Planning and Managing a Farmer-Implemented ATM involving a Partial Transfer of Consumptive Use Water

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Regenesis Management Group

https://www.regenmg.com

Presentation:

- RegenesisMG and the research team.
- Background on water rights under prior appropriation.
- Consideration of alternative farming practices.
- Implementation strategies.
- Proof of concept projects funded by CWCB.
- Discussion / questions.

Who we are:

Regenesis MANAGEMENT GROUP

swiim™

Underpinned by researchers:

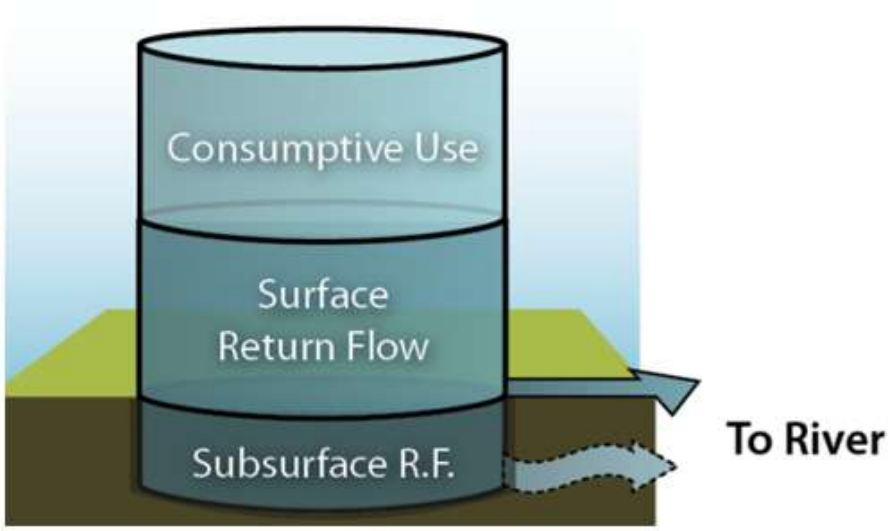
USDA

ars Agricultural Research Service

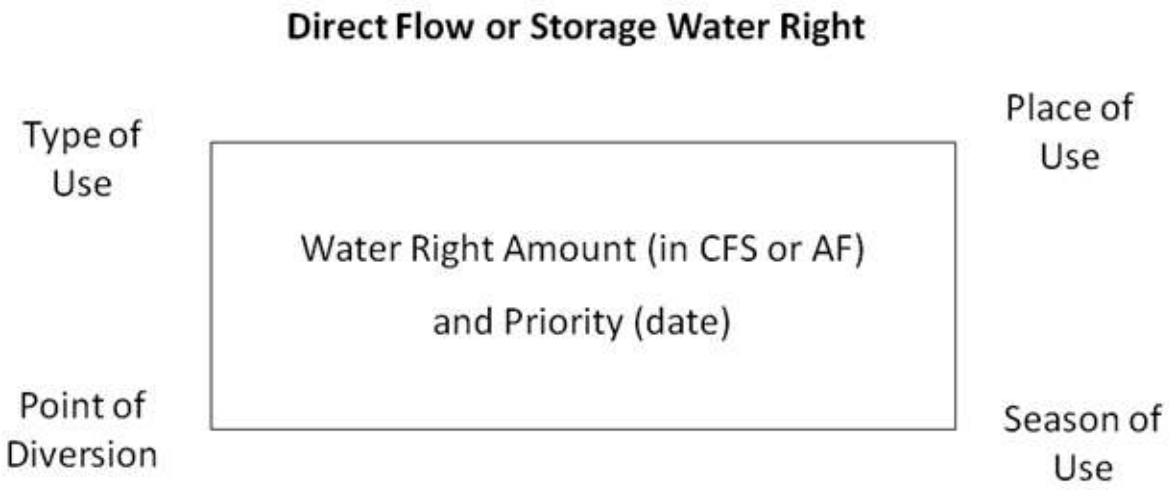
Colorado State University

Ag to urban water transfers:

- Driven by population growth and municipal interests in developing a safe yield with their water supplies.
- Often accomplished with “buy and dry” strategies.
- Question: can we avoid “buy and dry”?
  - allow a farmer to part off a portion of their consumptive use (CU) water
  - encourage sustainable farming and regional viability
- Some farmers will evaluate their future operations s a CU water budget and ask themselves if they wish to adopt a package of changed practices in order to see a new and relatively low risk revenue stream added into their existing operations.



Quantification of Historic Consumptive Use Water



Decreed Water Rights under Prior Appropriation

SWIIM®

Sustainable Water and Innovative Irrigation Management®

SWIIM is a technology package:

- A mathematical optimization.
- GIS mapping of the farm.
- SCADA-based monitoring.
- Wireless communications.
- Internet, server-based delivery of software.
- Instrumentation:
  - Water measurement.
  - Soil moisture measurement.
  - Remote sensing.

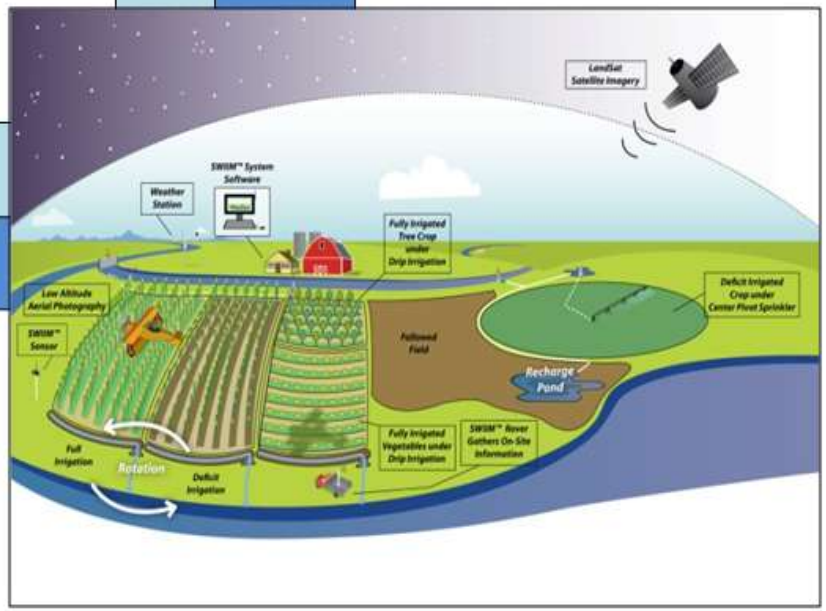
SWIIM™ System

SWIIM Planner

- GIS farm data entry
- Historic net returns
- Acceptable practices
- Mathematical optimization

SWIIM Manager

- SCADA Monitoring
- Water balance reporting
- Soil moisture sensing
- Remote sensing



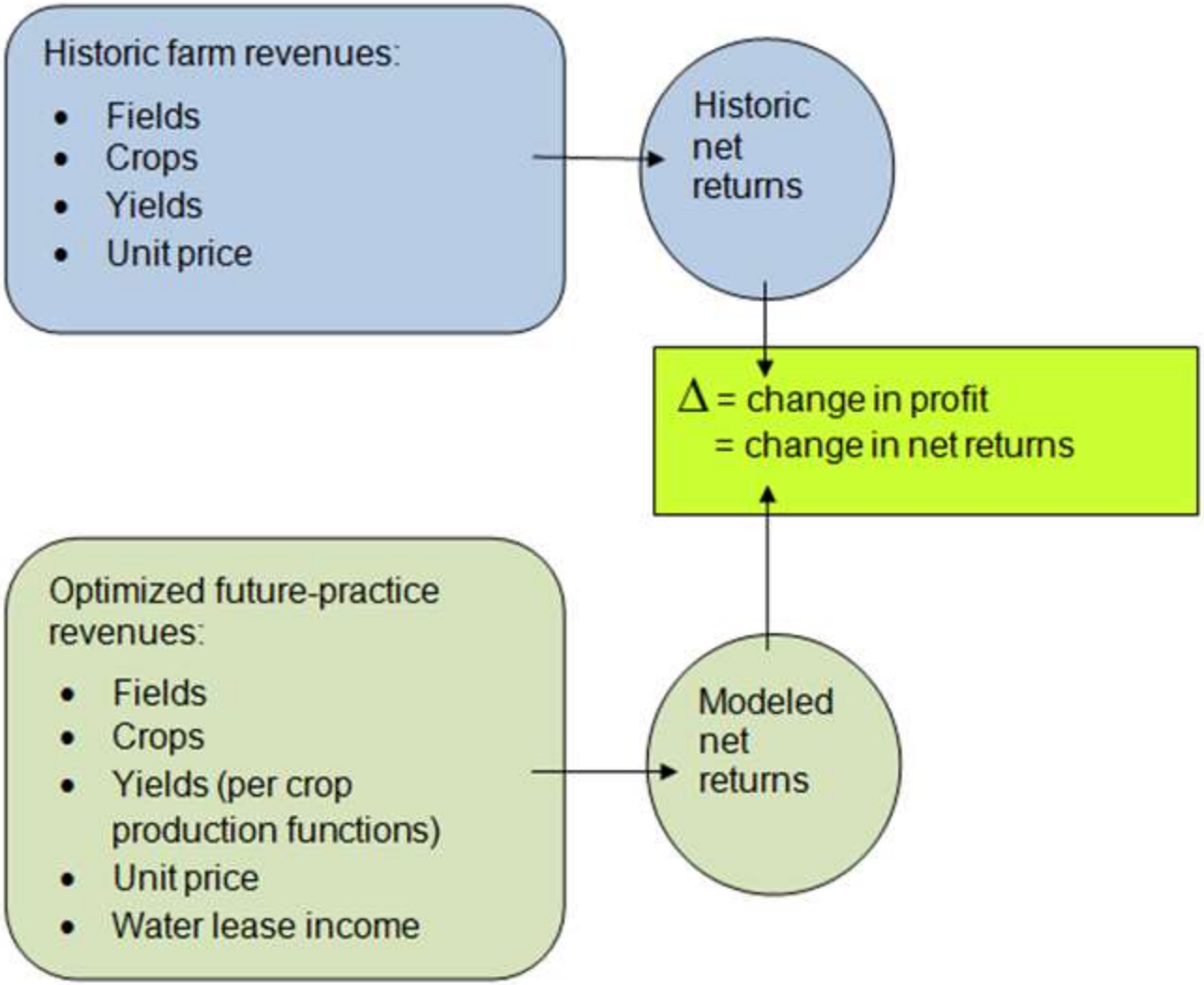
Operational simulation:

- Fields.
- Crops.
- Practices.
- Input costs.
- Crop prices.

http://www.nass.usda.gov/

Mathematical optimization:

- Objective function.
- Constraints.
- Decision Variables.
- Parameters.


Historic farm revenues:
Fields
Crops
Yields
Unit price
Historic net returns
Δ = change in profit
= change in net returns
Optimized future-practice revenues:
Fields
Crops
Yields (per crop production functions)
Unit price
Water lease income
Modeled net returns

Potential for changed farming practices:

- Deficit irrigation of selected crops.
- Crop rotations.
- Introduction of new crops including perennial crops.
- Permanent fallowing or rotational fallowing.
- Introduction of dryland crops.
- Continued full irrigation of selected crops.
- Combinations of the above.

What is
deficit irrigation?

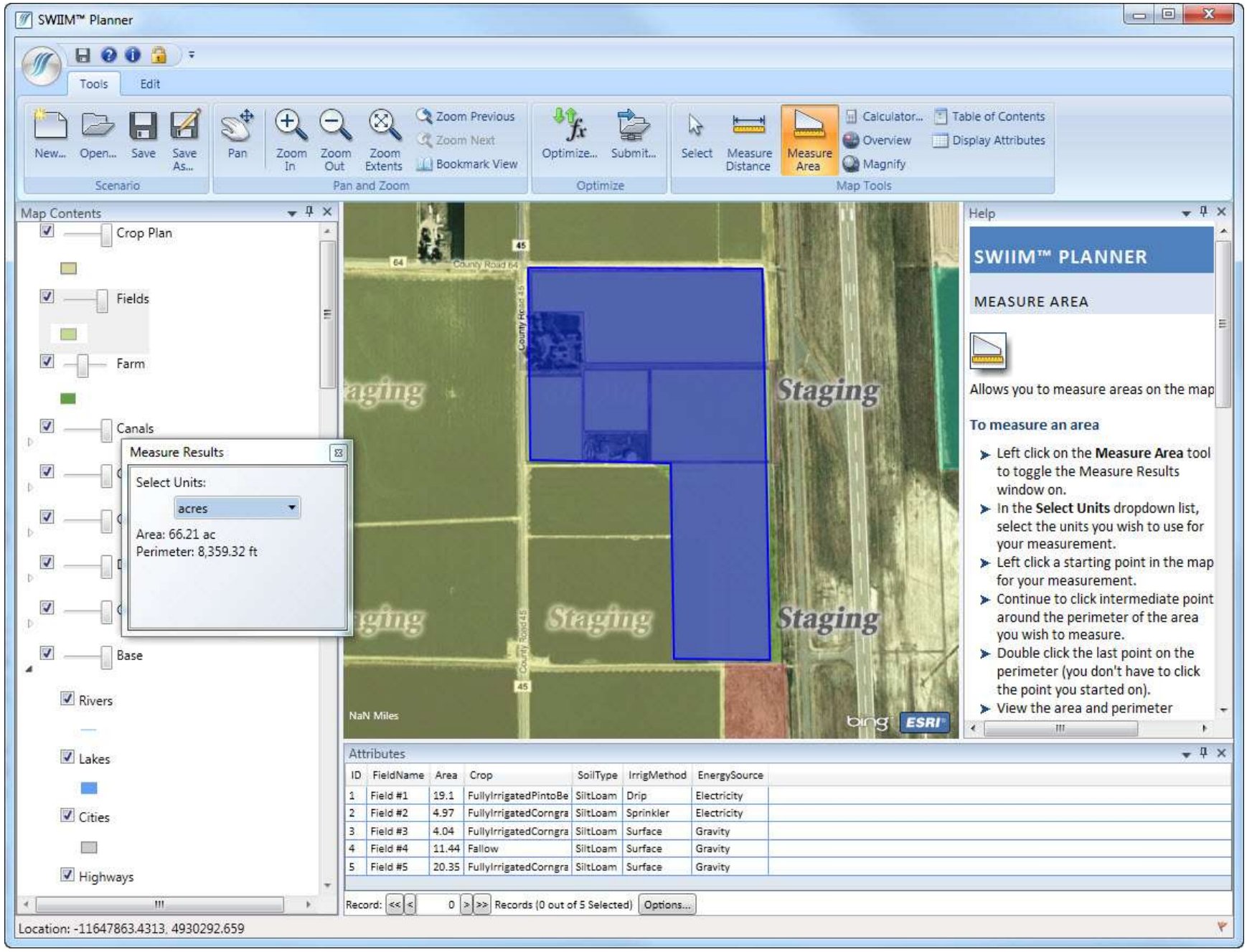
Deficit irrigation …

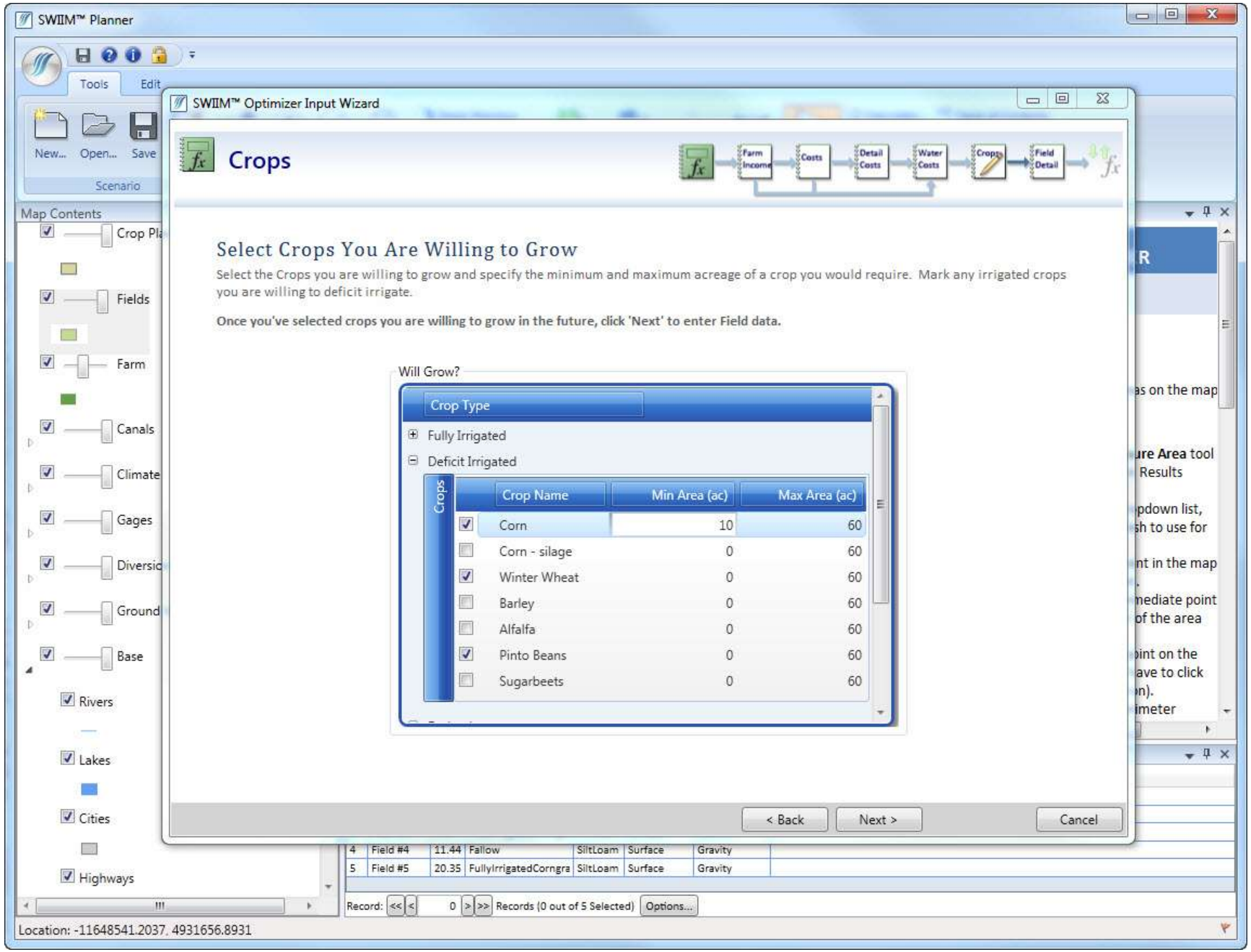
Irrigation that allows stress in a significant fraction of the (field) at times during the season.

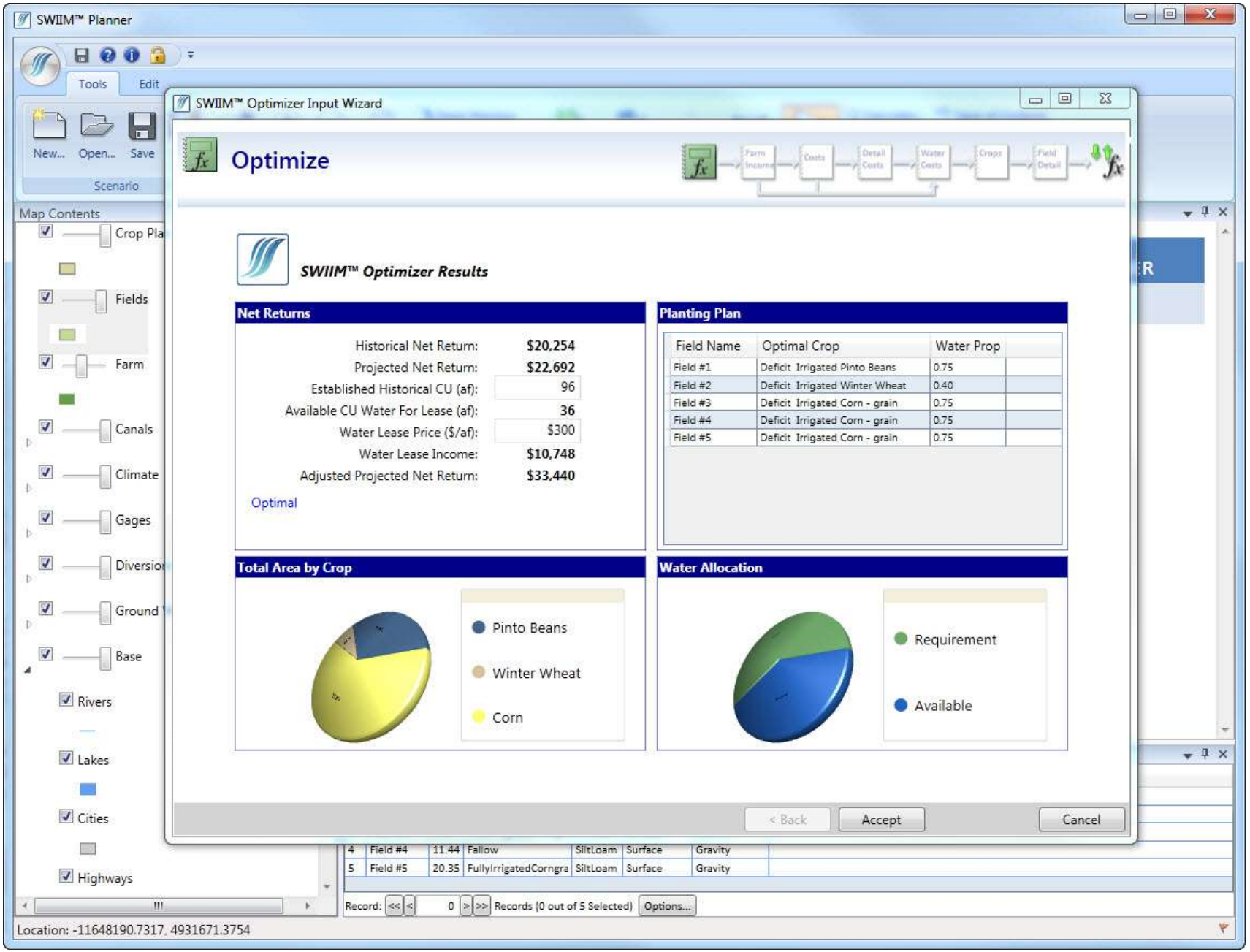
– Marshall English, Oregon State Univ.

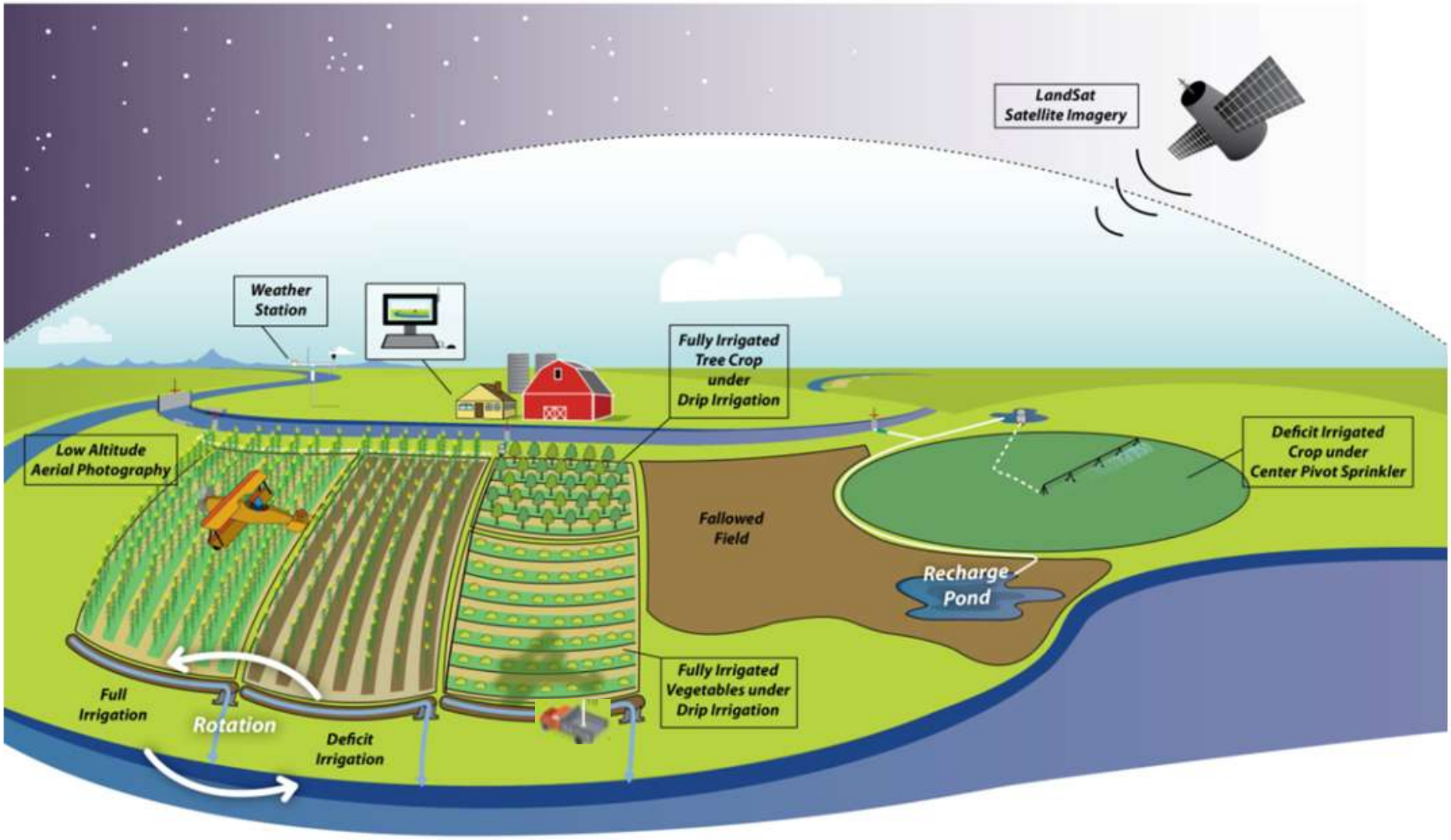
Deliberately tolerating stress for maximizing the productivity of water. -- Sam Geerts, Univ. of Leuven, Belgium

Irrigation at a level under the expectation of reduced crop yield with economics justifying the deficit. -- Freddie Lamb, Kansas State Univ.


SWIIM™ Planner
Tools
Edit
New...
Open...
Save
Save As...
Scenario
Pan
Zoom In
Zoom Out
Zoom Extents
Zoom Previous
Zoom Next
Bookmark View
Pan and Zoom
Optimize...
Submit...
Optimize
Select
Measure Distance
Measure Area
Calculator...
Overview
Magnify
Table of Contents
Display Attributes
Map Tools
Map Contents
Crop Plan
Fields
Farm
Canals
Base
Rivers
Lakes
Cities
Highways
Measure Results
Select Units:
acres
Area: 66.21 ac
Perimeter: 8,359.32 ft
Staging
NaN Miles
Help
SWIIM™ PLANNER
MEASURE AREA
Allows you to measure areas on the map
To measure an area
Left click on the Measure Area tool to toggle the Measure Results window on.
In the Select Units dropdown list, select the units you wish to use for your measurement.
Left click a starting point in the map for your measurement.
Continue to click intermediate point around the perimeter of the area you wish to measure.
Double click the last point on the perimeter (you don't have to click the point you started on).
View the area and perimeter
Attributes
ID FieldName Area Crop SoilType IrrigMethod EnergySource
1 Field #1 19.1 FullyIrrigatedPintoBe SiltLoam Drip Electricity
2 Field #2 4.97 FullyIrrigatedCorngra SiltLoam Sprinkler Electricity
3 Field #3 4.04 FullyIrrigatedCorngra SiltLoam Surface Gravity
4 Field #4 11.44 Fallow SiltLoam Surface Gravity
5 Field #5 20.35 FullyIrrigatedCorngra SiltLoam Surface Gravity
Record: 0 Records (0 out of 5 Selected) Options...
Location: -11647863.4313, 4930292.659


SWIIM™ Planner
Tools
Edit
New...
Open...
Save
Scenario
Map Contents
Crop Pl
Fields
Farm
Canals
Climate
Gages
Diversio
Ground
Base
Rivers
Lakes
Cities
Highways
SWIIM™ Optimizer Input Wizard
Crops
Farm Income
Costs
Detail Costs
Water Costs
Crops
Field Detail
Select Crops You Are Willing to Grow
Select the Crops you are willing to grow and specify the minimum and maximum acreage of a crop you would require. Mark any irrigated crops you are willing to deficit irrigate.
Once you've selected crops you are willing to grow in the future, click 'Next' to enter Field data.
Will Grow?
Crop Type
Fully Irrigated
Deficit Irrigated
Crops
Crop Name
Min Area (ac)
Max Area (ac)
Corn 10 60
Corn - silage 0 60
Winter Wheat 0 60
Barley 0 60
Alfalfa 0 60
Pinto Beans 0 60
Sugarbeets 0 60
< Back
Next >
Cancel
4 Field #4 11.44 Fallow SiltLoam Surface Gravity
5 Field #5 20.35 FullyIrrigatedCorngra SiltLoam Surface Gravity
Record: 0 Records (0 out of 5 Selected) Options...
Location: -11648541.2037, 4931656.8931

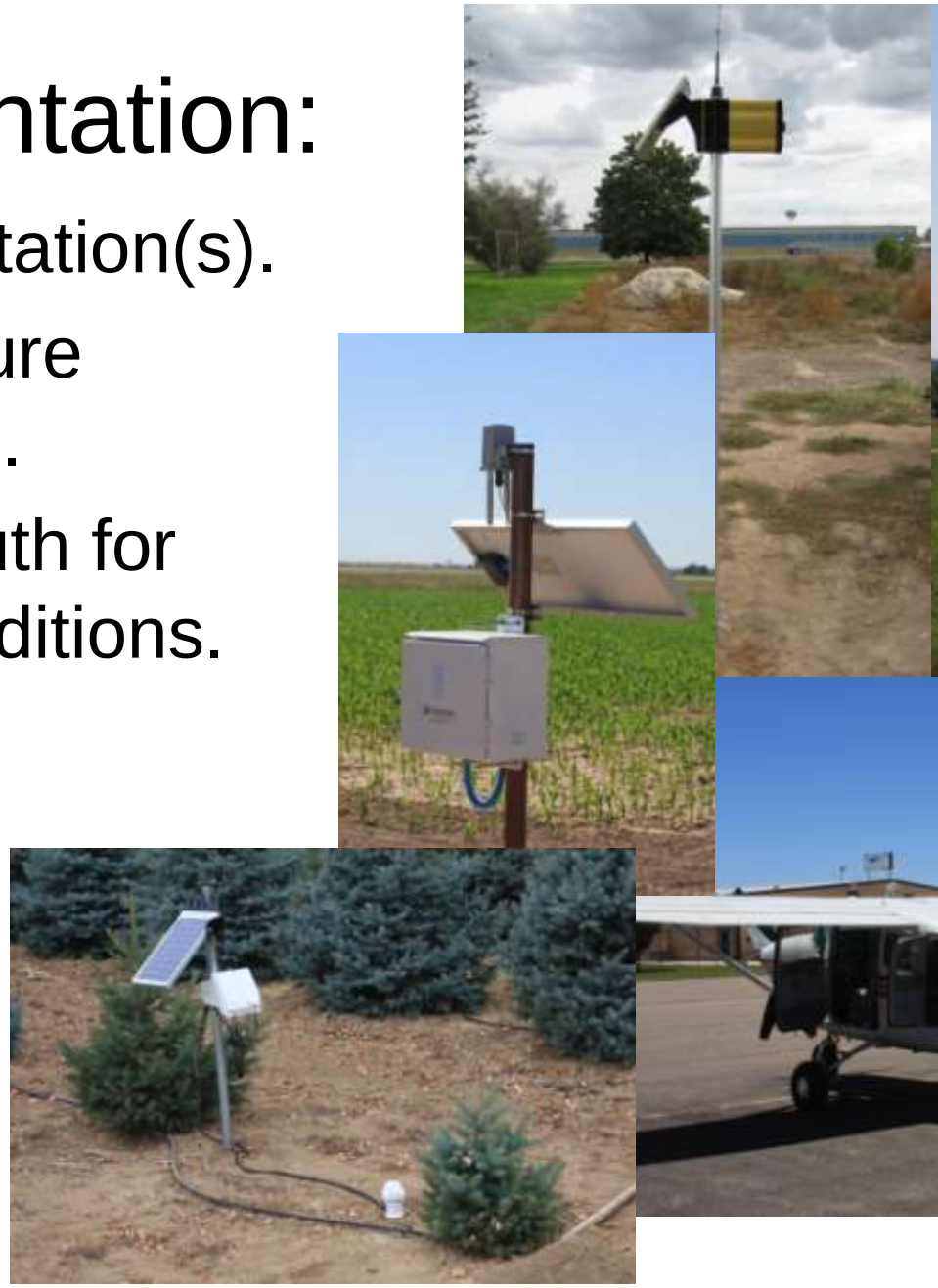

SWIIM™ Planner
Tools
Edit
New...
Open...
Save
Scenario
Map Contents
Crop Pla
Fields
Farm
Canals
Climate
Gages
Diversio
Ground
Base
Rivers
Lakes
Cities
Highways
SWIIM™ Optimizer Input Wizard
Optimize
SWIIM™ Optimizer Results
Net Returns
Historical Net Return: $20,254
Projected Net Return: $22,692
Established Historical CU (af): 96
Available CU Water For Lease (af): 36
Water Lease Price ($/af): $300
Water Lease Income: $10,748
Adjusted Projected Net Return: $33,440
Optimal
Planting Plan
Field Name | Optimal Crop | Water Prop
Field #1 | Deficit Irrigated Pinto Beans | 0.75
Field #2 | Deficit Irrigated Winter Wheat | 0.40
Field #3 | Deficit Irrigated Corn - grain | 0.75
Field #4 | Deficit Irrigated Corn - grain | 0.75
Field #5 | Deficit Irrigated Corn - grain | 0.75
Total Area by Crop
Pinto Beans
Winter Wheat
Corn
Water Allocation
Requirement
Available
< Back
Accept
Cancel
4 Field #4 11.44 Fallow SiltLoam Surface Gravity
5 Field #5 20.35 FullyIrrigatedCorngra SiltLoam Surface Gravity
Record: 0 Records (0 out of 5 Selected) Options...
Location: -11648190.7317, 4931671.3754



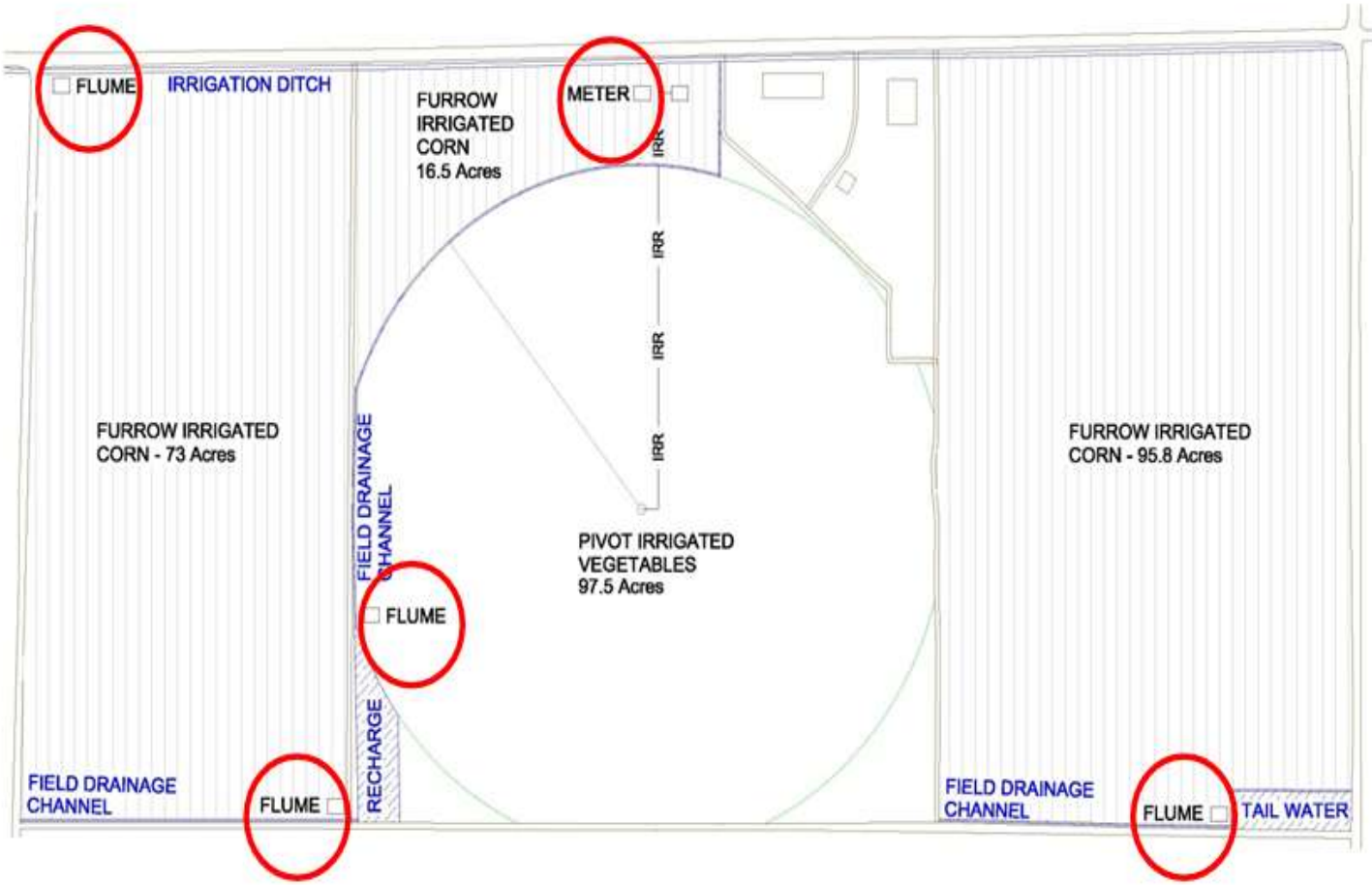
A characterization of a full single-farm SWIIM® implementation.

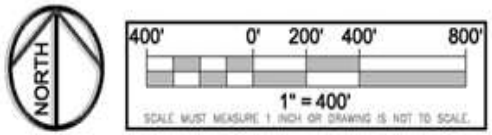
Instrumentation:

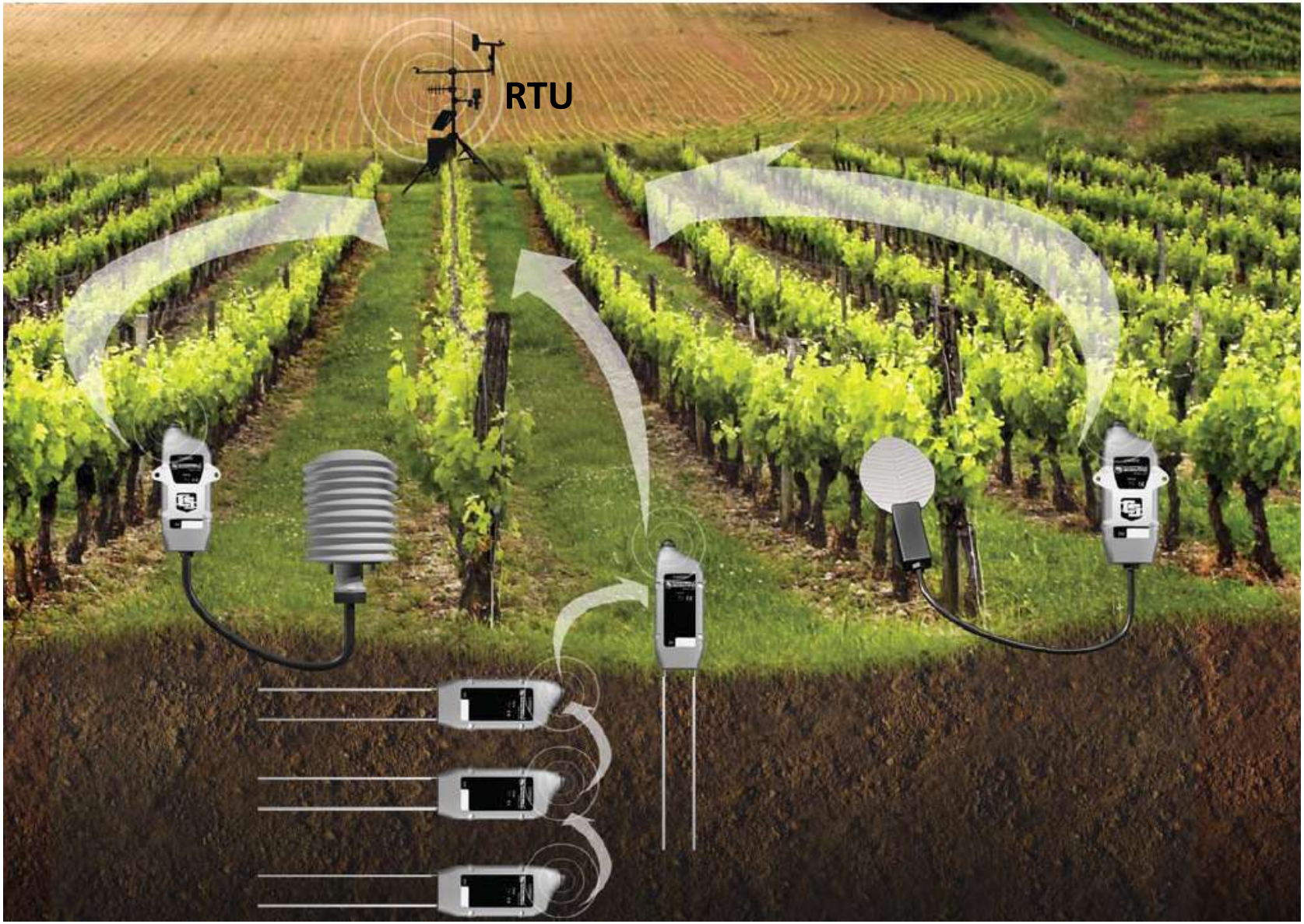
- Weather station(s).
- Soil moisture monitoring.
- Ground truth for stress conditions.




GeoVantage strut mount and setup for Cessna 150, 172, and 182.


FLUME
IRRIGATION DITCH
FURROW
IRRIGATED
CORN
16.5 Acres
METER
IRR
IRR
IRR
IRR
FURROW IRRIGATED
CORN - 73 Acres
FIELD DRAINAGE
CHANNEL
PIVOT IRRIGATED
VEGETABLES
97.5 Acres
FURROW IRRIGATED
CORN - 95.8 Acres
FLUME
RECHARGE
FIELD DRAINAGE
CHANNEL
FLUME
FIELD DRAINAGE
CHANNEL
FLUME
TAIL WATER

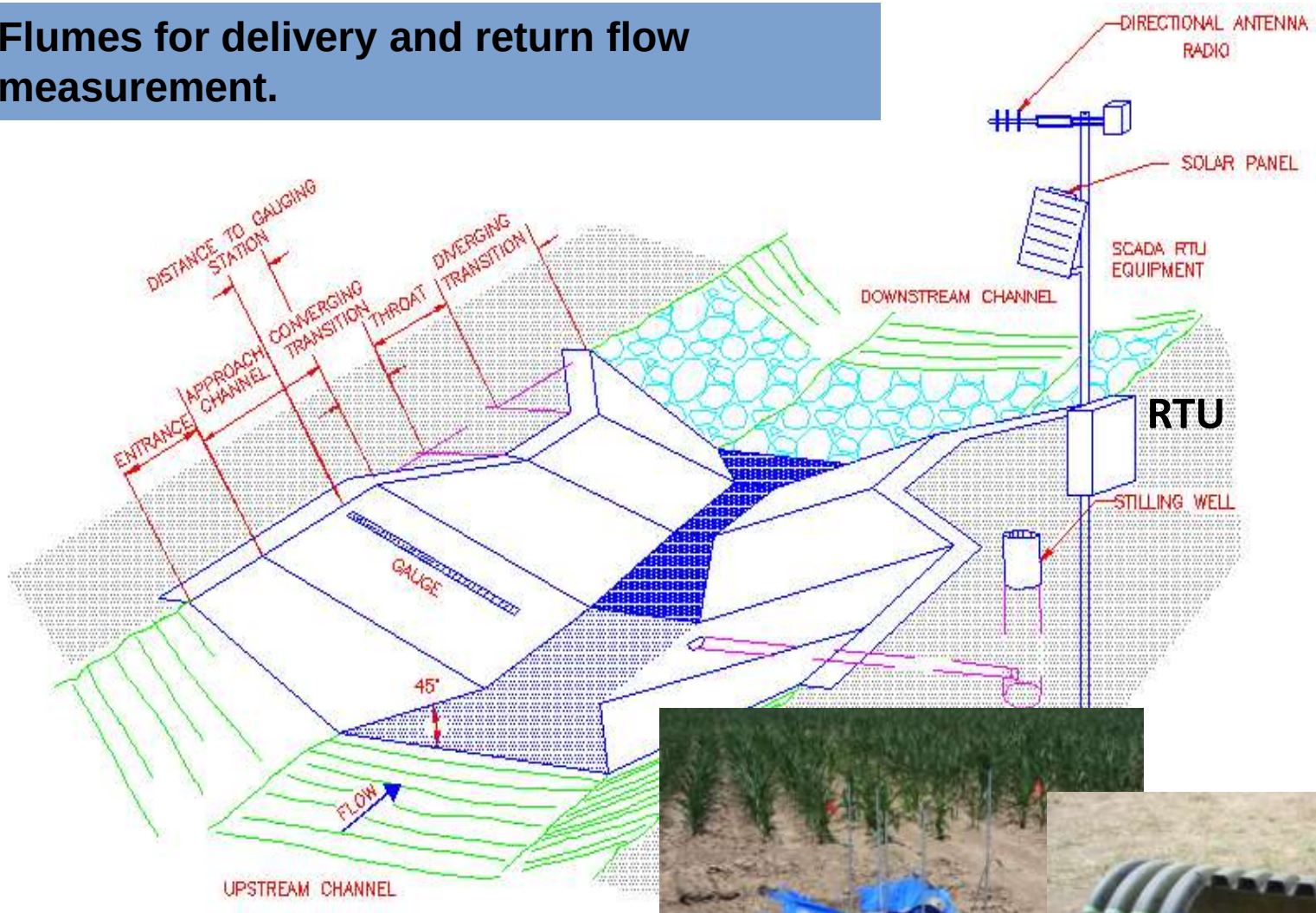

NORTH
400'
0'
200'
400'
800'
1" = 400'
SCALE MUST MEASURE 1 INCH OR DRAWING IS NOT TO SCALE.



Graphic provided by Campbell Scientific

A vertical array of soil moisture sensors.

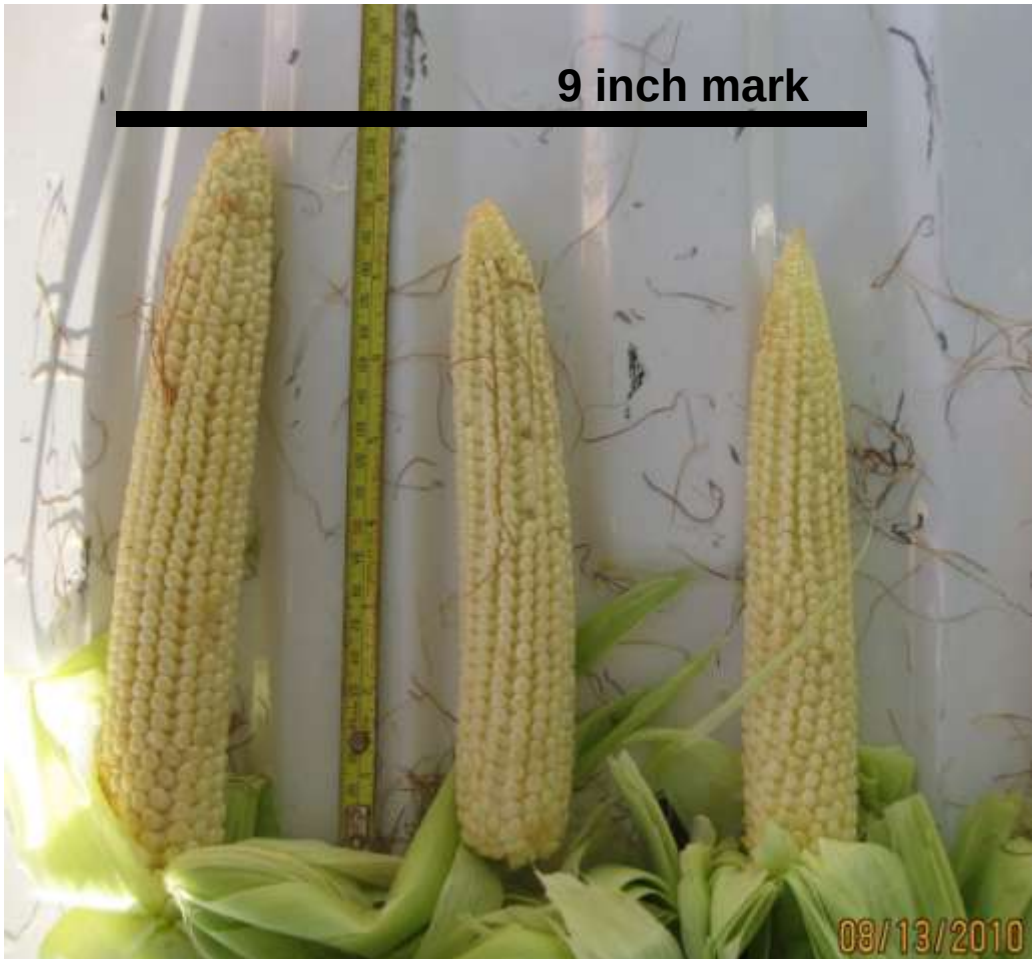
Flumes for delivery and return flow measurement.



Research is establishing the yield difference and the crop water product functions for key crops.

Sustainable Water and Innovative Irrigation Management™ (SWIIM™)
Field Research Project

Corn samples from the research site - August 2010



Sample # 1 **#2** **#3**

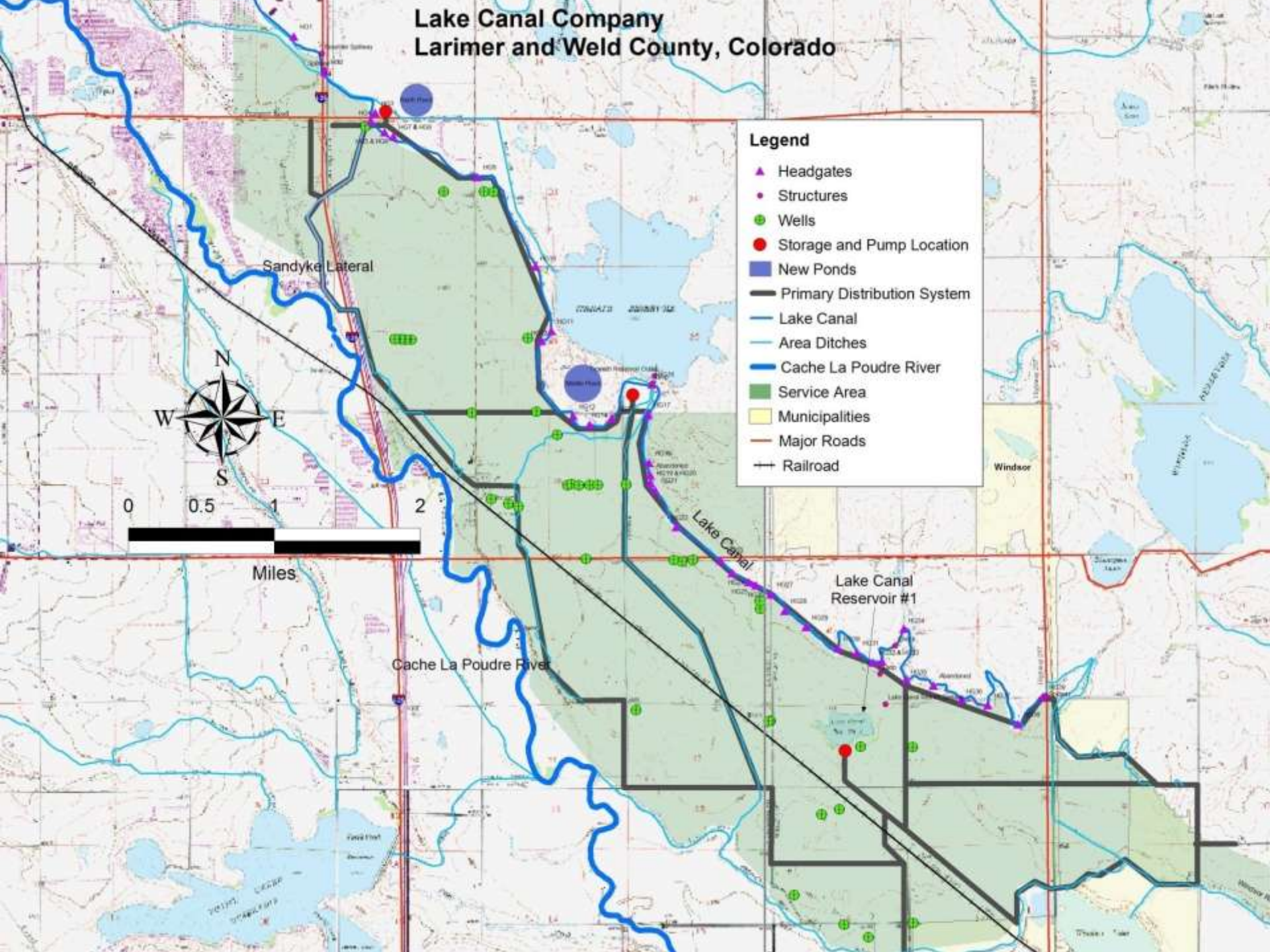
Corn ear sample #1 was taken from Treatment #1 (the fully-irrigated section of the site). Samples #2 and #3 were taken from the middle of Treatment #2 (deficit irrigation), and represents a significant reduction in application of water to the corn.

Based upon the approximate number of kernels in a row, the yield reduction between the fully-irrigated plots and the stressed plots are tentatively estimated at 10 to 15 percent.

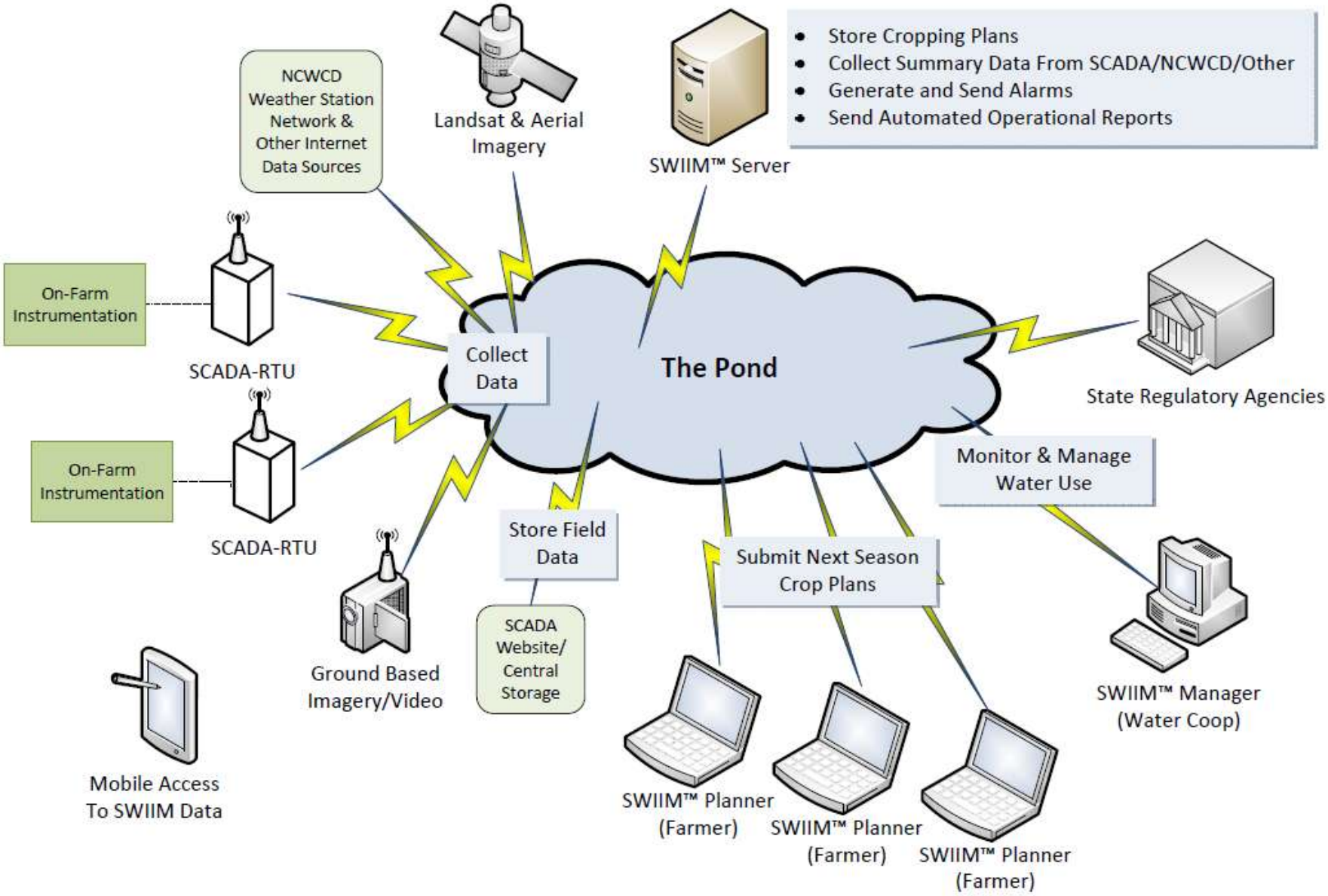
USDA Agricultural Research Service Colorado State University Regenesis Management Group swiim

2011 and 2012 proof of concept strategy:

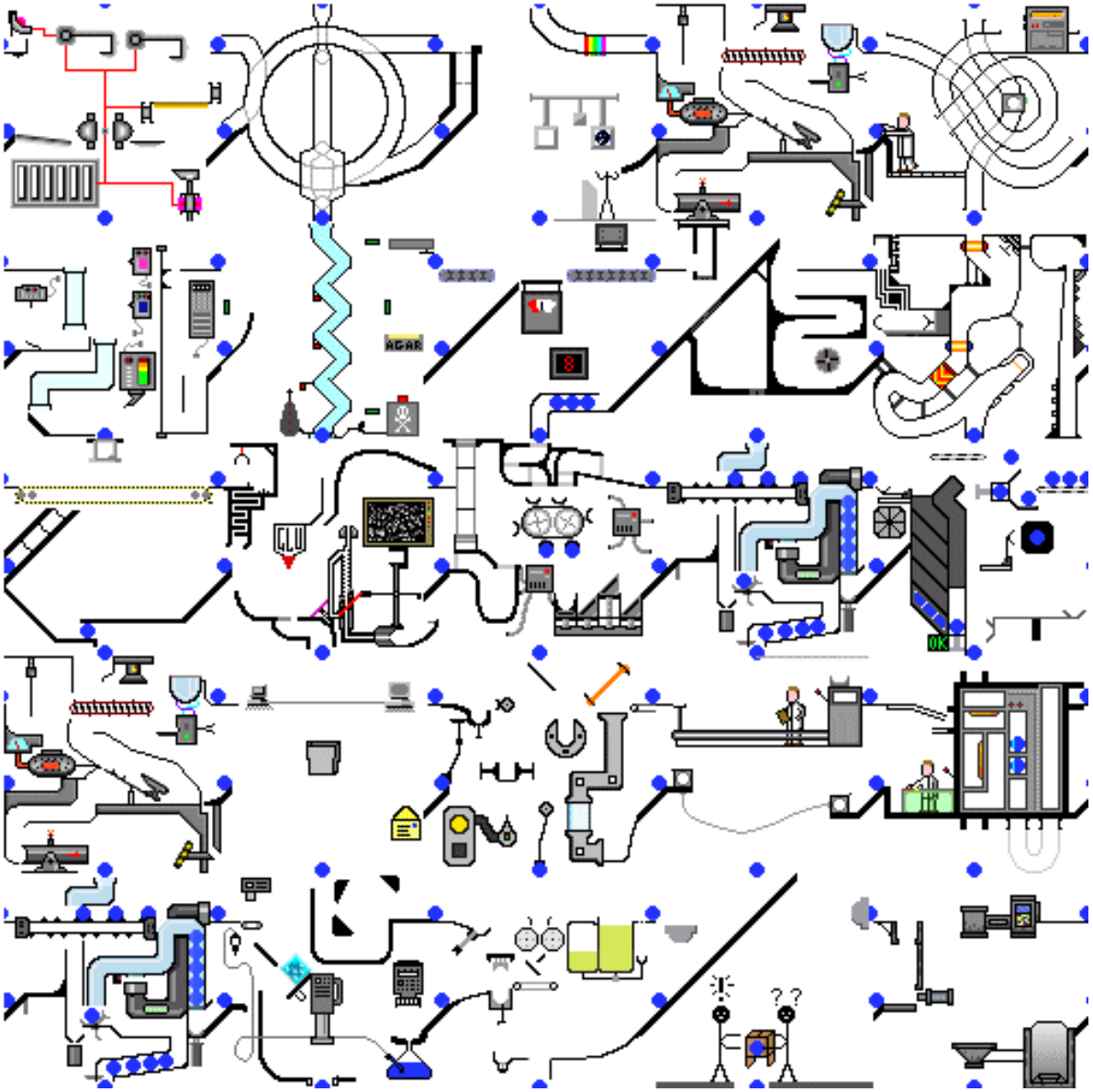
- Colorado Water Innovation Cluster is the lead, under contract to CWCB, in one of the ATM grant program projects.
- Partnered with a water right holder (aka water right lender) – Lake Canal Co.
- Partnered with a municipality and/or environmental interest (aka water right borrower) – The Nature Conservancy, City of Fort Collins, and New Belgium Brewery.
- Procure and install instrumentation.
- Building a small transferable CU water block.
- Transferring water in Spring 2012 as validation and water transfer proof of concept.


Lake Canal Company
Larimer and Weld County, Colorado
Legend
Headgates
Structures
Wells
Storage and Pump Location
New Ponds
Primary Distribution System
Lake Canal
Area Ditches
Cache La Poudre River
Service Area
Municipalities
Major Roads
Railroad
Sandyke Lateral
Lake Canal
Lake Canal Reservoir #1
Cache La Poudre River
Windsor
N
W
E
S
0
0.5
1
2
Miles

SWIIM™ Instrumentation Architecture



The following graphic will make everything perfectly clear and understandable …


AGAR
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OK

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