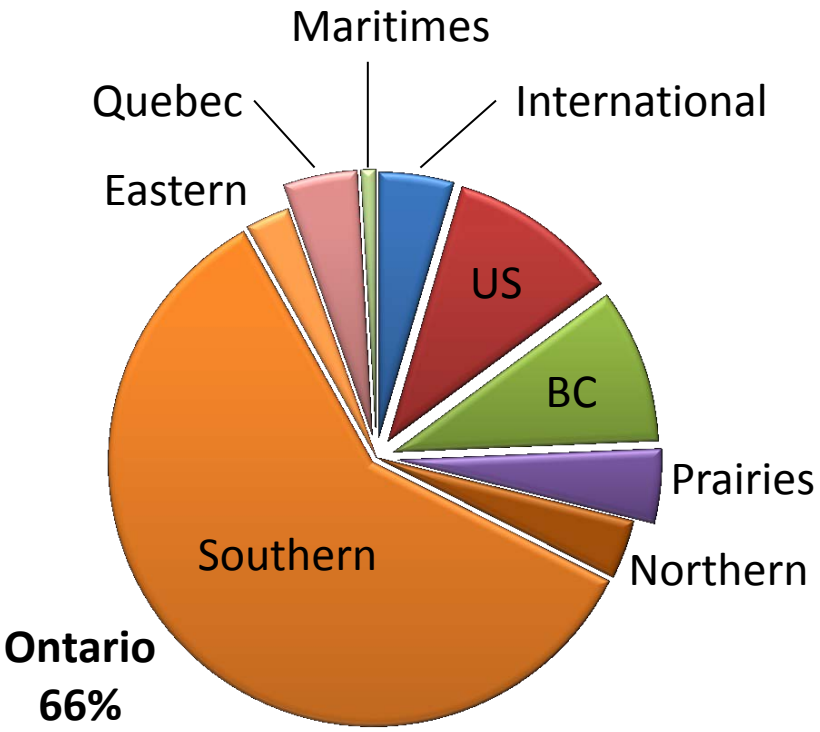
Not a full-time geomorphologist? No problem — this survey is for ANYONE interested in 'Natural Channel' systems. As a contribution to the 2016 Natural Channels Conference, the purpose of this survey is to gauge the role of GEOMORPHOLOGY in the science and application of 'Natural Channel' assessment and stream corridor rehabilitation. The issue of professional regulation is also considered. While the focus is on applied geomorphology in Ontario, respondents from elsewhere in Canada and internationally are encouraged to contribute their perspectives. EVERYONE is welcome to participate!

The survey consists of four sections with a total of about 20 questions and takes about 10 minutes to complete. Please note that all survey responses collected here using Google Forms are anonymous.

The authors of this survey are Dr. Roger TJ Phillips (Western University and Aquafor Beech Ltd), Mariëtte Pushkar (Ecosystem Recovery Inc.), and Dr. Peter Ashmore (Western University).

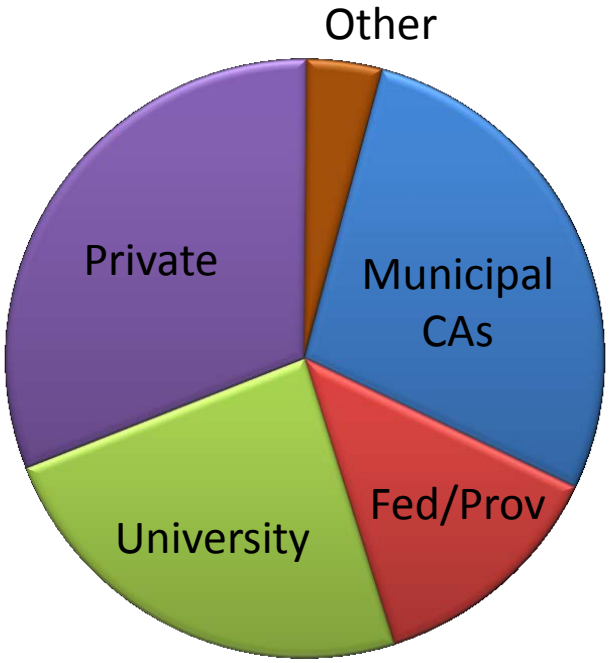
For questions or comments about the survey please email: roger.phillips@uwo.ca

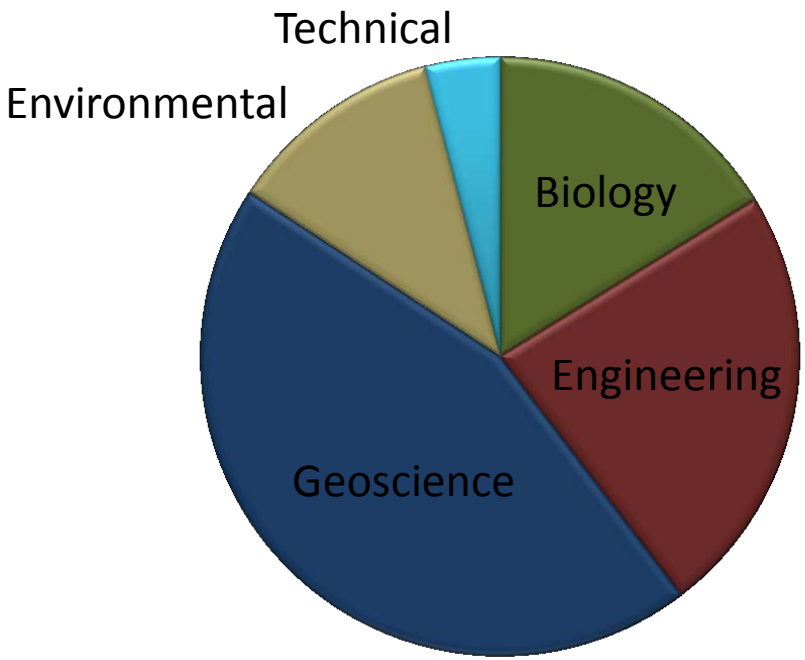
Geography of 222 Respondents



International		5%
United States		10%
British Columbia		9%
Prairies		5%
Ontario		66%
	Northern	4%
	Southern	59%
	Eastern	3%
Quebec		5%
Maritimes		1%

Background of 222 Respondents

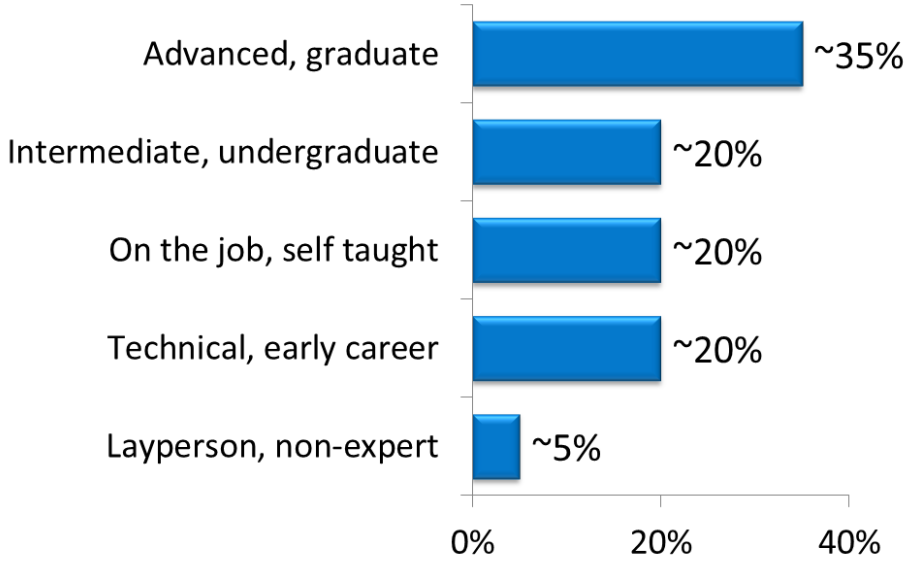




Government	41%
Municipal, CAs	28%
Federal, Provincial	13%
University	24%
Faculty	18%
Students	6%
Private Sector	31%
Other (NGO, Retired)	4%

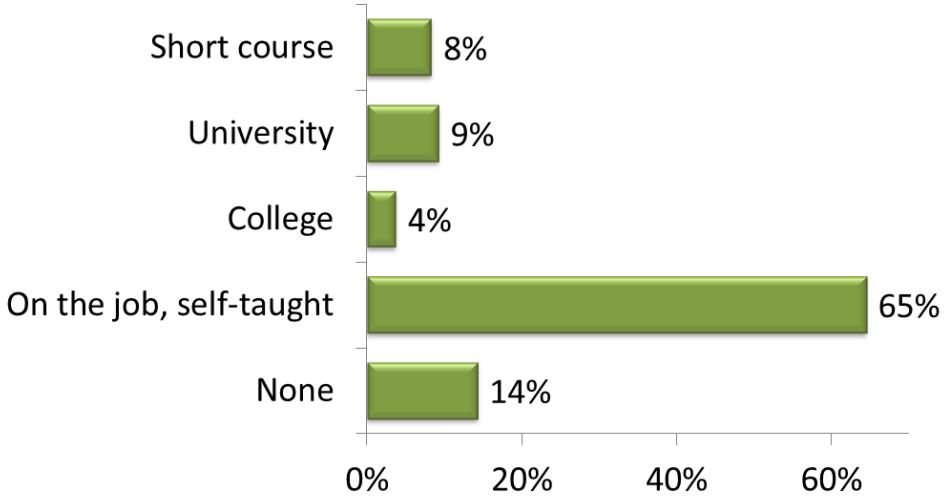
Biology	16%
Engineering	23%
Geoscience	45%
Environmental	12%
Science, Planning	
Technical, Other	4%

Education and Training of 222 Respondents

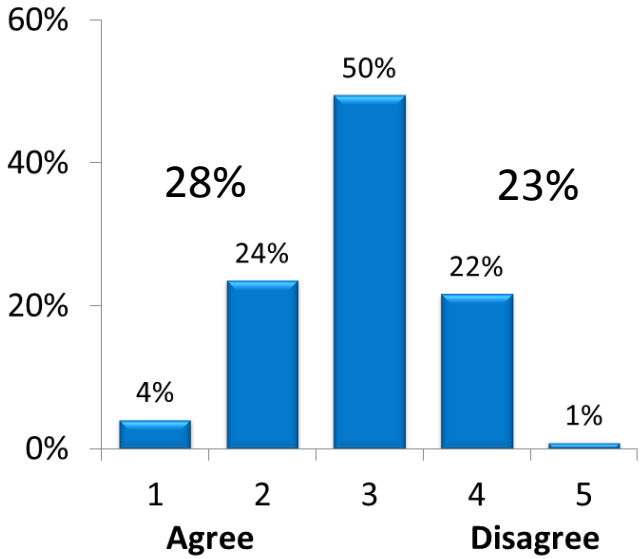


Geomorphology Expertise and Training

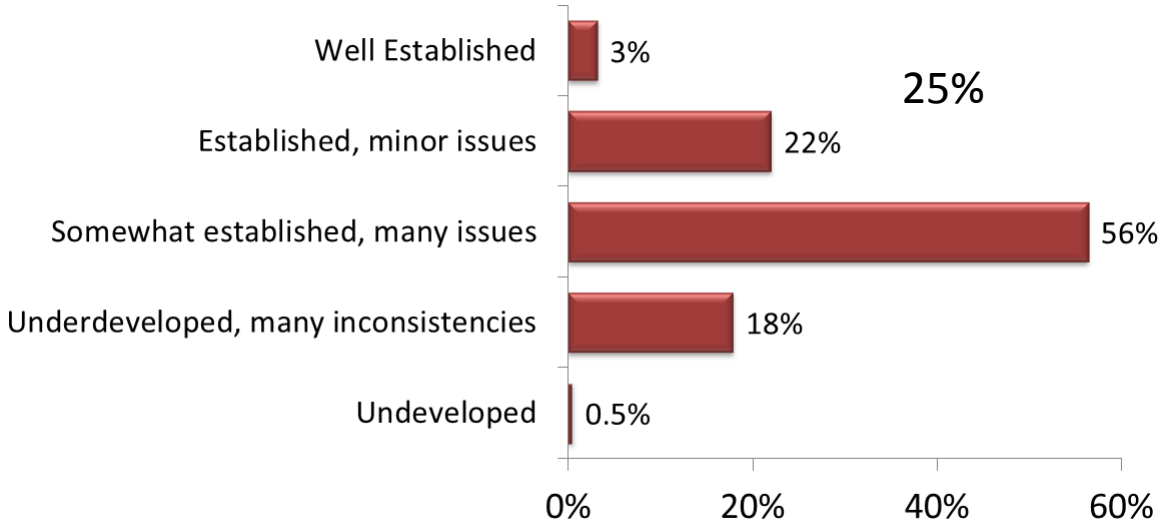
Training in Stream Restoration

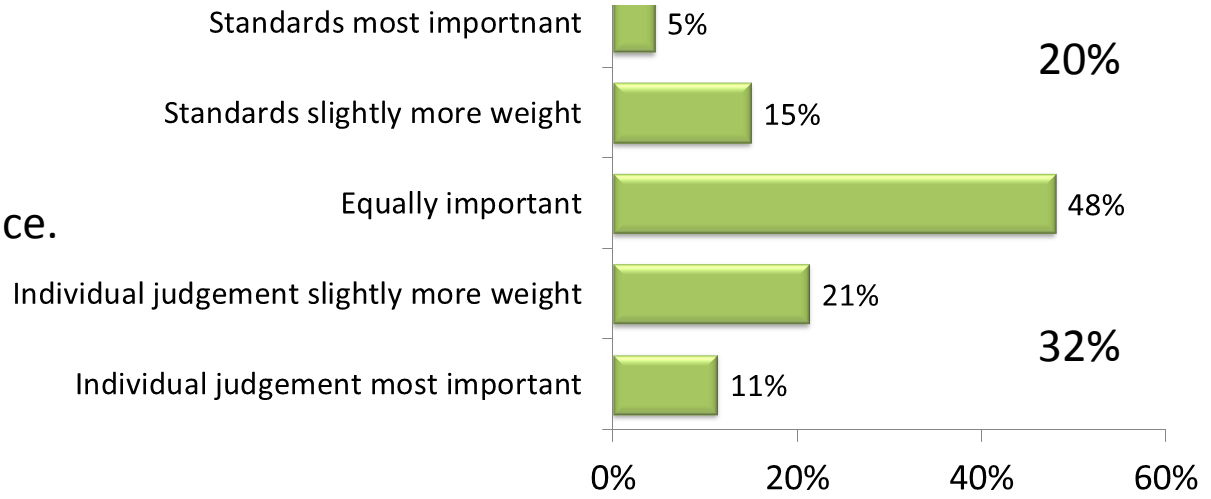


Standards of Practice

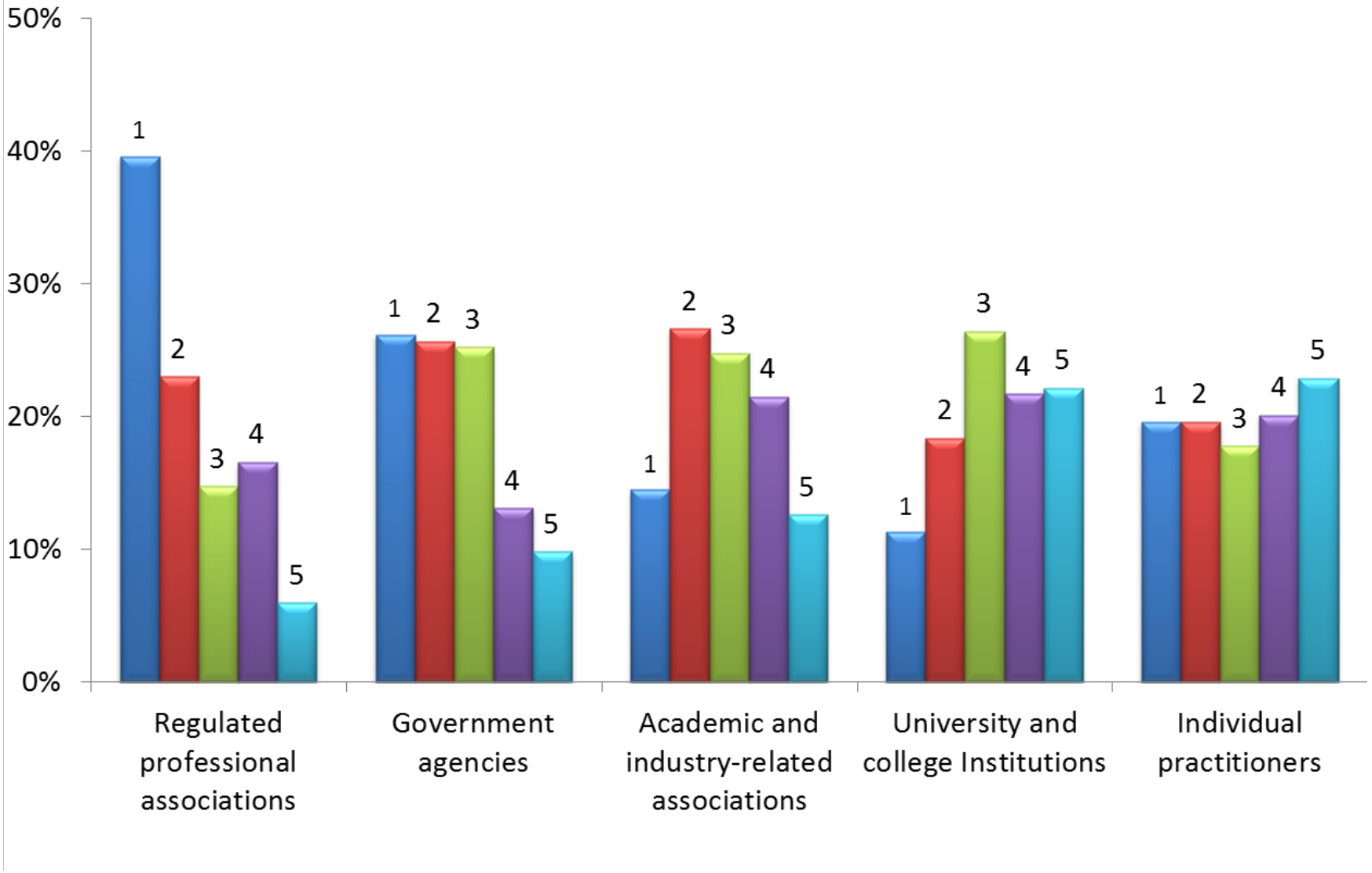


Scientific knowledge is **well represented** in applied geomorphology practice.



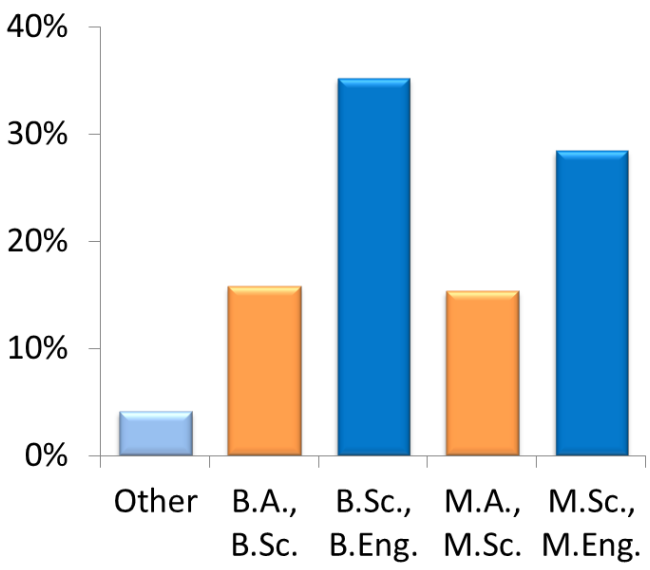


Responsibility for Standards of Practice

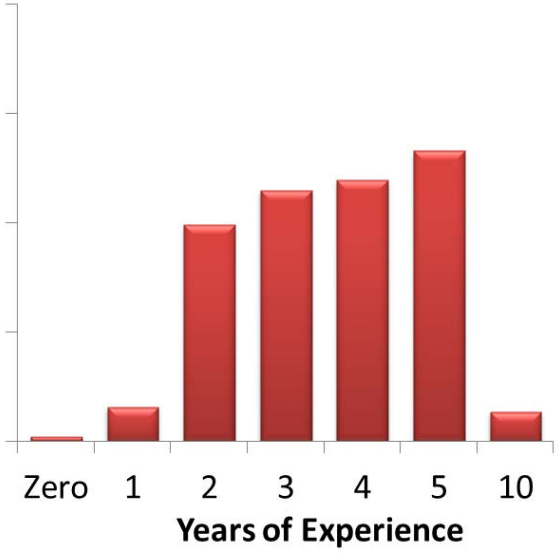


Qualified Geomorphologist

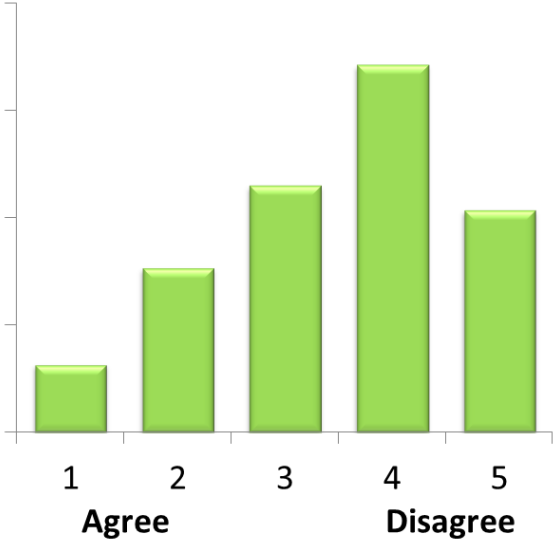
Education

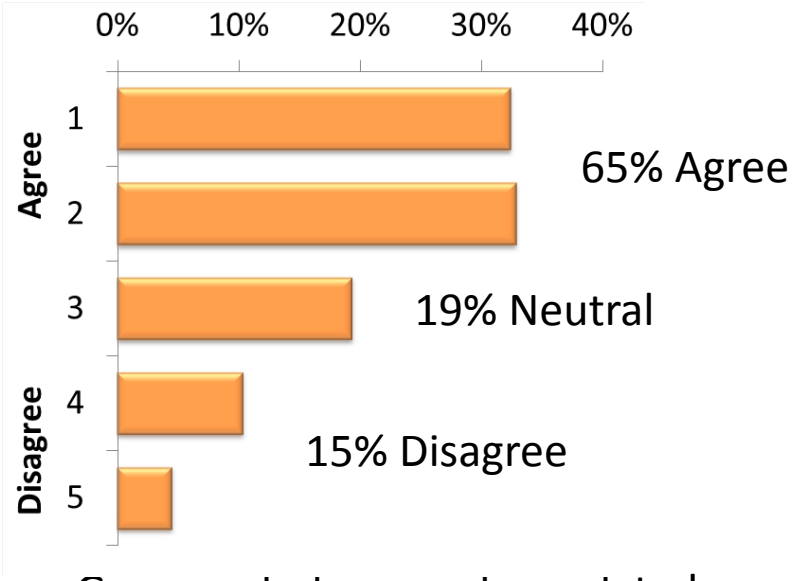


Work Experience

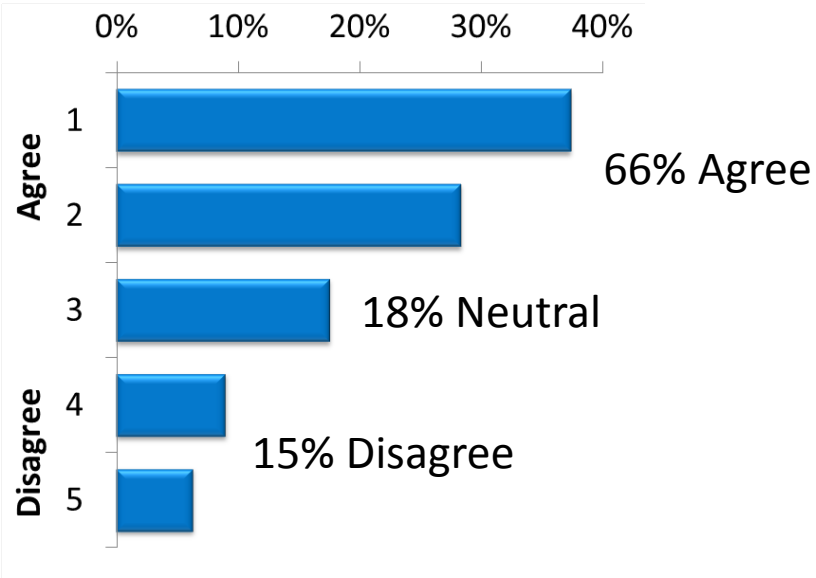


Short Courses?



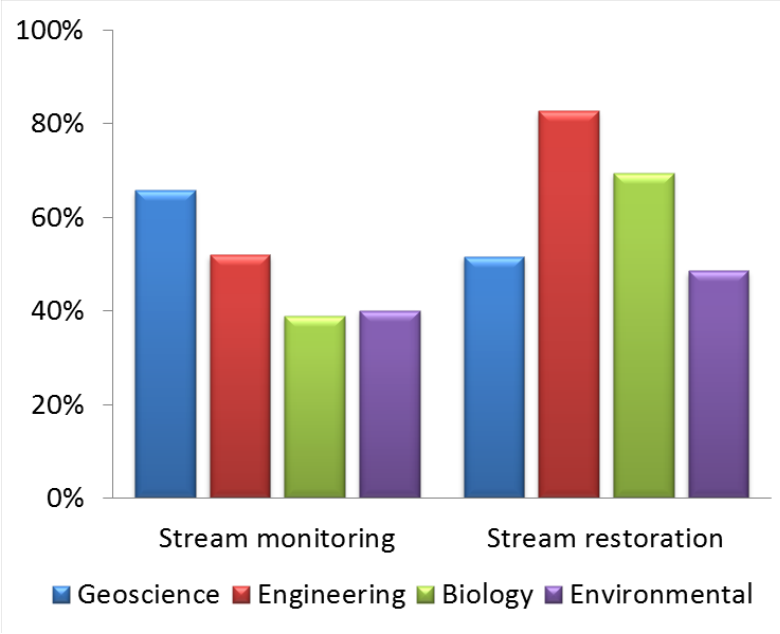


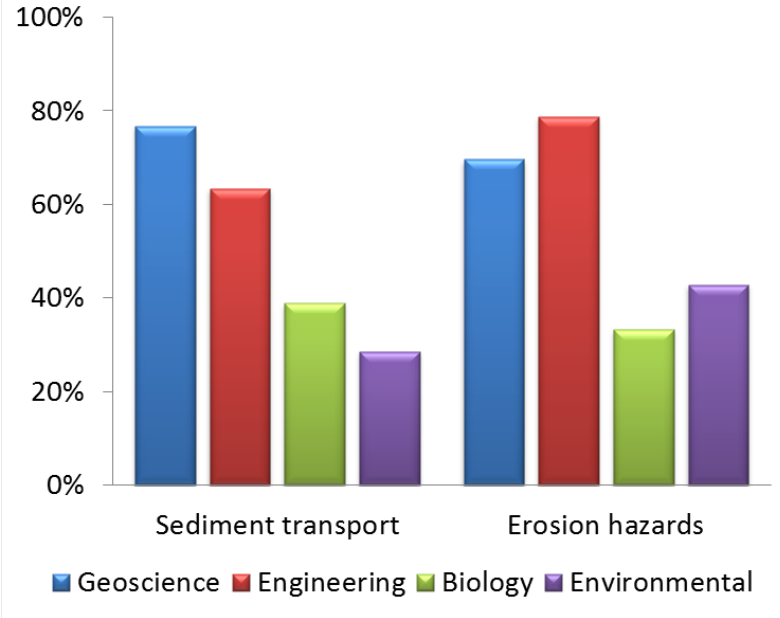
Geomorphology work regulated as professional geoscience?



Qualified Geomorphologist accredited as P.Geo.?

Percent Practitioners by Profession





Professional Geoscience (P.Geo.) Knowledge Requirements

Foundation Science

Group 1: Math, Physics, Chemistry, Biology, Statistics

Foundation Geoscience

Group 2A: **Geology**, Sediment and Stratigraphy, Field Techniques

Group 2B: Geochemistry, Geophysics, Hydrogeology, Engineering Geology, **Geomorphology**

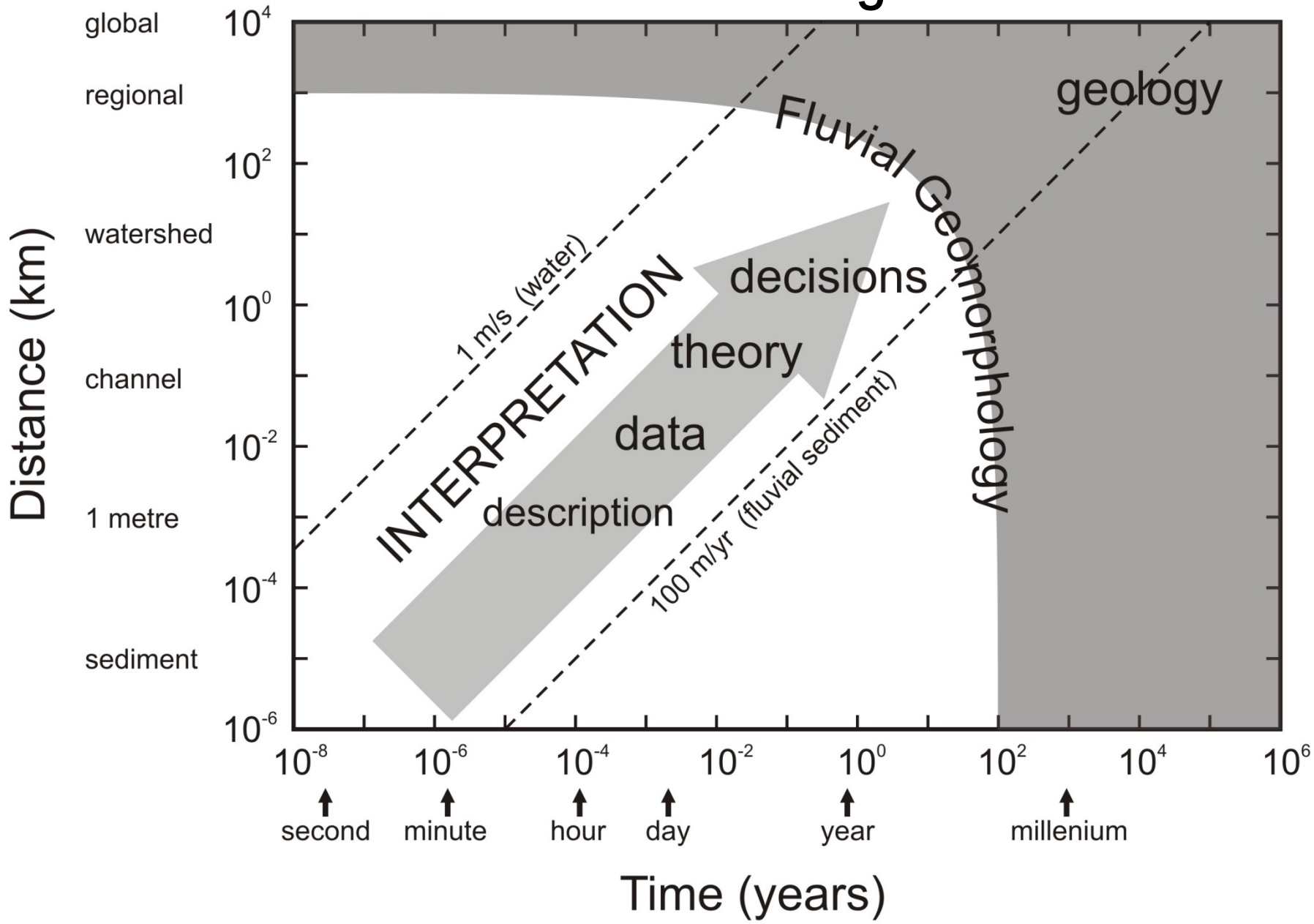
Additional Geoscience

Group 2C: Earth Systems, Environmental Assessment, Geochemistry, Geophysics, Geomorphology, **Quaternary Geology**

Value of Geoscience

Advanced geomorphic interpretation, **watershed impacts , erosion hazards**

"…obsession with longer time scales"



Adapted from Church (1996)

Comments Moving Forward

Recognizing geomorphologists

- Roots in historical **geology** and geography, with scientific and interdisciplinary focus
- "…obsession with **longer** time scales!"
- Advanced interpretation needs advanced **geoscience** training (e.g., erosion hazards)

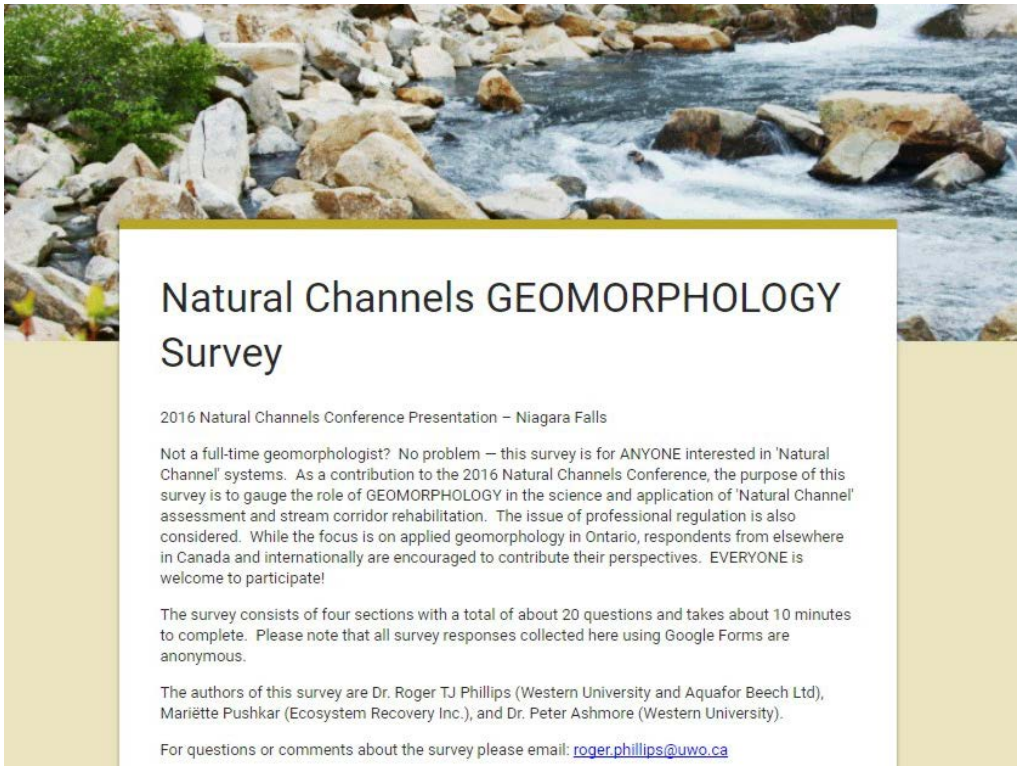
Regulating geomorphologists

- **Support** for regulating geomorphology work and professional accreditation (**P.Geo.**)
- Geoscience B.Sc. **M.Sc.** 4 years experience

"Re-Visioning" standards of practice

- **We** have a lot of work to do!
- Regulated **professional** associations
- **Natural Channels** Initiative

Please Comment!



APPLIED FLUVIAL GEOMORPHOLOGY: Where have we come from, where do we go?

Roger TJ Phillips, Mariëtte Pushkar, and Peter Ashmore

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ecosystem recovery inc. PROFESSIONAL ENGINEERS

Western

MITACS

Natural Channels GEOMORPHOLOGY Survey
PRELIMINARY RESULTS

Published October 6, 2016 ©

Applied fluvial geomorphology: Where have we come from, where do we go?

Roger T.J. Phillips[1, 3]
Mariëtte T.H. Pushkar[2]
Peter E. Ashmore[1]

[1]Department of Geography, Western University, London, Ontario, Canada
[2]Ecosystem Recovery Inc., Waterloo, Ontario, Canada
[3]Aquafor Beech Limited, Mississauga, Ontario, Canada

249 RESPONSES

Natural Channels GEOMORPHOLOGY Survey

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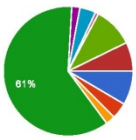
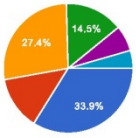
BACKGROUND (249 RESPONSES)

Please select the geographic area in which you primarily work (or study).



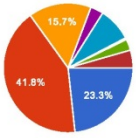
British Columbia	21	8.4%
Prairies (AB, SK, MB)	10	4%
Northern Ontario (including Near North)	6	2.4%
Southern Ontario (including Southwest)	152	61%
Eastern Ontario	5	2%
Quebec	10	4%
Maritimes	2	0.8%
United States	25	10%
Other	18	7.2%

Please select the group that best describes your place of employment/study.



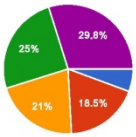
Private sector (e.g., consulting)	84	33.9%
Government (federal, provincial or state)	33	13.3%
Government (regional, municipal, or conservation authority)	68	27.4%
University faculty	36	14.5%
University/college student	16	6.5%
Other	11	4.4%

Please select the discipline that best describes your formal educational background/training (e.g., university, college).



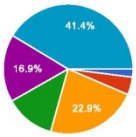
Engineering (water resources and other related fields)	58	23.3%
Geoscience (geology, earth science, geomorphology)	104	41.8%
Biology, Ecology, or Forestry	39	15.7%
Landscape Architecture	0	0%
Environmental Planning	8	3.2%
Environmental Science	21	8.4%
Environmental Stewardship	1	0.4%
Technical College (e.g., Engineering Technology, Restoration Science, etc...)	7	2.8%
Other	11	4.4%

On a relative scale in terms of knowledge and experience, please indicate your general level of expertise in geomorphology.



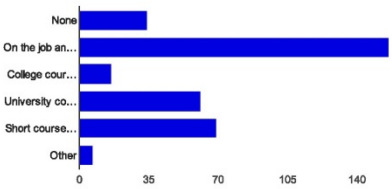
Layperson, non-expert	14	5.6%
Basic and/or early career	46	18.5%
Intermediate with informal training	52	21%
Intermediate with formal training	62	25%
Advanced	74	29.8%

What training do you have in (fluvial) geomorphology?



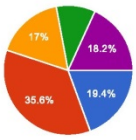
None	5	2%
General interest, conference sessions	11	4.4%
On the job and/or self-taught	57	22.9%
Technical courses and/or workshops	31	12.4%
Undergraduate-level university courses (geoscience or engineering)	42	16.9%
Graduate-level university research and/or course work (geoscience or engineering)	103	41.4%

What training do you have in stream restoration?



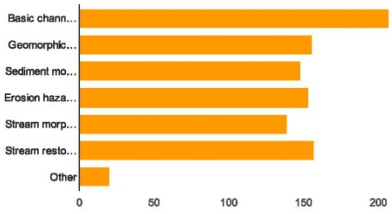
None	34	13.7%
On the job and/or self-taught	156	62.7%
College course (e.g., Niagara College)	16	6.4%
University course	61	24.5%
Short course (e.g., Rosgen, Newbury, etc...)	69	27.7%
Other	7	2.8%

How much of your time do you spend completing and/or evaluating geomorphology work?



Rarely, less than 1%	48	19.4%
Occasionally, less than 25%	88	35.5%
Regularly, 25 to 50%	42	16.9%
Routinely, 50 to 75%	24	9.7%
Primarily, 75 to 100%	45	18.1%

If applicable, which of the following kinds of work have you completed and/or evaluated?



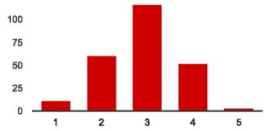
Basic channel measurements and stream characterization	207	85.9%
Geomorphic field assessments	156	64.7%
Sediment mobility, sediment transport (e.g., erosion thresholds, stone sizing)	148	61.4%
Erosion hazards (e.g., meander belts, slope stability)	153	63.5%
Stream morphology monitoring (e.g., land use impacts)	139	57.7%
Stream restoration and/or natural channel design	157	65.1%
Other	20	8.3%

GEOMORPHOLOGY STANDARDS OF PRACTICE (249 RESPONSES)

The responsibility for developing and maintaining standards of practice for natural channel systems is a collective obligation. Examples of geomorphology work where standards of practice are most applicable include, but are not limited to, erosion assessments and sediment transport, erosion hazards (e.g., meander belts, slope stability), stream morphology monitoring targets, and stream restoration design.

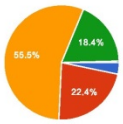
Geomorphology Standards of Practice

To the best of your knowledge, established scientific knowledge is well represented in applied geomorphology practice.



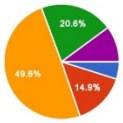
Strongly agree: 1	11	4.5%
2	60	24.8%
3	116	47.9%
4	52	21.5%
Strongly disagree: 5	3	1.2%

How do you perceive current standards of practice in geomorphology? Current standards are generally:



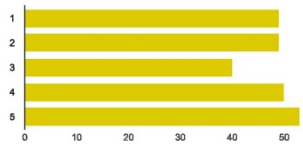
Well established	8	3.3%
Established with minor issues to be addressed	55	22.4%
Somewhat established with many issues to be addressed	136	55.5%
Underdeveloped with many inconsistencies	45	18.4%
Undeveloped	1	0.4%

How would you typically balance the importance of 'standard guidelines' versus 'individual professional judgment' in geomorphology practice?



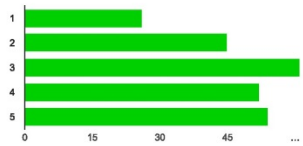
Standard guidelines are most important	12	4.8%
Standard guidelines should be given slightly more weight	37	14.9%
Standard guidelines and individual professional judgement are equally important	123	49.6%
Individual professional judgement by a qualified person should be given slightly more weight	51	20.6%
Individual professional judgement by a qualified person is most important	25	10.1%

Individual practioners [Given that standards of practice for geomorphology are the responsibility of the following groups, please order the following randomized list from most-1 to least-5 responsible.]



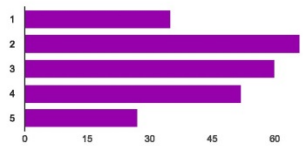
1	49	20.3%
2	49	20.3%
3	40	16.6%
4	50	20.7%
5	53	22%

University and college institutions [Given that standards of practice for geomorphology are the responsibility of the following groups, please order the following randomized list from most-1 to least-5 responsible.]



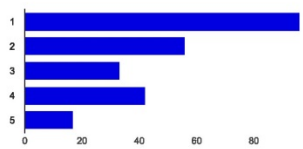
1	26	10.9%
2	45	18.9%
3	61	25.6%
4	52	21.8%
5	54	22.7%

Academic and industry-related associations [Given that standards of practice for geomorphology are the responsibility of the following groups, please order the following randomized list from most-1 to least-5 responsible.]



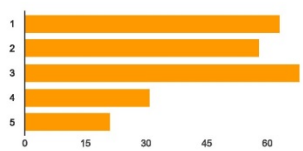
1	35	14.6%
2	66	27.5%
3	60	25%
4	52	21.7%
5	27	11.3%

Regulated professional associations [Given that standards of practice for geomorphology are the responsibility of the following groups, please order the following randomized list from most-1 to least-5 responsible.]



1	96	39.3%
2	56	23%
3	33	13.5%
4	42	17.2%
5	17	7%

Government agencies [Given that standards of practice for geomorphology are the responsibility of the following groups, please order the following randomized list from most-1 to least-5 responsible.]



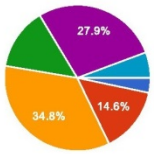
1	63	26.1%
2	58	24.1%
3	68	28.2%
4	31	12.9%
5	21	8.7%

QUALIFIED GEOMORPHOLOGISTS AND PROFESSIONAL GEOSCIENCE (249 RESPONSES)

Recognizing that some geomorphology work may be completed without advanced qualifications, including by supervised technical staff and specialists from other fields of science and engineering, advanced geomorphology work may be identified as requiring a 'Qualified Geomorphologist'. The potential requirement of professional accreditation (e.g., P.Geo.) is also considered in this survey.

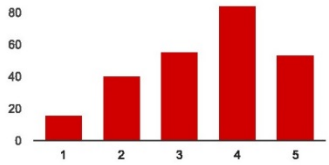
Qualified Geomorphologists and Professional Geoscience

In your view, what should be the minimum level of education for a 'Qualified Geomorphologist'?



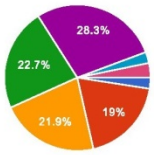
College, short courses, workshops, and/or other technical training	8	3.2%
B.A., B.Sc., or equivalent in related field	36	14.6%
B.Sc., B.Eng., or equivalent in geoscience and/or engineering	86	34.8%
M.A., M.Sc. or equivalent in related field	34	13.8%
M.Sc., M.Eng., or equivalent in geoscience and/or engineering	69	27.9%
Other	14	5.7%

If not trained in geomorphology at a university, short courses and training workshops provide an acceptable academic basis to be considered a 'Qualified Geomorphologist'.



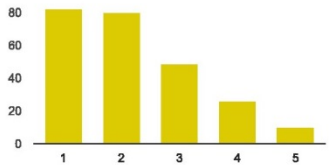
Strongly Agree: 1	16	6.5%
2	40	16.1%
3	55	22.2%
4	84	33.9%
Strongly Disagree: 5	53	21.4%

How many years of professional work experience should a practitioner have before being considered a 'Qualified Geomorphologist'?



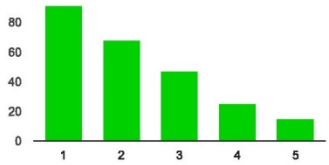
Academic knowledge requirements and/or technical training are sufficient	6	2.4%
2 years	47	19%
3 years	54	21.9%
4 years	56	22.7%
5 years	70	28.3%
10 years	6	2.4%
Other	8	3.2%

Geomorphology work should be regulated as professional geoscience.



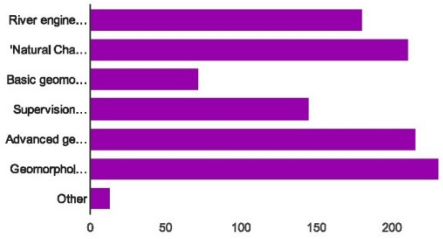
Strongly Agree: 1	82	33.2%
2	80	32.4%
3	49	19.8%
4	26	10.5%
Strongly Disagree: 5	10	4%

A 'Qualified Geomorphologist' should be accredited as a professional geoscientist (P.Geo.).



Strongly Agree: 1	91	37%
2	68	27.6%
3	47	19.1%
4	25	10.2%
Strongly Disagree: 5	15	6.1%

In your view, when should a 'Qualified Geomorphologist' be required for 'Natural Channel' projects?



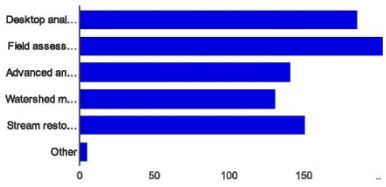
River engineering	180	73.2%
'Natural Channel' design	211	85.8%
Basic geomorphology work (e.g., basic channel measurements, stream characterization)	72	29.3%
Supervision of basic geomorphology work (e.g., basic channel measurements, stream characterization)	145	58.9%
Advanced geomorphology analysis (e.g., erosion hazards, sediment transport)	216	87.8%
Geomorphology work with professional responsibility and liability (e.g., erosion hazards, channel design)	231	93.9%
Other	13	5.3%

APPLIED FLUVIAL GEOMORPHOLOGY CHECKLIST (249 RESPONSES)

Survey of major types of geomorphology work completed for 'Natural Channel' systems.

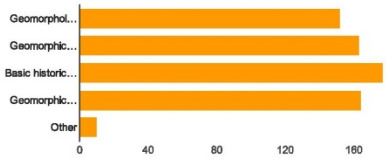
Applied Fluvial Geomorphology Checklist

In your work on 'Natural Channel' systems, which of the following types of GEOMORPHOLOGY-related work have you personally completed and/or evaluated?



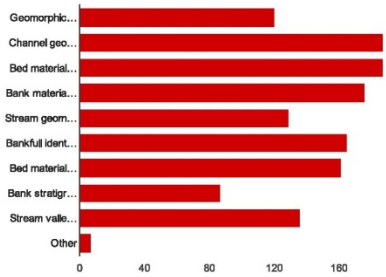
Desktop analysis (please complete detailed list below)	186	78.8%
Field assessment (please complete detailed list below)	203	86%
Advanced analysis and interpretation (please complete detailed list below)	141	59.7%
Watershed management and planning (please complete detailed list below)	131	55.5%
Stream restoration design and/or construction (please complete detailed list below)	151	64%
Other	5	2.1%

Desktop Analysis



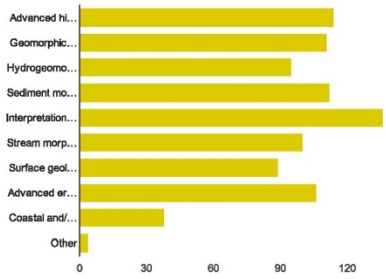
Geomorphology literature review (scientific and 'grey' literature)	152	76.4%
Geomorphic mapping (stream order, drainage density, reach delineation, etc...)	163	81.9%
Basic historic airphoto analysis (georeferencing, stream network delineation, channel overlay, etc..)	177	88.9%
Geomorphic field data processing (basic channel measurements)	164	82.4%
Other	10	5%

Field assessment



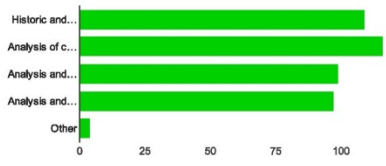
Geomorphic channel condition assessment (RSAT, RGA, or OSAP)	120	56.6%
Channel geometric measurements (cross-section, width, depth, profile, slope, etc...)	187	88.2%
Bed material characterization (general)	187	88.2%
Bank material characterization (general)	176	83%
Stream geomorphology monitoring (set-up and data collection)	129	60.8%
Bankfull identification (field indicators)	165	77.8%
Bed material sampling (pebble count, bulk sieving)	161	75.9%
Bank stratigraphy and alluvial sedimentology (advanced)	87	41%
Stream valley corridor assessment (floodplain access, entrenchment, incision history, terracing, valley fill)	136	64.2%
Other	7	3.3%

Advanced Analysis and Interpretation



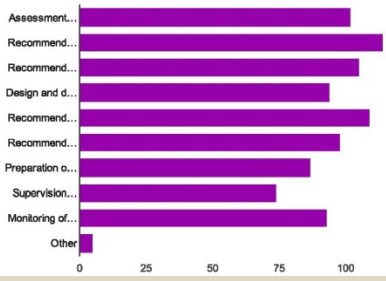
Advanced historic airphoto analysis (erosion rates, planform evolution, etc...)	114	69.9%
Geomorphic field data processing (advanced processing and interpretation)	111	68.1%
Hydrogeomorphic relations (empirical statistics)	95	58.3%
Sediment mobility, sediment transport analyses (including erosion thresholds)	112	68.7%
Interpretation of channel processes (fluvial processes, hydraulic characteristics and functions)	136	83.4%
Stream morphology monitoring data analyses (advanced data compilation and statistical analyses)	100	61.3%
Surface geology and landform interpretation (geologic history, hillslope processes, glacial landforms, etc...)	89	54.6%
Advanced erosion hazard assessment (e.g., meander belts, slope stability) with risk to public	106	65%
Coastal and/or aeolian geomorphology	38	23.3%
Other	4	2.5%

Watershed management and planning



Historic and urban land use impact assessment on stream systems and networks	109	71.2%
Analysis of channel erosion and watercourse instability, and recommendations for remediation strategies	116	75.8%
Analysis and recommendations for (sub)watershed management strategies from geomorphological perspective	99	64.7%
Analysis and recommendations for storm water management erosion control targets and strategies	97	63.4%
Other	4	2.6%

Stream restoration design and/or construction



Assessment and design of geomorphologically stable, compatible, and/or sustainable channel forms	102	63%
Recommendations for channel geomorphic design parameters (design flow, cross-sections, planform, profile)	114	70.4%
Recommendations and/or design for channel and floodplain topography for flood management objectives (including for culverts and bridges)	105	64.8%
Design and develop construction details for a riffle-pool and/or a step-pool bed morphology for stream rehabilitation	94	58%
Recommendations and/or design for physical channel habitat for aquatic ecology objectives	109	67.3%
Recommendations and/or design for physical floodplain habitat for riparian ecology objectives	98	60.5%
Preparation of and/or supervision of preparation for channel construction drawings	87	53.7%
Supervision of channel construction from geomorphological perspective	74	45.7%
Monitoring of post-construction stream conditions from geomorphological perspective	93	57.4%
Other	5	3.1%