

*Leveraging High-Resolution
Satellite Imagery for
Baseline Environmental
Assessments in Arctic
Locations*

Greg Lewis

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Project Objective

“...to conduct an aerial site inspection of several abandoned wells... to assess the site conditions, and potential for environmental risks related to historical operations.”




Existing Assessment Form

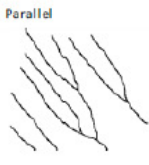
Sump Name			
Is there a Sump Present?	Y	N	<i>Survey is complete if No</i>
Is this a Camp Sump?	Y	N	
Waypoint Name			<i>Record Lat and Long after survey</i>
Date Flown			
Time (MDT)			
Photo Numbers	facing N		
	facing W		
	facing S		
	facing E		
	Sump Cap	Lease (or within 100 m radius of cap centre)	
Ponding (%)			
Slumping (%)			
Vegetation Stress (%)			<i>dying vegetation / bare ground</i>
Overproductive Vegetation			<i>unusually tall/thick shrubs</i>
Does Ponding Follow a Polygonal Pattern?			
Y			
N			
Cap Integrity			
High			<i>< 30% degraded</i>
Medium			<i>30-70% degraded</i>
Poor			<i>>70% degraded</i>
Ice Wedges or Polygonal Terrain Present at Sump Perimeter?			
Y			
N			
Camp Sump Observed?			
Y			
N			
Distance from Sump Cap to Receiving Water Bodies			
Water Feature	Distance downstream (m)		
Lake			
Pond			
Wetland			
Coast			
Stream/Riparian System			
Sump Drainage			
trellice (angular)			
parallel			
denritic			
radial			
Downstream Connectivity (Please Check One)			
high (sump in floodplain)			
high (drainage network apparent)			
low			



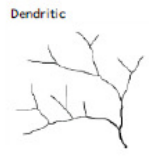
Radial



Trellice



Parallel



Dendritic



Proposed Approach

- Reviewed options and evaluated on:
 - Safety Risk
 - Flexibility in deployment
 - Spatial and temporal resolution
 - Cost

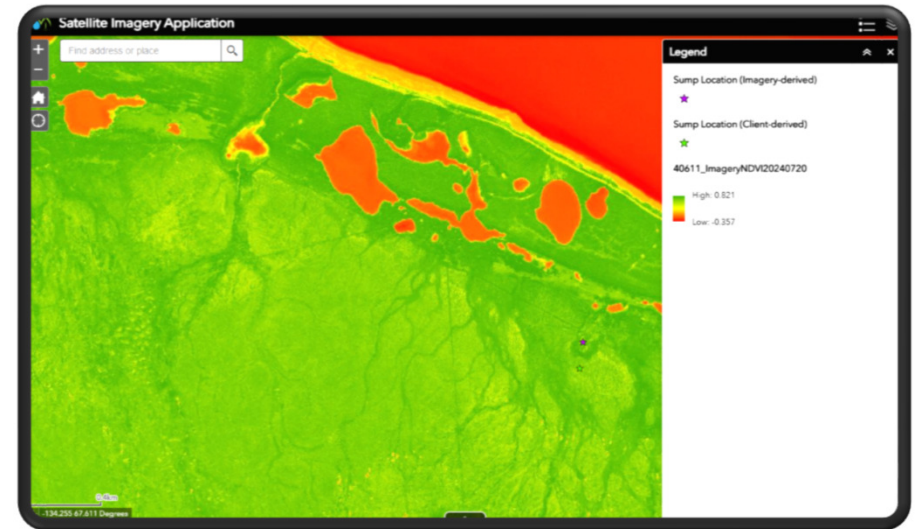
Platform	Safety Risk	Deployment Barriers	Resolution(s)	Cost
Helicopter / Personnel	Medium	Medium	High	High
Fixed Wing Aircraft Camera Pod (Internal)	High	Low	High	Low
Fixed Wing Aircraft Image Acquisition (External)	Medium	Medium	High	Medium
Satellite Imagery	Low	High	Medium	Low

** Ratings are relative and subjective*



Proposed Approach

- Methodology to complete preliminary environmental site assessments and establish quantitative vegetation baselines, with ability to expand application.
- Two platform options:
 - Traditional Aerial Photography (3rd party)
 - Satellite Based Imagery
- A multidisciplinary team to execute



Methodology

- Visually identify
 - Standing water
 - Sump location
 - Target vegetation polygons
- Normalized Difference Vegetation Index (NDVI)
 - Quantitative measure of biomass
 - Establishment of baseline and target values
- Baseline areas of interest
 - Sump location (20 m)
 - Lease location (100 m)
 - Landscape (500 m)
 - Target vegetation polygons (visually identified)



Platform

- **Pléiades Neo**

- Designed, owned and operated by Airbus for commercial purposes

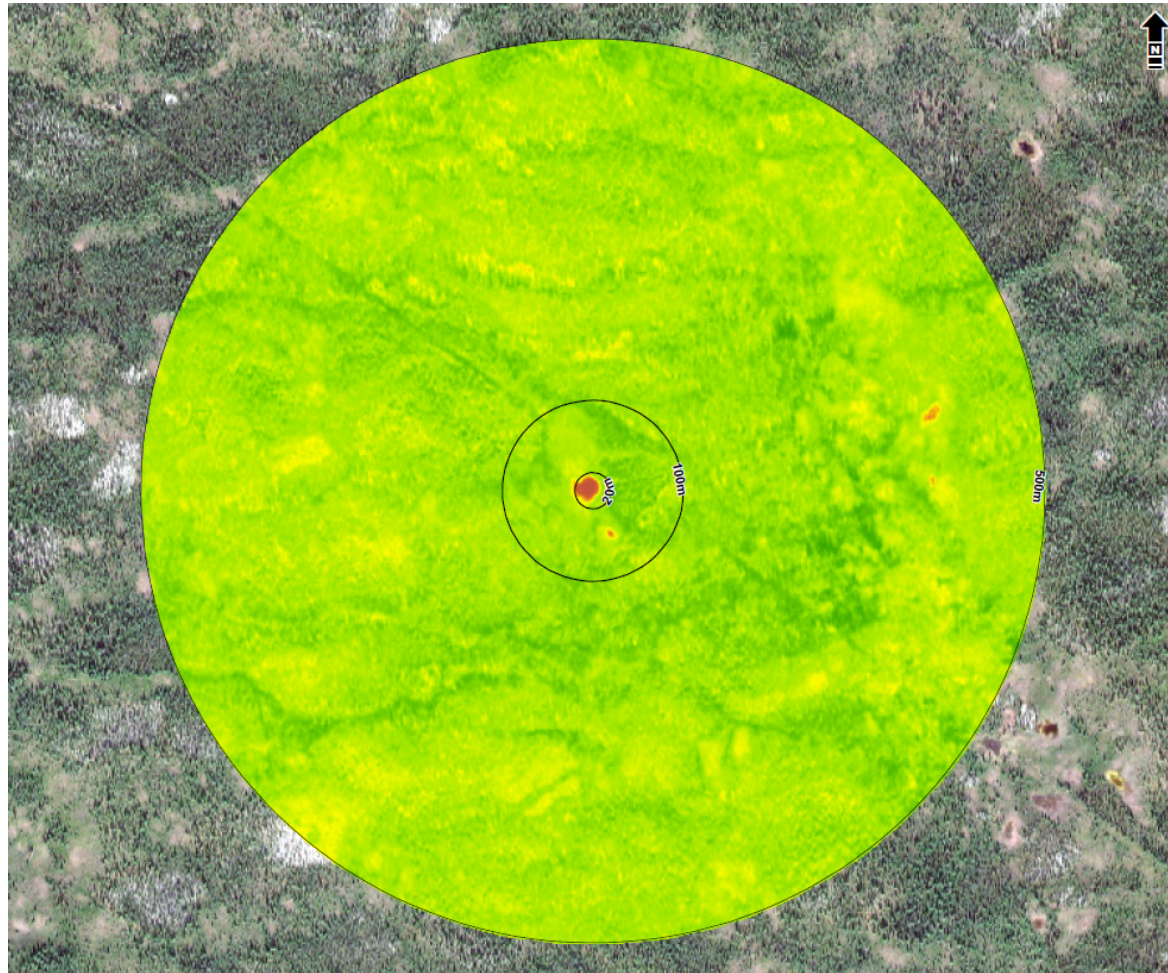
- Reactive tasking

- Target during peak vegetation (July 15 – August 15)

Spatial Resolution	30 cm (Panchromatic) 120 cm (Multispectral)
Spectral Bands	Panchromatic: 450-800 nm Deep Blue: 400 - 450 nm Blue: 450 - 520 nm Green: 530 - 590 nm Red: 620 - 690 nm Red Edge: 700 - 750 nm Near-infrared: 770 - 880 nm
Temporal Resolution	Daily
Processing Turnaround	~ 2 Weeks



Deliverables



Deliverables

- Stressed Vegetation
 - 2 St. Dev. **below** average NDVI value of landscape
- Over Productive Vegetation
 - 2 St. Dev. **above** average NDVI value of landscape
- Compiled list of sites for easy review

Sump Name		
Is there a Sump Present?	<input checked="" type="checkbox"/>	Survey is complete if No
Is this a Camp Sump?	<input checked="" type="checkbox"/>	
Waypoint Name	-	Record lat and long after survey
Date Flown	2024-07-24	
Time (MDT)	-	
Sump Coordinates	Latitude	
	Longitude	
	UTM Zone	
	Northing	
	Easting	

	Sump Cap	Lease (or within 100 m radius of cap centre)
Ponding (%)	49.20%	3.49%
Slumping (%)	Ground Verify	Ground Verify
Vegetation Stress (%)	55.55%	3.79%
Over Productive Vegetation	0.48%	3.11%

Dying vegetation / bare ground
Unusually tall / thick shrubs

Does Ponding Follow a Polygonal Pattern?

Y
N

Cap Integrity

High < 30% degraded
Medium 30 - 70 % degraded
Poor > 70% degraded

Icy Wedges or Polygonal Terrain Present at Sump Perimeter?

Y Ground Verify
N Ground Verify

Camp Sump Observed?

Y
N

Distance from Sump Cap to Receiving Water Bodies

Water Feature	Distance Downstream (m)
Lake	1382
Pond	369
Wetland	-
Coast	-
Stream / Riparian System	-

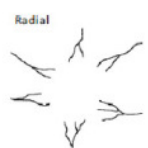
Sump Drainage

Trellice (angular)
Parallel
Dendritic
Radial

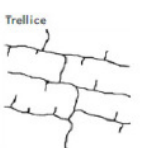
Downstream Connectivity (Please Check One)

High (sump in floodplain)
High (drainage network apparent)
Low

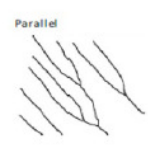
Radial



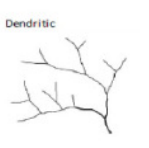
Trellice



Parallel



Dendritic





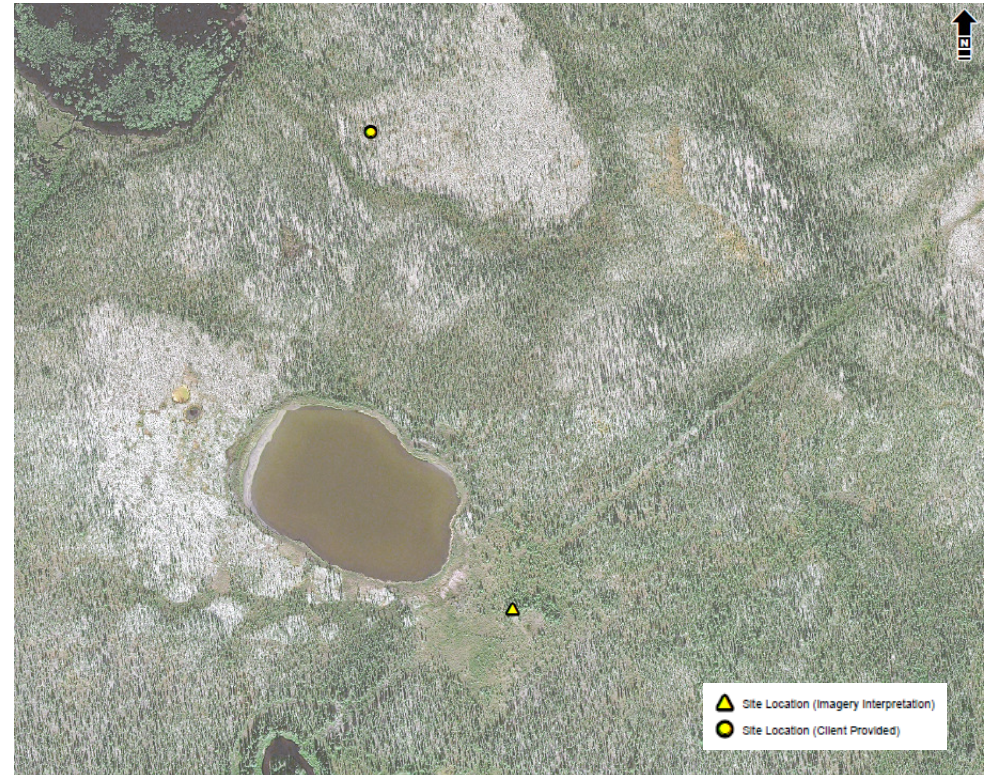
Deliverables

NDVI Summary Statistics				
	20m	100m	500m	Target
Min	-0.00448	-0.00448	-0.00448	0.46410
Mean	0.31070	0.55128	0.54074	0.51348
Max	0.69452	0.73229	0.76510	0.56471
Range	0.69901	0.73678	0.76958	0.10060
Standard Deviation	0.22544	0.08956	0.06085	0.01941
Variance	0.05082	0.00802	0.00370	0.00038



Challenges

- Accuracy of site locations
- Limited historical information on the sites
- Timing and image quality (*cloud cover*) from satellite imagery
- Large datasets, served to several people
- Some attributes require ground perspective / additional data



Conclusion

- The Pléiades Neo has proven to be an appropriate platform to allow for the establishment of baseline environmental assessments
- This is particularly relevant in the Arctic, where site access and historical information may be limited
- Methodology allows for quantitative vegetation assessments which could be efficiently applied to many sites
- Future work needed to validate vegetation change identification and monitoring using successive imagery





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Office Locations (17)

British Columbia

- Fort St. John

Alberta

- Calgary (main)
- Cold Lake
- Edmonton
- Grande Prairie
- Medicine Hat

Manitoba

- Virden

Saskatchewan

- Kindersley
- Lloydminster
- Oxbow
- Regina
- Swift Current
- Weyburn

Ontario

- Guelph
- London
- Oakville

