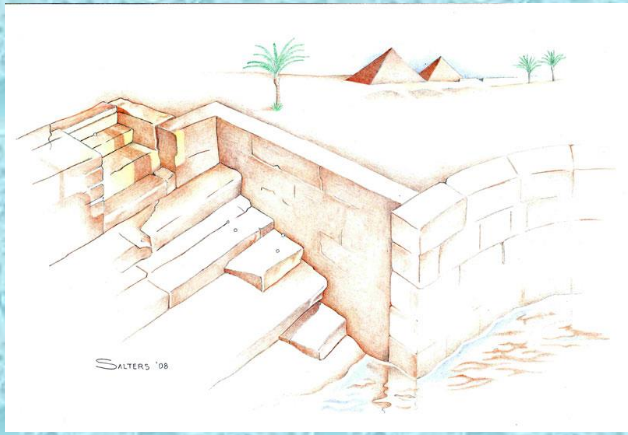
Modern Technology for an Ancient Practice

Automation and Hydraulic Modeling at Aberdeen-Springfield Canal Company

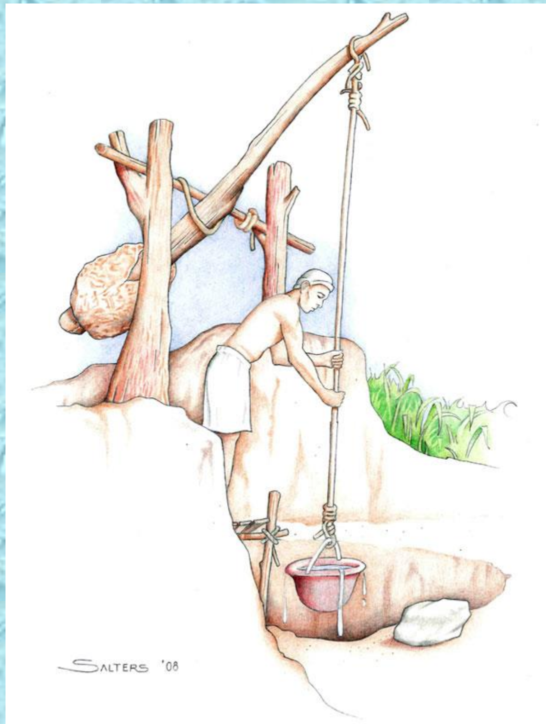
Steve Howser, General Manager

Irrigated agriculture is not new

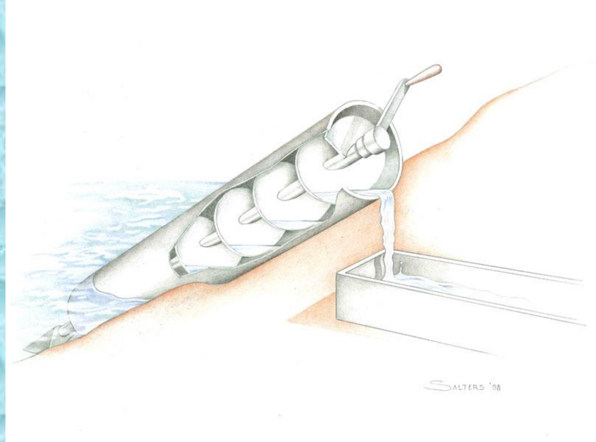
- Earliest archaeological evidence of irrigated agriculture dates to about 6,000 BCE in the Jordan Valley
- The earliest pictorial representation of irrigated agriculture is from Egypt and dates to around 3,100 BCE
- From about 3,000 BCE to 2,000 BCE irrigated agriculture spread throughout Persia, the Middle-East and westward. It also appeared around this time across the Asian continent.
- The Babylonian King Hammurabi was the first to institute water regulations in his kingdom
    - Proportional water distribution based on acreage
    - Farmer's responsibility for maintaining ditches on their property
    - Collective administration of the canal by all users
- In the western hemisphere irrigation was practiced by the Aztecs and Mayans. The Hohokam, in central Arizona, built at least 700 miles of canals in the 14^{th} century.



Nilometer ca. 3,500 BCE - steps were used as a staff gauge to measure water level

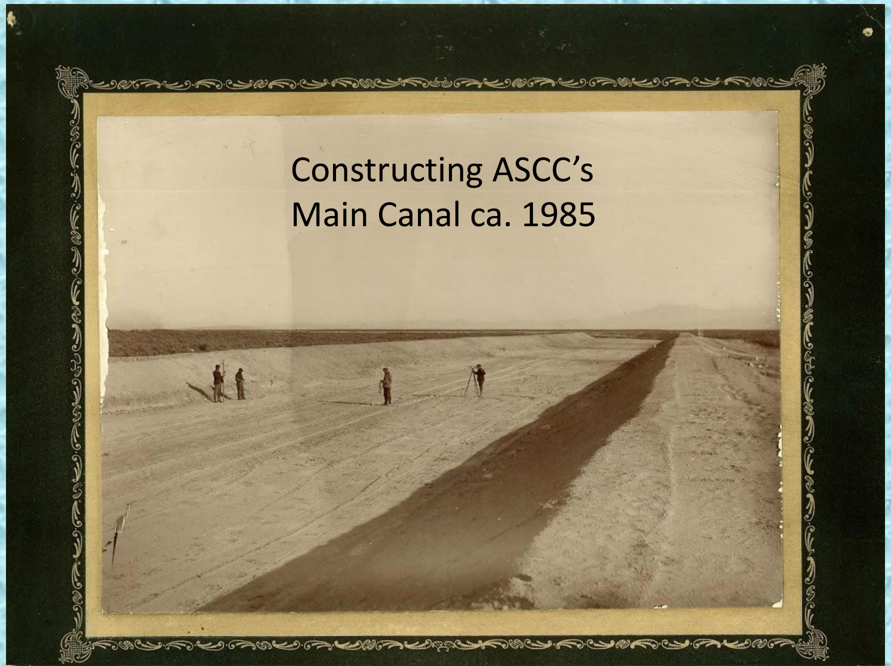


Shaduf ca. 1,700 BC – device for lifting water into canals

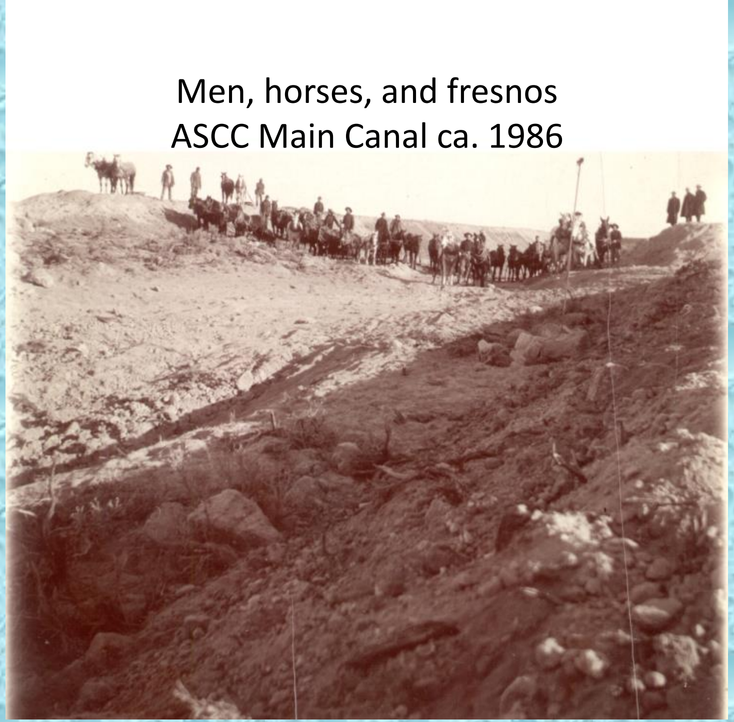


Archimedes screw

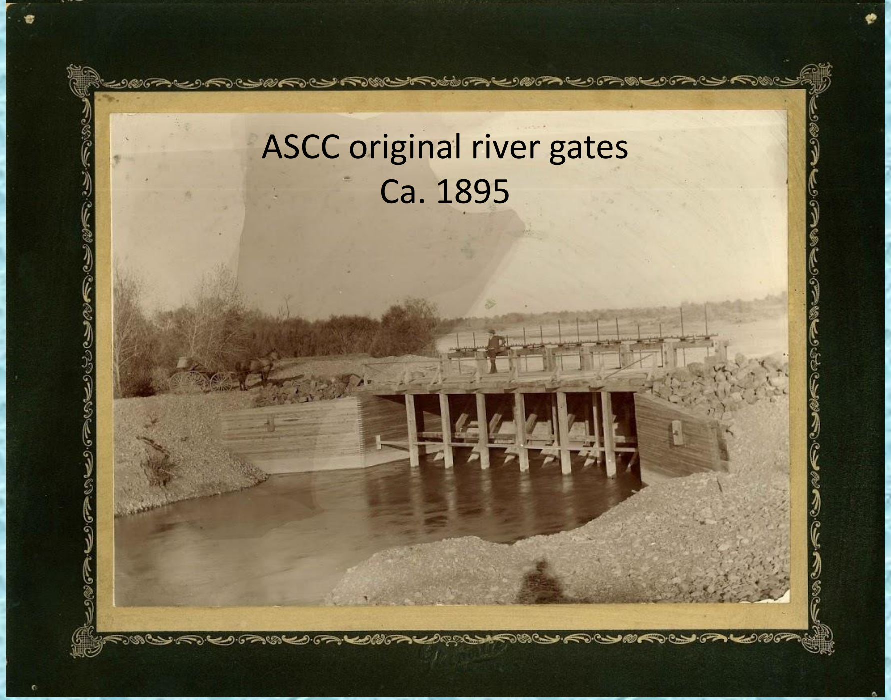
Gravity



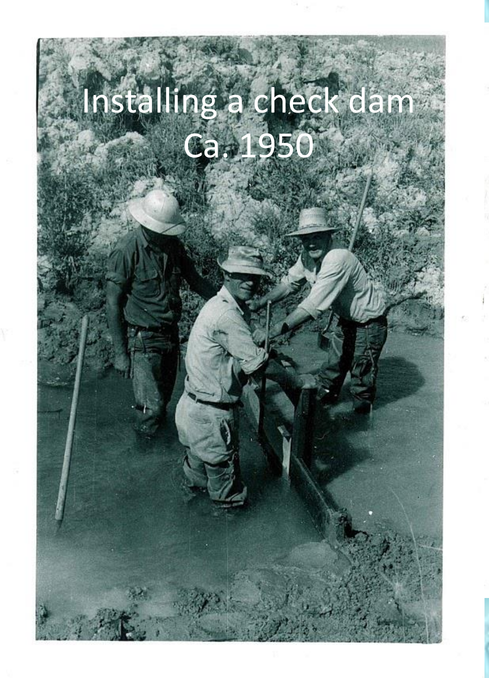
Constructing ASCC's
Main Canal ca. 1985



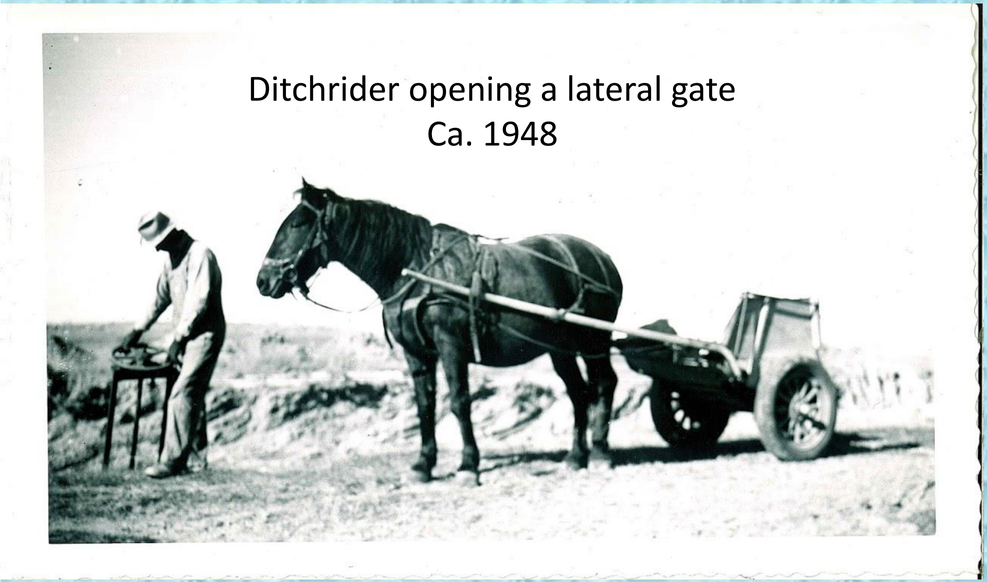
Men, horses, and fresnos
ASCC Main Canal ca. 1986



ASCC original river gates
Ca. 1895



Installing a check dam
Ca. 1950



Ditchrider opening a lateral gate
Ca. 1948

Irrigation today

- Starting in the mid-1800’s people started diverting water from the Snake River for irrigation
- The Carey Act and Reclamation Act started a new era in irrigated agriculture, bringing millions of acres under production in the 17 western states, with about 1 million acres developed in Idaho.
- By the early 1900’s it became apparent that the ‘natural flow’ of the river was too inconsistent to provide a sufficient supply of water every year. The first dam on Jackson Lake was constructed in 1906, and later rebuilt by the USBR.
- Today, the upper Snake River reservoir system has a capacity of approximately 4 MAF

Canal Management Requirements

- Equitable (proportional) distribution based on acreage
- Accurate measurement to insure the above
- Dependable delivery flows (much more important since the advent of sprinkler irrigation)

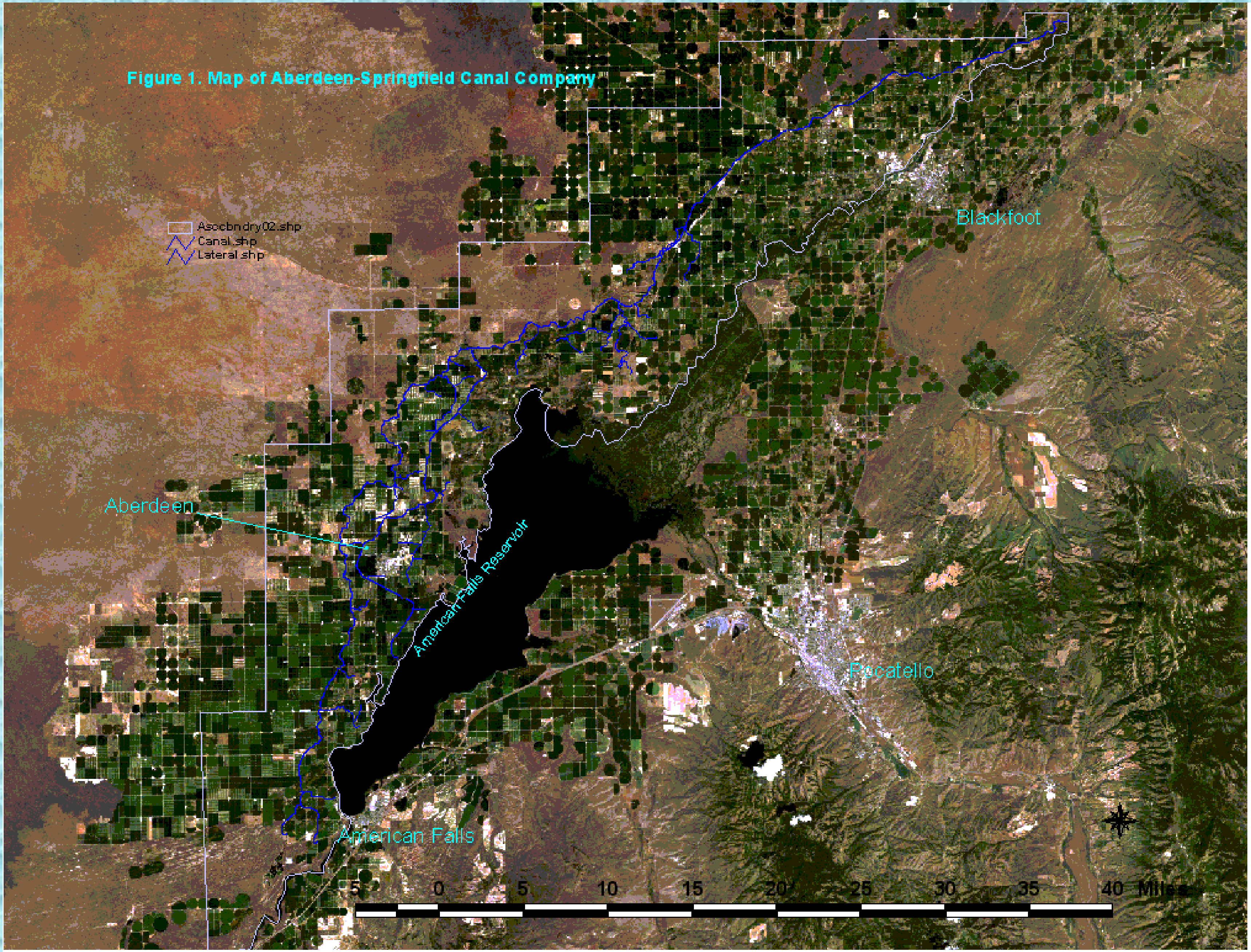


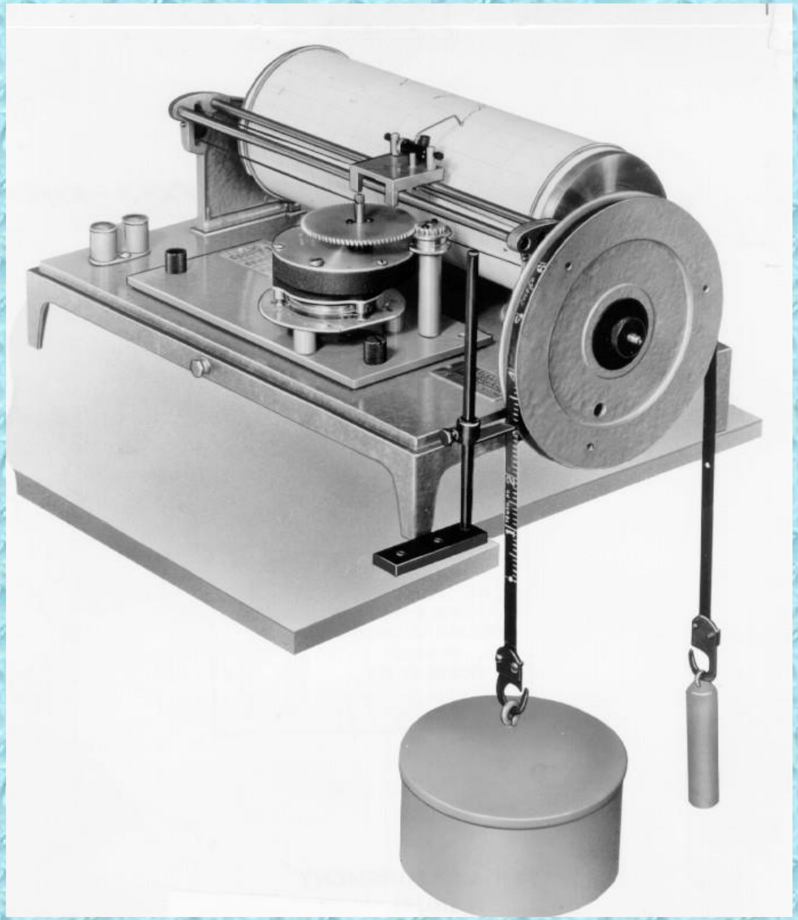
Figure 1. Map of Aberdeen-Springfield Canal Company
Asocbndry02.shp
Canal.shp
Lateral.shp
Blackfoot
Aberdeen
American Falls Reservoir
Pocatello
American Falls
5 0 5 10 15 20 25 30 35 40 Miles

Traditional Operation

- Farmers order their water 48 hours in advance
- Watermaster totals deliveries and makes twice daily changes to diversion from river as necessary
- Ditchriders visit each head gate each day to manually measure delivery
- Intermediate control structures (checks) adjusted once daily

Problem – bad things happen in the middle of the night

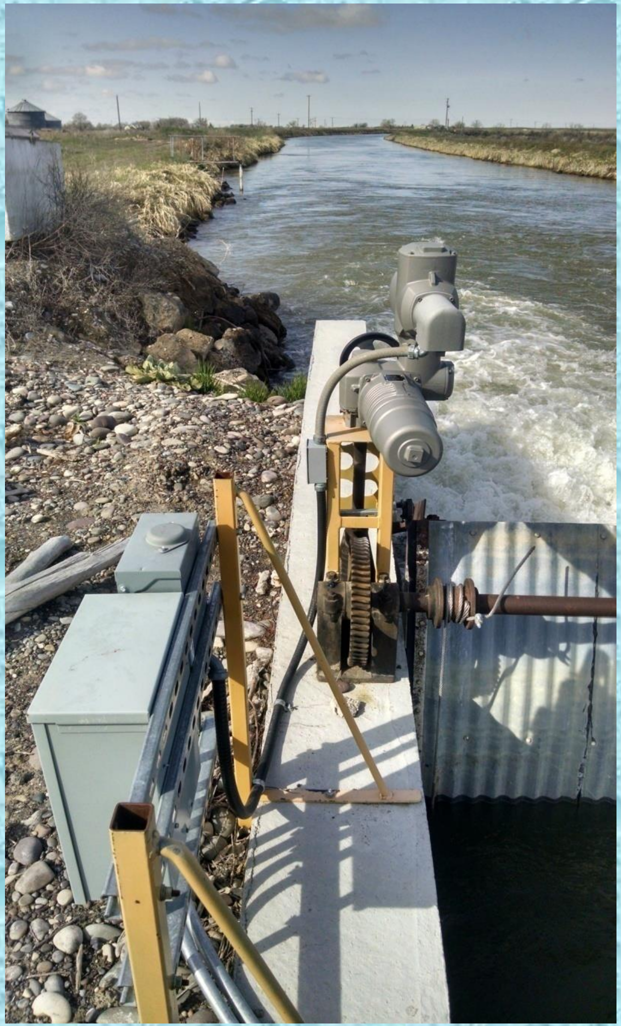
Water level recorder ca. 1950



Weirs – devices of known area. Water elevation on upstream side is measured, formulae applied, and flow calculated

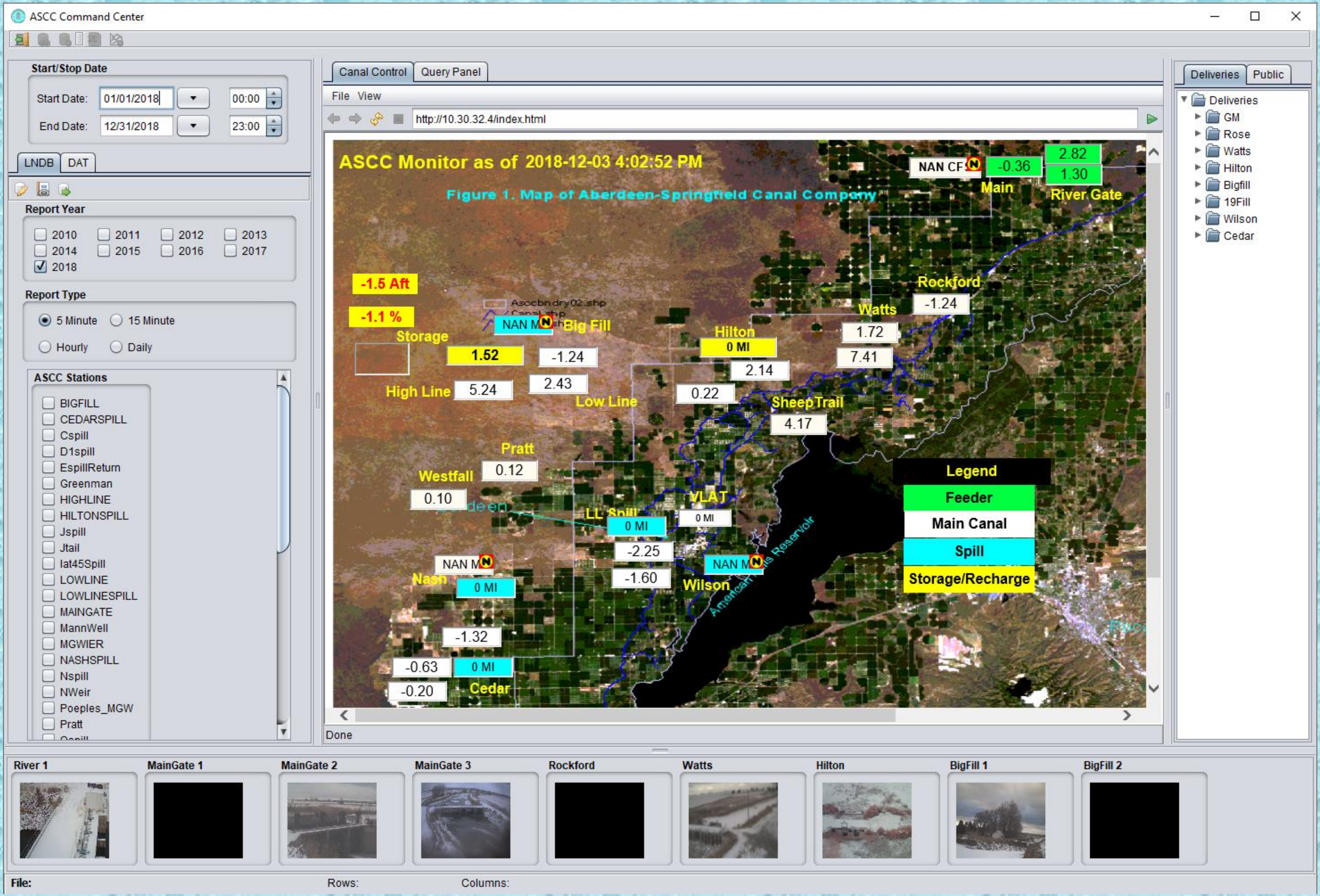
1950's – ASCC begins automating check dams

SCADA: Real-time monitoring and control

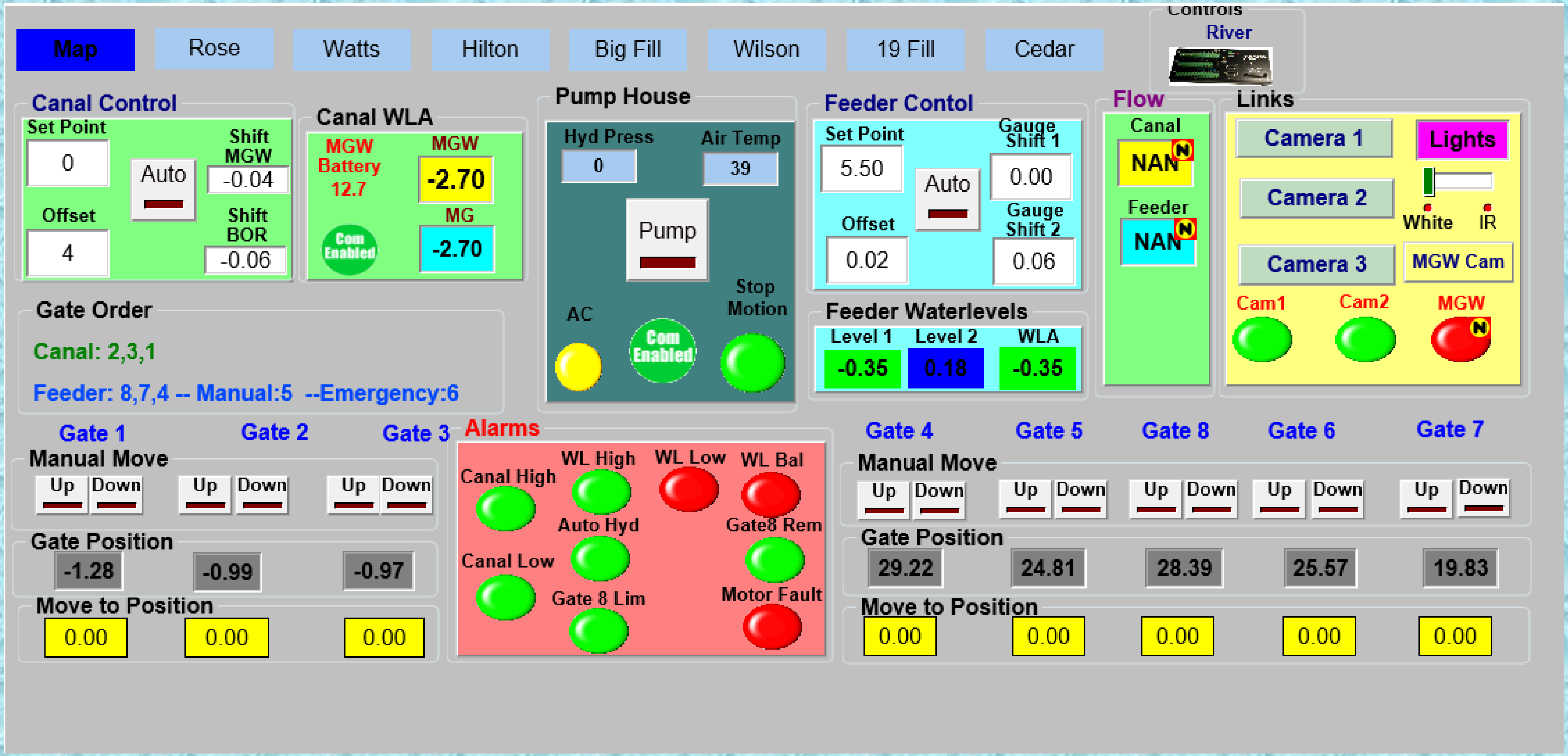


ASCC Current Deployment

- Dataloggers – 45 total (Campbell Scientific CR 1000’s, CR 800’s, CR 300’s)
  - 17 control stations
  - 28 monitoring stations
- Sensors
  - 60 water level sensors (pressure transducers)
  - 30 gate position sensors
  - 4 mag-flow sensors (wells)
- Servers
  - 2 real-time data collection and webserver
  - 1 long-term data storage (SQL)


ASCC Command Center
Start/Stop Date
Start Date: 01/01/2018 00:00
End Date: 12/31/2018 23:00
LNDB
DAT
Report Year
2010
2011
2012
2013
2014
2015
2016
2017
2018
Report Type
5 Minute
15 Minute
Hourly
Daily
ASCC Stations
BIGFILL
CEDARSPILL
Cspill
D1spill
EspillReturn
Greenman
HIGHLINE
HILTONSPILL
Jspill
Jtail
lat45Spill
LOWLINE
LOWLINESPILL
MAINGATE
MannWell
MGWIER
NASHSPILL
Nspill
NWeir
Poeples_MGW
Pratt
Canal Control
Query Panel
File View
http://10.30.32.4/index.html
ASCC Monitor as of 2018-12-03 4:02:52 PM
Figure 1. Map of Aberdeen-Springfield Canal Company
NAN CFS
-0.36
Main
2.82
1.30
River Gate
Rockford
-1.24
Watts
1.72
7.41
Hilton
0 MI
2.14
-1.5 Aft
-1.1 %
Storage
1.52
NAN M
Big Fill
-1.24
High Line
5.24
2.43
Low Line
0.22
Sheep Trail
4.17
Pratt
0.12
Westfall
0.10
VLAT
0 MI
LL Spill
0 MI
-2.25
-1.60
NAN M
Wilson
American Falls Reservoir
NAN M
Nash
0 MI
-1.32
-0.63
0 MI
-0.20
Cedar
Legend
Feeder
Main Canal
Spill
Storage/Recharge
Done
Deliveries
Public
Deliveries
GM
Rose
Watts
Hilton
Bigfill
19Fill
Wilson
Cedar
River 1
MainGate 1
MainGate 2
MainGate 3
Rockford
Watts
Hilton
BigFill 1
BigFill 2
File:
Rows:
Columns:

ASCC Main Gate Control



Capacity Issues

- Beginning in the late 1920's ASCC began experiencing capacity limitations at peak demand (June-August)
  - Flood irrigation is amenable to decreased delivery due to capacity limitations (e.g. normal requirement is 100 miners inches, proportional delivery is set at 80% - flood irrigation just takes longer)
- In the mid-1950's water users began installing sprinkler systems
  - Pumps and sprinklers will not operate on 'percentage' delivery
  - Farmers begin installing supplemental ground water wells
  - Convenience results in full-time use of wells, decreasing demand on the canal
- By the late 1970's, enough acres were being irrigated exclusively by wells that capacity issues were alleviated.
- SWC/IGWA settlement agreement is forcing acres back on the canal

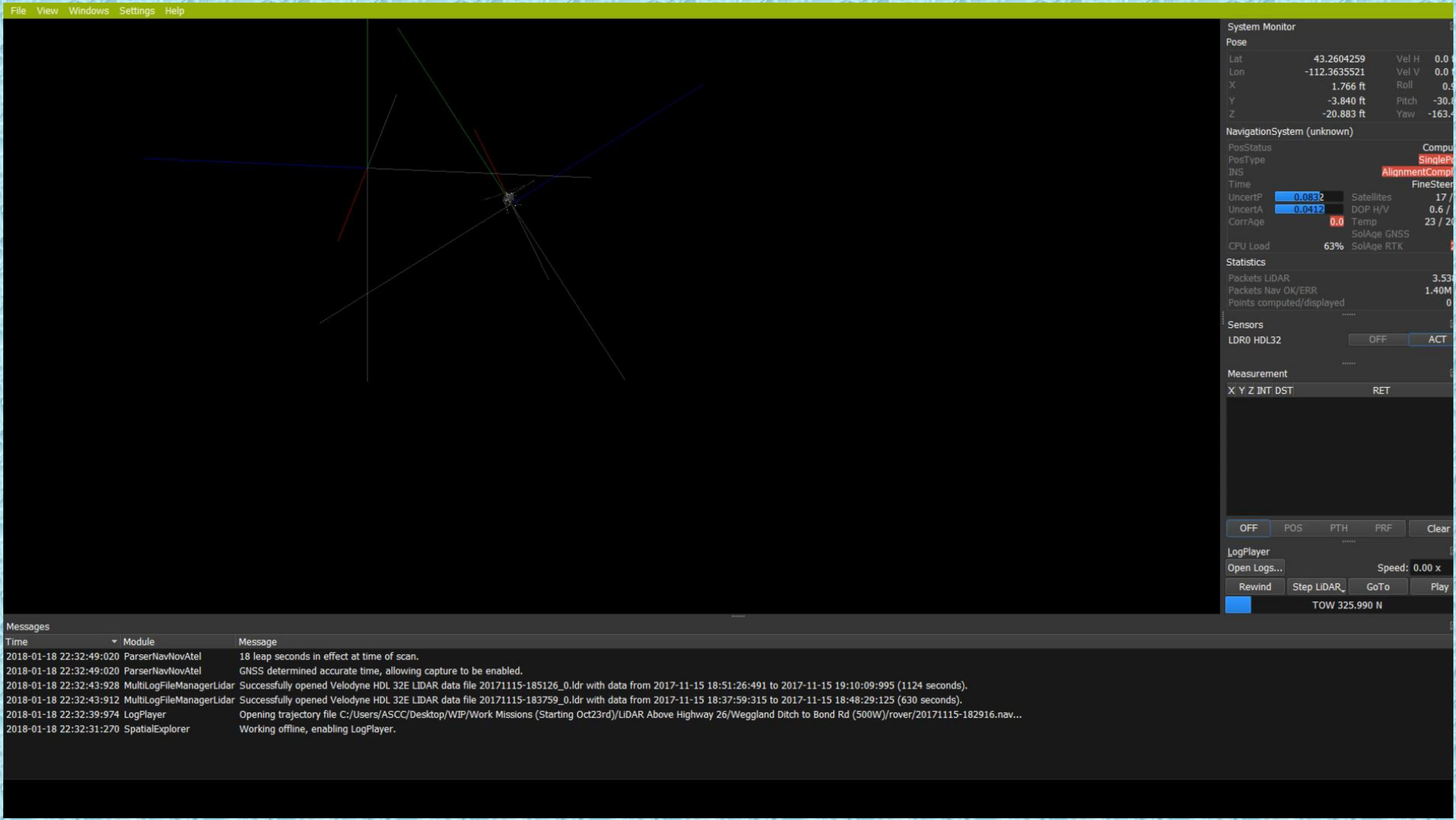
Modeling Capacity

- In 2016 the ASCC Board of Directors authorized a canal capacity and flow modeling project
  - Requires detailed survey of entire system
  - State of the Art computer modeling will be used to determine the ‘choke points’ on the system to allow good decisions about where to improve

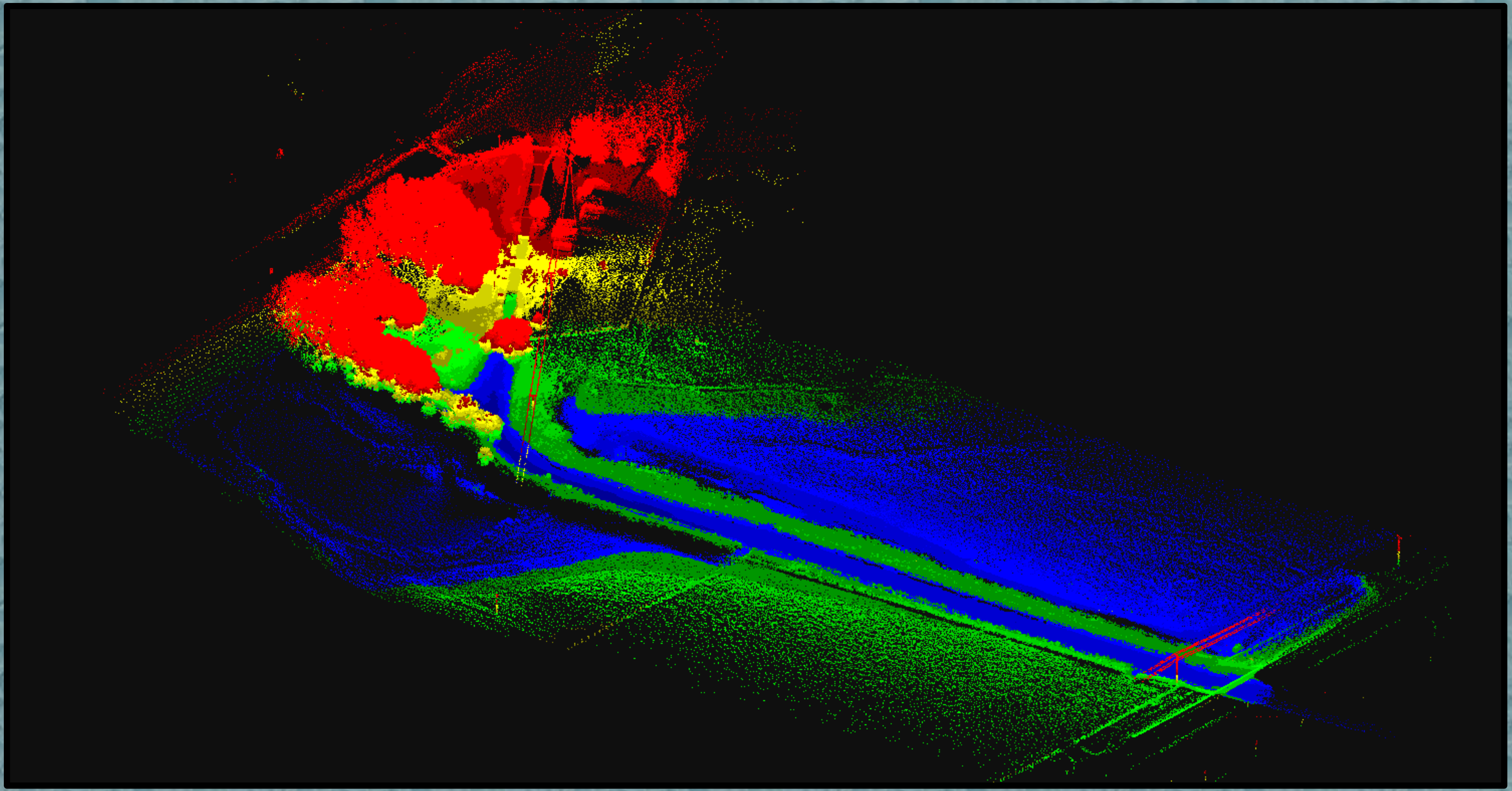
- With approximately 170 miles of canals and laterals, traditional survey methods would take 3 years and cost over $150,000
- LiDAR survey could be completed in a single year for a cost of $175,000

LiDAR unit

Backpack mount


File View Windows Settings Help
System Monitor
Pose
Lat 43.2604259
Lon -112.3635521
X 1.766 ft
Y -3.840 ft
Z -20.883 ft
Vel H
Vel V
Roll
Pitch
Yaw
NavigationSystem (unknown)
PosStatus
PosType
INS
Time
UncertP 0.0832
UncertA 0.0412
CorrAge 0.0
CPU Load 63%
Satellites
DOP H/V
Temp
SolAge GNSS
SolAge RTK
Statistics
Packets LiDAR
Packets Nav OK/ERR
Points computed/displayed
Sensors
LDR0 HDL32
OFF
ACT
Measurement
X Y Z INT DST
RET
OFF POS PTH PRF Clear
LogPlayer
Open Logs...
Speed: 0.00 x
Rewind
Step LiDAR
GoTo
Play
TOW 325.990 N
Messages
Time
Module
Message
2018-01-18 22:32:49:020 ParserNavNovAtel 18 leap seconds in effect at time of scan.
2018-01-18 22:32:49:020 ParserNavNovAtel GNSS determined accurate time, allowing capture to be enabled.
2018-01-18 22:32:43:928 MultiLogFileManagerLidar Successfully opened Velodyne HDL 32E LIDAR data file 20171115-185126_0.ldr with data from 2017-11-15 18:51:26:491 to 2017-11-15 19:10:09:995 (1124 seconds).
2018-01-18 22:32:43:912 MultiLogFileManagerLidar Successfully opened Velodyne HDL 32E LIDAR data file 20171115-183759_0.ldr with data from 2017-11-15 18:37:59:315 to 2017-11-15 18:48:29:125 (630 seconds).
2018-01-18 22:32:39:974 LogPlayer Opening trajectory file C:/Users/ASCC/Desktop/WIP/Work Missions (Starting Oct23rd)/LiDAR Above Highway 26/Weggland Ditch to Bond Rd (500W)/rover/20171115-182916.nav...
2018-01-18 22:32:31:270 SpatialExplorer Working offline, enabling LogPlayer.

LiDAR survey (this point cloud contains 368,478,275 points)



Processing removes vegetation