# User Needs Requirements

April 2, 2014 ● Klamath Falls, OR

*From Fisheries to Family Farmer:*
*Improved Products for Communicating*
*Water Supply, Drought, and Climate Change Risk for*
*Daily Decision-Making Within the Klamath Basin*

***This work is funded under a grant from the Sectoral Applications Research Program (SARP) of the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. The views expressed represent those of the author(s) and do not necessarily reflect the view or polices of NOAA.***

# Outline for Today

1. Meeting reasons, SARP purpose, vision & feedback
2. Present results from the applied research:
   - How we got here
   - Lessons learned & focus group process
   - Data use challenges
   - Recommended methods to increase data value
   - Managing decision risk through alternative decisions
3. Tools and design considerations (a solution):
   - Robustness
   - Concept application
4. Feedback

# Reasons for this meeting

- Presentation by another “expert” from outside the Basin
- Somebody else that thinks they can solve our problems
- Another study to place on the shelf
- I had nowhere else to go, so I came here
- Another consultant working on a government grant
- See if Deutschman got it right

# Sectoral Applications Research Program (SARP)

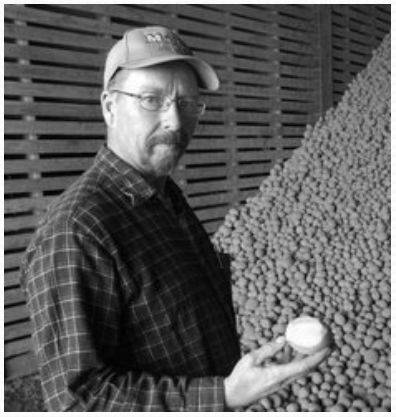
- Focus on how various socioeconomic sectors address climate and water issues (using data)
- Current priorities are water resources management initiatives (e.g., coping with drought)
- Must understand how climate and water data are used for decision-making
- Recognize the need for tools and methodologies for decision-making
- Recognize the need to develop improved tools and methodologies

# Our Research Vision

- Better understand reliance on climate and water data delivered by federal agencies as case study for western US
- Identify, describe, and document stakeholder community decisions relying on climate and water data
- Recommend methods and tools to improve data delivery, use, and value
- Streamline resource discussions to make them more efficient
- Implement recommendations

# Your Participation

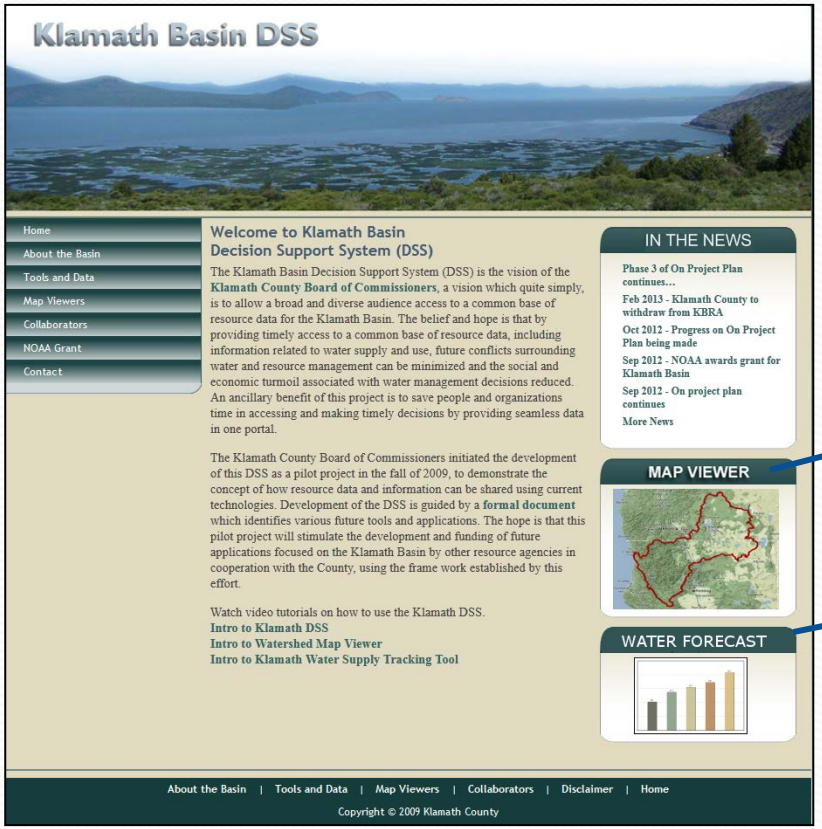
- Are your needs and decisions identified properly?
- Are there really alternative decisions based on data risk?
- Have we correctly connected your decisions to data needs, the criteria for action, and your actions?
- Is there value in the tools, methods, and concept presented?
- Proceed with development?

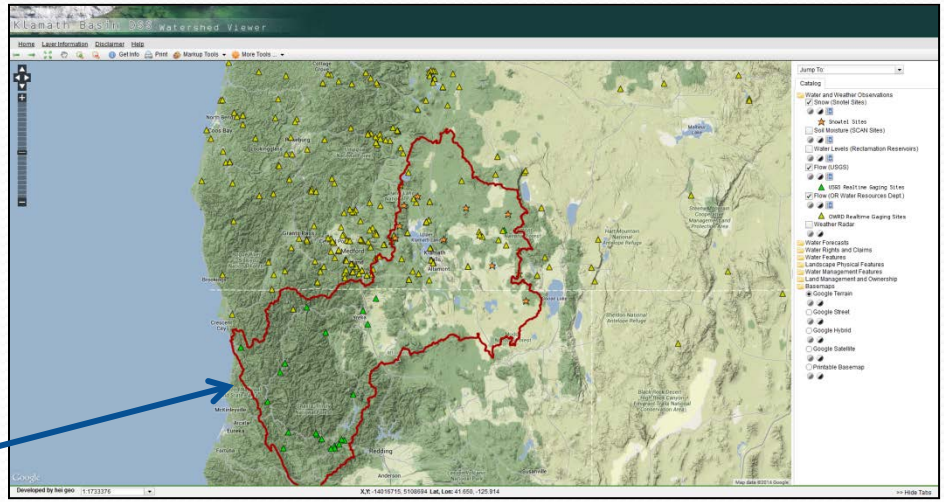


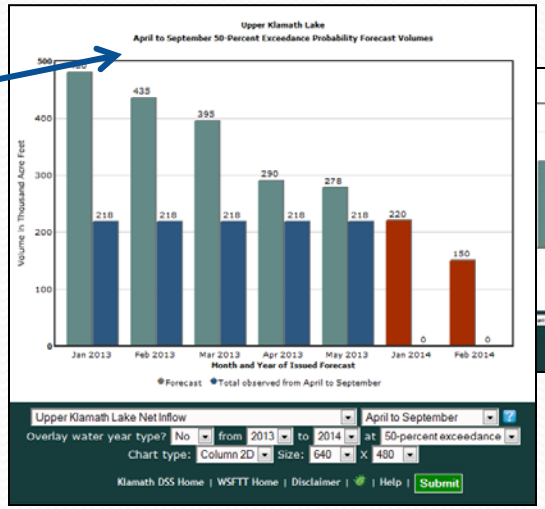
# Research Summary

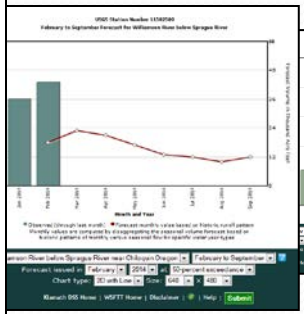
Providing Recommendations to Improve Tools and Methodologies for Communicating Information and Enhancing Decisions

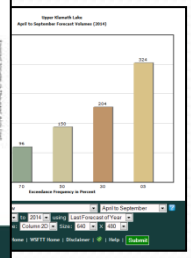
# How Did We Get Here?





# Participants









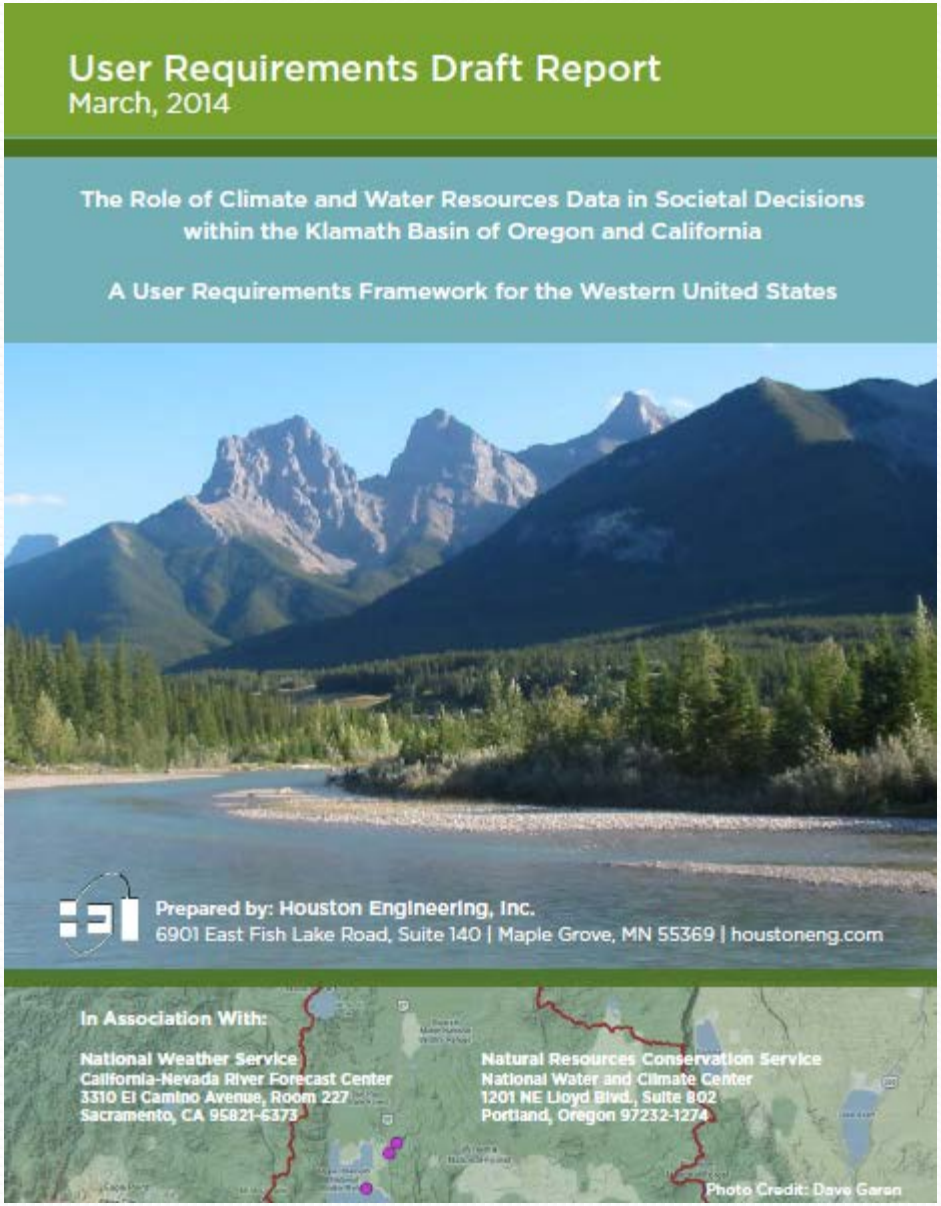




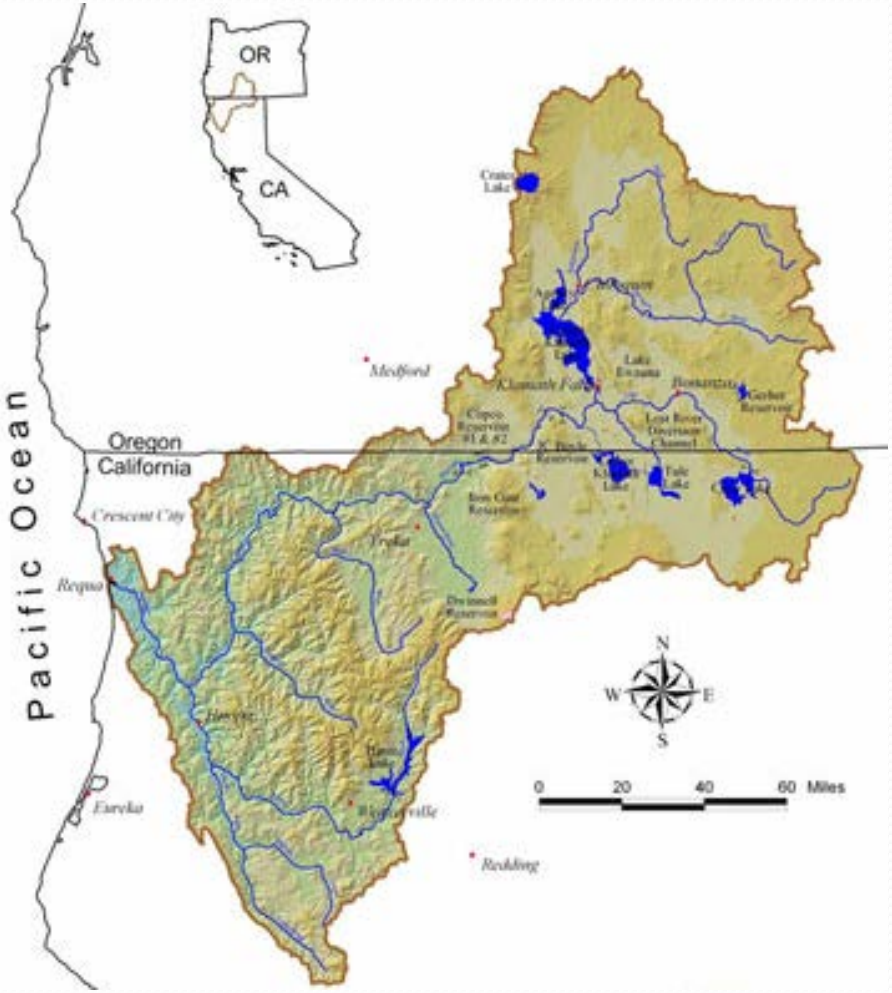

# Report

- Draft report
- Finalize after meeting
- Download it:

http://ftp.houstoneng.com:443/main.html?download&weblink=7c4be79fe400fe22b82f5e7f423fd9e3&realfilename=3.10.14_UserRequirementsReport.pdf



# Location



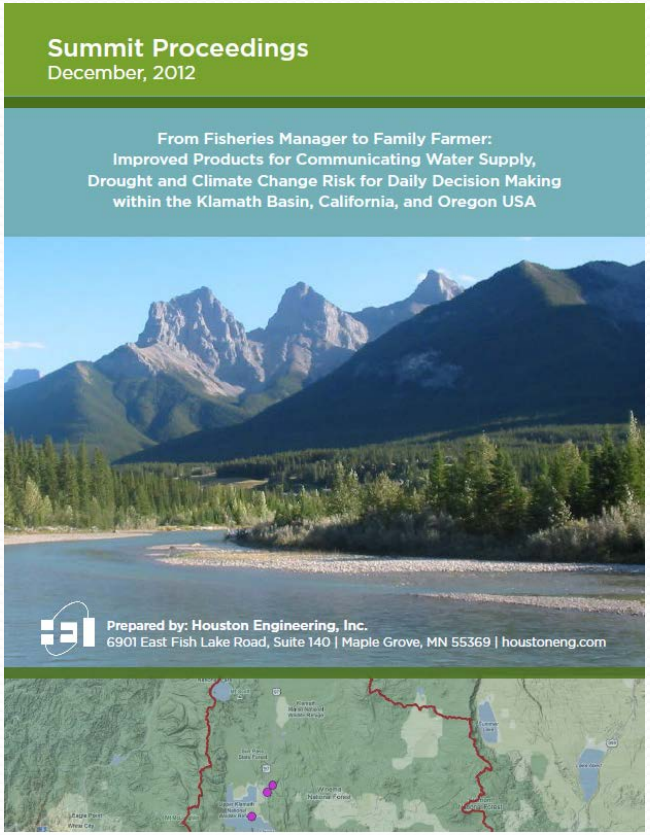

- Using the Klamath Basin as the geographic focus
- Results intended to be generalized to the Western US

# Lessons Learned – Use of Climate and Water Data in Decision-Making

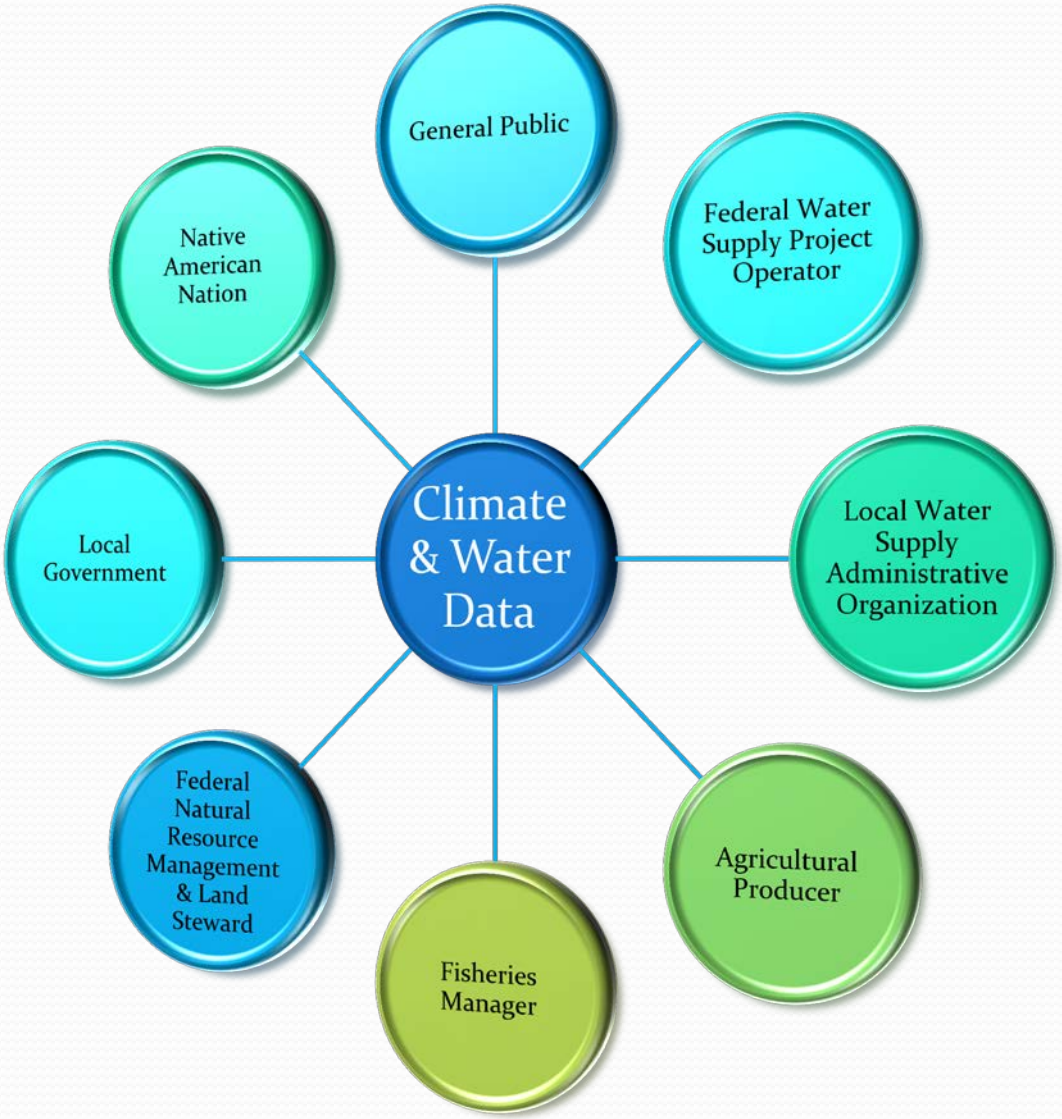
Linking the Data, Question, Decision, and Action

# Process

- Focus group approach
- Workshops to frame the issues
- Defined the questions
- Completed research
- Linked questions, decisions, criteria for action, and actions
- Recommend tools and data for decision-making
- **Reality check**
- Develop



# Data Users (Focus Group Categories)



# Water Supply Forecasts



## Water Supply Forecast Accuracy

- From a statistical sense, accuracy of water supply forecasts is good.
- From a practical perspective, the forecast error represents a large volume of water.
- The desired greater accuracy unlikely to be achieved.


## Water Supply Forecast Uncertainty

- Generally understand how forecast uncertainty is expressed.
- Alternative decisions to manage risk poorly defined.
- Need to continue improvements in communicating uncertainty.

# Climate & Water Data Needs


Temporal and Spatial Scales

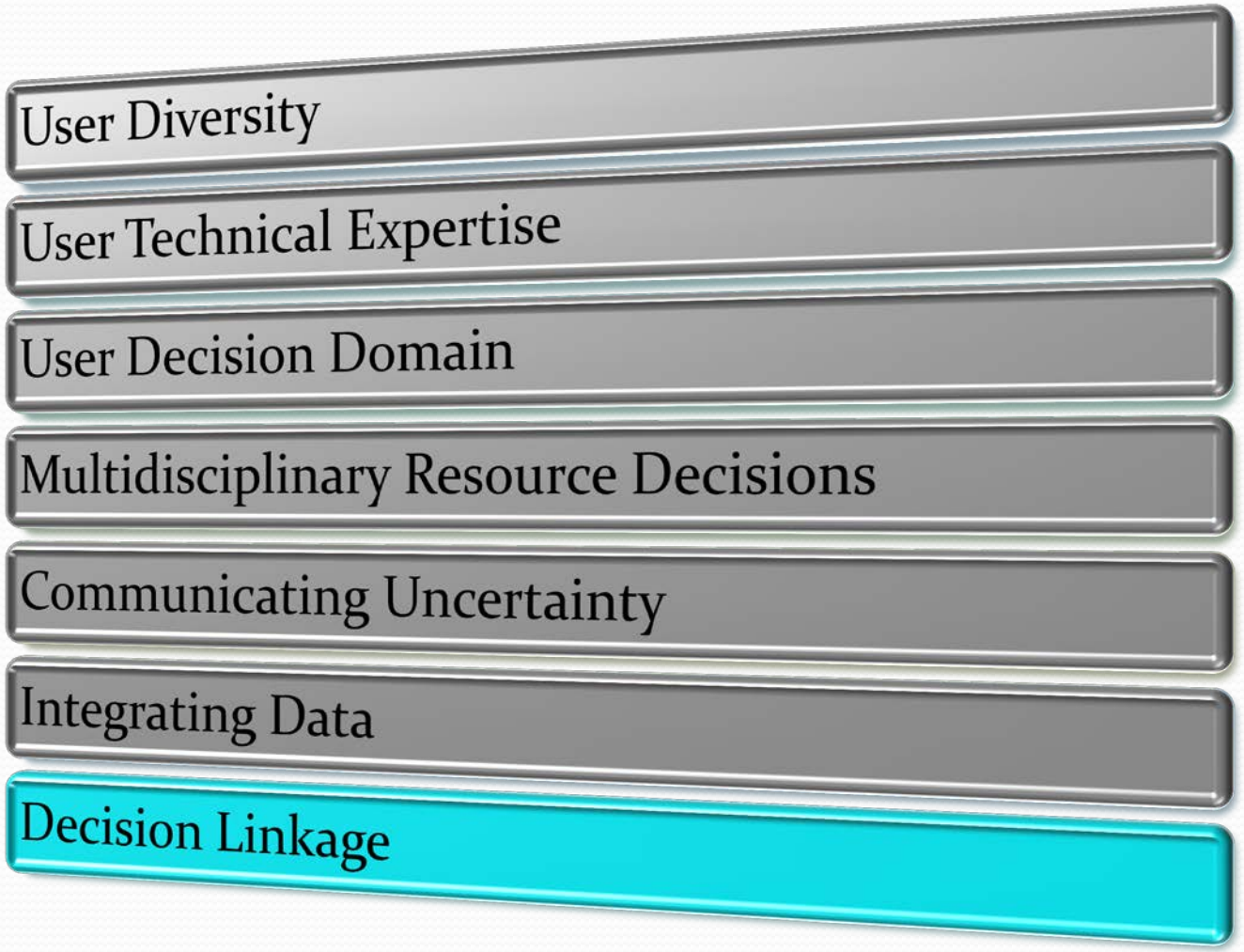
- Generally more data are needed at a finer spatial scale.
- Scale is driven by the temporal and spatial scale of issues.
- Generally shorter time periods needed.


Dependence on Data

- Rely daily on climate and water data for making decisions.
- User expertise varies widely.

# Recognizing Data Use Challenges

# Data Use Challenges



# Defining the Decision Linkage

# Climate and Water Data

## Data Type

- Surface air temperature;
- Precipitation;
- Snowfall (depth);
- Growing degree days;
- Snow water equivalent;
- Streamflow;
- Groundwater elevation;
- Lake/reservoir surface water elevation ;
- Soil Moisture; and
- Evapotranspiration.

## Temporal Scale

- Instantaneous (near real-time, generally 15-minute);
- 1-hour;
- Last 1-day;
- Last 7 days;
- Last 14 days;
- Last 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 18, 24, 30, 36, 48, 60, and 72 months, ending on the last day of the latest month;
- Water Year To Date (WYTD); and
- Calendar Year to Date (CYTD).

# Decision Timelines

## Fisheries & Natural Resource Manager & Klamath Tribe

Purpose: Evaluate current and forecast conditions with regard to the existing biological opinions and the quality of ecosystem services.
User skill level: **Intermediate**

Decision(s): The decisions for this user are expected to be related to whether current water levels, flows, and volumes are presently sufficient or forecast to be sufficient for providing ecological functions and services, largely expressed by specific criteria identified by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service in their joint Biological Opinion.

Information needs: 1. Storage volumes in UKL, Clear Lake and Gerber Reservoirs (see current water level pod on p.1)
2. Current release rate from Link River Dam, A-canal, Gerber Reservoir and Clear Lake
3. Estimated UKL inflow volume (today, cumulative water year) estimated from Williamson below Sprague gage
4. Most recent NRCS seasonal water supply 50% forecast (Mar - September, but the months will change)
5. Flows
6. Cumulative volumes for points of diversion

Today's Date: 3/1/14
Station Location:

2013 2014
Oct Nov Dec Jan Feb Mar Apr May Jun July Aug Sept

BASIN CONDITION
INTERACTIVE MAP

SNOW PACK
14 Inches

LAKES & RESERVOIRS
4,142.2 elevation 1988 NAVD

CLIMATE INDICES
Value unit

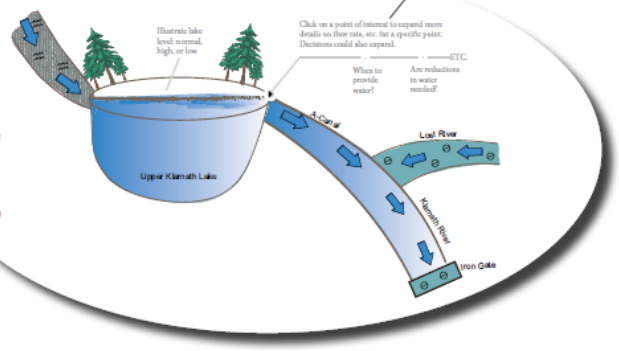
STREAMS, RIVERS, DRAINS, CANALS
100 TAF

Drill Down Level 2

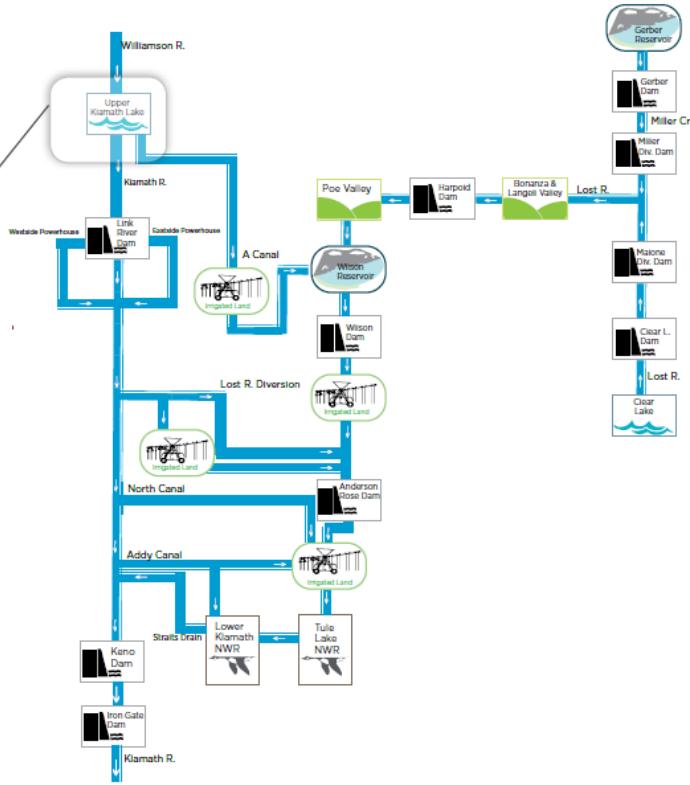
TIME PERIOD: DAILY
DEPTH (IN.): ____
MAXIMUM INTENSITY IN./HR.): ____
PERCENT OF NORMAL: ____
DEPARTURE FROM NORMAL (IN.): ____

HISTORIC: 1999
DEPTH (IN.): ____
MAXIMUM INTENSITY IN./HR.): ____
PERCENT OF NORMAL: ____
DEPARTURE FROM NORMAL (IN.): ____

User Interface




*Note: This timeline would graphically illustrate all areas of interest, how they're related, and what is occurring throughout the basin. User can view the "big picture", but also narrow in on more details for their specific area of interest by clicking their point of interest.*




Water Supply Demand

AVERAGE MONTHLY PROJECT DEMAND (KAF): ____
AVERAGE WATER YEAR CUMULATIVE PROJECT DEMAND (KAF): ____
CURRENT MONTH KBRA POINTS OF DIVERSION VOLUME (KAF): ____
IRRIGATION SEASON KBRA POINTS OF DIVERSION VOLUME (KAF): ____
WINTER SEASON KBRA POINTS OF DIVERSION VOLUME (KAF): ____
CURRENT MONTH REFUGE VOLUME (KAF): ____
REFUGE IRRIGATION SEASON VOLUME (KAF): ____
REFUGE WINTER SEASON VOLUME (KAF): ____

Pattern in the river graphic would indicate flow trend:
= Flow Rate Increasing
= Flow Rate Constant
= Flow Rate Decreasing

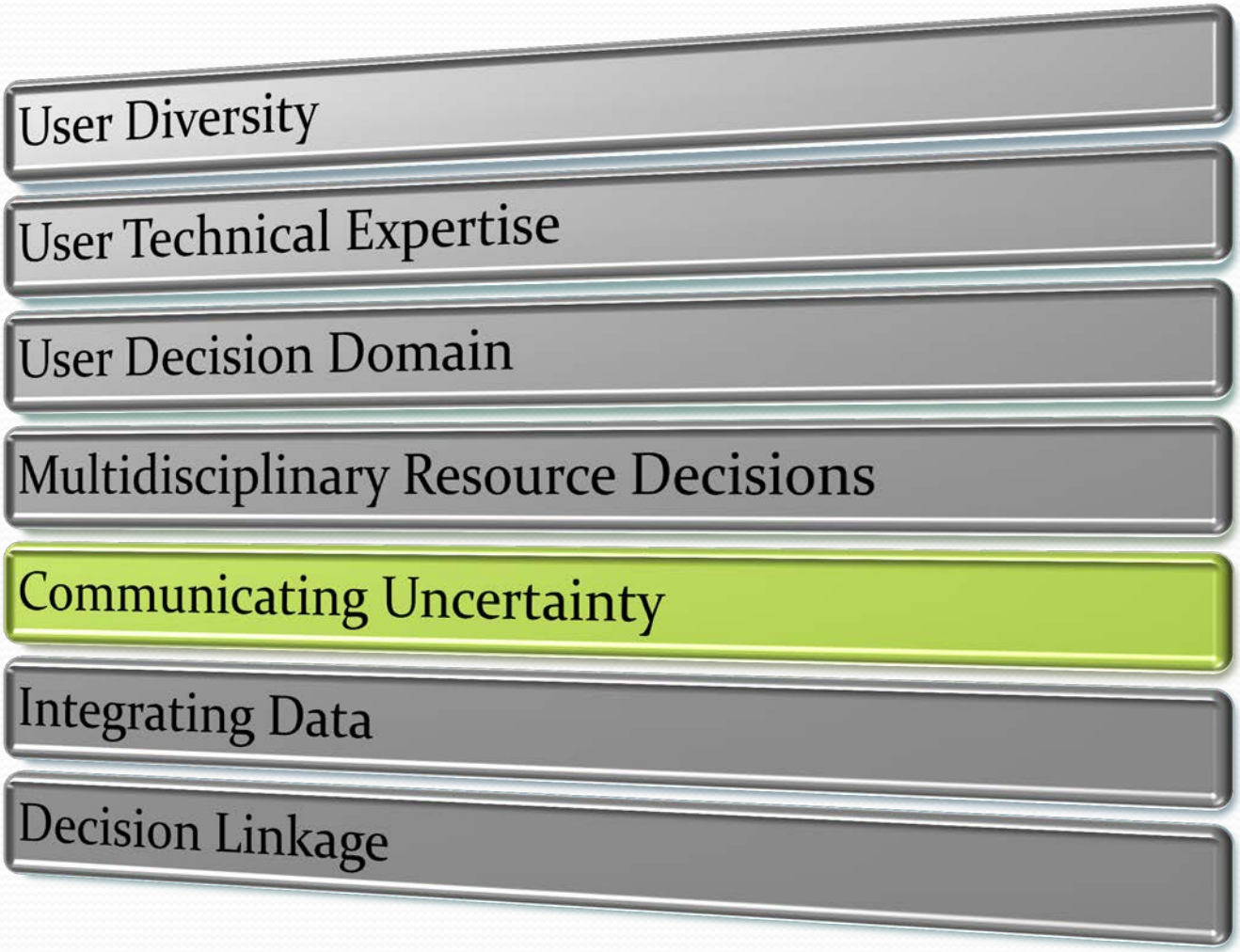
# Data Inventory
# (same data from multiple sources)

| | Type of Data | Name of Dataset | Shortest Measured Interval | Source of the Data | Entity Responsible for Data Management | Link |
|---|---|---|---|---|---|---|
| **Measured** | | | | | | |
| **Precipitation** | Climate | Local Climatological Data Publication | Hourly (from 1945)<br>Daily (from 1930)<br>**Available by state or station | National Climatic Data Center | NOAA (Satellite and Information Service - NESDIS) | http://www.ncdc.noaa.gov/IPS/hpd/hpd.html |
| **Evaporation** | Climate | Monthly Average Pan Evaporation | Monthly Average over certain period of years<br>**Only avail. For certain sites | WRCC | NOAA?? | http://www.wrcc.dri.edu/htmlfiles/westevap.final.html |
| **Solar Radiation** | Climate | Solar Hourly Series for day of - / -/ - | Hourly (from 2003)<br>**Only available at certain stations | National Water and Climate Center | USDA – Natural Resources Conservation Service | http://www.wcc.nrcs.usda.gov/nwcc/inventory |
| **Wind Speed** | Climate | Local Climatological Data Publication | Every 3 Hours<br>Daily (from 1945)<br>**Available by state or station | National Climatic Data Center | NOAA (NESDIS) | http://www.ncdc.noaa.gov/IPS/lcd/lcd.html |
| **Wind Direction** | Climate | Local Climatological Data Publication | Every 3 Hours<br>Daily (from 1945)<br>**Available by state or station | National Climatic Data Center | NOAA (NESDIS) | http://www.ncdc.noaa.gov/IPS/lcd/lcd.html |
| **Sky Cover** | Climate | Local Climatological Data Publication | Daily (from 1945)<br>**Available at certain sites | National Climatic Data Center | NOAA (NESDIS) | http://www.ncdc.noaa.gov/IPS/lcd/lcd.html |

# Documenting Decision Linkage

| Category | Description | Type | Data | | Criterion | | | Reference |
|---|---|---|---|---|---|---|---|---|
| | | | Time Scale | Spatial Scale / Locations | Description | Value | Units | |
| **Water Supply Availability** | | | | | | | | |
| | Volume allocated to irrigation supply within the Klamath Project | Surface water volume | March through October | Upper Klamath Lake Inflow (Net) | April 1 – September 30 volume forecast by the NRCS-NWCC for their forecast issued on March 1 | Forecast volume<br><br>If <= 287,000 then 387,000<br><br>If > 287,000 but less than 569000 then 378 + {42.64 x [(Forecast Volume – 287)/282}*1000<br><br>If > 569,000 then 445,000 | Acre-feet | |
| | | | November through February | | Seasonal volume | 45,000 | Acre-feet | |
| | Volume allocated to the Lower Klamath Wildlife Refuge | Surface water volume | March through October; | Upper Klamath Lake Inflow (Net) | April 1 – September 30 volume forecast by the NRCS-NWCC for their forecast issued on March 1 | If <= 287,000 then 48,000<br><br>If > 287,000 but less than 569000 then 48 + {7.64 x [(Forecast Volume – 287)/282}*1000<br><br>If > 569,000 then 60,000 | Acre-feet | |
| | | | November through February | | Seasonal volume | 35,000 | Acre-feet (values given are in 1000 acre-feet) | |

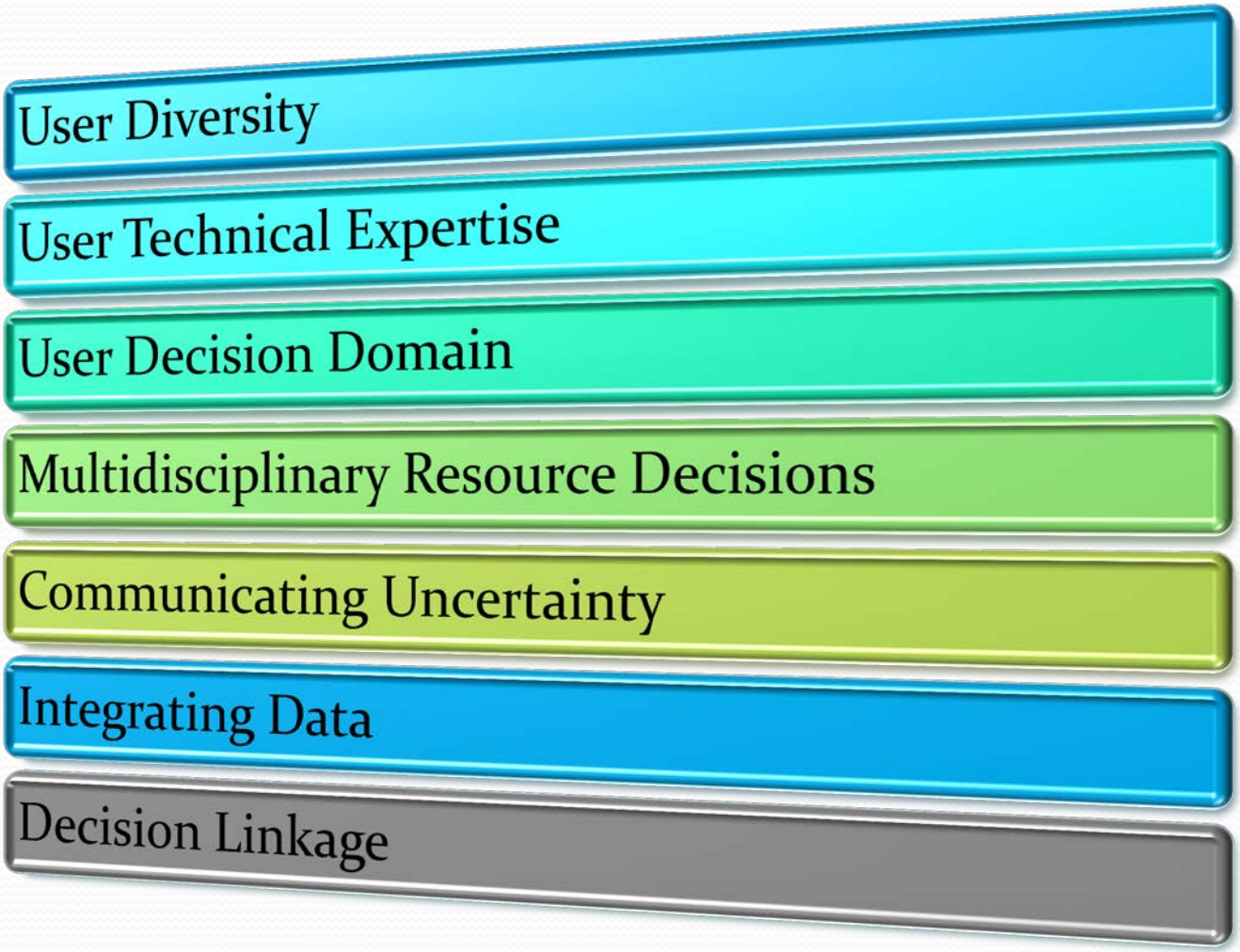
# Data Use Challenges



# Managing Uncertainty with Decision-Making

| Focus Group | Decision Actions | Range of Options |
|---|---|---|
| **Agricultural Producer** | Acreage Planted | • All arable land<br>• Some portion of arable land<br>• Fallow arable land |
| | Source of Water | • Use of surface water supply only<br>• Use of surface water supply and supplemental supply (e.g., ground water)<br>• Use of supplemental supply only<br>• Fallow |
| | Crop Types | • High water demand crops (e.g., orchards)<br>• Mix of high water demand and low water demand<br>• Low water demand crop (pasture) |
| **Federal Water Supply Project Operator** | Delivery of Water Supply | • Decrease Rate<br>• Maintain current rate<br>• Increase rate<br>• Stop Delivery |
| **Local Water Supply Administrative Organization** | Need for Water User Mitigation Program | • Volume of supplemental water supply needed<br>• Amount of acreage fallowed |
| **Irrigation District** | Delivery of Water Supply | • Proportion of lands served<br>• Range of water supply provided (up to full) |
| **Fisheries Manager** | Fish Harvest | • Alter harvest limits in response to anticipated impacts of instream flow allocations |
| | Challenge Flow Allocations | • Petition Reclamation<br>• File lawsuit |

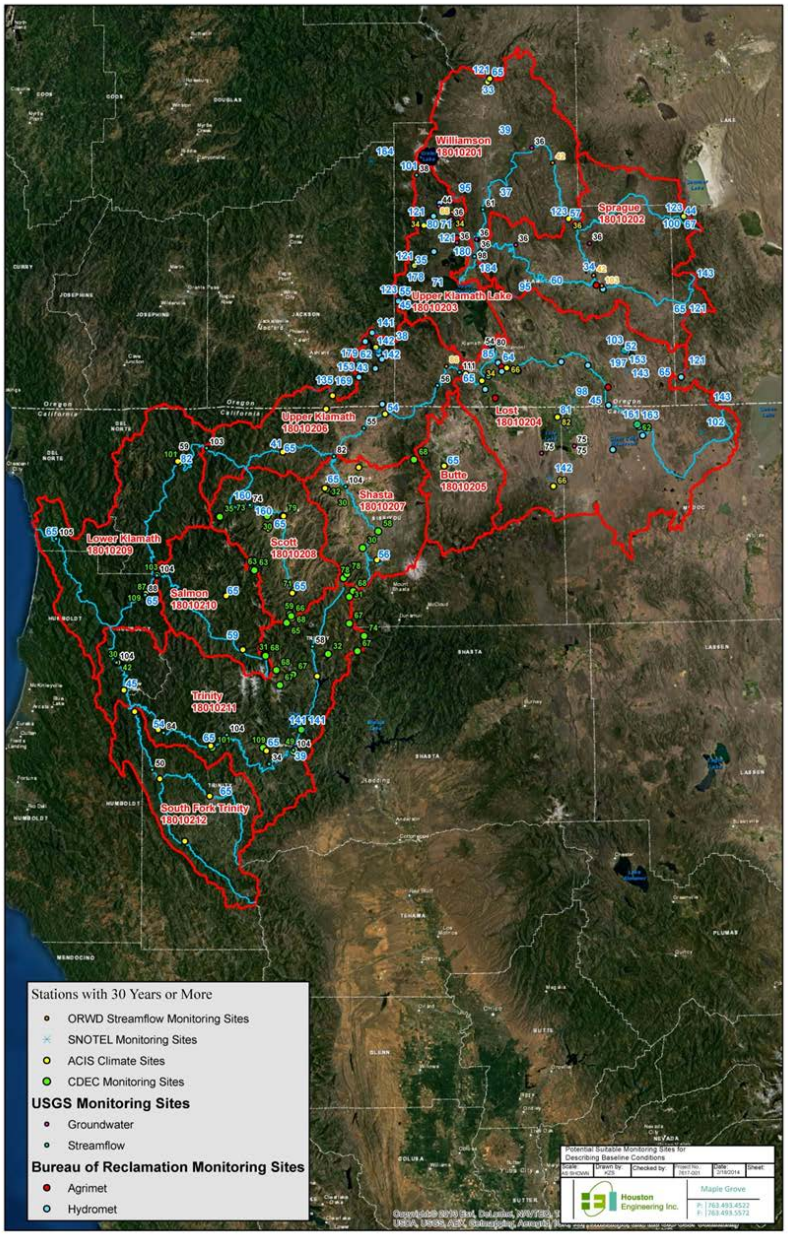
# Data Use Challenges



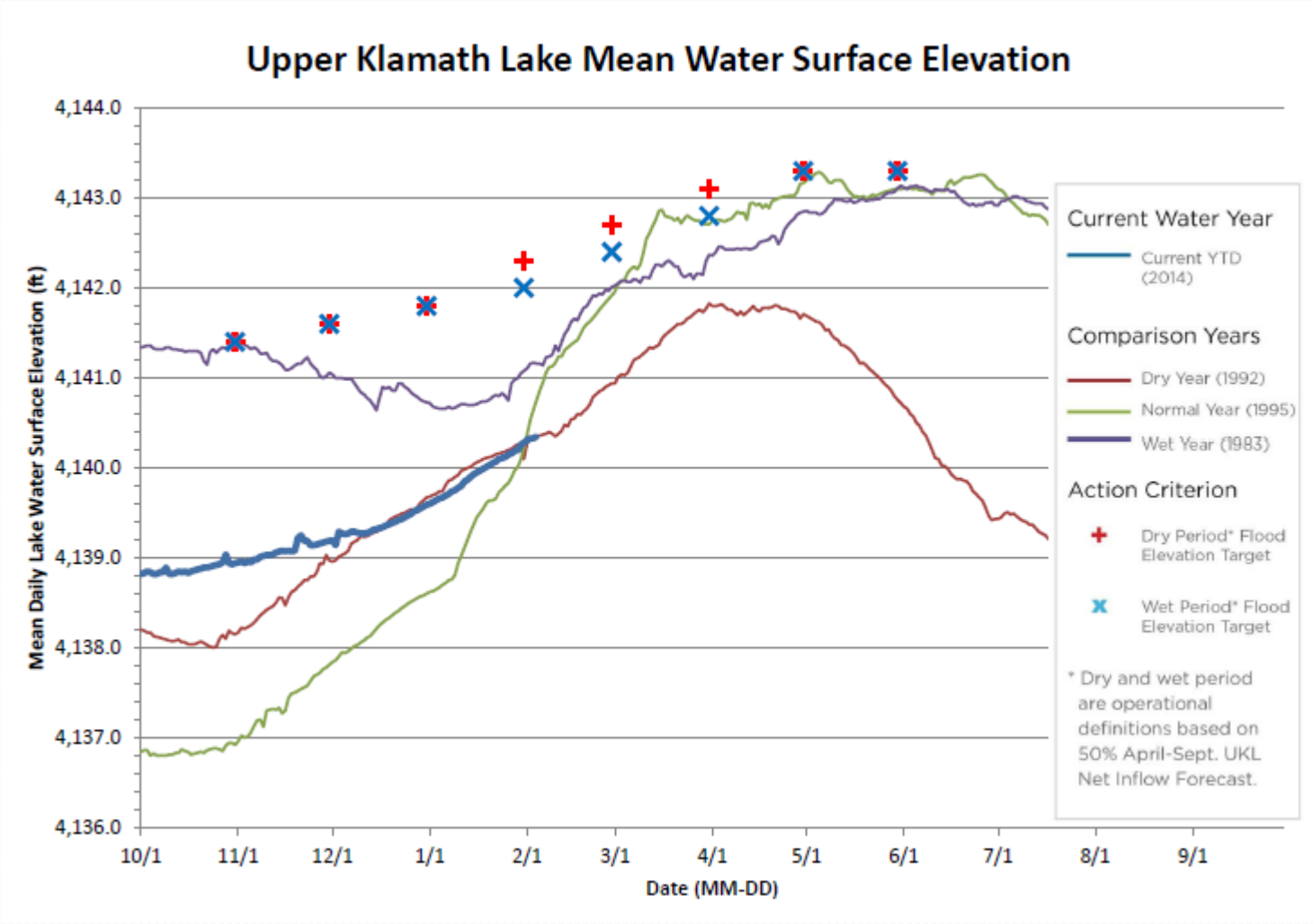
# Establishing Context

- Compare current time period to some baseline condition
- Show data in comparison to one or more values where the value(s) result in a decision
- Display information for a specific period of time with which the user has firsthand knowledge or experience
- Display information along with historical ranges and percentiles for the period of record
- Integrate measured and forecast information into a single graph
- Provide the opportunity to compare data for inferential purposes

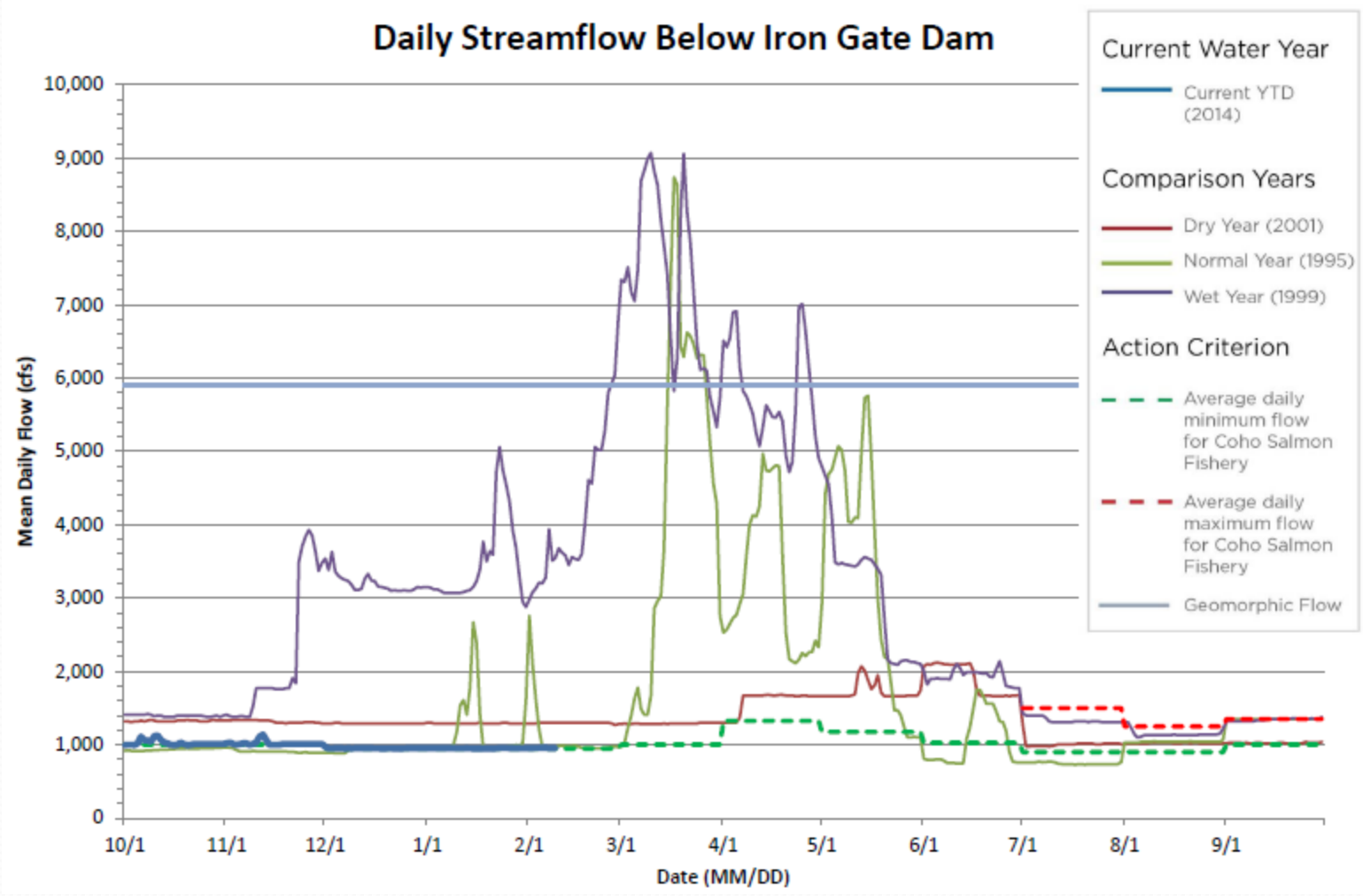
# Baseline Conditions for Climate and Water Data



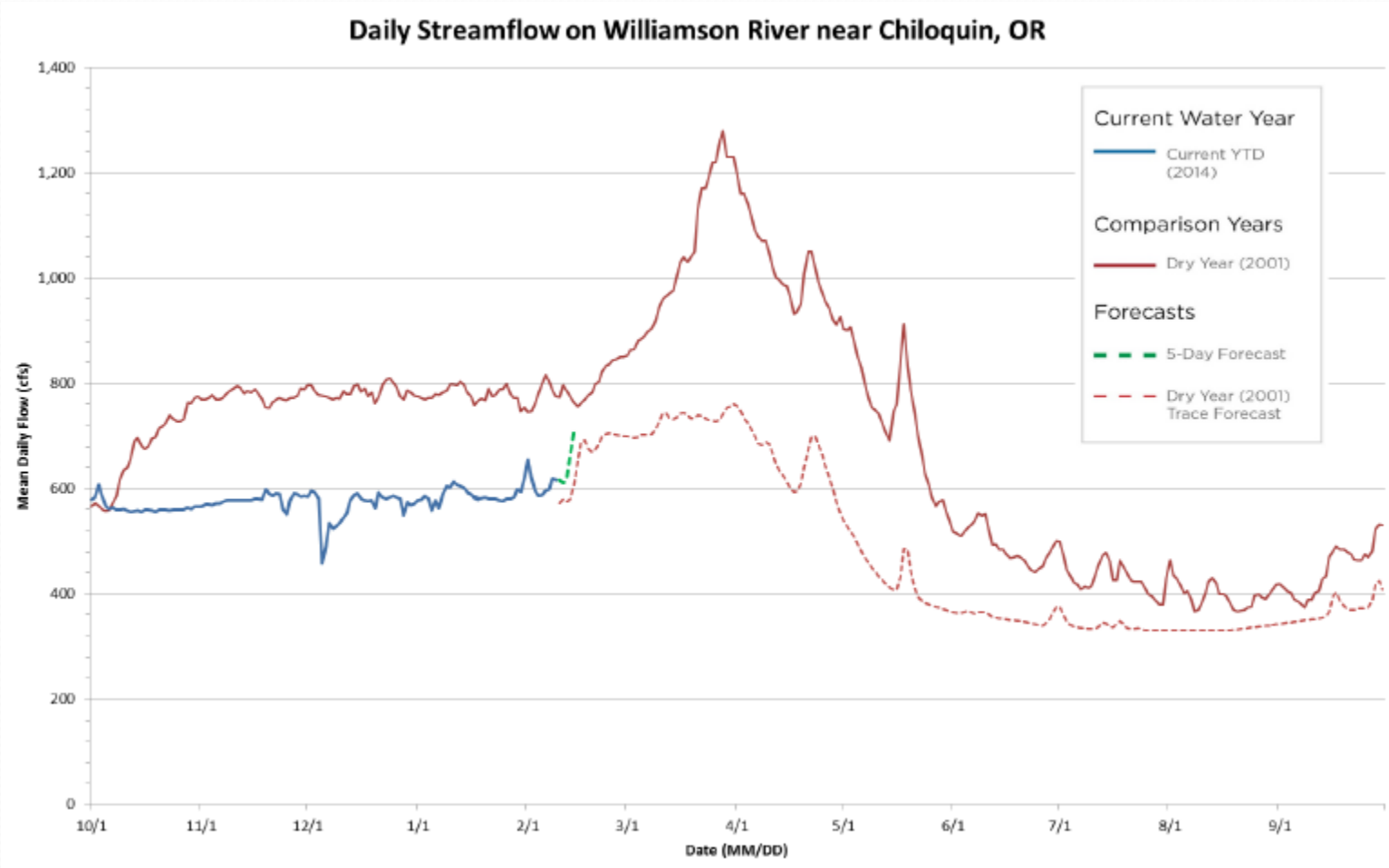
# Using Baseline Condition



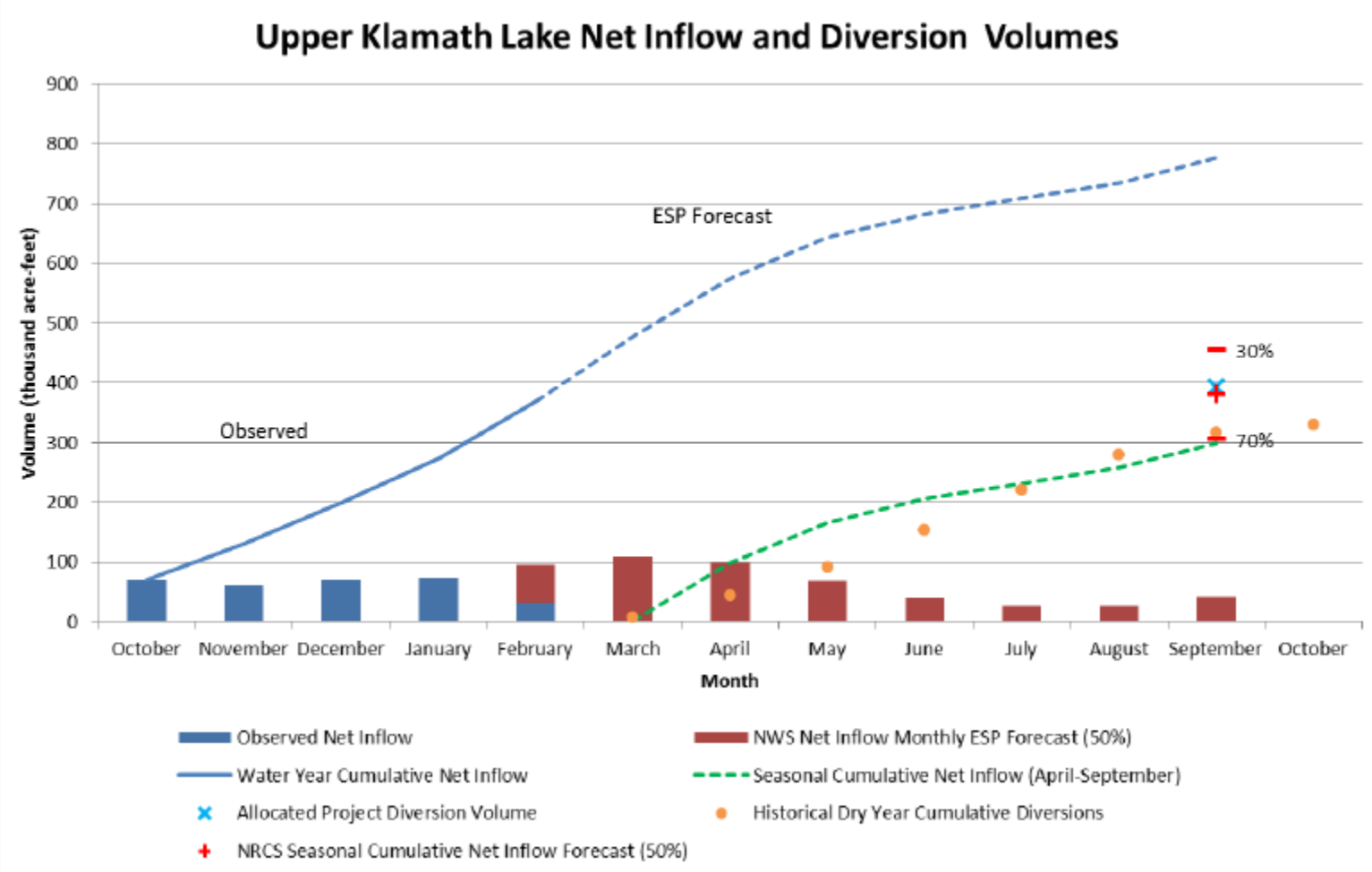
# User Defined Criteria



# Integrating Forecasts & Real Years

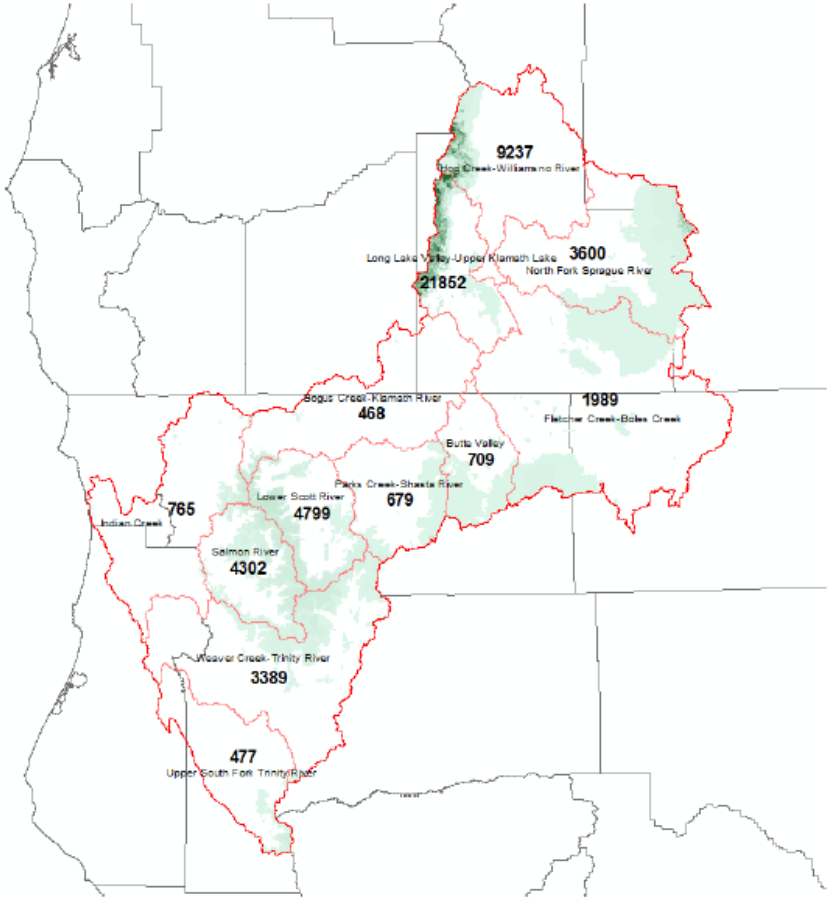


# Integrating Forecasts



# Alternative Presentation Methods

- Intensity of Supplemental Water Program
- Compare estimated water volume in snow pack plus volume in storage to seasonal water supply forecast




SWE in af on January 31, 2014 (from NOHRSC)

# Tools and Design Considerations

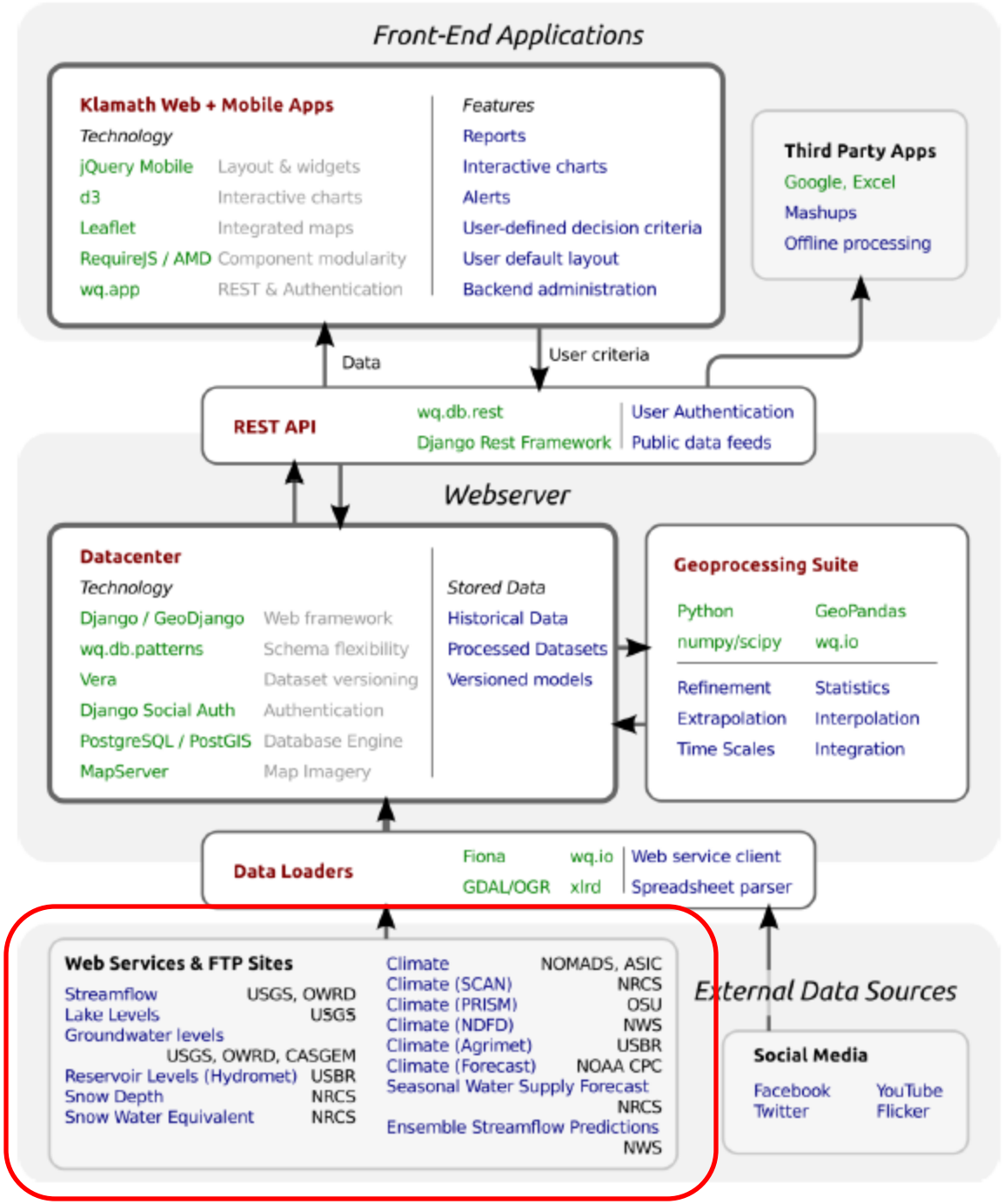
Implementing the Recommendations –
Designing and Building Robust Tools and Applications

1. Robust Tools and Apps
2. Recommended Platform
3. Wireframes

# Defining Robust Tools and Apps

- User access to standardized, time invariant, (e.g., SHEP, NWS text product) electronic data (not images, graphs)
- Available through a data Application Interface (API)
- Data must fit within the “normal workflow process”
- Users provide resources to ingest newly created data
- Automatic error checking of web servics and web master notification for system failures
- Data categorization for use in standard data charting, analysis, and reporting tools.
- Standard data charting, analysis, and reporting (by data type?)
- Users enter, upload, and evaluate against specific decision criteria
- Understandable method of describing and understanding the data

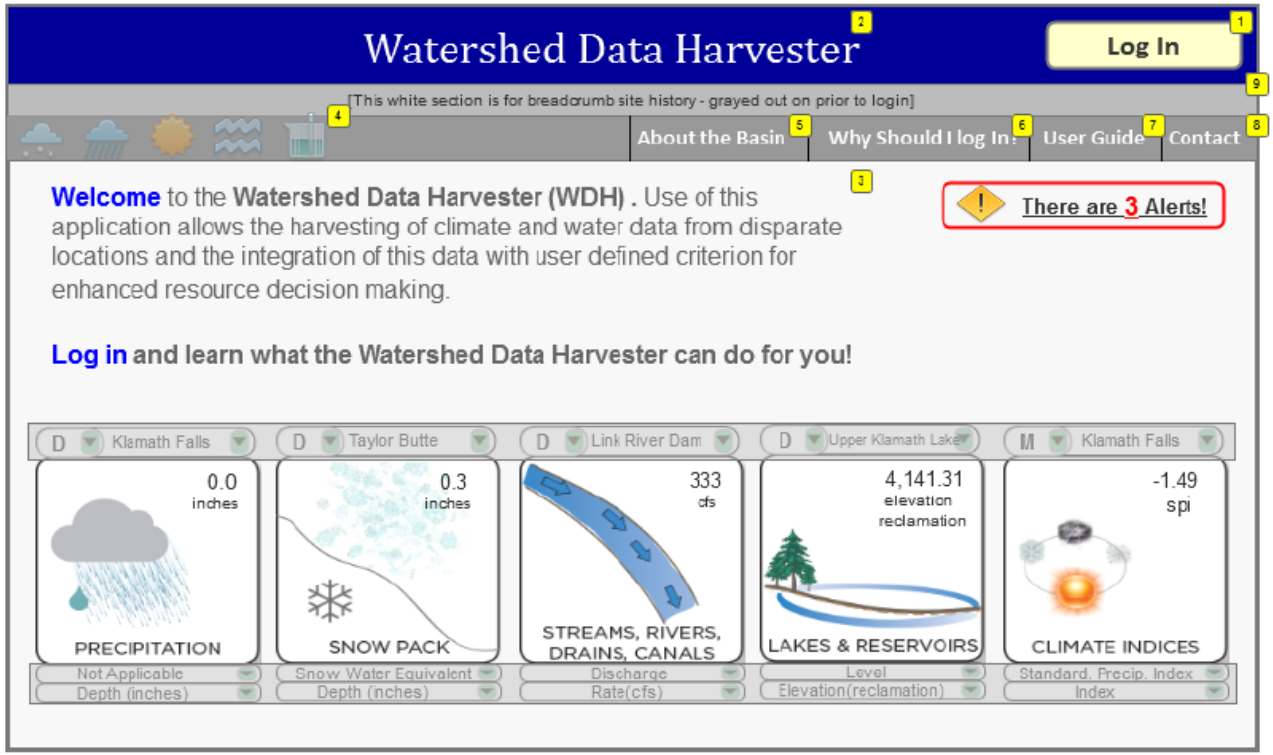
# Recommended Technologies



# Wire Framing

## 1.2. Home

### 1.2.1. User Interface

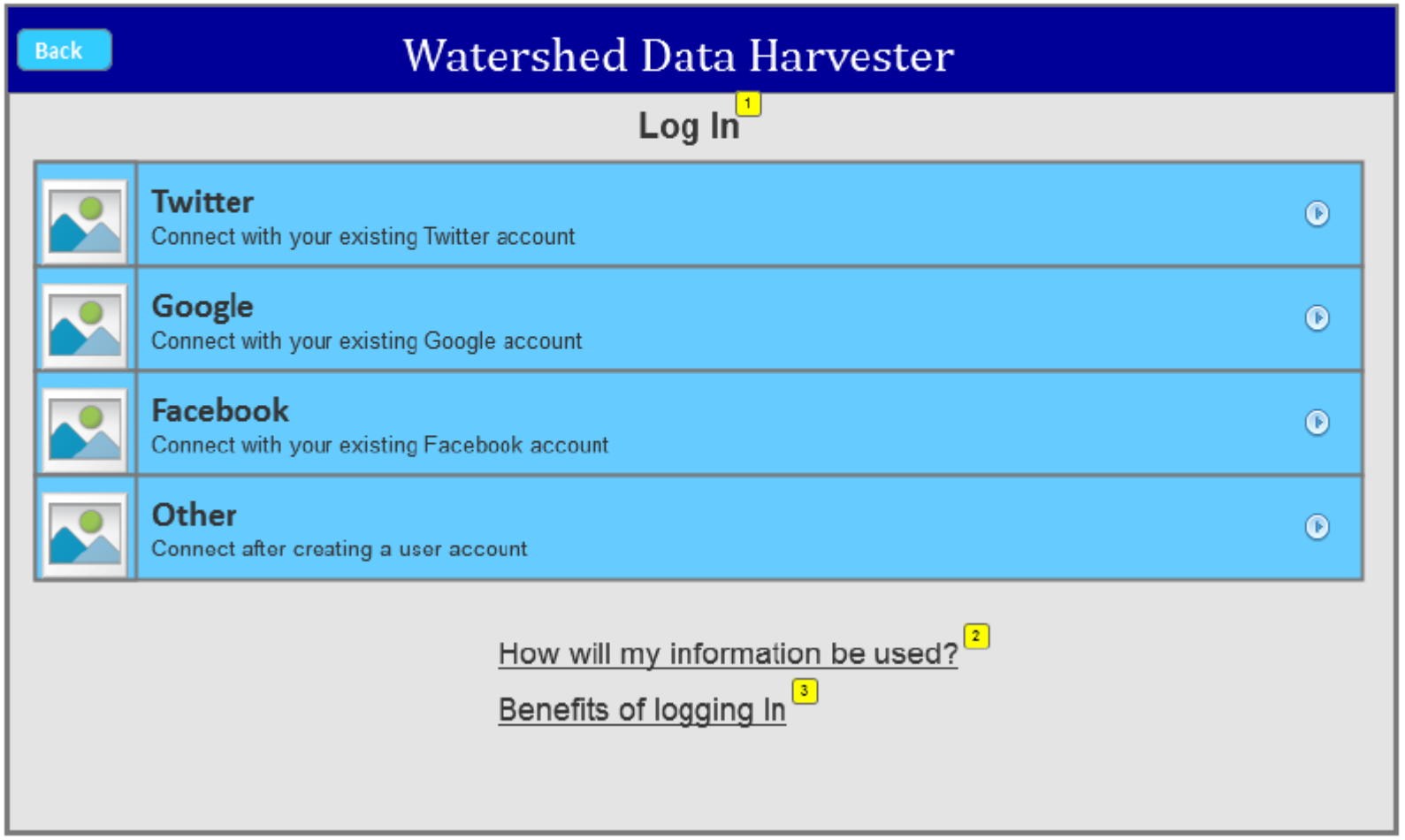



### 1.2.2. Widget Table

| Footnote | Label | Description |
|---|---|---|
| 1 | Log In | A visitor must authenticate himself/herself to access the site. After account information has been obtained, the next visit will take the user to the customizable Dashboard page |
| 2 | Site Title | Site title for now |
| 3 | Welcome Text | Welcome Text |
| 4 | Pod Access Menu | This is not assessible until and the user is authenticated |
| 5 | About the Basin | This link takes user to a page that gives information about the basin |
| 6 | Why Should I login in? | This link takes user to a page that explains the benefits of logging in and how the information gathered about the user will make their site experience better. |
| 7 | User Guide | This link will take a user to a page that will explain different functionality present within the site. |
| 8 | Contact | This link will take the user to a page that will display key contact information |
| 9 | Breadcrumb Trail | This section is not active prior to login |

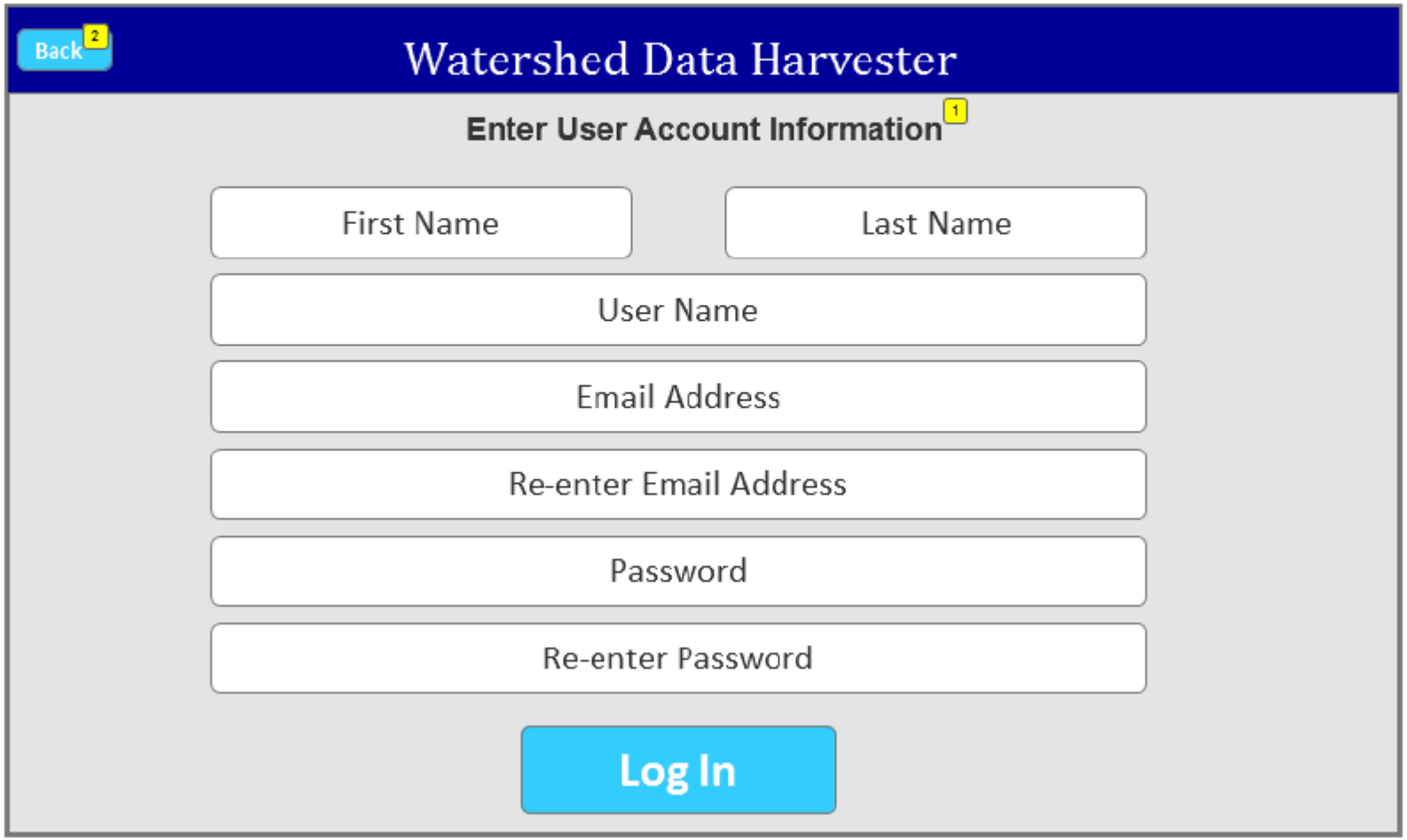
## 1.3. Social Media Authentication and LogIn

### 1.3.1. User Interface



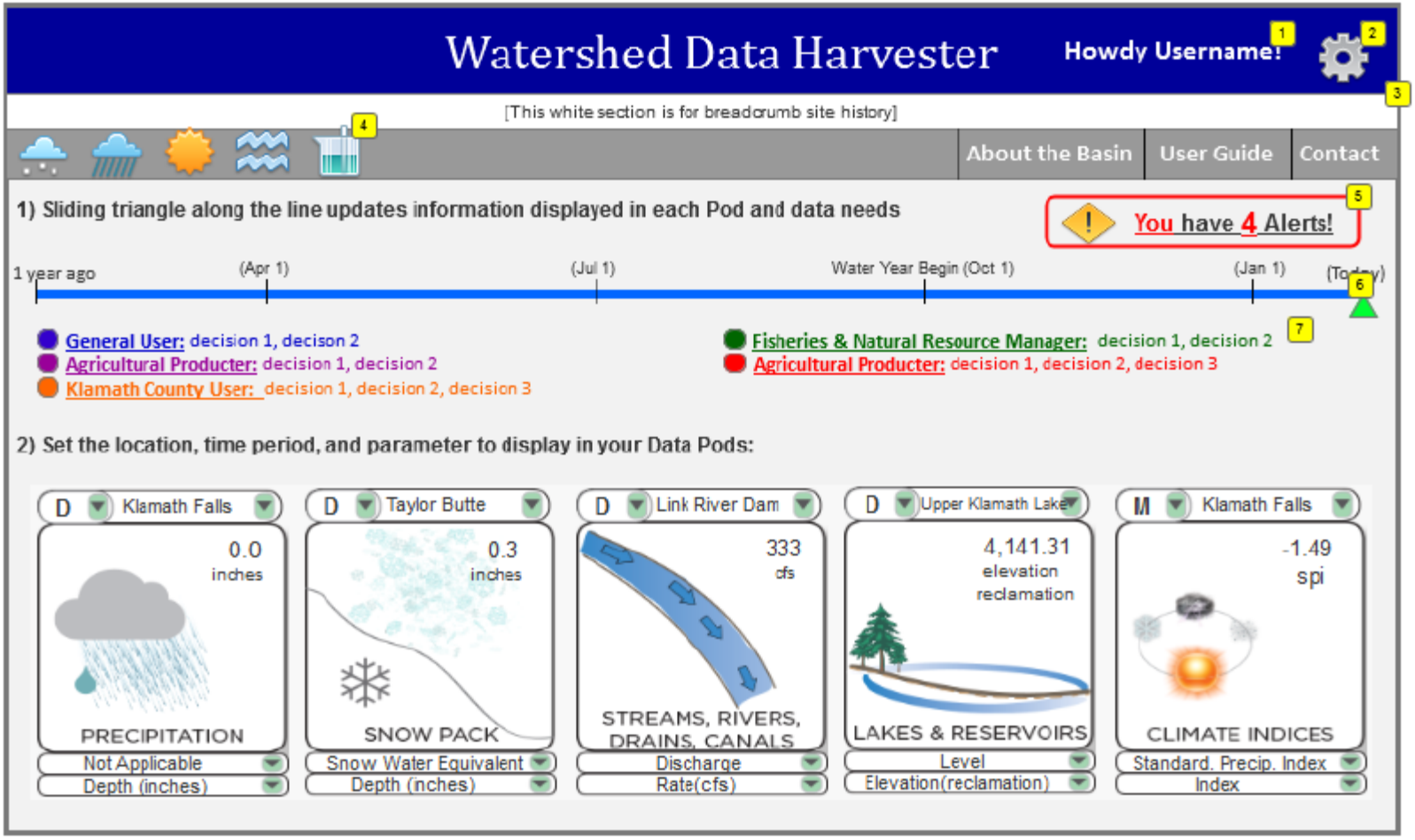
## 1.4. Traditional Authentication and LogIn

### 1.4.1. User Interface



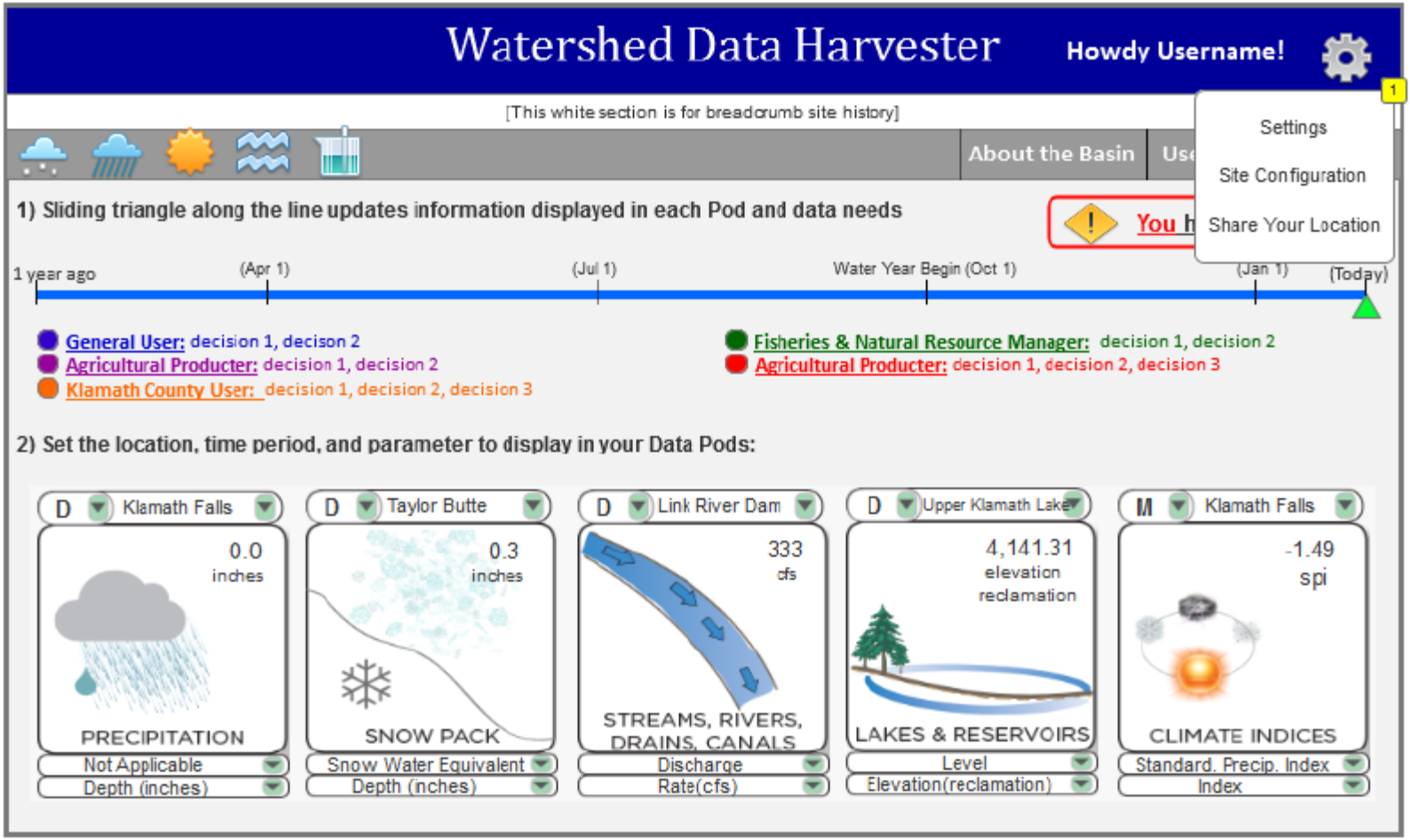
# 1.5. Dashboard

## 1.5.1. User Interface



## 1.6. Dashboard_Config_Menu

### 1.6.1. User Interface



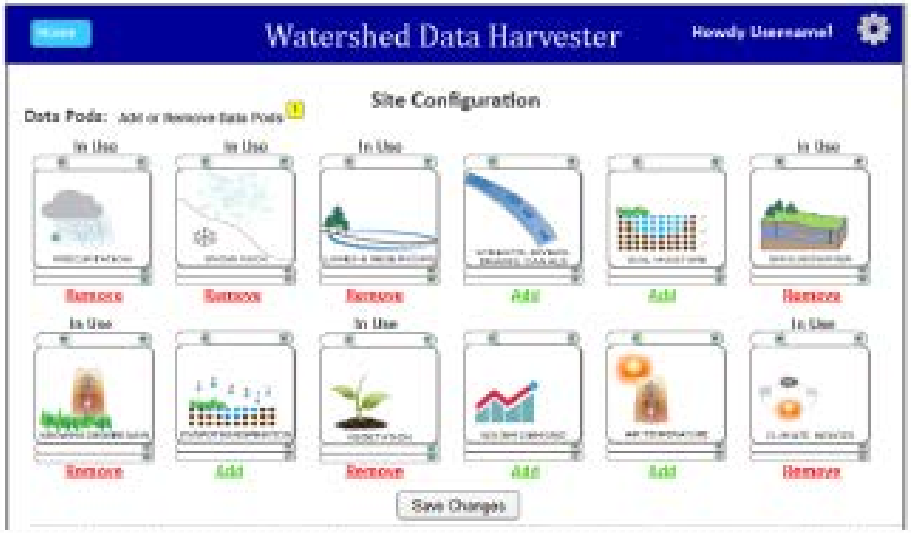
# Configuration

## 1.7. Configuration

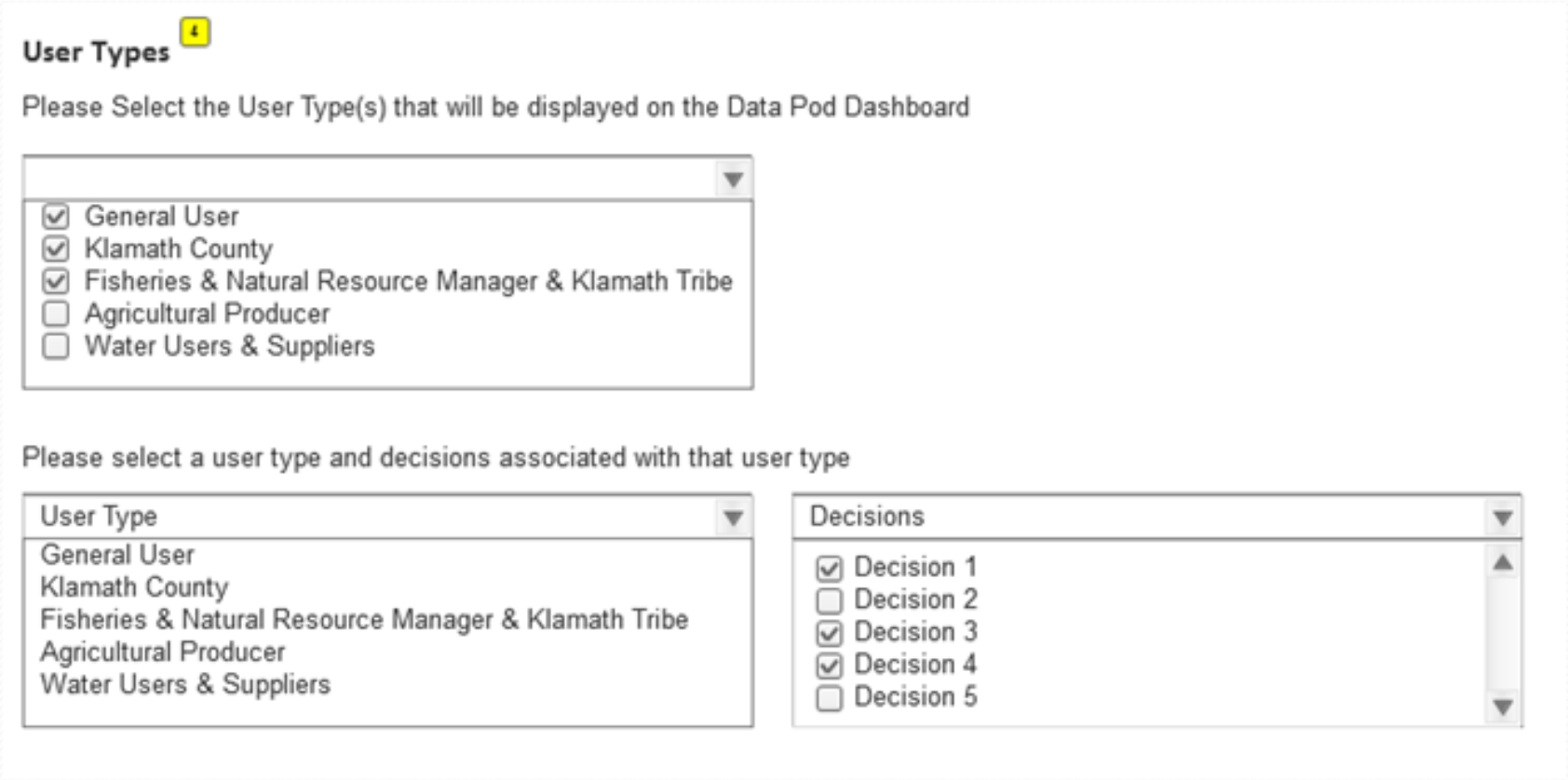
### 1.7.1. User Interface

Select User Type

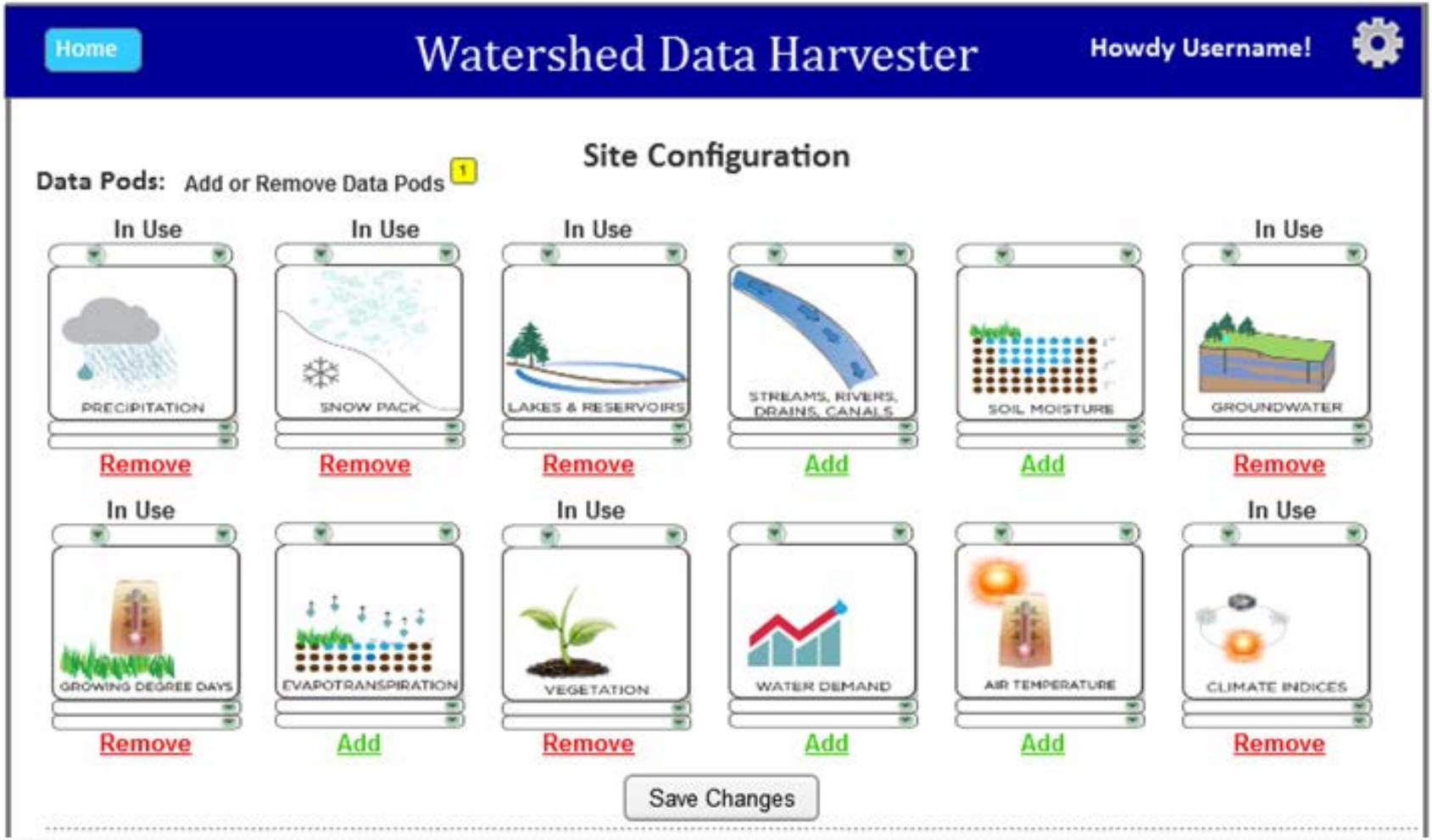
Pods (data types)
Time period
Locations
Pod Parameters
Alerts



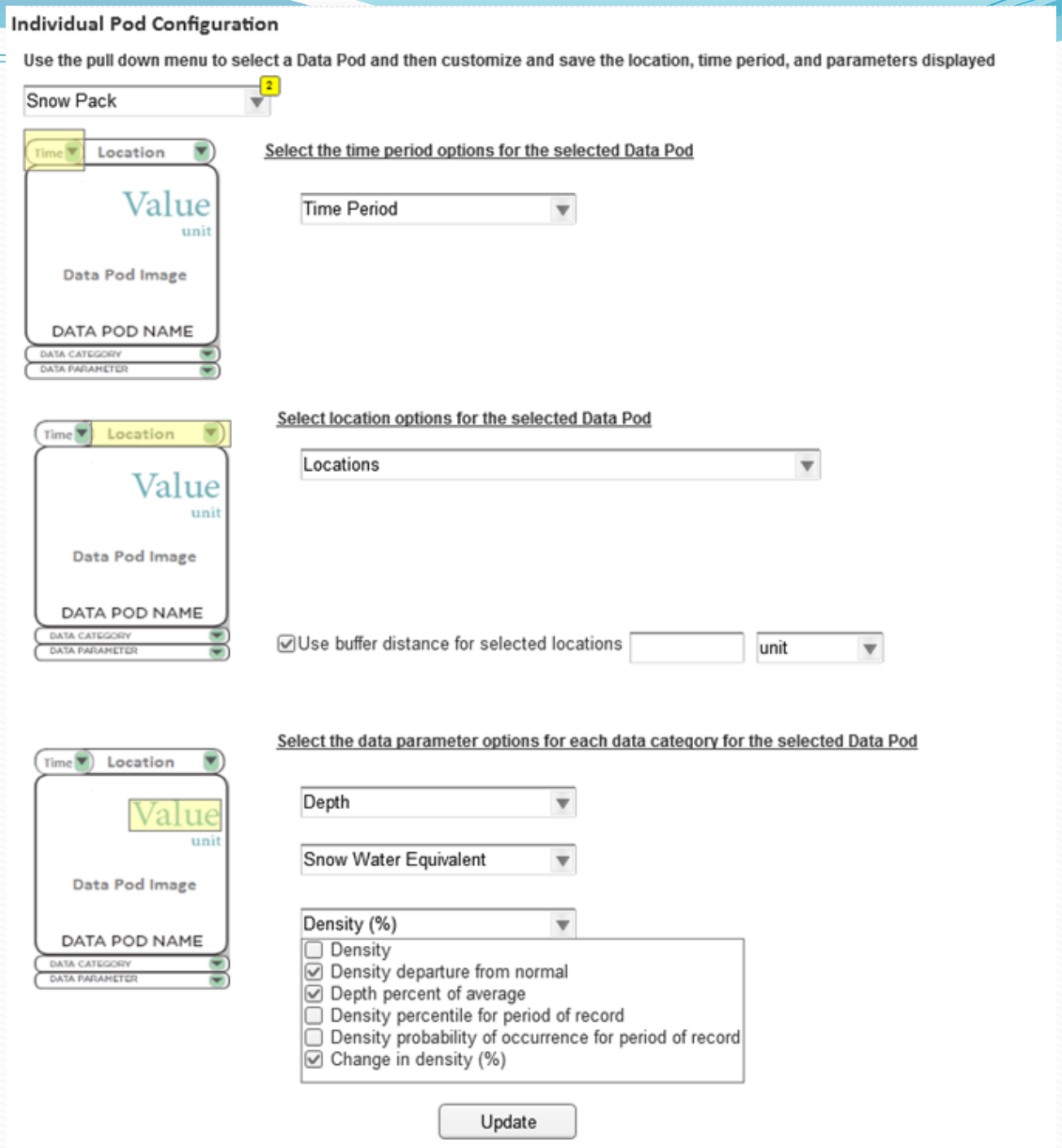
# Default User Type



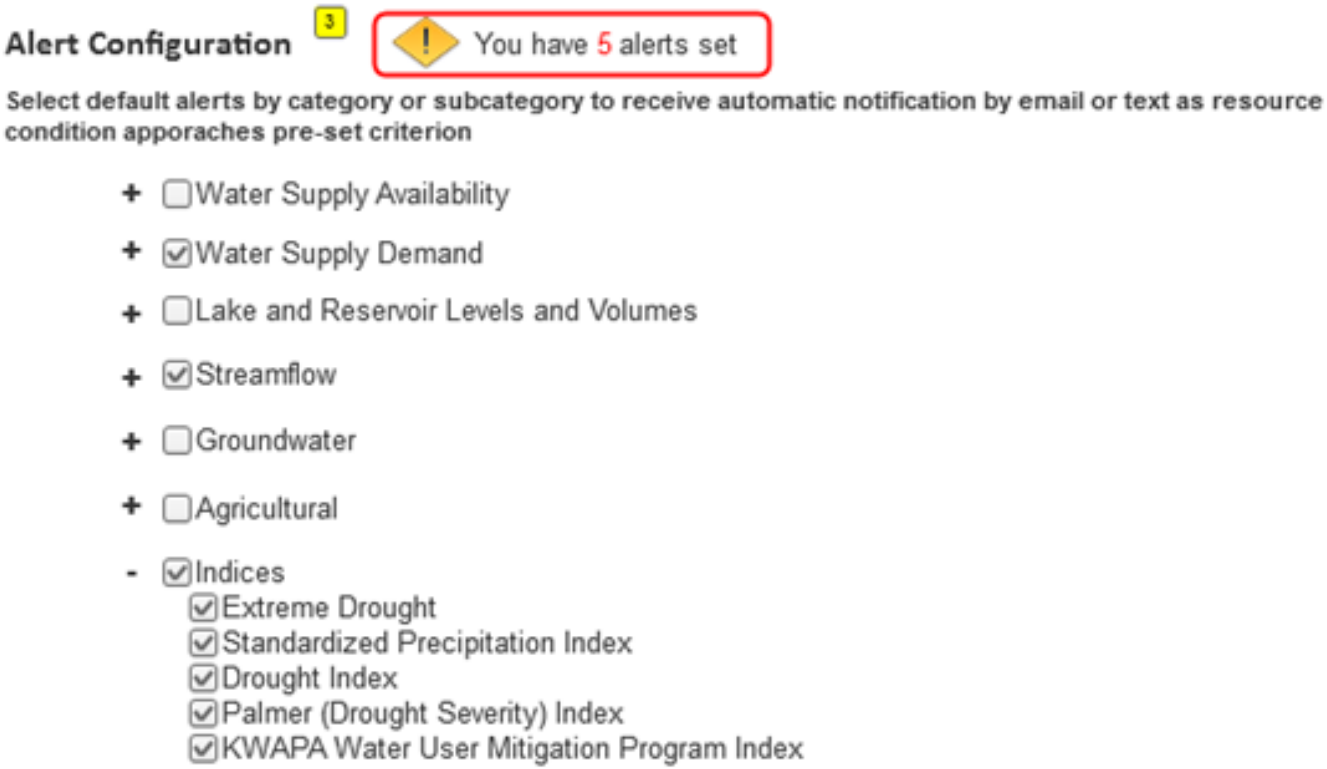
# Configure Dashboard Pods



# Configure Pod Data



# Configure Alerts

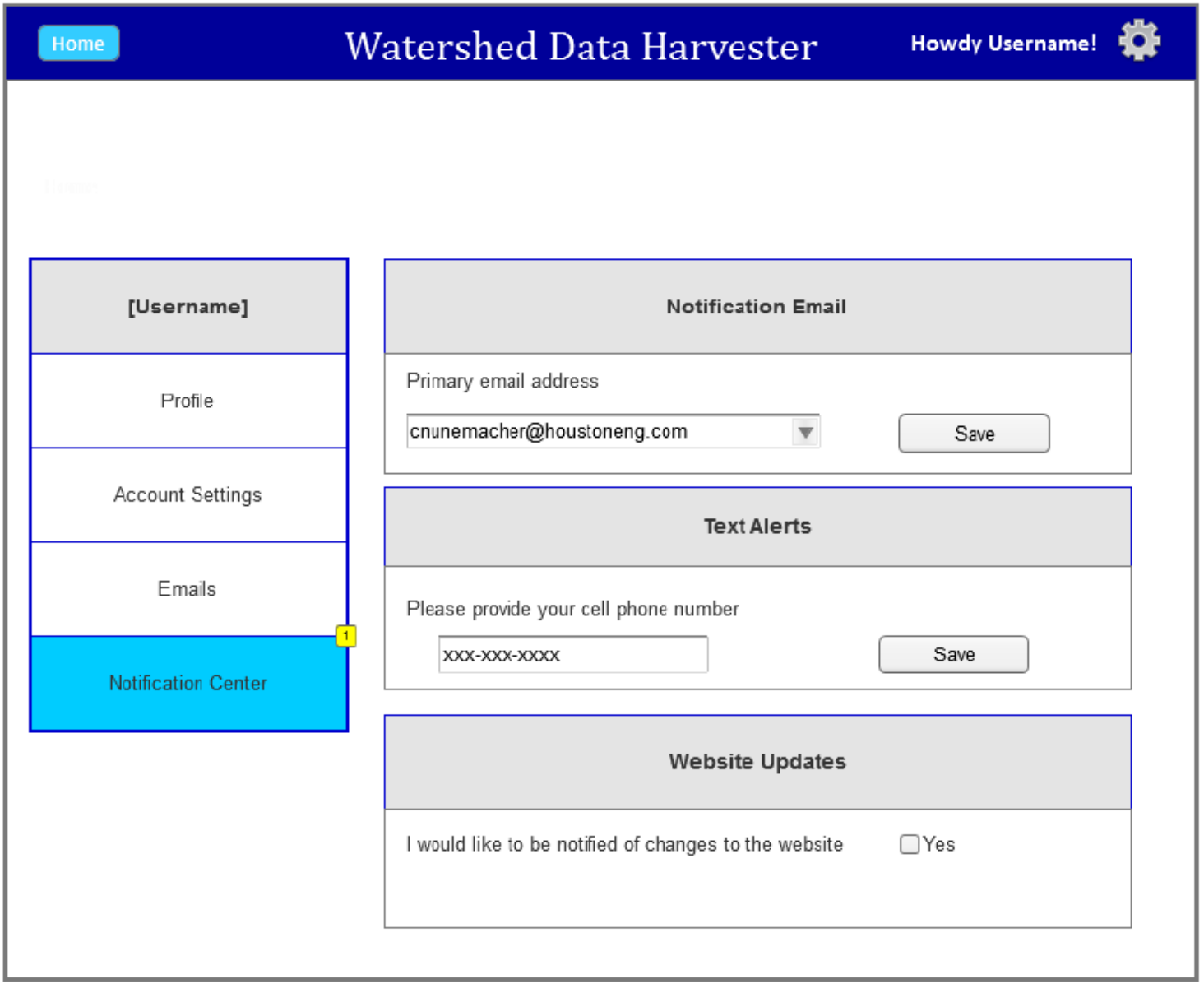


# Configurable Alert Options

- Alert Levels (these all have a time and space aspect)
- Water Supply Volume
  - Klamath Project for irrigation
  - Lower Klamath National Wildlife Refuge
- Klamath Project water supply demand
- Lake and Reservoir Levels
  - Maximum temporary flood elevation
  - Maximum operating elevation
  - End of irrigation season minimum operating elevation
  - Current amount of water in storage
  - Remaining useable storage volume
  - Average flow release rate through dam
  - Rate of reservoir filling
  - Carry over volume
  - Ecological elevation
- Streamflow
  - Williamson River streamflow rate
    - William River streamflow threshold
    - Proportion of Upper Klamath Lake inflow from Williamson River
  - Volume accretions to the Klamath River below Link River Dam
  - Iron Gate Dam
    - Minimum flows for Coho Salmon
    - Summer maximum flow targets
  - Rate of discharge target
  - Accumulated volume target
  - Maximum stage alert level (flood)
  - Minimum stage alert level
  - Point of diversion
- Basin water supply index for Water User Mitigation Program
- Amount of accumulated precipitation
- Number of growing degree days
- Soil moisture percentage
- Drought condition
  - Potential for drought
  - Extreme drought
- Groundwater target water elevation in well

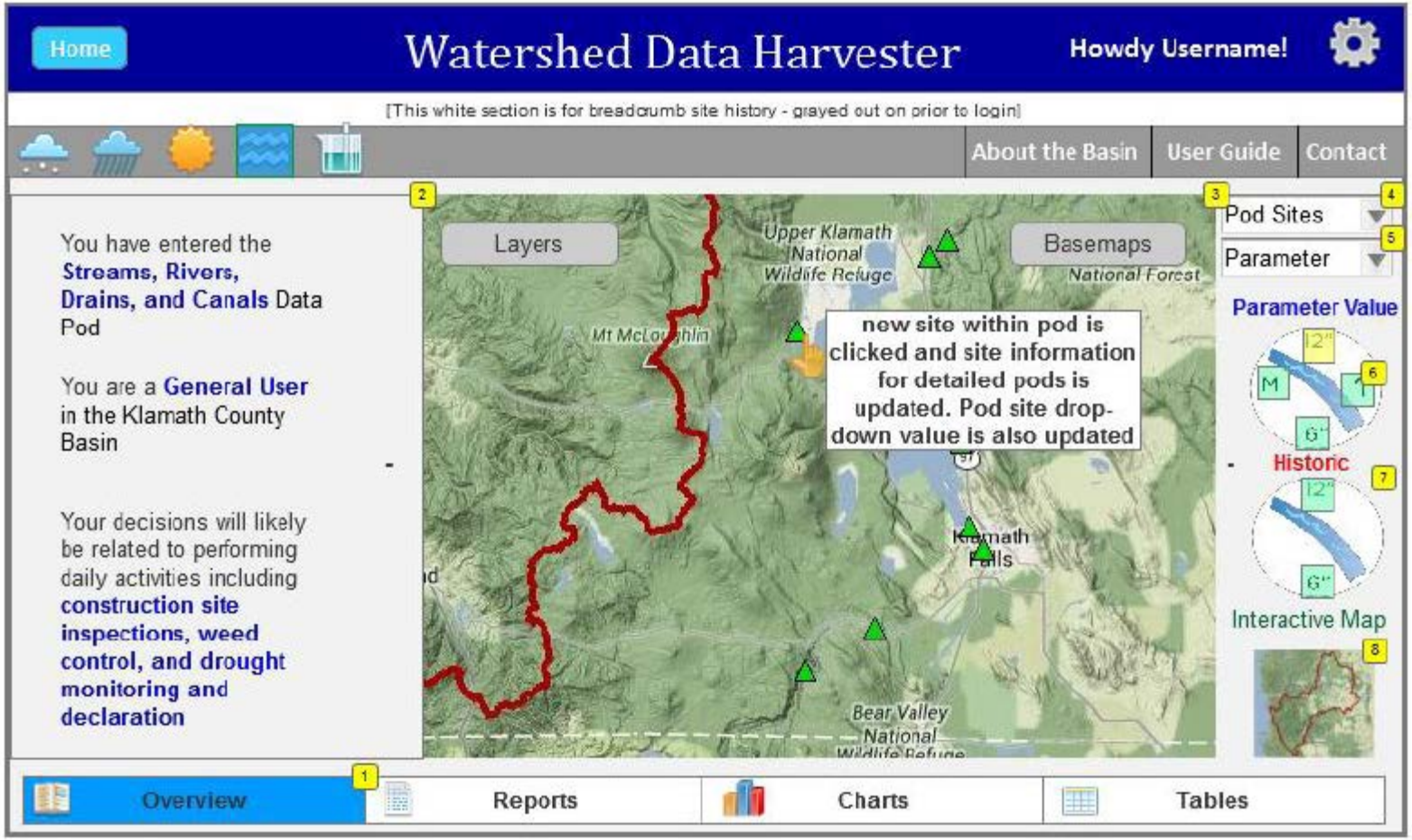
## 1.11. Notification Center

### 1.11.1. User Interface



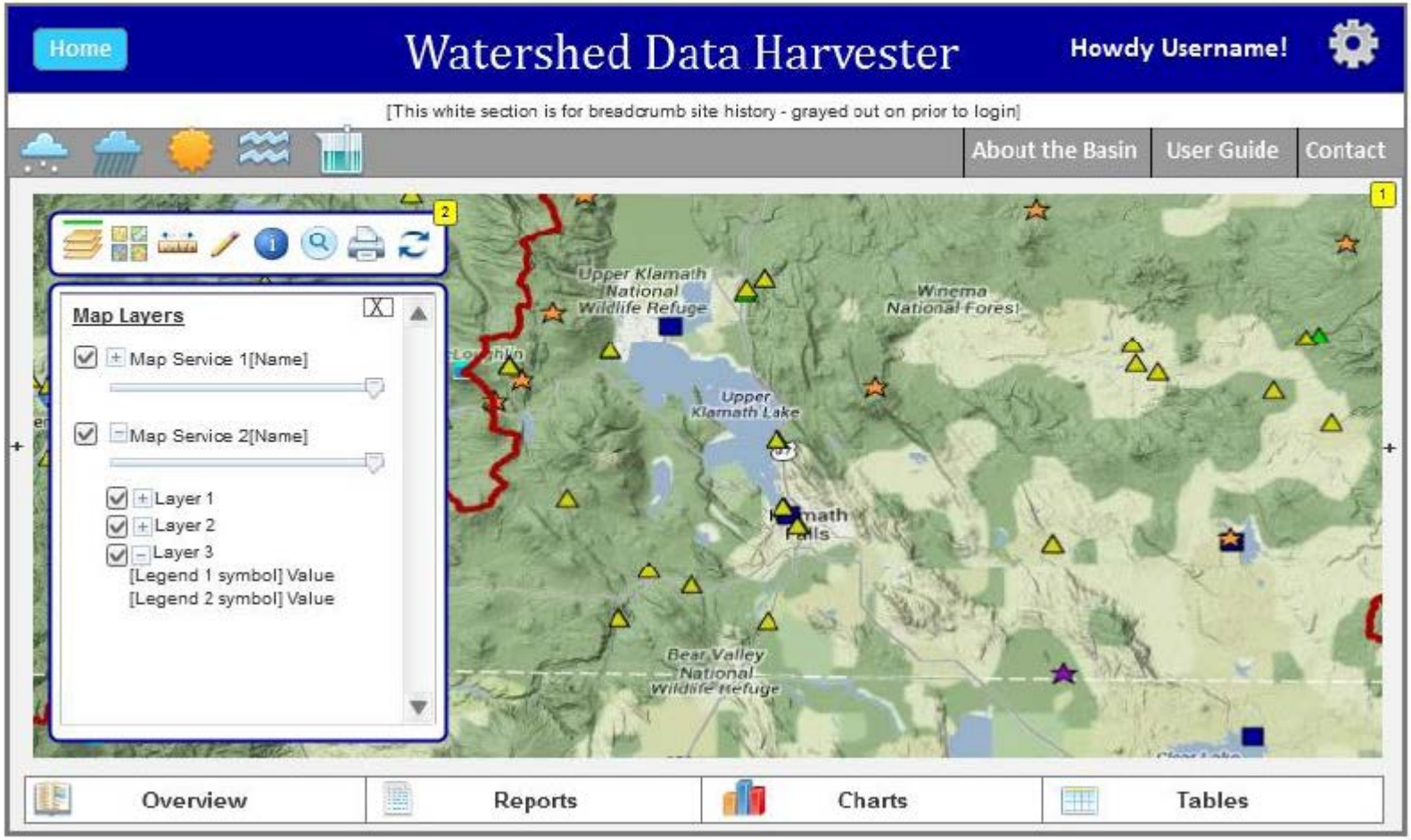
## 1.12. Streams_overview_page

### 1.12.1. User Interface



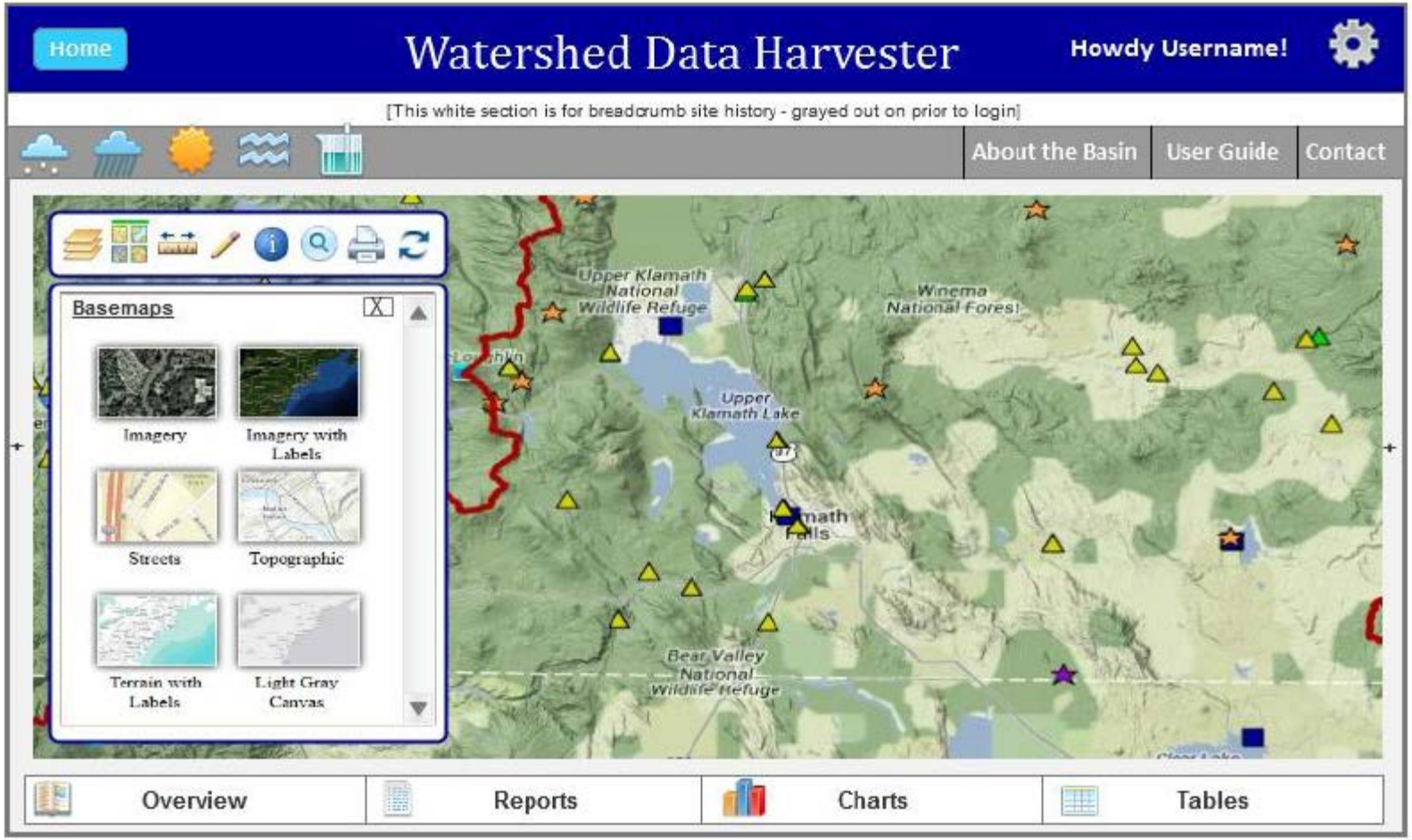
## 1.14. Interactive Map

### 1.14.1. User Interface



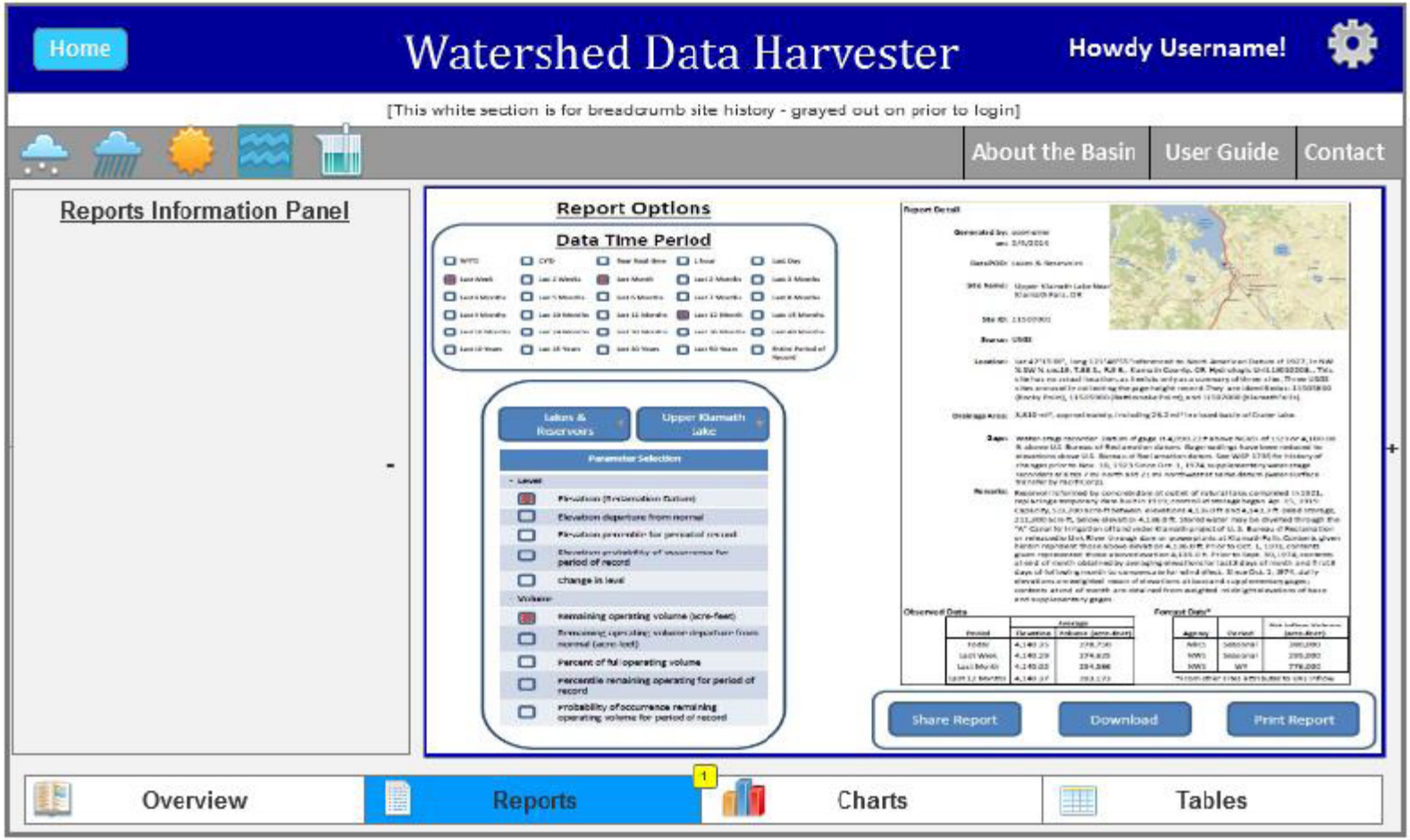
## 1.15. Basemaps

### 1.15.1. User Interface



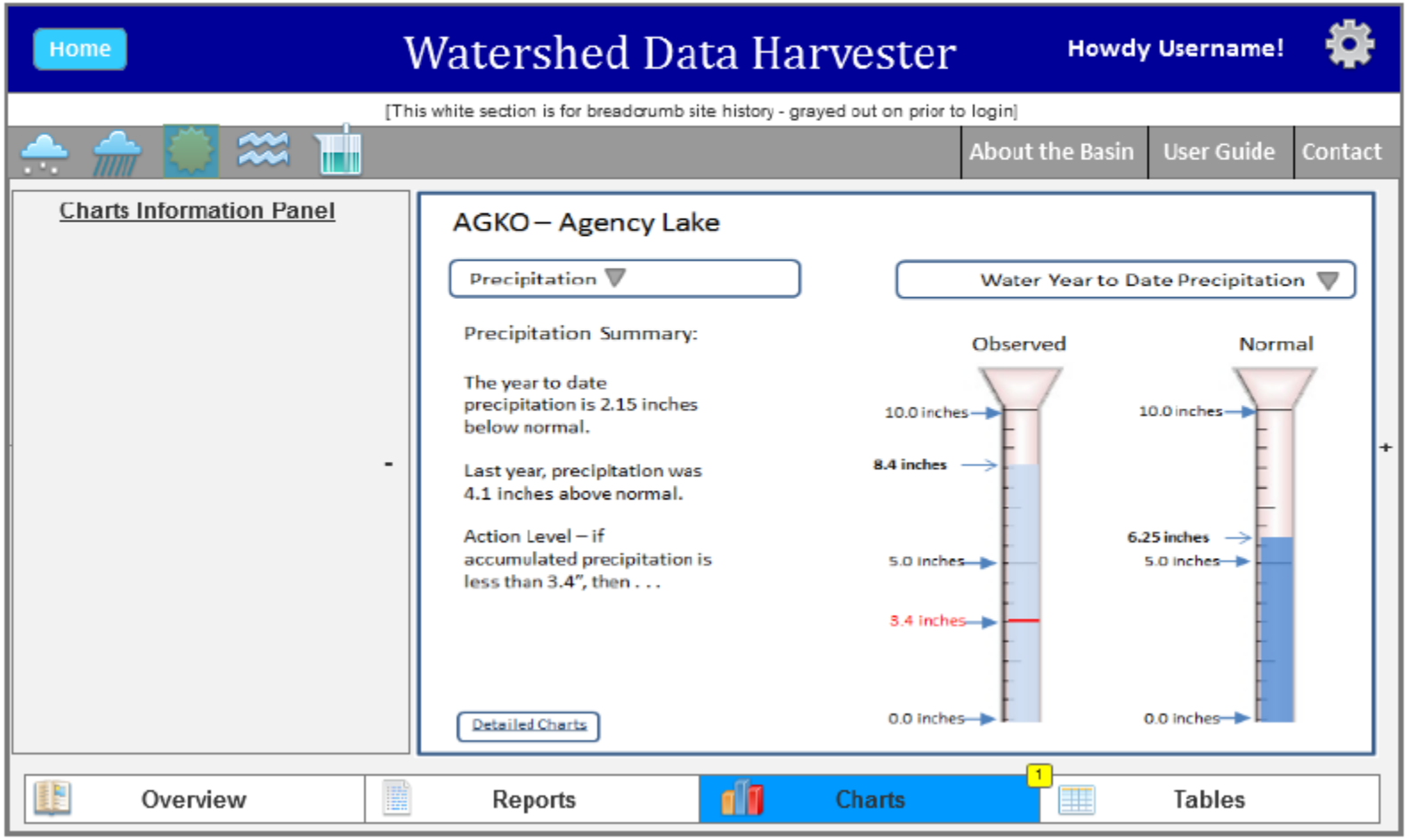
# 1.21. Reports Page

## 1.21.1. User Interface



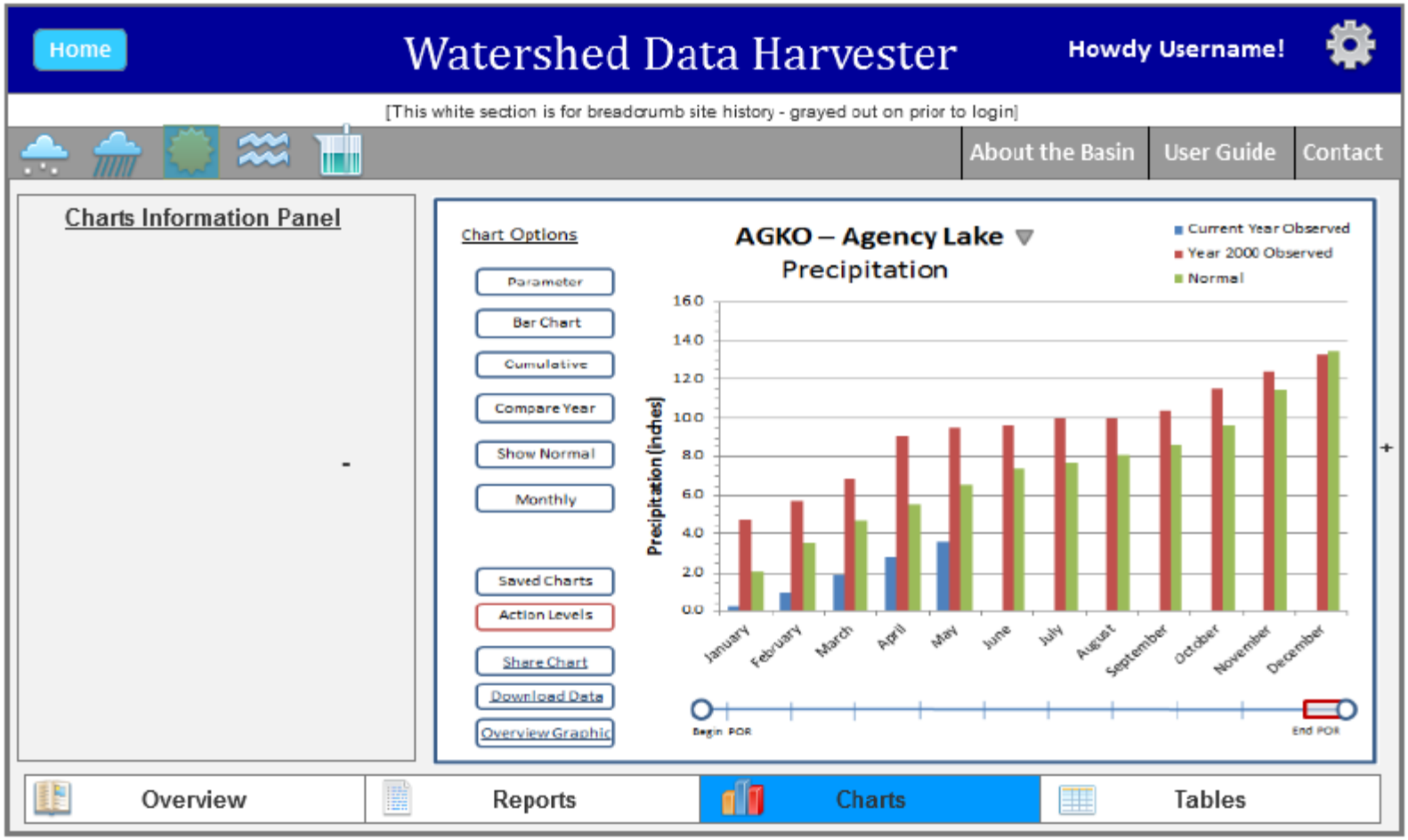
## 1.22. Charts Page

### 1.22.1. User Interface



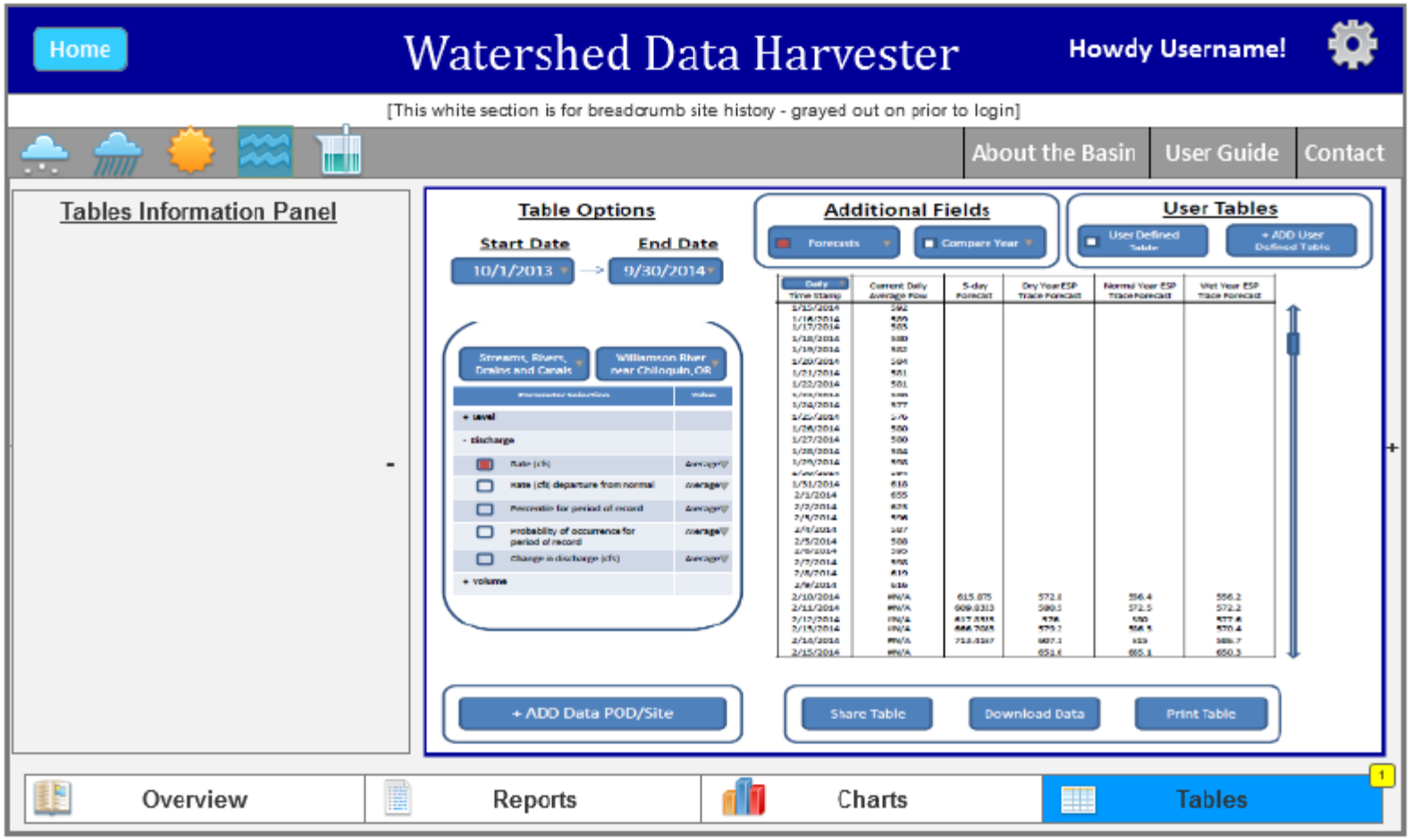
## 1.23. Detailed Charts Page

### 1.23.1. User Interface



# 1.24. Tables Page

## 1.24.1. User Interface



# Configurable for Flexible Use

- Sum cumulative runoff volumes => points of diversion
- Subtract gage station flows => Klamath accretions
- Drought indices at local scale => sub County declarations
- User defined criterion and alert levels
- Water supply index for WUMP program

# Your Participation

- Are your needs and decisions identified properly?
- Are there really alternative decisions based on data risk?
- Have we correctly connected your decisions to data needs, the criteria for action, and your actions?
- Is there value of the tools, methods and concept presented?
- Proceed with development?

# Thanks for participating!

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# The end

And the answer to the reason for being at this meeting is?

- ❑ Presentation by another “expert” from outside the Basin
- ❑ Somebody else that thinks they can solve our problems
- ❑ Another study to place on the shelf
- ❑ I had no where else to go, so I came here
- ❑ Another consultant working on a government
- ☑ See if Deutschman got it right

# Forecast Accuracy

**Forecast Accuracy**
**Based On 1981 - 2011 Reconstructed Forecast**
**April - September Seasonal Volumes**

**Median (50%) Forecast**

| | Williamson River | | | | UKL Net Inflow* | | | |
|---|---|---|---|---|---|---|---|---|
| Forecast Date | Median Forecast Value (KAF) | Jacknife Standard Error (KAF) | Mean Absolute Error (KAF) | Mean Percent Difference | Median Forecast Value (KAF) | Jacknife Standard Error (KAF) | Mean Absolute Error (KAF) | Mean Percent Difference |
| 1 January Forecast | 319.3 | 96.0 | 71.3 | 22.7% | 426.7 | 136.2 | 106.9 | 27.1% |
| 1 February Forecast | 358.2 | 76.8 | 52.6 | 16.1% | 482.7 | 103.8 | 75.6 | 18.4% |
| 1 March Forecast | 365.9 | 66.8 | 48.9 | 16.0% | 493.8 | 88.8 | 69.4 | 17.9% |
| 1 April Forecast | 307.5 | 43.3 | 32.4 | 9.6% | 511.8 | 63.2 | 46.5 | 10.1% |

**70% Exceedance Forecast**

| | Williamson River | | | | UKL Net Inflow* | | | |
|---|---|---|---|---|---|---|---|---|
| Forecast Date | Median Forecast Value (KAF) | Jacknife Standard Error (KAF) | Mean Absolute Error (KAF) | Mean Percent Difference | Median Forecast Value (KAF) | Jacknife Standard Error (KAF) | Mean Absolute Error (KAF) | Mean Percent Difference |
| 1 January Forecast | 268.8 | --- | 80.5 | 22.0% | 354.5 | --- | 114.7 | 24.2% |
| 1 February Forecast | 317.5 | --- | 61.6 | 17.3% | 427.7 | --- | 85.7 | 18.4% |
| 1 March Forecast | 330.4 | --- | 34.5 | 16.1% | 446.7 | --- | 77.8 | 17.7% |
| 1 April Forecast | 284.5 | --- | 35.8 | 11.2% | 478.3 | --- | 52.5 | 11.6% |

**** "Known" UKL Net Inflow is an estimated value from BOR MODSUM (water balance) model (not measured).***

***Mean percent difference computed from absolute values of (forecast volume - measured volume) divided by measured volume.***

***Observed April through Steptember volumes were 344.8 and 473.03 kaf for the Williamson River and Upper Klamath Lake (UKL) Net Inflow respectively.***