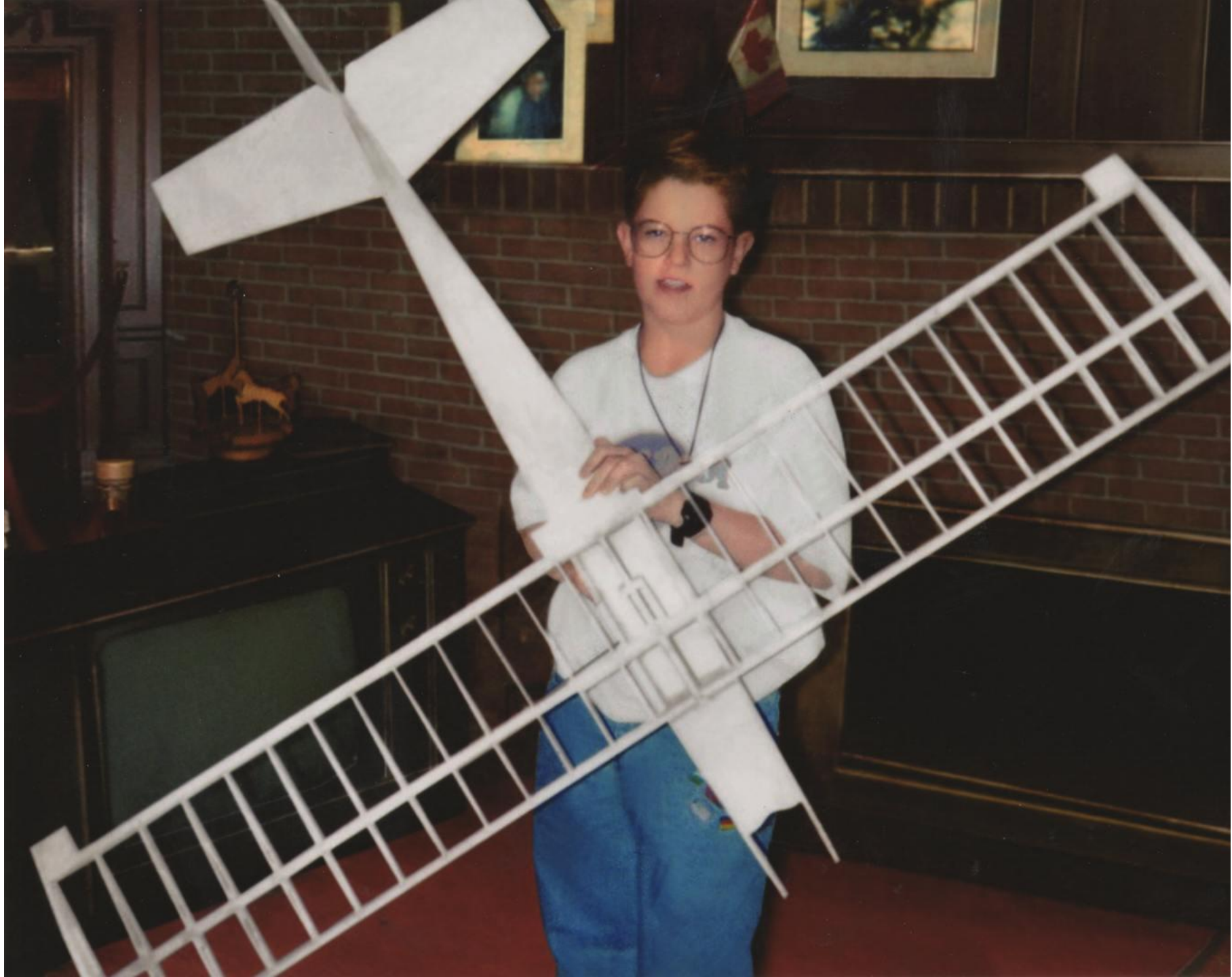


# UAV's for Pipeline Inspection

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NuvAero Flight Systems Ltd.

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# Intro to NuvAero

# Original “Mission”

- To advance industrial applications of UAV

# Revised Mission

- Earn huge profit using UAV's to collect data for heavy industry.













# 2014

- We're done proving it's possible and are in the process of growth

# “Hedging our bets” case study oilsands

## **We UAV for you**

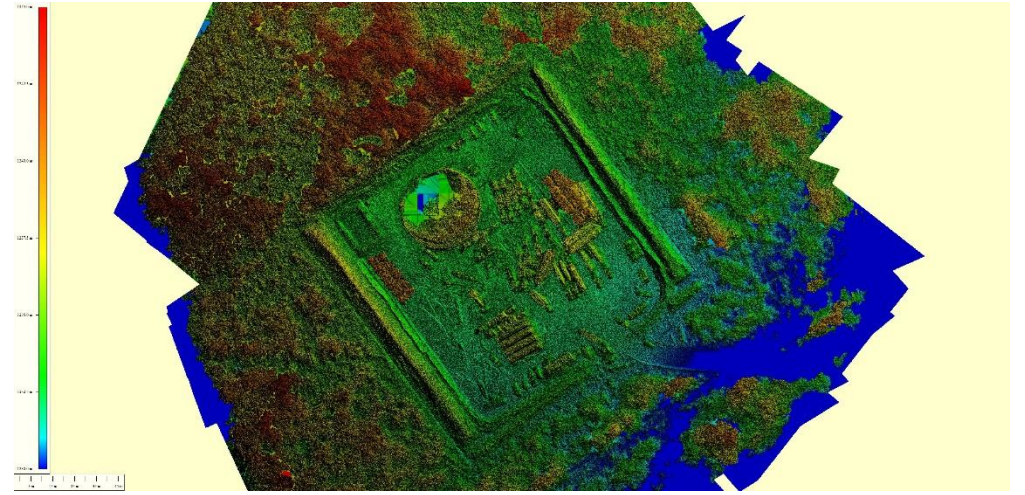
- Performed weeks of trial survey
- Verified against lidar data
- UAV data 10x resolution
- Verified against real world
- Hired back for rest of season
- Most UAV survey data collected in oilsands that year
- Costs were known and results were guaranteed

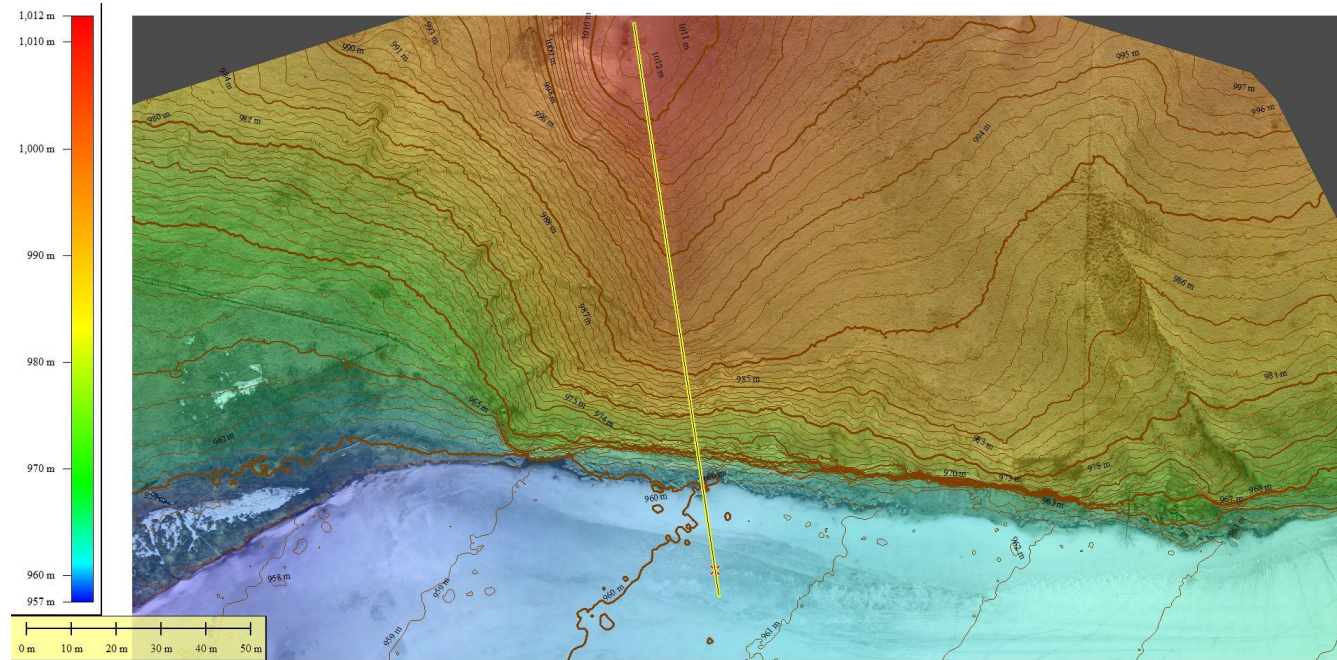
## **We teach you to use your RTF UAV**

- Your system is overpriced
- Your staff is expensive
- UAV’s are difficult
- Took months to train
- UAV broken, not used all year
- Over 1.4mil spent, zero data completed
- UAV now in closet

# NuvAero's Research & Development

- Air Law, Safety, Logistics
- Integrating UAV into heavy industry's operations
- Building custom platforms using off the shelf parts
- Training and consulting to other organizations
- Determine actual cost of operating UAV's in the real world.
- Find The biggest opportunities to use UAV





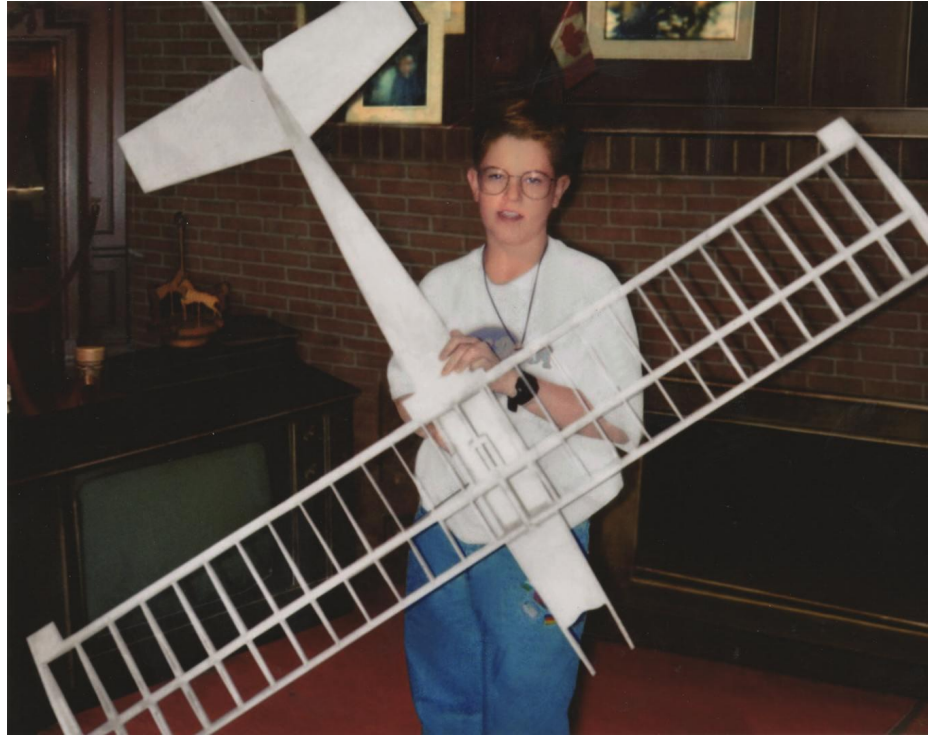


# Brief history of UAV's

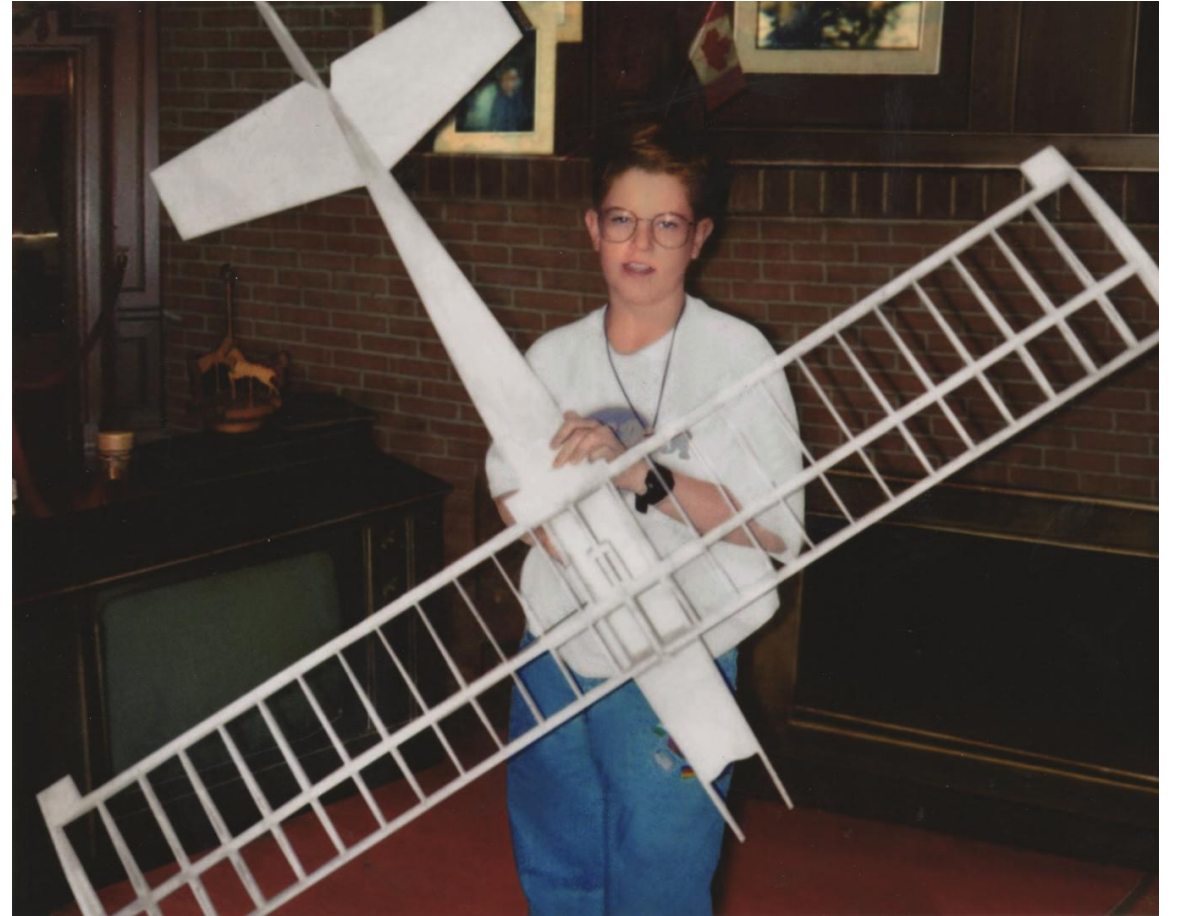


# Radioplane OQ-2











Most popular UAV ever, and the worst



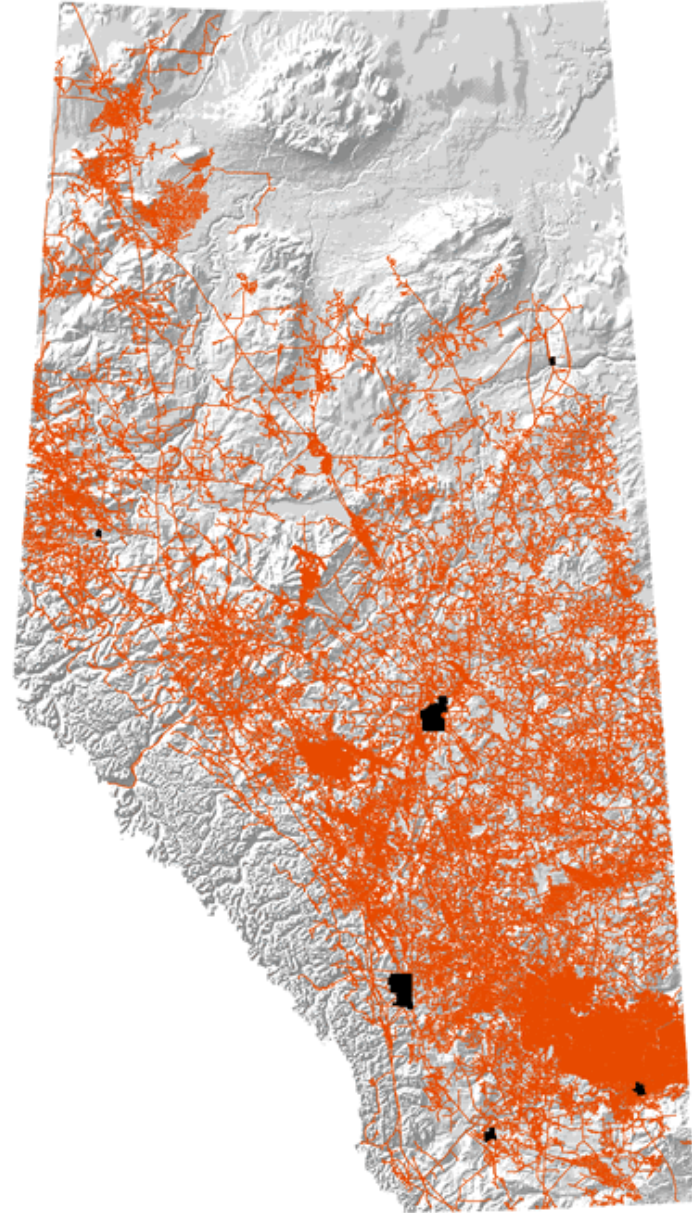


# Why now?

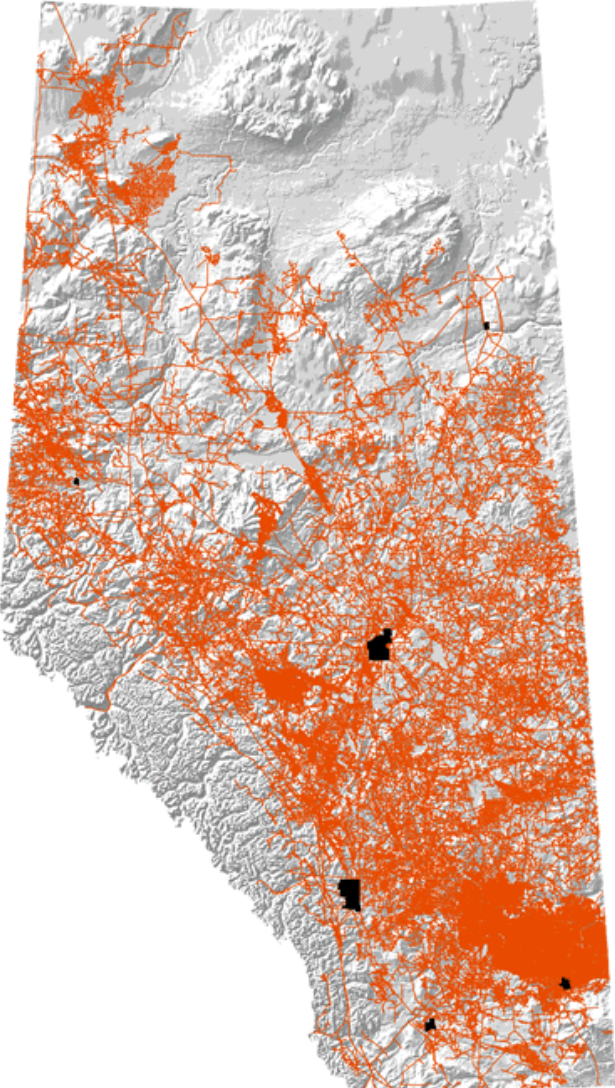


# UAV's for pipeline inspection

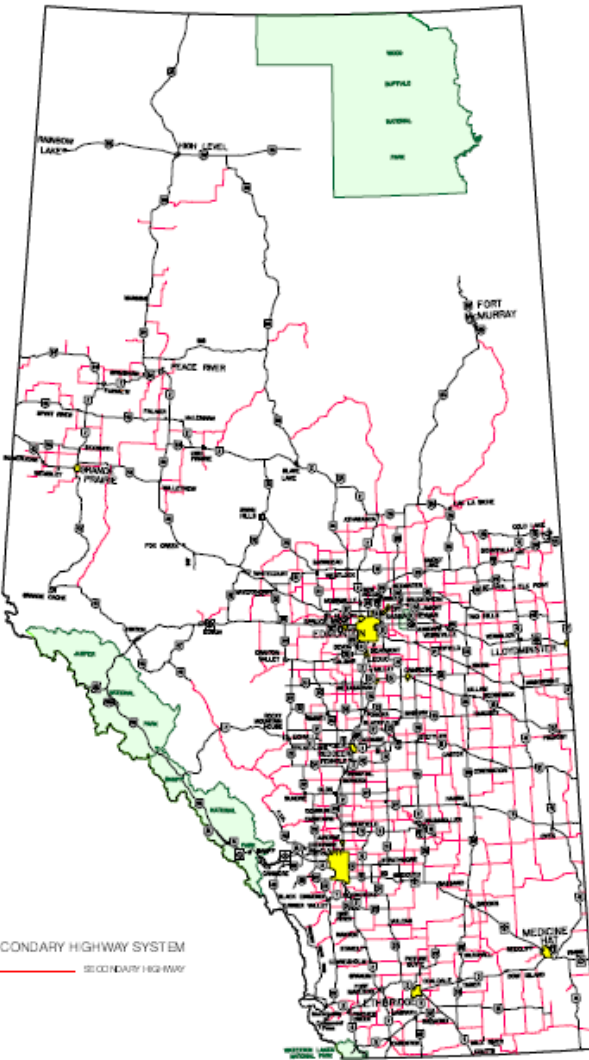
# Alberta Pipeline System



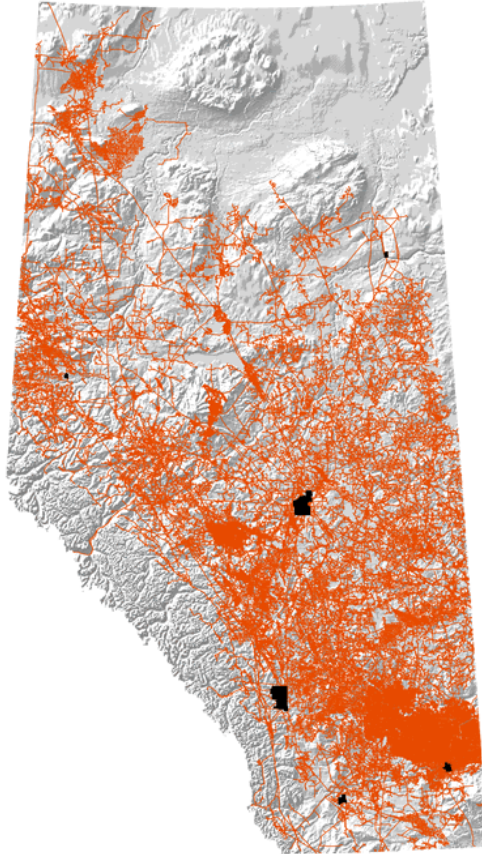
# Energy Pipeline



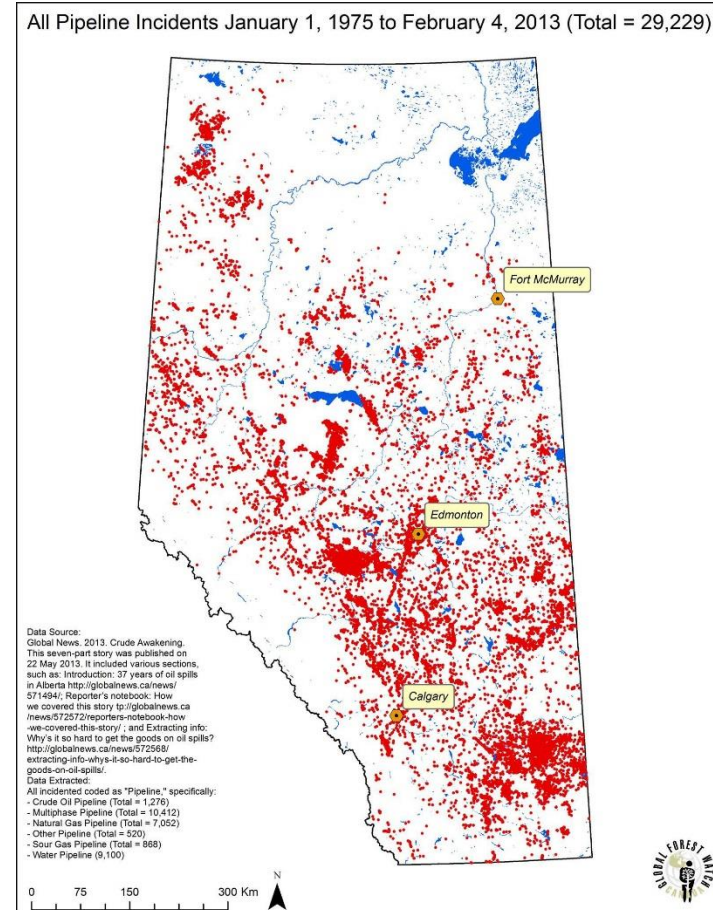
# Highway System



# Existing Pipelines



# Incidents since 1975



What kind of inspection is required?

# This info is from one of Canada's largest companies operations manuals, this is the entire section in regards to pipeline ROW inspection:

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- *RIGHT OF WAY INSPECTION AND MAINTENANCE*
- *1.0 PIPELINE PATROL & SURVEILLANCE (R11)*
- *Inspections of all operating pipeline rights-of-way (ROW) are to be scheduled by the Operations Supervisor and performed as required. The frequency of such inspections shall be dictated by pipeline service and condition, pipeline size, operating pressure, terrain, weather, population density and other operating or unusual conditions. Major losses in production shall initiate a pipeline right-of-way inspection in accordance with CSA Z662.*
- *The minimum frequency of a documented ROW inspection is annually. Additional ROW inspections shall be determined by considering risk of failure of the pipelines and the regional regulatory requirements on frequency of inspection. (R11)*
- *Refer to Appendix D - Right of Way Maintenance and Patrol Log form and Pipeline Inspection/Crossing Report for the appropriate documentation. ROW inspection results can also be captured by using other suitable methods, which can include the use of an acceptable electronic data capturing application such as HDMS or Abadata. These documents shall be retained for a minimum of 5 years. (R11)*
- *ROW inspections should be conducted more frequently than once a year if the pipeline ROW crosses or is near a higher risk area. Some examples of higher risk areas are: (R10)*
- *Railway or road crossings*
- *Water crossings (lake, river, stream, pond, slough, seasonal water body, etc.)*
- *Sour pipelines with residents nearby*
- *Liquid pipelines on a slope that would increase the spill area*
- *Vegetation on ROW shall be controlled to maintain clear visibility from the air and provide ready access for maintenance crews in accordance with CSA Z662. Special consideration shall be given to the inspection and maintenance of pipeline crossings of major utilities, other pipelines, railways, roads and water crossings.*
- *The purpose of these inspections is to monitor the condition of the right-of-way so that quick and appropriate remedial action can be taken when the system is damaged or the integrity of the system is threatened.*
- *Particular attention shall be given to the following: (R08)*
- *a) Loss of cover for below ground pipelines.*
- *b) Changes in vegetation.*
- *c) Erosion.*
- *d) Ice Effects.*
- *e) Scour.*
- *f) Soil Slides.*
- *g) Construction Activity.*
- *h) Seismic Activity.*
- *i) Dredging Operations.*
- *j) Subsidence or sinking of soil on right of way and water crossings.*
- *k) State of general housekeeping of above-ground piping and pipeline appurtenances.*
- *l) Missing, damaged or obscured pipeline identification markers.*
- *m) Stray H2S odors or other evidence of leaks.*
- *n) Drains accessible. (R11)*
- *o) Condition of supports, shoes and anchors (R11)*
- *p) Condition of physical barrier addressed in Clause 6.2 in Section 8.14 (R11)*

# Current methods of inspection

- The cheapest method possible for each site, with consideration to worker risk. Typically this means sending teams of 2 workers in a truck or off highway vehicle to perform a visual inspection and check off boxes on a form. While the cheapest, this is time consuming and puts workers at risk
- If the line is impossible or dangerous to access by ground, they may resort to full scale helicopter which requires pilots, engineer, and person performing the inspection. Most of the time the only record is still the checklist and a pen.
- Internal inspection with a pig. While providing the most detailed inspection of pipeline health, this process is expensive and involves downtime.



# Full Scale VS UAV

**\$5,400,000**



**Less than \$5,400,000. 3600:1**

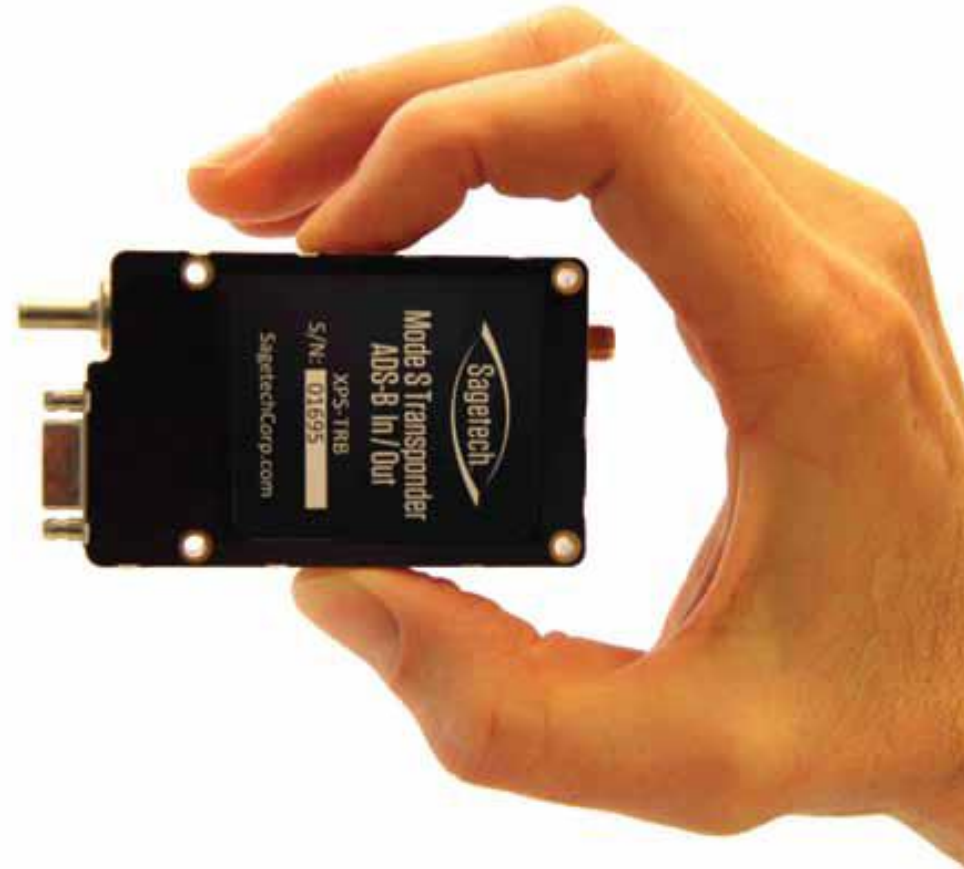


What is still required before UAV's are the standard tool for pipeline inspection?

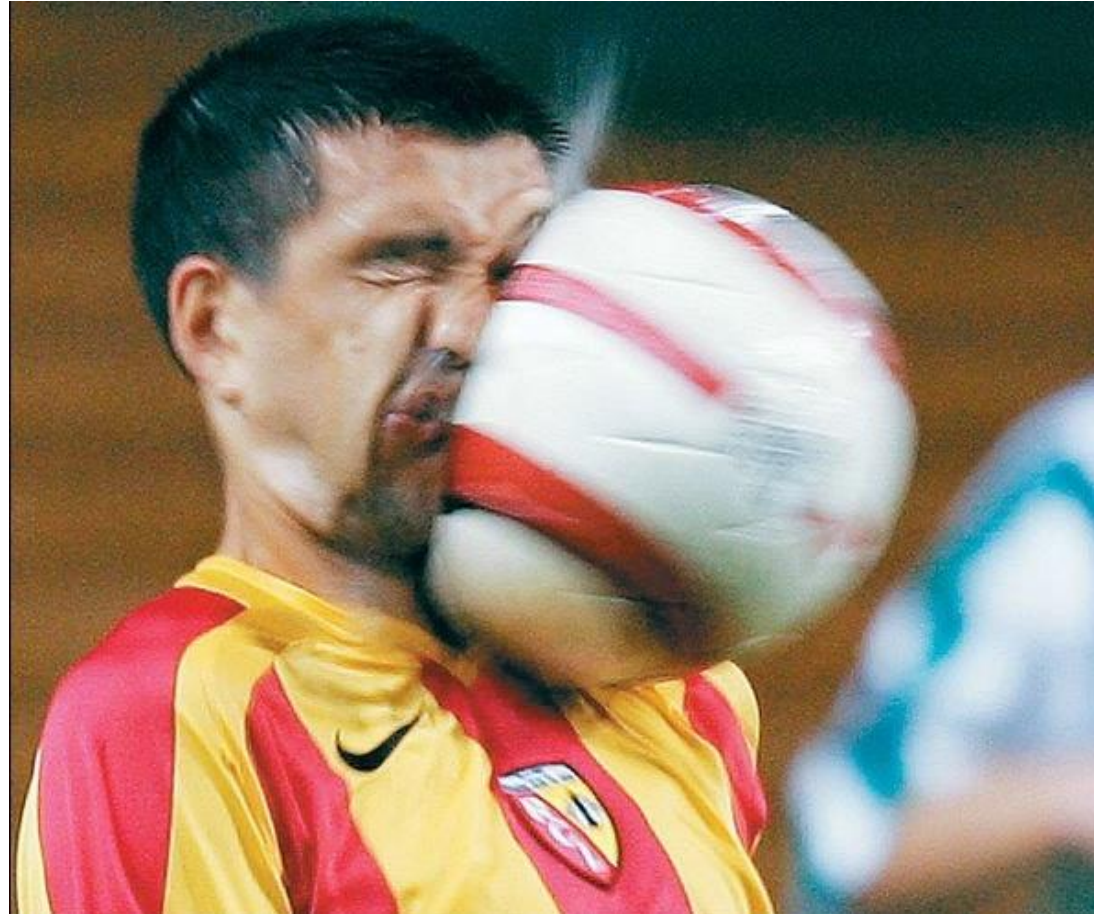
# Option 1 – Sense and avoid systems



# Option 2 - Transponders



## Option 3 – Minimize Energy



# Option 4 -

- Likely the most realistic for now.
- As an alternative use of all the following conditions may enable the operator to obtain a SFOC.
  - -Operating in only remote areas.
  - -Exceptional Mission planning and preparation
  - -Operating below 500' AGL as to not risk air traffic.
  - -safe UAV's. Meaning light weight, low speed, and reliable.
  - -Flexible UAV's. They will have to take off and land in a variety of environments, none of which will have a groomed runway.
  - -Inexpensive UAV's that the operator can afford to occasionally damage or lose.
  - -Cheap and legal long range wireless video, control, and telemetry system