ے مے ۵^۲۲ ^۱۵۵۲۲ ^۱۵۵۲۲ ۱۵۵۲۲۶۸۵ و ۲^۵۴۵ *43*



Nunavik Research Fact Sheet 43

᠘᠘᠆᠋᠆᠘᠘

᠔᠘ᡒᡄ᠖᠘᠄ᡗ᠆ᡘᡆ᠘᠂ᠯᠳᡀ᠋᠕᠈᠘ ᠘᠘ᡒᡶᢗ᠂ᠮᠣᠴ᠋᠘ᡕ᠘ᡔ

ϞͿϪϞͼ·ͳ· ຼ໑ϫϹʹͼ·; - ͽʹϲϹͶ·ϒϹϏͽ Ͻϒϟϫ·ͶϟͿͶ· Ĺ·ϒ 2017 Ͻϒϟϫ·ͶϟͿͶϷϟ΅ ϐͽͲ;ϟϭͿͻϲϟϭϹϷϚ ϐϾϳΛ·ͿͽͲʹͼ·

∧⊾ሪc⊳< ⊃il°℃

Y

- Δ^c ¹ ² ¹ ² ¹ ²

 Δ^c ¹ ² ¹ ² ¹ ²

 Δ^c ¹ ² ² ¹ ²

 Δ^c ¹ ² ² ¹ ²
- Dalffybesindes
 Adfor
 <

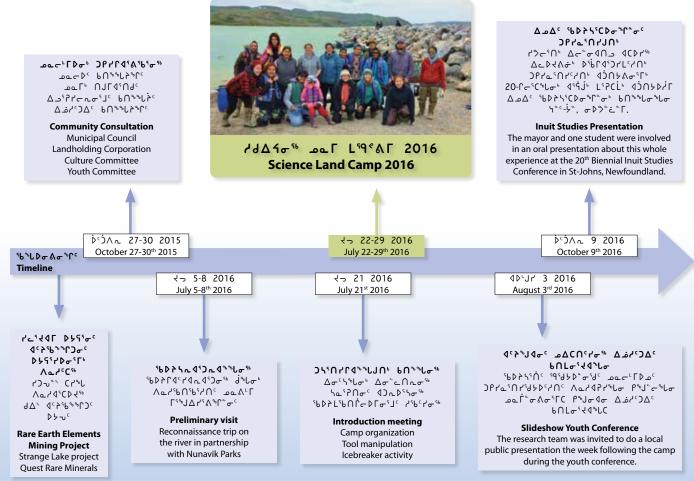
IMALIRIJIIT

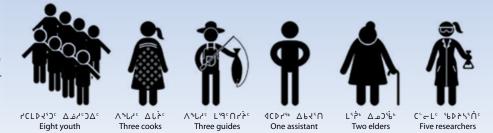
Monitoring George River Water Quality

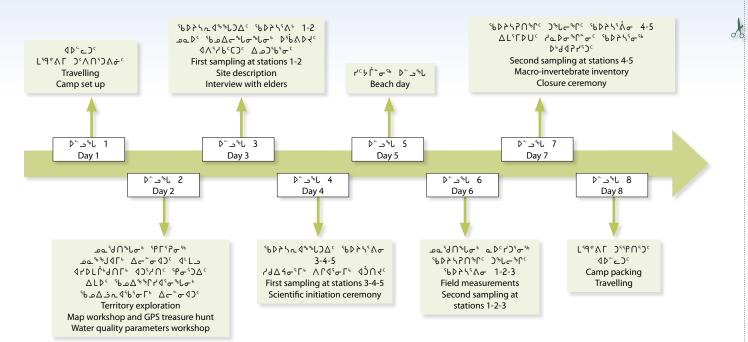
Science Land Camp – Summary report March 2017 Presented to Northern Village of Kangiqsualujjuaq

Project objectives

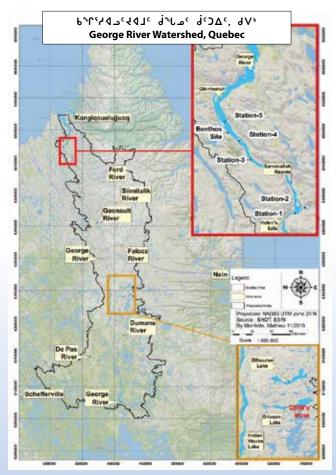
- To put in place a long-term community-based environmental monitoring program of the George River water quality.
- To foster local capacity in biological sampling, data management and analysis and interactive mapping.
- To create interest for environmental sciences among youth while addressing local environmental issues.







The George River flows northerly for 505 kilometers (km) towards Ungava Bay and its watershed spreads over 41,700 km². The George River is a large river, 0,7 to 1,7 km wide at the sampling stations. The water flow was moderate and deep water holes of more than 60 meters (m) were measured near Sarvakallak rapids.



IMALIRIJIIT: Science activities and training

ᠴ᠌ᡄ᠋᠋᠋᠋᠈᠋ᡏ᠘ᠮ᠋ᡎᢓ᠘ᡄ᠊ᢛᢦ᠒ᢕ᠋᠙᠂ᠺ᠇ᠴ᠀᠘ᡁᡁ᠀

ነበት፣ርው ንቴበዜ«ነገላትው ንቴልር፣ቴዋ፣ «በርትንፊስት J«––– ግር ሳግኑ^ים כילראי איזער איזעראייטראיטראיטראיטראיט איזער איזער איזער איזעראייט טעראי ᠂ᡣ᠘ᡙ᠈ᡆ᠋᠆ᡁ᠖᠘᠘᠘᠉ᡧ᠖᠕ᡔ᠘᠃ᡧᢙ᠉ᡧ᠘᠘᠘ <u></u> ϷʹϽϚϷႶϷϞϧʹͺ

Map workshop and GPS treasure hunt

Y

The first activity was a treasure hunt using GPS to initiate and consolidate the use of this tool for every student. GPS is a very important tool to provide a precise location based on satellite positioning in any experimentation.



۵۹۵% د', ۵۲۵ ۹۰۲۵ ۲۰۵۴ GPS workshop with Lise, Émilie and Justine



₽،,50 ،1026 ₽ ᢩᡆ᠙᠋᠋ᡃᡗᠫ᠕ᠳ᠋᠋᠋᠖᠘ᡝ᠋᠋ᠮᡨ᠋᠈᠘᠕᠖ Manual measurement of turbidity with Morgan

ຉ௳ℾ℠ ௳ℙິ۲⊃ჼႫჼჼ

᠈ᡃ᠋ᡰᢄᢣ᠋᠋᠋᠋᠋ᡪᡄ᠕᠋᠋᠘᠆ᡁᡄ᠆᠈ᠳᠴ᠘᠉ᠳ᠘᠆᠕᠋᠃ᢕᡄ᠉᠂ᢆᡆ $\Delta = C^{+}U^{+} \Delta^{-} = D^{-}U^{-} \Delta^{-} \Delta^{-}$ ναια -γαργισιάς -γαργολίο - ήτασια - γαργολίο - Αιαγ ۵٬۱۲۲ م^۰ م^۰ د۲۷٬۹۸۲ ک^۱۵٬۹۵۲ ک^۱۵۵٬۹۵ $^{\circ}$ ل م $^{\circ}$ ک ש $^{\circ}$ b pH, ר $^{\circ}$ ר, אר $^{\circ}$ ר, $^{\circ}$ L, $^{\circ}$ L א $^{\circ}$ ۹۳٬۲۵۵ ک^۰ ۵۵۵ ک^۰ ۵۵۵ ک^۰ ۵۵۲ ک^۰ ۵۵

Field measurements

In order to assess the water quality of a river, many physical and chemical parameters have to be measured. Manual kits and electronic probe were used to measure water quality parameters such as temperature, pH, hardness, turbidity, and dissolved oxygen concentration.

በ' ላ ል ላ ለ ' ረ ረ . ۵ " ነ ነ ነ ነ ነ ነ ነ $\Delta L D^{<}$ `b_ Δ °°C $d^{\circ}\sigma$ °L σ° $\mathsf{\Gamma}^c\mathsf{\cap}\mathsf{L}\mathsf{C}\mathsf{c}^{\mathsf{L}}\mathsf{\Gamma}\mathsf{D}\mathsf{F}^{\mathsf{s}\mathsf{b}},\ \mathtt{a}\mathtt{e}\mathfrak{D}^c\mathsf{\Gamma},\ \mathtt{A}\mathtt{c}\mathfrak{D}^{\mathsf{s}}\mathsf{d}^{\mathsf{s}\mathsf{b}}$ L'9°ΔΓ ΛαζιδΛΓ'ΟΔς. Δεδοδι. ∠-`¬ℰԴԼ⅃հզдi `¬ℰ∪ԼԻ`∪Ի-------- $\Lambda P \mathcal{A}^{\circ} \sigma^{\circ} \mathcal{A}^{\circ} \Delta \dot{\sigma} \mathcal{A}^{\circ} \mathcal{D} \sigma^{\circ} \Delta c P \mathcal{A} c \dot{L} \sigma \sigma$. ۵۵٬۹۰۲٬۹۰۲، ۵۵٬۹۲۲، ۵۵٬۹۹۱ CL°a.

Tim Anaviapik Soucie, Inuk researcher in water quality from Pond Inlet, Nunavut, was part of the camp team. His presence, teachings and valuable insights were especially inspiring for the youth and all participants. It also allowed the researchers to gain great cultural insights.



◊℃٢٢، ڡ٥؞٢٢ $\nabla^{c} = \nabla^{c} \nabla^{c} + \nabla^{c} + \nabla^{c} \nabla^{c} + \nabla^{c} \nabla^{c} + \nabla^{c} + \nabla^{c} + \nabla^{c} \nabla^{c} + \nabla^$ Probe measurements with Tim

ᡃ᠖᠌᠌᠌᠌ᢄᢣᡪ᠋᠋ᡗ᠋᠋᠂ᠳ᠘ᠵᡕ᠌

᠔᠋ᡏ᠘ᡄ᠆ᢆᠣ᠋᠂᠘᠈᠋ᡃᠥ᠙᠘ᡄ᠆ᡐ᠋ $\Delta c^{\circ} \sigma 4 \Omega' c J \Omega' b' b' c \sigma' \Gamma c \Omega a c c 4 2 c' \Gamma,$ ۲۰۶-۲۵- ۱۲،۵۵-۵۲,۵۵ مهل، ۲۹۹ مې ۲۹۹ د ۲۹۵ د ۲۹۷ م أُله. ۵۵٬۵۲ ما۲۰۲۲ ما۳٬۵۲ ما۳٬۵۲ ما۳٬ $\Delta = \Gamma^{c} + \Delta + \Gamma^{c} + \Gamma^{c$ ۲٬۱۵ ٬۹۰۵ د ۱٬۹۰۵ ۲٬۹۰۵ ۲٬۹۰

Sample Collection

Several scientific activities and workshops were organized during the week and five sampling stations were established on the George River. In order to separate dissolved and suspended fractions, some samples were filtered. Guides and students participated in the water collection and filtration.

۹۲٬ ۱٬ ۲٬ ۲٬ ۲۵٬ ۹۵٬ ۲۵٬ ۹۵٬ ۹۵٬ ۹۵٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ ۹۲٬ Jσ-۶٬Uc (ϷϲͻϽϹͻϹς ϞͿΛ،ϞϽϤς ΔΥΡ،ϲς mayflies), Plecoptera (ϷϲͻϽϹͻϹς ህለናንልና stoneflies) ላካሬ *Trichoptera* (ኦርጋበቦጋቦና caddisflies), ርሀኑኦርረበካ Diptera (διΌΠΓωΓι ΔΟδίς, ήθιΟποζω). Λθιλάς λογτάς τοι του αιθουσιά του ματά του ματό του ματά του ματό του ματά του ματ ᠂ᡃ᠋ᠯᢗ᠈᠋᠋᠋᠋ᠶ᠆ᢤ᠕᠅᠕᠅᠕᠅᠕᠅᠕᠅᠕᠅᠕᠅᠕᠅᠕᠅᠕

᠄᠕᠈᠋ᡏ᠋᠋᠋᠊᠋ᠺ᠊᠋ᢄᠳ᠖᠖ᢞ᠖᠘ᡱᡩ᠋᠋ᠴᢄ᠆᠘᠂ᠳ᠘᠅᠘᠃᠕᠃᠘ᡔ

Macro-invertebrate Inventory

Macro-invertebrates live in brooks and rivers under rocks, and, depending on the species we find, it tells us the health of the water stream. The dominant macroinvertebrates we identified were Ephemeroptera (e.g., mayflies), Plecoptera (e.g., stoneflies) and Trichoptera (e.g., caddisflies), along with Diptera (e.g., blackflies, mosquitoes). The first three groups/orders are good indicators of a pristine environment.

ΔCDch9c hiPch1Ųc

دال دور دار ۲۰ مارد دارد در در در در د ሳርነጋፊ የነበላ የምንግራ የትንግራ በተነላጋ በተነላይ የትንግራ የግራን የምንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ የትንግራ

Integration Activities

Scientific initiation ceremony, discussions with elders and group activities were organized in order to strengthen the group cohesion.

۵۸٬۶۹۰ دל۲۵٬۹۰۱ ۱۹٬۵۰ د۵۰٬۹۰ ۵۱٬۹۰ ۱۹٬۹۰ دفاقه ۵۸٬۹۰ CL°ຉຉ ዮ୬Jぐ፟ኊኑዾ⊀ቍና ጋዮተレーጶ୮JNጶና≀ቍ. CL°J4 ≀℅ィᆉĴሱና ۲۰۶ م- ۲۵ مرد ۲۵ م ۹۹۹ مورد ۲۵۰ مرد ۲۹۹۵ مرد ۱۹۹۵ مرد ۱۹۹۵ مورد الما α ᠄ᡃ᠋ᡰ᠘ᡰ᠘ᡶ᠘ᡶ᠖᠆ᡁ᠆ᡨ᠕ᡍ᠘᠘ᡶ᠘

Interviews and discussions with the elders and guides took place several times to encourage intergenerational knowledge transfer. These activities allowed for documenting Inuit knowledge related to the George River and observations of hydrological changes, thus linking Inuit knowledge and science.

Lⁱ9ឺ៑៑Ϸ ៤¯[®]៤ਗ਼, Δਗ਼៓៑ϹͶ៱Ϳ៓៓ϲ៸^៲⁶ ឞϷϒϞϒͶϲͺϳϿϲͺϫͶϹͺͺϤ¹ϹϿͺϗ

The students rapidly learned the manipulations, were generally engaged and remembered well the protocols. At the end of the camp, they could do the set-up, conduct all the tests and record the data all by themselves.

Field measurements

Manual kits were used by the students to measure physical and chemical water quality parameters and the results were combined with those obtained with an electronic probe. Field measurements were made twice at each sampling station and results are showing the mean value.

pН

рΗ

Measuring pH allows to determine if the water sample is acid (like a lemon), basic (like bleach) or neutral (like distilled water). pH is measured on a scale of 0 to 14; 7 is the neutral value. The pH of a river water is usually stable and stands between 6 and 8.5. The mean pH of our water samples was 7.05. To compare, the mean pH value of the Koroc River (Nunavik) was 6.60 in 2015.

ባ Lr ንሪ ግډעም የጉብ የጉብ የ

Nutrients

The nutrient analyses include the measurement of nitrogen (N) and phosphorus (P) concentrations. In the South, nutrient overload is often caused by fertilizer release in water. Nutrient levels in the George River are expected to be low, because agricultural areas do not surround the river. The mean concentrations of N and P in our water samples were respectively 0.120 milligrams per liter (mg/L) and 0.0100 mg/L.

ᢦ՟<mark>ᡄ</mark>᠌ᡆ^ᡪᠣ^ᢐᡶ

 $σ^{-} c = 5 σ^{+} b = 4^{+} h^{+} b^{-} b^{-} c^{-} c^{-}$

S

Temperature

Temperature is a variable parameter, changing between day and night, along weeks, months and seasons. It is measured with a thermometer. The mean temperature of our water samples was 16 degrees Celsius (°C). To compare, the mean temperature of the surface water of the Koroc River (Nunavik) was 11°C in September 2010.

¹6024¹87 ¹6024¹6°

ΔΤ΄ ὑΡΡΥϤΎΥΑΟΑΘ΄ ΔΟΚΘΕ΄ ΦΡΈΟΠΟΡΥΛΟ ΔΕΓΑΥΡΥΔ΄ ὑΡΡΥΊΑΔΟ΄ (ΦΩΠΕΛΡΊΔΥΓ΄ ΒΟΓΓ ΦΊΔΟ ΔΕ^{*}σΦΛΎΤΦ⁵ Δ^{*}ΟΛΦ΄) ὑΔ^{*}ΔΟΠ ΠΓ¹Ι΄ ὑΔΔ^{*}ΤΤΦΊΔΣΥΓὑΊΔΟ, ΛΡΎΟΘ΄ ΛΤΓ΄ ὑΔΔ^{*}ΤΤΦΊΔΣΥΓὑΊΔ⁵ ΠΓ¹Ι΄, ΦΊΔΟ ΡΡΦ΄ΥΥΥΓὑΊΔ^{*} ὑΡΡΥΊΩ⁵.

Laboratory analyses

Water samples were collected and sent to accredited laboratories (Environment Canada and the University of Montreal) for nutrient, chlorophyll and trace metal analyses.

۷۶،۵⁻، ۷۲، به ۳۵*۰* ۵٬۳۵۰ موتر ۲۲، ۷۲، ۷۲، ۷۲، ۷۲، ۷۲،

Chlorophyll

Essential to capture the energy of the sun, chlorophyll is a pigment found in plants and algae. Chlorophyll concentration can be related to the abundance of phytoplankton and micro-algae living in water. The mean concentration of chlorophyll in our water samples was 0.32 micrograms per liter. No comparison value is available for chlorophyll in the Koroc River (Nunavik).

⊄ ∩ ి৮৮ Parameter	ರ್⊂್_್ರಿ Temperature	рН	ΔLÞ´	ィ∩ ー ィ L σ [∿] し Hardness
ک ഛ⁵σ ^৯ Ր° Units	°C	-	mg/L-∩J℃ mg/L	mg/L-∩J ^c CaCO ₃ mg/L CaCO ₃
^ነ Ե▷ጉጓነል፦ 1 / Station 1	17.8	6.75	10.10	4.58
^ና Ե▷ጉጓ⁵ል፦ 2 / Station 2	13.2	7.06	11.51	3.07
^ና Եቦትናል፦ 3 / Station 3	17.7	7.16	10.06	4.49
⁵Ե₽产५⁵ል፦ 4 / Station 4	16.0	7.11	10.40	4.17
^ና Ե▷ጉጎናል⁵ 5 / Station 5	16.1	7.18	10.80	4.11

᠘᠆ᢣ**᠘**᠆ᢧᡕ

Hardness

Y

The water hardness is defined by its concentration in mineral salts, calcium and magnesium mainly. A very soft water contains between 0 and 30 milligrams per liter (mg/L) of mineral salts and very hard water contains over 160 mg/L of mineral salts. The mean value of hardness in our water samples was 4.08 mg/L of calcium carbonate (mg CaCO₃/L). To compare, the mean value of hardness for the Koroc River (Nunavik) was 14 mg CaCO₃/L in 2014.

᠘ᠠ᠋᠂ᠳ᠈ᡃ᠘

Turbidity

Turbidity is a measure of the water cloudiness, of how suspended matter in the water allows the light to pass through it. Some waters are completely clear while others are full of particles and therefore cloudy. Natural turbidity levels can vary greatly, from less than 1 Jackson Turbidity Unit (JTU) to 50 JTU. Variations are mainly due to the erosion of the river's shoreline and heavy rainfall. The mean turbidity value of our water samples was 8 JTU. To compare, the mean turbidity value for the Koroc River (Nunavik) was 0.2 JTU in 2014.

ርብትውምርጋና ይይላናለና

CdFPC'6CD' PPG'C4' Δε'6'σ'6' αρ'72PNP'7σ 15σ' Δ'P'6'σΔ'P'C'Dσ' 7ε'74T PF5'σ', 11 PPG'C4' Δ'Lσ L'P' λ'dα'DC' PF5'5', αρ'75'C&σ' 16σΔ'σ4L'C Δσ' α'P'σ' PF5'CFσ' 16PPN'7JNPε'16' 7dΔ4σ'T' DP7a'N7JN%tσ'. Strange Lake-T PF5'σ4σ'T Λα7'CPA%tσ' Λ5'CP7' Δ'P'6'σ4P'C'Dσ' 7ε'74T PF5'σ', C'd4 Δσε%T' αρ'75'CPT4ε' 7% σPFD Λ'.

Trace Metals

Trace metal analysis included the measurement of 15 Rare Earth Elements (REE), 11 metals and 2 radioactive elements. Measured concentrations for each element will be available in the detailed scientific report.

As the Strange Lake mining project will be extracting REE, those elements must be measured in priority.

Dissolved Oxygen

As oxygen is an essential gas for most living organisms, the measurement of dissolved oxygen is a crucial parameter. A concentration of oxygen between 7 and 11 milligrams per liter (mg/L) is ideal for most fish species. The mean dissolved oxygen concentration in our water samples was 10.57 mg/L. To compare, the mean concentration of dissolved oxygen in the surface water of the Koroc River (Nunavik) was 8.62 mg/L in 2015.

- ΔLϷ< ʹϧϿϘͺϳϾϧϷͼ, ;ϷϷϯϽͺϲͺϷͼ, Γϲ-Γ,Οͺ;Ϸͼ,
- ሀርላም⁶ የትባላም የምንትሳላው የምንትሳላው⁶ ምንትሳላው⁷ ግንም የትላይ የምንት የሚያምንት የምንም የትላይ የምንም የትላይ የ
- రిసిట్ విగ్రెల్ గెరిగా నిల్లో గిరి విగిగి ఉన్నారి. ఎరినిరిని సిరిగిరాల్ గెళించిన్ ఎరిగిరాల్ నిలిగి సిరిగిలి సినిగి ఒదిగిన్ని చిగిరాల్ సిలిసికి సిరిగిల్ ఎరికార్లు. ఎది విద్దాలు

What do we know about Rare Earth Elements (REE)?

- REE make good permanent magnets and are used in many hightech products such as solar panels, wind turbines, electric vehicles, mobile phones and computers.
- REE were recently discovered, thus, we have a poor understanding of their potential environmental risks.
- There is no water quality criteria for these elements.
- Many research projects are currently underway, trying to understand their mobility in ecosystems and their toxicity for living organisms.
- REE are mostly attached to soils, consequently their mobility is restricted in water. It would be interesting to make analysis of REE in sediments, macro-invertebrates, plants and fish.

Thus, the IMALIRIJIIT project is essential to create knowledge on the behaviour of REE in Northern aquatic ecosystems. Measured concentrations must be compared to regional measurements made in similar water bodies.

∆لائم <i>∿</i> ل Turbidity	ለ?ንምና ለ∢ኈ የሥት∿∿∿የነር∽⊦ በLrገւ Chlorophyll	Nitrogen-Jᠳᠲ⁵C ^њ Nitrogen	Phosphorus-J <i>ज</i> -५°C [%] Phosphorus		
JTU	μg/L	୮ϲժհ ^ւ 1ϲϹΓ mg/L/L	୮ᡄ᠋᠊᠋᠆᠆᠆ mg/L	⊅ഛ⁵ল° Units	
13	0.45	0.145	0.0144	^ነ Ե▷ጉጓነል፦ 1 / <mark>Station 1</mark>	
8	0.19	0.084	0.0048	^ነ Ե▷ጉጓነል፦ 2 / Station 2	
10	0.38	0.117	0.0162	ჼ⊌₽ትጓჼል፦ 3 / Station 3	
6	0.25	0.122	0.0080	⁵Ե₽ጉኁል፦ 4 / Station 4	
6	0.31	0.131	0.0066	⁵Ե▷ጉኻጜ፦ 5 / Station 5	

ΔLー[~]⁻ ۲^c: Δ² – J በ[°]Γ^c IMALIRIJIIT: Conclusions

2016Γ ἐσωστοικός μαραγικά το μαραγικός το μ

- ³ L³ -
- ۲۵٬۰۱۲٬۲۹۹، ۲۵٬۰۱۲٬۰۱۰، ۲۵٬۰۱۲٬۰۲۸، ۲۵٬۰۱۲٬۰
- ΛͿ[°]ͼᡤϲϿΓΠ[°]ᡤσ[%] ϼͼϲ^ιΓϷσ[°] ኣ[>]^ιΓϷϷσ[%]Ⴑσ[»] ԵԼՐϷϷσ[®]ႱσϿ ϤϚΠΓσ[°].

Preliminary results highlight the high water quality of the George River including neutral pH, very soft water, and low nutrient and metal levels. Complete data analysis and interpretation will be provided in a detailed scientific report.

The 2016 Science Land Camp was a very successful first edition of the IMALIRIJIIT project from the perspective of researchers, guides, elders, students and Kangiqsualujjuamiut.

S

Participating in scientific measurements with committed local adults and elders as well as researchers had an important positive impact on the youth. First observations showed that being on the land, camping together, doing hands-on activities, mixing scientific work with other activities and sharing between generations and cultures contributed to:

- A different perception of science for the youth and local participants;
- · A better link between the community and researchers;
- A greater local capacity in the protection and monitoring of its environment.

Plan for 2017: working at watershed scale using innovative tools: remote sensing and interactive mapping.

حا^ء۲ָכ¢ Acknowledgements

$$\begin{split} \mathsf{P}_{\mathsf{I}} = \mathsf{P}_{\mathsf{I}}$$

Very special thanks to the Northern Village of Kangiqsualujjuaq, particularly to Hilda Snowball for her trust and involvement, the Youth Committee, the Landholding Corporation, the Recreation Committee, Makivik Corporation, Kativik Regional Government, OHMi Nunavik, Labex DRIIHM, the Centre d'études nordiques and ArcticNet for their financial support, to Parks Nunavik for their logistical support and for welcoming us in their space. Very warmful thanks also to all camp participants: Tim Anaviapik Soucie, the two elders Mary Elisabeth Annanack and Minnie Mae Annanack, the guides Paulosee Jararuse, Alex Noah Morgan, Joe Etok, and Joshua Annanack, the cooks Louisa Minnie Etok with Qipita, Mary Annanack and Julianne Imbeault, and especially the youth Lise Morgan, Vanessa Snowball, Vanita Weetaltuk, Clara Unatweenuk, Sarah Unatweenuk, Eli Annanack, Morgan Annanack and Rupert Annanack. We really enjoyed this journey with you and we hope it will continue!

