ATTACHMENT 1
GRANT QUARTERLY PROGRESS REPORT

Quarter: (circle one) (2016 1st) 2016 2nd 2016 3rd 2016 4th

Grant Program, Number and Title: USFWS NA LCC, NA LCC 2015-05

"Developing a GIS-based freshwater classification for the Canadian portion of the North Atlantic Landscape Conservation Cooperative"

Organization: Nature Conservancy of Canada (NCC)

Project Leader: Margo Morrison (NCC), Arlene Olivero-Sheldon (TNC), William Millar (NCC)

Abstract: Please provide a short (1-2 paragraphs) abstract that addresses EACH of the following: the objectives of your project, accomplishments to date, future plans and timelines with an estimate for when the project will be completed.

The overall goal of this project is to increase the knowledge and data available for freshwater ecosystems in the Canadian and cross-border portions of the North Atlantic Landscape Conservation Cooperative (NA LCC). Identifying portions of the aquatic network that have ecological similarities can help to more effectively protect and manage freshwater resources and aquatic species. The objectives of this project are to 1) create a seamless classification of freshwater ecosystems based upon their distinct ecological characteristics within Eastern Quebec, New Brunswick, Nova Scotia and Prince Edward Island (the Canadian portion of the NA LCC), 2) agree upon common mapping and habitat definitions, and 3) provide a standardized approach to freshwater classification. The ecological characteristics being analyzed are stream size, slope (gradient), temperature, geological buffering capacity and tidal influence.

Progress to date includes the formation of a core team of freshwater experts, compilation of most of the necessary abiotic datasets, a detailed discussion of the GIS modelling methodology, and presentation of the initial gradient analysis. The core team consists of at least one representative from an NGO, an academic institution, and a provincial/federal government department for each province included in the Canadian portion of the NA LCC. The key datasets that have already been acquired are high resolution Digital Elevation Models (DEM's), national hydrographic networks (NHN's), surficial geology, bedrock geology, soils, and other variables associated with tidal influence. It is anticipated that all other necessary datasets, including stream temperature data, climate, water quality, land cover and biotic data will be compiled by end of NA LCC's next quarter, and that some initial watershed delineations and size analysis will be done by the end of June 2016. It is anticipated that this project will be completed by May 2017.

Were planned goals/objectives achieved last quarter?

Almost all planned goals/objectives were achieved last quarter (January- March 2016). The majority of January and February was spent collecting the remaining key datasets from core team members and provincial/federal data warehouses. There was significant progress made on acquiring stream temperature and biotic data during this quarter, with valuable input from PEI, New Brunswick and Quebec provincial agencies. Mary Lynn

McCourt from PEI Dept. of Agriculture and Fisheries was able to provide us with stream temperature data (summer max/min), as well as the most current watershed boundaries, hydrological network, soils, DEM's (10m and 1m), and surficial geology. We have also received some fragmented stream/river temperature data from Mike van den Huvel and Scott Roloson at UPEI. Mary Finch and Megan Harris have also been instrumental in reaching out to watershed groups and other NGO's in PEI; it is anticipated that when identifying potential project advisory team members, we will also be able to gain access to additional temperature, water chemistry, and biotic datasets. Claudine Boyer from the Quebec Institut National de la Recherche Scientifique (INRS) has provided us access to her regional stream temperature database, which has extensive coverage for the Quebec portion of the NA LCC. Julie Moisan and Daniel Blaise from the Quebec Ministre Developpement durable, Environnement et Lutte contre les Changements Climatiques (MDDELCC) have provided us with access to their stream temperature, pH, and benthic macroinvertebrate databases. Erin Douthright from the NB Dept. of Environment and Local Government has provided us with valuable pH, stream temperature, and alkalinity datasets, while one of her colleagues, Krista DeBouver, from NB Dept. of Natural Resources has provided us with fish community data.

The largest gap in our study area occurs in Nova Scotia; however, contact has been made with Oliver Woods from St. Mary's University and Sarah MacLeod from Dalhousie University, who have agreed to share access to their water quality/water chemistry data portals. Additionally, we have been able to acquire some provincial fish community data from Jason LeBlanc at the Nova Scotia Dept. of Inland Fisheries and some federal fish community data from Daniel Cassie at the Department of Fisheries and Oceans (DFO). Jason Leblanc has also been able to acquire alkalinity data for Nova Scotia lakes, which will drastically improve our accuracy of our geological buffering capacity modelling.

Finally, we have reached out to all the Canadian Aquatic Biomonitoring Network (CABIN) members in the Canadian portion of the NALCC in order to gain access to the extensive benthic macroinvertebrate database. With such a large amount of data already collected and with other inquires pending, we are confident that all datasets will be collected by the end of next quarter.

To help facilitate data collection we held the second core team meeting via webex and conference call on February 10th, 2016. During this meeting, we reviewed the status of all key datasets necessary to complete our GIS modelling processes, and we also solicited core team members for additional GIS data (i.e. in-stream alkalinity (or pH), stream temperature, groundwater influence, and soils data). We also discussed the best available sources of biotic data necessary to complete our calibration of the classification. The core team members continue to be enthusiastic about the project and are content with adopting a similar GIS modelling approach as was used in the US classification; agreeing that the same analyses were also relevant and scientifically accurate for Canadian Maritime provinces.

Progress Achieved: (For each Goal/Objective, list Planned and Actual Accomplishments)

1. Review classification variables, key datasets and outline GIS methodology
    - Planned: Review classification variables, status of key datasets, and outline methodology of certain GIS processes/modeling at 2nd core team meeting

    - Actual: William Millar reviewed the current status of key datasets with the core team members during the February meeting. The limitations of all data were reviewed to ensure core team members were agreeable with the methods going forward. William also presented the initial gradient results (using 30m DEM) and outlined the Geospatial Modelling Environment (GME)

methodology. The February PowerPoint presentation also included input from Arlene Olivero-Sheldon (TNC), who outlined the stream buffering capacity and temperature modeling methodologies. Arlene outlined the random forest statistical modelling process and highlighted the usefulness of Threshold Indicator Taxa Analysis (TITAN) when determining class breakages. It was also suggested that certain climatic datasets could improve the accuracy of certain models or act as a reference (i.e. land use/land cover, monthly air temperature, precipitation, and base flow data).

2. Identify and acquire necessary biotic/abiotic datasets

- Planned: Identify all necessary biotic/abiotic datasets for the freshwater classification and begin data compilation

- Actual: All datasets for the classification were identified through multiple discussions with Arlene-Sheldon Olivero and core team meetings. Datasets were categorized by each ecological characteristic.

Identified Datasets:

i. Size
    1. Finest Level of Watershed Delineation
    2. River Discharge
    3. Precipitation (Climatic Dataset)

ii. Gradient
    1. National Hydrographic Network
    2. Digital Elevation Models (30m) *adequate for analysis
    3. Digital Elevation Models (10m) *ideal for analysis

iii. Temperature
    1. Stream Temperature
    2. Air Temperature (Climatic Dataset)

iv. Geologic Buffering Capacity
    1. Surficial Geology
    2. Bedrock Geology
    3. Soils (texture)
    4. Alkalinity
    5. pH

v. Tidal Influence
    1. Salinity
    2. Depth of Exposure to Open Sea

vi. Biological (needed to test/calibrate classification)
    1. Fish Collection Records
    2. Benthic Macroinvertebrate Occurrences

Classification Variable:	Dataset:	Percentage Acquired:	Comments:
Size	Finest Level of Watershed Delineation	50%	All Tertiary Watersheds provided by GeoGratis/TNC Awaiting response from core team member(s) regarding

Classification Variable:	Dataset:	Percentage Acquired:	Comments:
			Secondary Watersheds (QC,NS) – May require some conversion processing via ArcMap tools due to various spatial scales
	River Discharge (m^3/s)	50%	Provided by DFO (half raw & half modelled data). Still need to explore provincial monitoring stations data
	Precipitation (Climatic Dataset)	100%	2km DEM of Monthly Max/Min Precipitation provided by NRCan *This dataset will be used to aid streamflow modelling wherever hydraulic gauging station data is lacking (may require some conversion processing via ArcMap tools)
Gradient	National Hydrographic Network (NHN)	100%	Provided by WWF/Geogratis/NRCan
	Digital Elevation Models (30m)	100%	Provided by WCS/TNC
	Digital Elevation Models (10m)	50%	10m DTM acquired for Nova Scotia (can convert to DEM via ArcMap tools). 1m LiDAR corrected DEM and 10m DEM acquired for PEI (can convert to 10m DEM via ArcMap tools). Still awaiting data sharing agreement for New Brunswick and Quebec *30m resolution is adequate for gradient analysis, but 10m is ideal (esp. for Province of Prince Edward Island, due to size)
Temperature	Stream Temperature	75%	Provided by Institute National de la Recherche Scientifique (INRS), Quebec Ministry of Environment, Sustainable Development and Fight Against Climate Change (MMDELCC), New Brunswick Dept. of Environment and Local Government and PEI Dept. of Agriculture and Fisheries *This database only covers roughly 75% of the project study area. Will need to collect additional data from core and/or advisory team. Especially in Nova Scotia (currently only lakes temp data)
	Air Temperature	100%	2km DEM of Monthly Max/Min Temperatures provided by NRCan *This dataset will be used to interpolate stream temperature wherever in-stream data is lacking (may require some conversion processing via ArcMap tools)
Geologic Buffering Capacity	Surficial Geology	100%	30 m DEM Provided by TNC (Charles Ferree)
	Bedrock Geology	100%	30m DEM Provided by TNC (Mark Anderson)
	Soils (Texture)	75%	Provided by 2C1F *Pending response from core team member(s) regarding more detailed soils (depth) data for Quebec watersheds
	Alkalinity	35%	Provided by New Brunswick Dept. of Environment and Local Government (NBDELG) and * Will need to collect additional data from core and/or

Classification Variable:	Dataset:	Percentage Acquired:	Comments:
			advisory team. Especially in Nova Scotia (currently only lakes Alkalinity data)
	pH	75%	Provided by MMDELCC, NBDELG, and PEI Dept. of Agriculture and Fisheries *Pending response from Jason LeBlanc/ Oliver Woods/Sarah MacLeod (Nova Scotia)
Tidal Influence	Salinity	0%	Pending response from core team member(s)
	Depth of exposure to open sea	90%	Provided by DFO *This dataset is missing information for certain watersheds in Quebec
Biological	Fish Collection Records	35%	Some fragmented fish occurrence data from provincial and federal academic publications (requires raw tables to be imported into ArcMap via csv file conversion) Pending response from core team member(s)
	Benthic Macroinvertebrate Occurrences	0%	Pending response from CABIN Groups/Environment Canada *8/13 CABIN groups have agreed to share data. Once all groups agree Environment Canada will release the data to us

3. Delineate watersheds and drainage basins

    - Planned: Begin watershed delineation and size analysis

    - Actual: It was anticipated that the size analysis would be complete between March 2016 and May 2016, but unfortunately we have run into some difficulties, which have affected our timeline. In order to properly delineate the watersheds and accurately calculate their drainage areas in the size analysis we had to manually "snap" the stream networks together. To avoid data errors and preserve certain attributes we chose to merge the harmonized NHN/NHD stream network provided by the International Joint Commission (IJC) with the World Wildlife Fund NHN stream network. The IJC stream network extends into the US portion of the NALCC and captures important transboundary waters (i.e. St Croix and St. John rivers). Although the IJC and WWF stream networks are more compatible with each other, than the TNC stream network from the US aquatic classification, some manual edge matching work is still needed to stitch together a seamless stream network across both portions of the NALCC." We additionally experienced some difficulties with the size analysis due to incompatible python scripts and outdated ArcHydro tools. We are currently finalizing this edge matching process, and when it is complete, we will be able to apply our solutions to the watershed delineation and size analysis issues.

4. Contact External Statistician
    - Planned: Contact an external statistician to help guide our analysis and verify that any correlation we make are statistically significant

    - Actual: On February 11th, 2016 Arlene Olivero-Sheldon and William Millar held a WebEx

conference call with Mathew Baker, the developer of TITAN. Dr. Baker conducted a quick tutorial on the new functionality of TITAN II and agreed to be an advisor for this project (1-3 days of work time to check validity of results). Any additional time may require funding.

Difficulties Encountered:

The main difficulties encountered this quarter were due to software compatibility issues when attempting to delineate watersheds and drainage basins. It was anticipated that by using the same ElevationProcessing.py python script that the TNC Eastern Conservation Science Division used, we would just need to replace the variable names, which would drastically reduce the amount of processing time needed for DEM reconditioning. Most of February and March was spent either trying to re-write the python script (because all arcpy library references were outdated and no longer compatible with ArcMap 10.2.2) or find alternative processing solutions. After consulting NCC and TNC staff, it was decided that the DEM hydrological reconditioning could be done in ArcHydro via the terrain pre-processing tools. After successfully creating a geometric network and trying to accumulate the local drainage areas and cumulative watersheds, some errors were identified in the edge matching of the stream network across the Canada-US border (which will require correction before finalizing size analysis). There was also some minor delays with collecting biotic and climatic datasets from core team members and other data contacts.

Activities Anticipated Next Quarter:

Over the next quarter, we will finalize the collection of outstanding key datasets (i.e. Alkalinity & pH data for Nova Scotia, and soil texture data for missing Quebec watersheds), acquire necessary biotic datasets (i.e. fish and benthic macroinvertebrates data), and secure any complimentary datasets (i.e. climatic data, land cover data and 10m DEM's). We also anticipate to rectify the edge matching errors with the Canada-US stream network as soon as possible, so that we can finalize our size analysis and present the results at the next core team meeting on May 12th, 2016. By the end of June, we plan to have both the gradient (using 10m DEM) and size analysis completed and tested/verified with biotic data (i.e. TITAN analysis). We plan to start the geological buffering capacity model as well. Finally, we will be inviting a larger group of aquatic conservation groups (i.e. watershed groups, aboriginal groups, other ENGOs) to learn about the Aquatic Classification Project. The project advisory team will be kept up to date about the projects progress via e-mail and will be contacted in January 2017 to coordinate a beta test of the classification. Members will be given a tutorial in ArcMap software and encouraged to flag any potential errors.

Expected End Date: May 31st, 2017

Costs:

Total life to date expenses (include this quarter): $19,378.81 USD

Total Approved Budgeted Funds: $110,000 USD

Are you within the approved budget plan and categories? YES

Signature: _____

Date: Apr. 29/2016