

ARKANSAS BASIN ROUNDTABLE

Website: www.arkansasbsin.com

Email: arkbasinrt@gmail.com

Wednesday, March 11, 2020
Pueblo Community College
900 Orman Ave., Pueblo, CO 81004

12:30 pm – 3:30 pm

Box Lunches will be available at

12:00 for RSVP'd members

12:20 for others

- 12:30-12:40** **WELCOME AND INTRODUCTIONS – Mark Shea [10 min]**
Introductions
Approval of minutes - January
Public Comment
- 12:40 – 1:30** **Reports [50 min]**
Executive Committee – Mark Shea (10 min)
CWCB Report – Ben Wade and Greg Felt (10 min)
IBCC Report – Jeris Danielson and Terry Scanga (10 min)
PEPO – Amber Weber (5 min)
Needs Assessment Committee – Abby Ortega (5 min)
Environmental and Recreational – Bob Hamel and Rena Brand (5 min)
Arkansas River Watershed Collaborative (ARWC) – Chelsey Nutter (5 min)
- 1:30 – 1:50** **Ark Valley Conduit Report Out [20 min]**
Jim Broderick
- 1:50 – 2:00** **Break [10 min]**
- 2:00 – 3:10** **Program [70 min]**

Colorado School of Mines USDA Water Management – Steven Smith [10 min]

Colorado Geological Survey - Martin Palkovic [30 min]

Colorado State E-Rams – Tyler Wible [30 min]

ADJOURNMENT

Upcoming Meetings

Arkansas Basin Roundtable – TBD with Water Forum

BIP Local Expert Selection – April 10, 2020

Subcommittees

- Enviro/Rec Comm. – March 23, 2020, Canon City BLM Office
- Ark Basin Water Forum – April 23-24, Salida, CO (registration is open)



Arkansas Basin Roundtable

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ROUNDTABLE MEETING NOTES

March 11, 2020 – Pueblo Community College, Pueblo, CO

More information and presentations may be found at: www.arkansasbasin.com

Roundtable Business

Mark Shea called the meeting to order at 12:30 pm. Members and visitors introduced themselves. Twenty-eight (28) members were present.

Approval of minutes of prior meeting

The meeting notes of the January and February 2020 meetings were approved by consensus.

Public Comment

Peter Barkmann notified the group that an update of the Colorado Groundwater Atlas has been completed and has been made available on their website: coloradogeologicalsurvey.org.

REPORTS:

Executive Committee – Mark Shea

Amber Shanklin has been added to the Executive Committee. She will serve on the ARWC board as Secretary/Recorder.

Regarding the local BIP contractor, two firms provided proposals: Leonard Rice Engineers/Forsgren and GMS Engineering. The Executive Committee discussed the proposals and the majority preference was for Leonard Rice Engineers. A minority of four voted for GMS. Roundtable consensus is needed in order to move forward.

Minority opinion: Our constituents represent folks that often don't have a voice, that are typically poor, rural, and unable to speak for themselves. GMS would excel in this area.

Majority perspective: LRE/Forsgren bring experience at a higher level of planning. GMS is very good at system infrastructure project work, but has less experience with big picture planning. As we've mentioned before, there will be a need for roundtable members to provide local advocacy for projects. Both teams expressed their willingness to listen to folks from small communities throughout the basin. Both applications will be on the website within a few days.

The recommendation of Leonard Rice Engineers was met with consensus by roundtable members.

Mark Shea welcomed Bill Banks, new director of the Fountain Creek Watershed, Flood Control and Greenway District. He replaces Larry Small as a voting member on the roundtable.

CWCB Report – Ben Wade

New website: cwcb.colorado.gov

The CWCB board meeting will be under the tab: public information. CWCB meeting may be viewed there as it occurs. Grants from this basin will go to the board for approval tomorrow. Webinar – water availability and flood taskforce. All are welcome to join.



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There was a Demand Management Regional Workshop. The exploration of feasibility of demand management program continues.

There will be meetings on April 9th in Salida and on May 7th in Frisco for the Environmental Considerations Work Group.

CWCB Staff changes:

- Megan Holcomb moved into Climate Change Specialist
- Sam Stein is new liaison for all nine roundtables. We won't see Ben anymore. Sam will likely attend every-other month.
- Brent Newman left last fall. His position was Section Chief of Federal and Interstate Issues. Greg Johnson is moving into that role
- Russ Sands is now Water Supply Planning Section Chief.
- WSRF questions are being handled by Craig Godbout.

IBCC Report

Jeris – The IBCC met March 4&5. The first day was an IBCC meeting, and the second day was a meeting of the Demand Management Work Groups.

- The Rio Grande Basin reports a major push to export water from the San Luis Valley.
- There is a big move in the state for the state to take control of the administration of USACE Sections 104 and 404 of the Clean Water Act. The state is currently split between three (404) ACOE divisions. This could be very important to the state, and we should perhaps have a presentation regarding this at a future meeting. The roundtable may wish to officially adopt a position regarding this matter.
- State Engineer Kevin Rein talked about the compact, what authority he has, and what it would take for him to act. Showed the hydrology of the Colorado River. Compact administration needs clear rules as to role of the state.

PEPO – Amber Weber

New webisodes are near completion and will be shown at the Forum.

Water Education Colorado tour is getting close to finalization. Registration is open. Make sure you get signed up for that. The tour will start in La Junta and work its way up to Pueblo Reservoir.

Needs Assessment – Abby Ortega

Grants will be taken up by CWCB tomorrow (that were approved at our January meeting). June 1st is the deadline for the next round of grants. Bring your projects forward!

Environment/Recreation Committee – Bob Hamel, Rena Brand

The next meeting will be held March 30th at 10:00 am, at the BLM offices in Canon City. We're working on our piece of the Master Needs List. We've found ARWC projects and agency projects. With agency projects, we're looking for ways to create lists within lists. Some are on the list just to let us know that they are happening versus projects that need project partners and funding.

Arkansas River Watershed Collaborative – Chelsey Nutter

Chelsey handed out a report. Call or email her with any questions you may have. Amber Shanklin has joined the ARWC board and the Executive Committee.



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Arkansas Valley Conduit Update – Jim Broderick, Chris Woodka

It's been a vision since the early 1950's. The last few months have been exciting to watch, as this dream comes to life.

2018: New Concept Report...no federal funding

Costing and Technical Study – why not use Pueblo's water system to carry the water through town rather than building a big pipeline around Pueblo.

One of the larger customers on the conduit decided they didn't want to be on it anymore (St Charles Mesa)

2019: Joint Senate Memorial – Unanimous support in both houses. Asked to get back in the federal budget.

New plan starts near Hwy 50, east of Pueblo. Pipeline would be built mostly by Reclamation. Lines off the trunk line would have various funding sources.

Nov 2019 – CWCB awarded a \$100 million finance package. \$90 million loan, \$10 million grants. This package will be in the water projects bill this funding session. Thank you to Jack Goble. These funds also give leverage for the federal funding ask.

February 4, 2020: Congress announces \$28 million in funding for AVC in FY 2020.

February 10, 2020: President requests \$8 million for AVC in FY 2021.

Construction outlook: Planning meetings are underway. Will start building at the east end of Pueblo's water system.

Pre-Construction Activities:

- Environmental review
- Cultural resources review
- Field exploration review
- Land planning and utilities investigation
- Final design
- Land acquisition
- Construction procurement
- Contract with Pueblo Water (mid-2021)

Construction with the next couple years

- First 12 miles of pipeline to Boone
- Breakpoint chlorination facility
- Pumping station
- Surge tank

Next steps: drafting project management plan with Bureau of Reclamation. Boone still has about 1.4 million in grants that could be applied to this project in some way. This plan starts delivering water as soon as the pipeline reaches each customer.

15-year timeline for the whole thing. It won't likely happen that quickly. Pipeline is ~ \$2million per mile.

BREAK



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PROGRAM - Please check out full presentations at www.arkansasbasin.com.

Innovative Governance of Scarce Surface Water and Groundwater - CO School of Mines USDA Water Mgmt – Alex Gebben

Project Overview

- USDA-Agriculture and Food Research Initiative Grant
 - 3-year project spanning the Arkansas, South Platte, and Rio Grande Basins
 - Build upon prior National Science Foundation grant that focused on the Rio Grande Basin
- Generate Scientific Knowledge on what governance structures and decisions are effective for managing irrigation water
 - Provide inputs for stakeholder policy deliberations
- Three Overarching Goals
 - Assess the agricultural, ecological and socio-economic impacts of financial incentives for groundwater commons
 - Analyze dynamics and performance of self-governing irrigation services
 - Use experiments to test and promote institutional innovations for local water governance.

Cretaceous Sedimentary Bedrock and its Impact on Uranium Concentrations in Irrigation Return Flows to the Arkansas River, Southeastern Colorado - Colorado Geological Survey – Martin Palkovic

- The Colorado Department of Public Health and Environment (CDPHE) asked CGS to investigate how the subsurface geology may be affecting groundwater uranium concentrations along the Arkansas River...
- From John Martin Reservoir to the Kansas State Line. This study area roughly corresponds to the extent of the irrigated land in the area.
- Groundwater in southeastern Colorado has uranium concentrations above the EPA Maximum Contaminant Level (MCL). U MCL = 30 µg/L. Main concern is U loading into the Arkansas River
- Kansas estimated that between 12-20,000 lbs/yr enter their state from 2012-2016. CDPHE's main concern is U loading into the Arkansas River
- The study area shows that most high uranium zones are located within areas of irrigated agriculture. On the presentation, bright red dots are >4x the MCL. How do these high uranium zones correlate to the geology? I set out to find out by looking at oil and gas logs and developing a drilling program to understand the geology of the area
- Agricultural practices in the Lower Arkansas River Basin believed to be contributing to water quality degradation of Arkansas River water
- Martin described study efforts and results (see presentation)

One World Solutions Institute Overview, Colorado State University – Tyler Wible

One World Solutions Institute (OWSI) Overview

- OWSI – One World Solutions Institute
- Catena Analytics
- eRAMS – Environmental Resource Assessment and Management Systems
- CSIP – Cloud Services Integration Platform
- Catena Analytics - examples



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Admin Email: ARKBASINRT@GMAIL.COM

MEETINGS/LINKS:

- Env/Rec Committee – March 30, 10 am, Canon City
- Arkansas Basin Roundtable: www.arkansasbasin.com
- PEPO: www.pepoarkbasin.com
- Arkansas River Basin Water Forum: <http://www.arbwf.org/>
- CWCB: <http://cwcb.state.co.us/Pages/CWCBHome.aspx>
- Colorado Water Plan: <http://coloradowaterplan.com/>
- Colorado Flood Threat Bulletin: www.coloradofloodthreat.com
- Stream Management Plan Resource Library: <https://coloradosmp.org/>

ARKANSAS BASIN ROUNDTABLE

EXECUTIVE COMMITTEE

Agenda

Wednesday, March 11, 2020

Start Time: 10:30 am

Pueblo Community College

900 Orman Ave., Pueblo, CO 81004

Greetings and necessary introductions

Minutes/Notes of the previous meeting

ARWC Board Meeting

- Follow-up from February
- Update on 2020 Budget

Reoccurring matters:

- Chair Comments – Mark Shea
- Other Outstanding Reports – Any executive member

New Business

- ABRT BIP Update/Local Expert
 - Follow Up from RFQ
 - April 10, 2020 Deadline
- CWCB Representative Recognition
- April RT Meeting with Water Forum

Work Session

- None

Old Business

- None

Needs Assessment Meeting

- None

Roundtable Business:

- Today's Roundtable Agenda - review and revise as necessary

Upcoming Meetings

- Arkansas Basin Roundtable – TBD
- Subcommittees
 - Enviro/Rec Comm. – March 23, 2020, Canon City BLM Office
- Ark Basin Water Forum – April 23-24, Salida, CO (registration is open)

Adjourn to lunch

Committee membership: Mark Shea (Ch), Bob Hamel (VCh-NonC), Mike Weber (VCh-Cons), Mike Fink (Rec), Sandy White (Past-Ch), Greg Felt (CWCB), Jeris Danielson (IBCC), Terry Scanga (IBCC), Tim Canterbury (IBCC Alternate), Abby Ortega (Needs Assessment), Amber Weber (PEPO), Paul Fanning (Legislative Rep)

Additional distribution: Ben Wade (CWCB staff), Chelsey Nutter (ARWC Coord.), Elise Bergsten (Secretary), Amber Shanklin (Environmental)



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Executive Committee Meeting Notes

March 11th 2020 – Pueblo Community College, Pueblo

www.arkansasbasin.com

Executive Committee Present: Mark Shea – Chair; Mike Weber - Vice Chair; Mike Fink – Secretary; Abby Ortega – Needs Assessment Committee; Al Tucker – Roundtable Member; Jeris Danielson – IBCC; Ben Wade – CWCB; Amber Weber – PEPO; Amber Shanklin – Secretary of ARWC; Chelsey Nutter – ARWC; Paul Fanning – Executive Committee Member; Sarah Mudge – Executive Committee Member; Sandy White – Past Chair; Terry Scanga – IBCC; Bob Hamel – Environmental and Recreation Committee Chair.

Executive Committee Absent: Greg Felt, CWCB Member, was at the CWCB Meeting, which was scheduled concurrently with the Arkansas Basin Roundtable Meeting this month.

Guests Present:

Brett Gracely – (LRE) Leonard Rice Engineers; Will Koger – Forsgren; Dave Frisch, and Jason Meyer – GMS

Call to order:

Chairman Mark Shea called the March 11, 2020 Executive Committee Meeting to order at 10:30 am. Greeting and introductions were performed.

Minutes:

Consensus approval of the February 12, 2020 Executive Committee Meeting Minutes.

ARWC Board Meeting:

- Follow-up from February: ARWC distributed the January/February written update report to the Executive Committee.
- Update on the 2020 Budget: There was an update on the current funding for Projects in the ARWC written report.

Recurring Matters:

- Chair Comments – Mark Shea: No Comments
- Other outstanding reports - No other outstanding reports



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New Business:

ABRT BIP Update/Local Expert Interviews:

Brett Gracely presented for LRE and Will Koger presented for Forsgren. LRE and Forsgren are presenting as one applicant. Brett Gracely indicated that LRE and Forsgren have previously worked together. Brett Gracely is familiar with the elements of the BIP. He said the specific RFQ elements for the Arkansas Basin Roundtable was helpful. Brett Gracely will be the Project Manager, with LRE focusing on Resource Management and Stakeholder Engagement. Forsgren's part of the project will be the more engineering focus. Will Koger cited the recent collaboration between the two organizations for the El Paso County Water Master Plan.

Mike Fink stated as disclosure, that Forsgren, LRE and GMS all have current contracts with the City of Fountain. He wanted to disclose that information but feels it should not eliminate him from the voting between the two Firms. Mark Shea agreed with Mike Fink's comment noting there were other Roundtable Members who have worked with the two applicants, either under current contracts or in the past.

Roundtable Executive Committee Members posed the following questions to the applicant and the responses were as noted:

1. **Q:** Is there any way the ARKDSS work can be done in the BIP update; is this something you have considered or talked about?
A: It is currently something LRE can go over when they interact with the stakeholders.
2. **Q:** Are you prepared to help with resources; how do you see funding working out?
A: One of the key elements is the three-day workshop at the state-wide level, and second LRE can produce a calendar for the Roundtable with due dates of various funding efforts that will be parallel to this process.
3. **Q:** Did either of your firms submit or respond to other RFQ's from other Basins?
A: LRE stated that a different section within LRE submitted an application to the RFQ for BIP Update to the South Platte Roundtable.
4. **Q:** As a follow up, if you were to be chosen by both the Arkansas and the South Platte Basin Roundtables, you would be potentially working for two Basins?
A: Brett Gracely spoke to that question that he wouldn't be working the firm's South Platte group if both Roundtables chose LRE; his firm will be under contract for both Roundtables, but he would be dedicated to the Arkansas Basin Roundtable as the Project Lead.
5. **Q:** What do you see is the highest priority for the Arkansas Basin?
A: There are entities that don't have internal planning resources and engineering resources to look out far enough into the future. Making that and maintaining the balanced with agriculture users are the two highest priorities.
6. **Q:** Can you clarify what you envision the role of this consultant should be?
A: Some things on the Master Needs List have been stale and some haven't even been talked about, since the BIP identified the Master Needs List in 2015. There are also potential projects and studies that have arisen since the 2015 BIP was adopted, but have not been brought to the list. LRE know there are needs that should be brought to the Roundtable's attention, and that is the consultant's role.



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7. **Q:** Is it going to be decided in your group or at a state level how the Master Needs List will be prioritized or do you see this as individually by Basin?
A: This Local Expert consultant gives the Roundtable access to additional professional staff to look at the projects. To help the experts understand what is old, what projects have already been considered and funded and what is new will require input from the Roundtable. The Roundtable will be able to give opinions of prioritization when it considers funding requests.
8. **Q:** How will you work with the partnerships or agencies?
A: This is the type of things that we will want to do during the workshop. LRE wants to be able to report back to the Roundtable and keep that communication and engagement.
9. **Q:** What is your flexibility while the process is going on, if for example another agency needs to jump in front of the Master Needs List?
A: Identifying the things that are most important; LRE knows things will change and be a continuing process. That will be important to discuss with the stakeholders and to make sure the priorities are being taken care of, and listening to any suggestions that may arise.
10. **Q:** At the Environmental & Recreation Committee we discuss how to narrow things down. We are finding that some of the specific things that CWCB requested in their RFP that the Environmental & Recreation Committee can't quantify such as the effect on the Water Supply Gap that any given Project will address. Is this something you anticipate assisting the Roundtable with?
A: LRE stated they don't think the schedule or the budget support a full-blown perfect answer to all those questions. LRE thinks there are benchmarks that can be applied from one area to another. If there are situations where there is no information, that's an opportunity to ask why the project should be funded.
11. **Q:** What are your top three priorities once you get the money and have this three-day meeting? What's next?
A: The Project Management Plan comes out of the workshop and becomes a plan for us going forward, and using the plan to communicate with the Roundtable to get some feedback and discuss anything that may be missing.

GMS presented: Dave Frisch and Jason Meyer spoke to their qualifications and experiences with small districts and water systems, and providing services from start to finish. Many small districts have little or no experience in projects. GMS stated they are used to working under deadlines; and described the scoping and workshopping early tasks. Jason described the different staff members and who would be assigned to which tasks. There would be specialists on communications and on technical efforts on the BIP Update and each of these specialists would have another staffer to provide depth of personnel. Ken White would be the Project Manager.

1. **Q:** Overall regarding ARKDSS update, do you feel comfortable enough to incorporate this work in what you are doing?
A: If it deals with water demands, then yes, GMS is be able to handle that. Not all projects specifically fit with ARKDSS.



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2. **Q:** Do you have any experience on the other side of it? For example, agricultural projects, environmental & recreation, forest health, and forest mitigation. Where do you think you fit in with that kind of work?
A: GMS has done the engineering reports and studies with the smaller communities. GMS stated they have taken agricultural wells and converted them into municipal wells.
3. **Q:** There are 500 projects on the Master Needs List. 70-80 require us to have a Benefit/Cost Analysis; how will you deal with reduction of the Master Needs List, and assistance to the communities?
A: Because GMS works a lot of small communities we would look on their Master Needs List and see what is on their list, and the benefits that would come out of that project; then do a rough benefit analysis report to see if it's a valued project or not.
4. **Q:** The Roundtable is concerned about the small communities that may not know that they have a problem. How would you go out in the Basin and identify X, Y, Z when it comes to a problem?
A: When identifying communities and their needs, there are a couple of things GMS can look at. First, we would look at current and upcoming regulations and how does it impact. Second, we would have a fairly good idea of their infrastructure. Third, we would look at their population numbers and how that would affect water demands.
5. **Q:** In regards to Environmental & Recreation, at times the list expands with more than just one community participating in a given project; I would like to know how you would handle that, and what you would look at going forward?
A: Asking the right questions to the agencies, going over projects with them and where they are currently at; collecting data from them and where they sit with those needs.
6. **Q:** What is your flexibility to move quickly regarding Environmental Recreation if a major issue such as wild fires or floods were to arise to and it needs to move to the top of the master needs list; how would you handle that?
A: GMS would agree that wild fires and floods are substantial needs, so when it comes to quick response, yes, they see the need. They would carve out time with each of the individual agencies so they have the ability to get up and move and act accordingly.
7. **Q:** Do you have staff available to handle the master needs list, because you will need field staff and personnel contact for a lot of these projects?
A: Todd McClermen (field personnel) will be doing a lot of this work alongside with Anna. Dave does think he has the personnel to tackle the Master Needs List.
8. **Q:** You will need a lot of workers on these projects, especially on Benefit/Cost Analysis; how is that going to work?
A: We have identified some key people on our staff that will help assist, we also have some key engineering personnel, and six other design techs to work under Todd and Anna.

After each of the applicants had presented and answered questions, the Chairman asked for a vote. The actual show of hands favored LRE over GMS. This is the decision that the Executive Committee presented to the Full Roundtable.



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Follow up from RFQ:

- April 10th, 2020 Deadline: Mark Shea said that Roundtable wants to have a decision deadline for the Local Expert choice of March 31st 2020 for the CWCB and Brown & Caldwell.

Work Session:

- None

Old Business:

- None

Needs Assessment Meeting:

- None

Roundtable Business:

- Mark will appoint Amber Shanklin to the Executive Committee. Amber Shanklin is representing Watershed Health.
- PEPO has received a request for the Arkansas Water Forum to support them with \$3,000 for the new system. Amber Weber needs approval from the Executive Committee in order to fill out any forms. Amber Weber stated \$1,000 for dinner and \$2,000 for general education. Mark Shea and the Executive Committee gave consensus approval to support PEPO.

Upcoming Meetings:

- Arkansas Basin Roundtable April Meeting: Only the Executive Committee April 22, 2020, 2:00 p.m. at the Upper Ark Office with call-in capability.
- Subcommittees Enviro-Rec Committee: Will Meet March 23, 2020 at the Canon City BLM Office
- Arkansas Basin Water Forum - April 23-24, in Salida, Colorado (registration is open) (Note: The Forum was cancelled due to the quarantine)

Mark Shea adjourned the Executive Board Meeting at 12:00 p.m.



Arkansas Valley Conduit Update

Arkansas Basin Roundtable
March 11, 2020



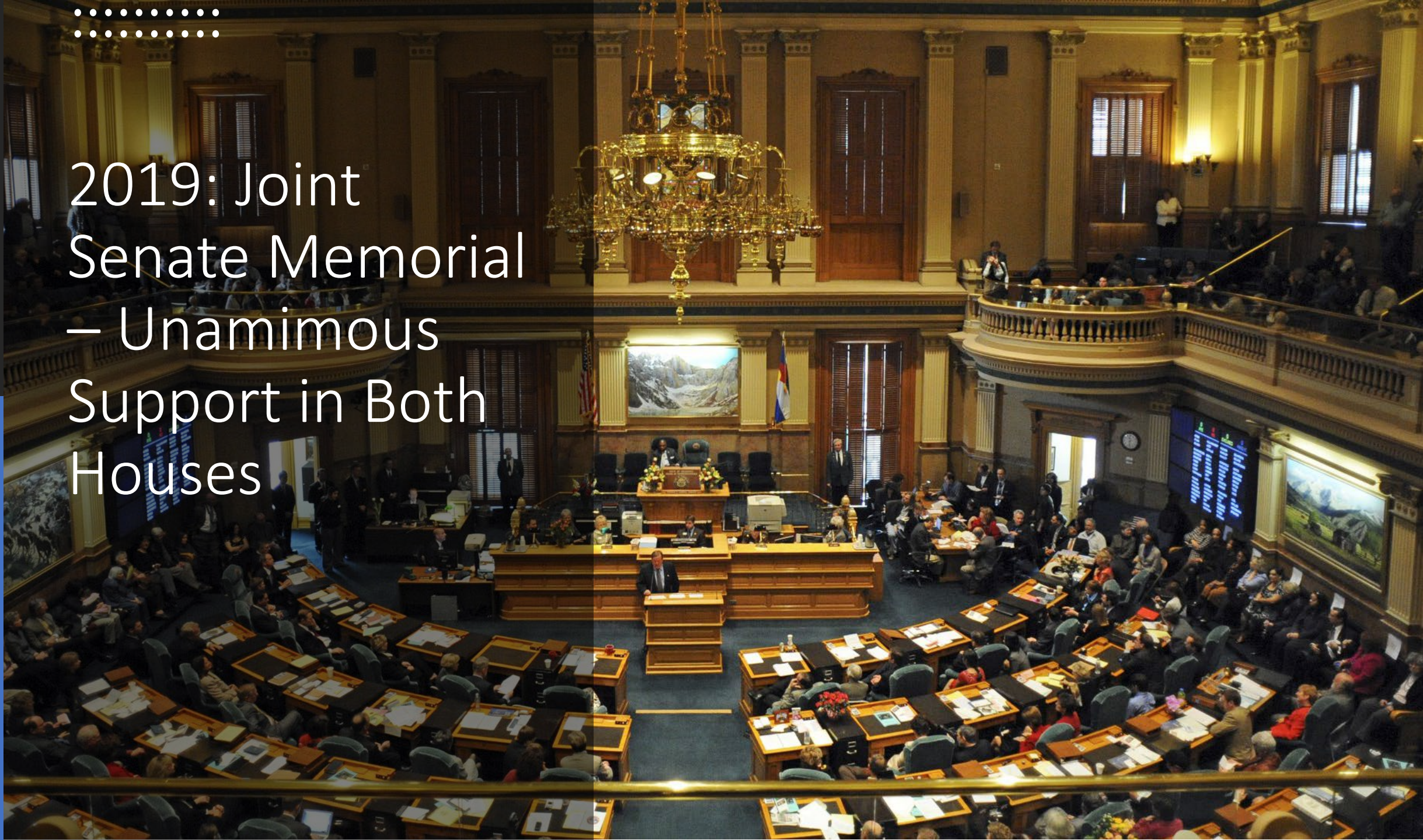
ARKANSAS VALLEY CONDUIT

2018: New
Concept
Report...
No federal
funding

New Concept Technical and Costing
Evaluation Report

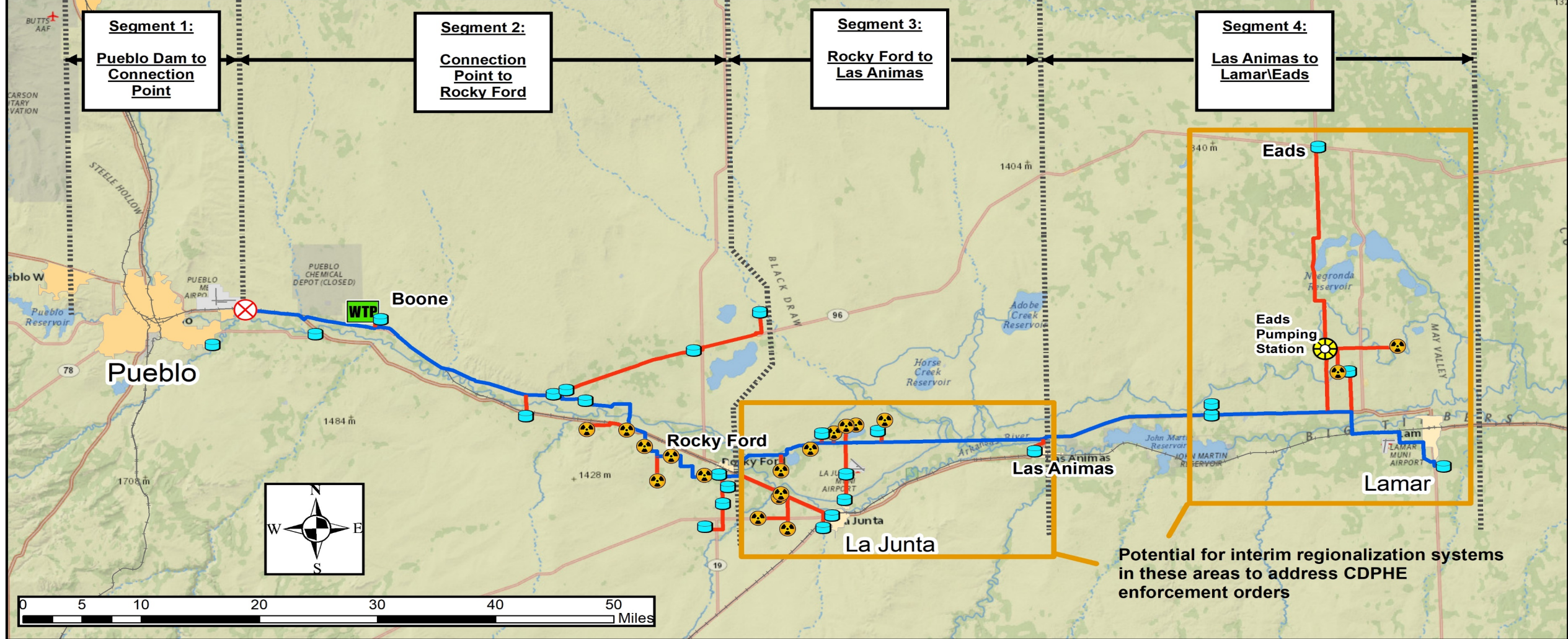


2019: Joint
Senate Memorial
– Unanimous
Support in Both
Houses



2019: Value
Planning and
Path Forward
discussions





- Legend**
- ⊗ Connection Point
 - ☀ Pumping Plant
 - ☢ Provider under CDPHE enforcement order for presence of radionuclides
 - 🟦 Other water providers
 - 🟩 WTP Breakpoint Chlorination Facility
 - 🔴 Delivery and Spur lines - to be funded and built by others
 - 🔵 Trunk line - to be funded and built by Reclamation



Arkansas Valley Conduit (AVC) A Path Forward

Bureau of Reclamation
Technical Service Center
Geographic Applications & Analysis
Revision Date: 11/22/19
Map Projection: Colorado State Plane South



November 20,
2019: Colorado
Water
Conservation
Board approves
\$100 million
finance
package.

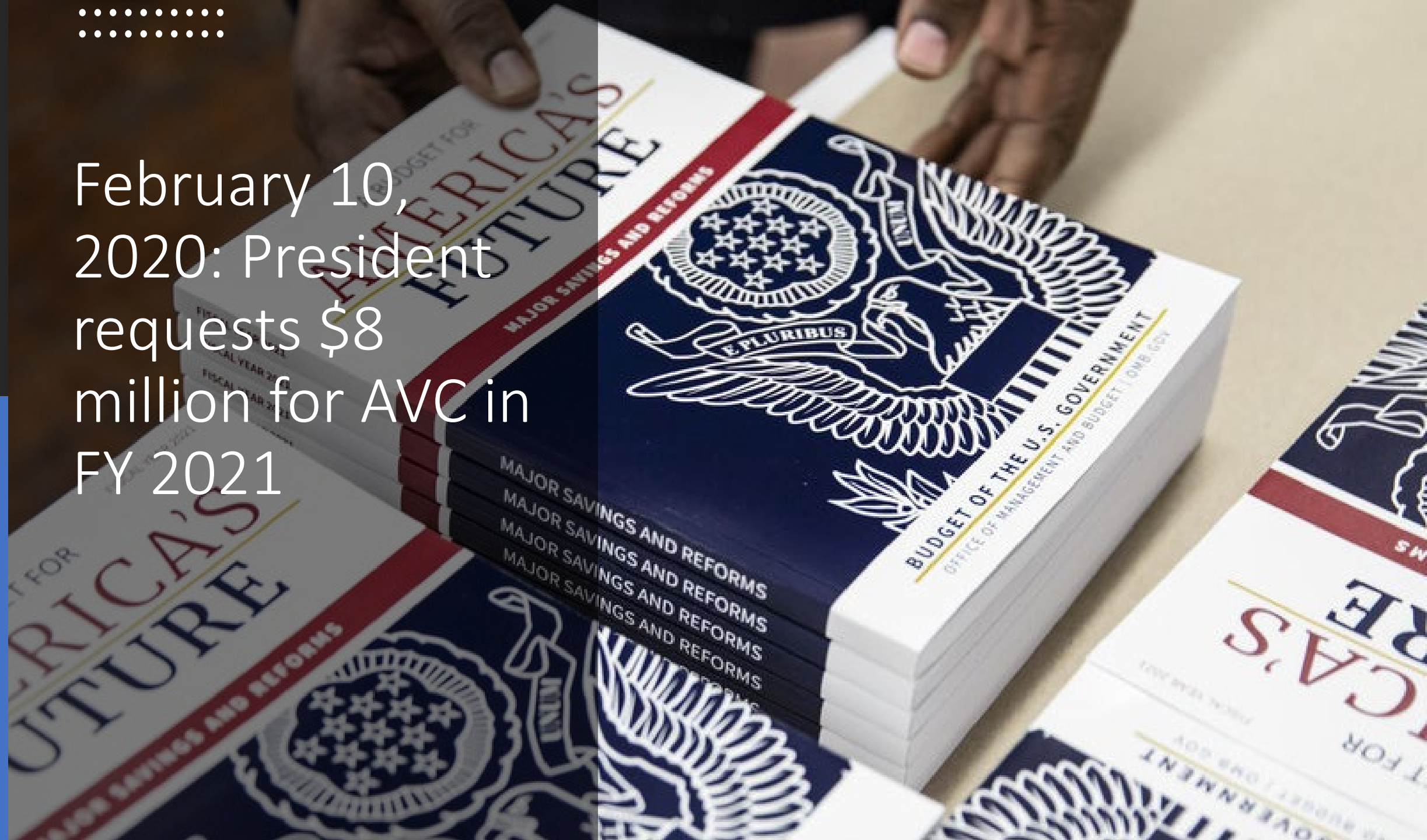


February 4, 2020:
Congress
announces \$28
million in funding
for AVC in FY 2020





February 10,
2020: President
requests \$8
million for AVC in
FY 2021





Construction
outlook:
Planning
meetings
underway





Pre-construction activities:

- Environmental Review
- Cultural Resources Review
- Field Exploration Review
- Land Planning and Utilities Investigation
- Final Design
- Land Acquisition
- Construction Procurement
- Contract with Pueblo Water (mid-2021)



Construction activities:

- First 12 miles of pipeline to Boone
 - Breakpoint Chlorination Facility
 - Pumping Station
 - Surge Tank
- (Reclamation funded)



NEXT

STEPS



Innovative Governance of Scarce Surface Water and Groundwater

BASIN ROUNDTABLE, MARCH 2020

Steven M. Smith

Alex Gebben



COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT



Institute of Behavioral Science
UNIVERSITY OF COLORADO BOULDER

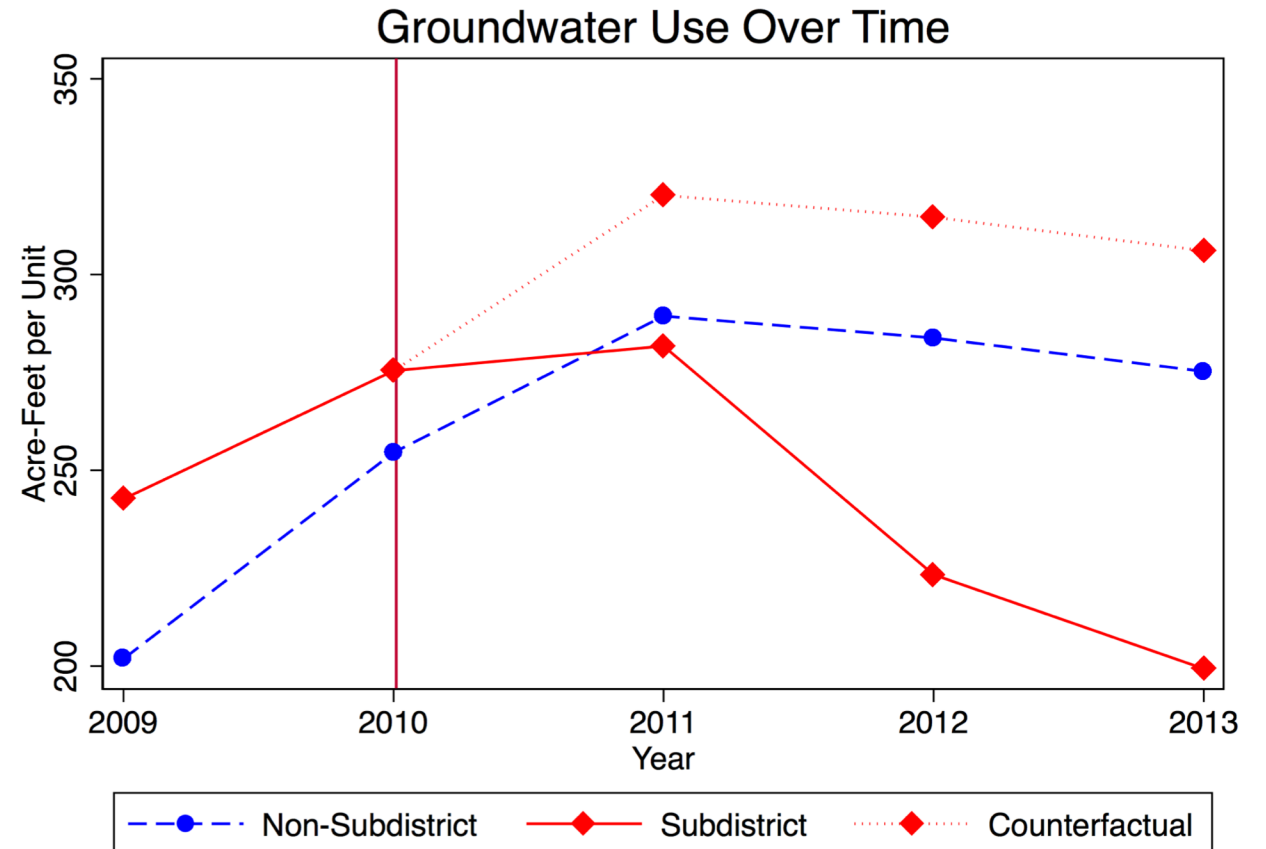
Project Overview

- USDA-Agriculture and Food Research Initiative Grant (#67023-29421)
 - 3 year project spanning the Arkansas, South Platte, and Rio Grande Basins
 - Builds upon prior National Science Foundation grant that focused on the Rio Grande Basin
- Generate scientific knowledge on what governance structures and decisions are effective for managing (irrigation) water
 - Provide inputs for stakeholder policy deliberations
- Three overarching goals
 1. *Assess the agricultural, ecological, and socio-economic impacts of financial incentives for groundwater commons*
 2. *Analyze dynamics and performance of self-governing irrigation systems*
 3. *Use experiments to test and promote institutional innovations for local water governance*



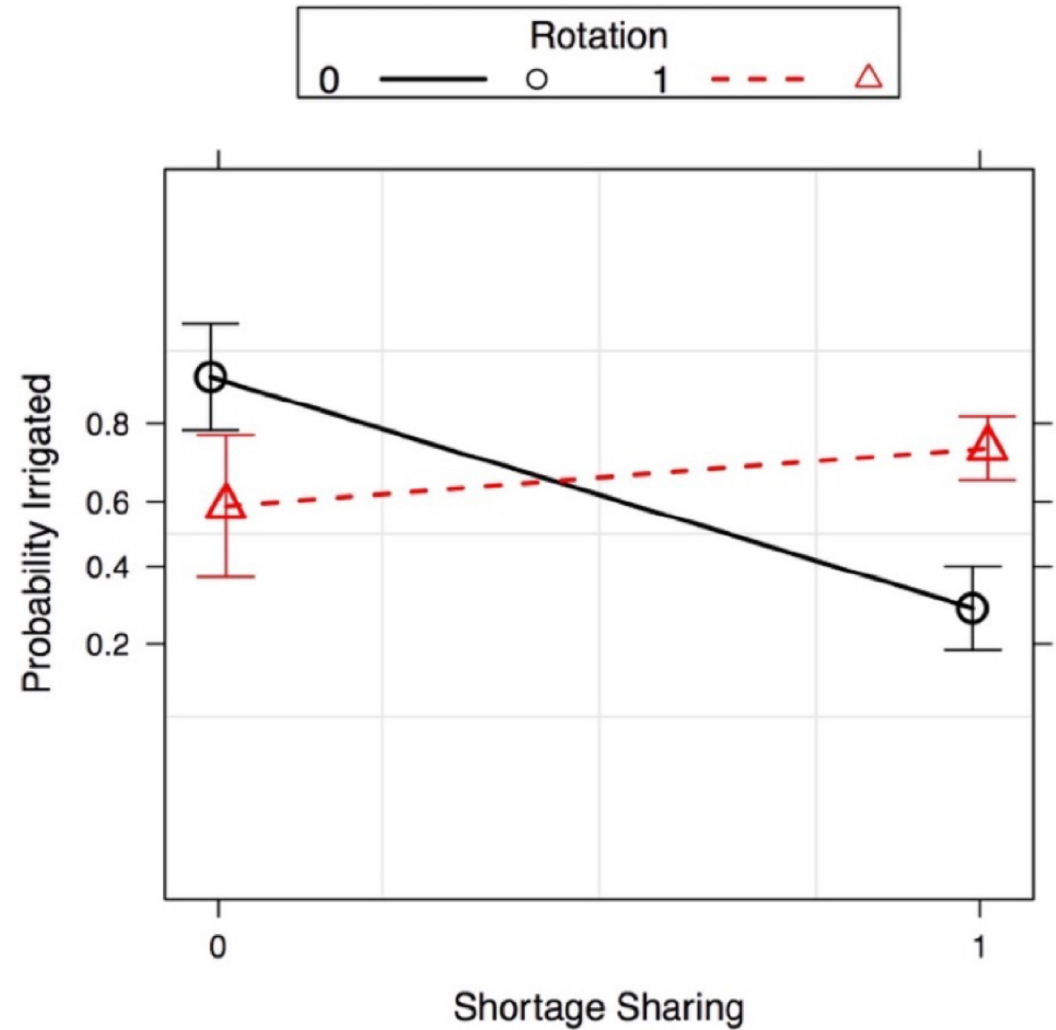
Groundwater in the Rio Grande Basin

- \$75/AF led to a reduction of 30 percent of groundwater extraction
- Reduced “competitive” pumping



Surface Water in the Rio Grande Basin

- Within a ditch, shortage sharing during droughts helps maintain irrigation
 - But only if delivery is rotational



Participation in the research process

1. Refining the research questions

- What are your questions?
 - We can provide scientific and statistical rigor to test your hypotheses
 - We can design experiments to test changes in behavior

2. Collecting information

- General background knowledge
- Participation with surveys
- Participating in experimental “games”

3. Reporting the results

- Providing venues and media for us to circulate findings



Thank You

Steven M. Smith (ssmith1@mines.edu)

Alex Gebben (alex.gebben@mines.edu)

Krister Andersson (krister.andersson@colorado.edu)



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Institute of Behavioral Science
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Cretaceous Sedimentary Bedrock and its Impact on Uranium Concentrations in Irrigation Return Flows to the Arkansas River, Southeastern Colorado

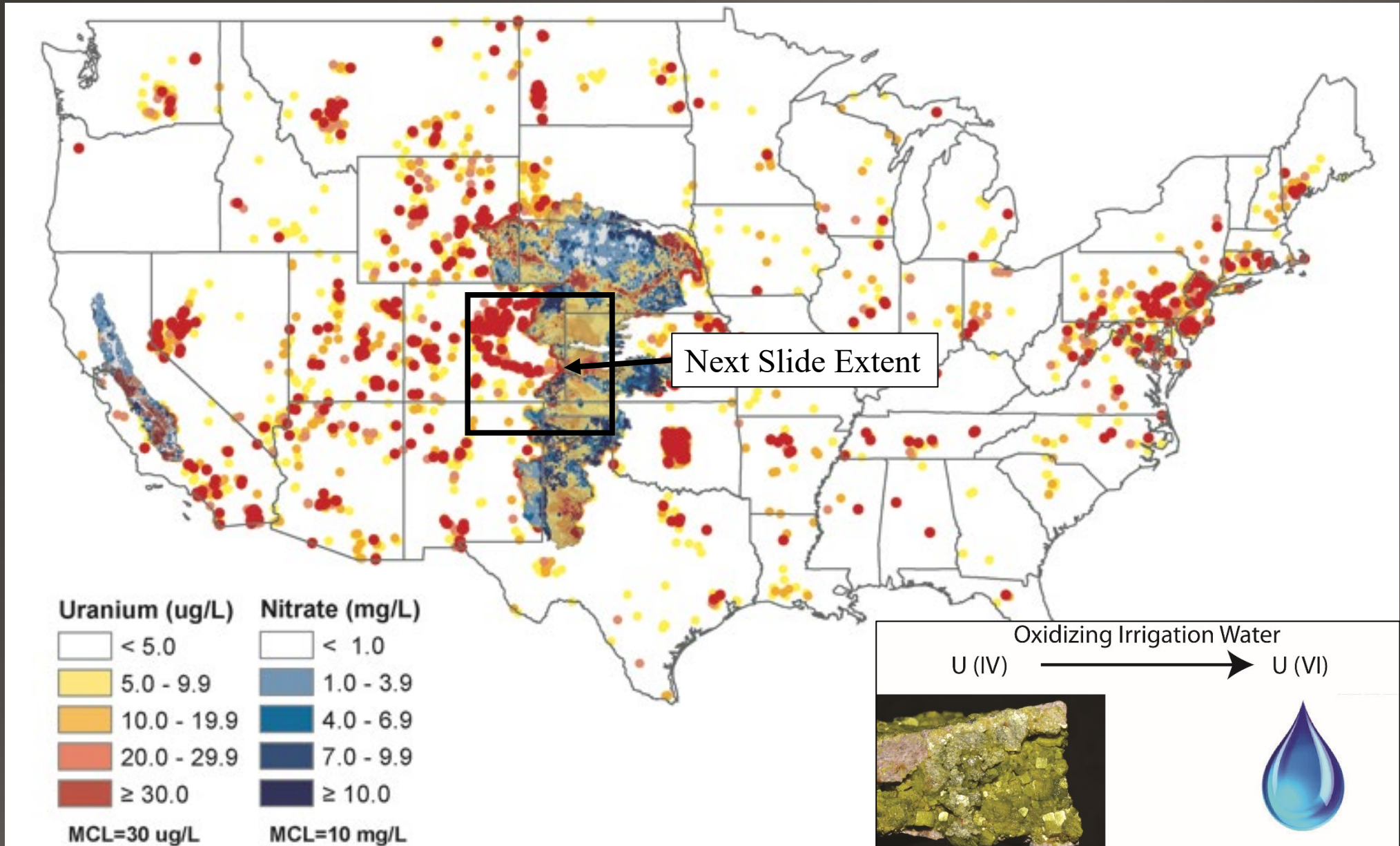
Martin J. Palkovic, Peter E. Barkmann, Lesley A. Sebol and Lauren D. Broes

Colorado Geological Survey, Colorado School of Mines, Golden, CO 80401

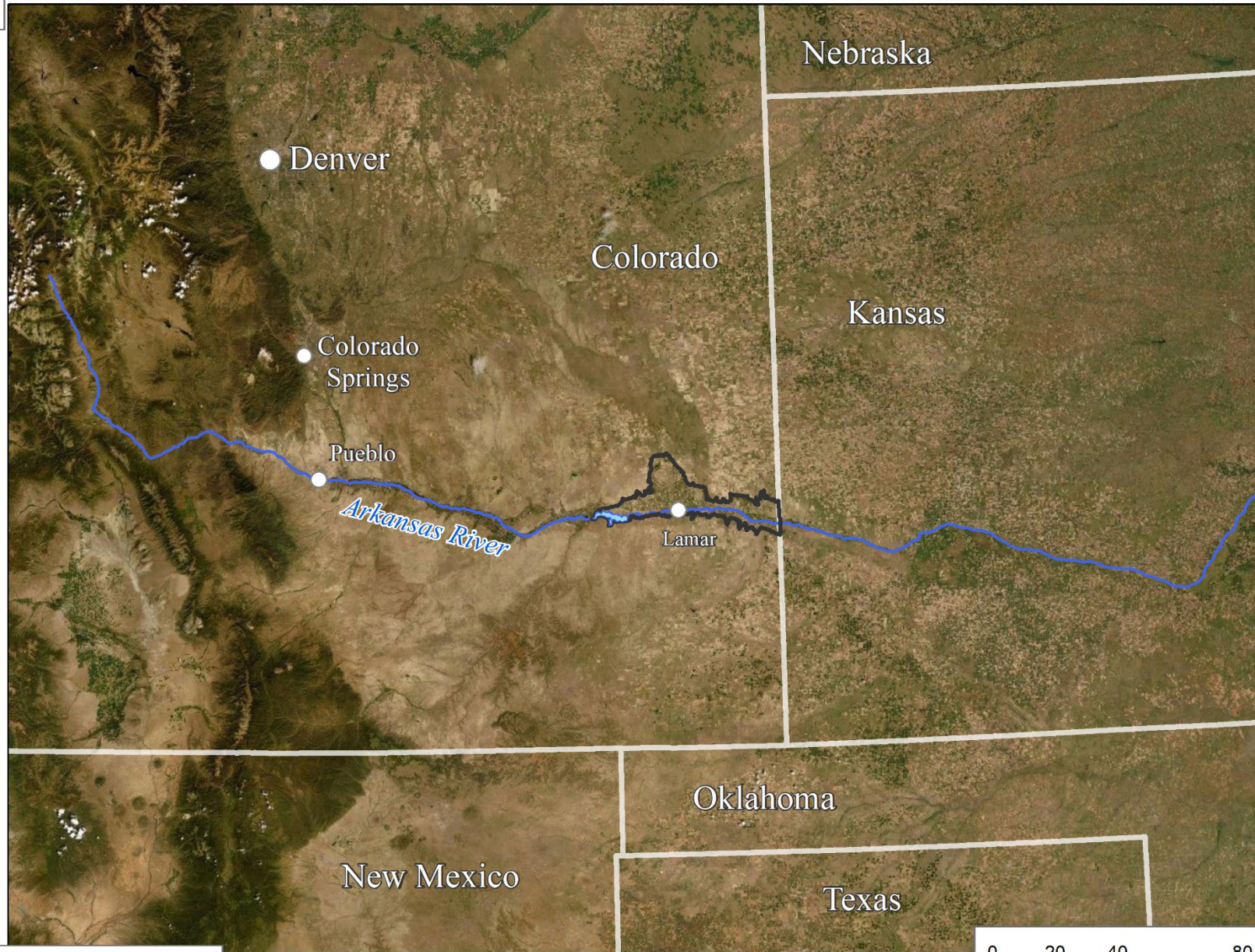





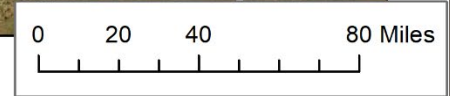
Independence Pass, near the headwaters of the Arkansas River. Northern Sawatch Range, Lake County, Colorado.
Photo Credit: www.exploringtherockies.com



Select uranium (red) and nitrate (blue) concentrations in the United States (Nolan and Weber, 2015)




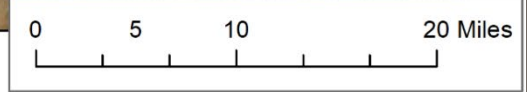
 Downstream Reach



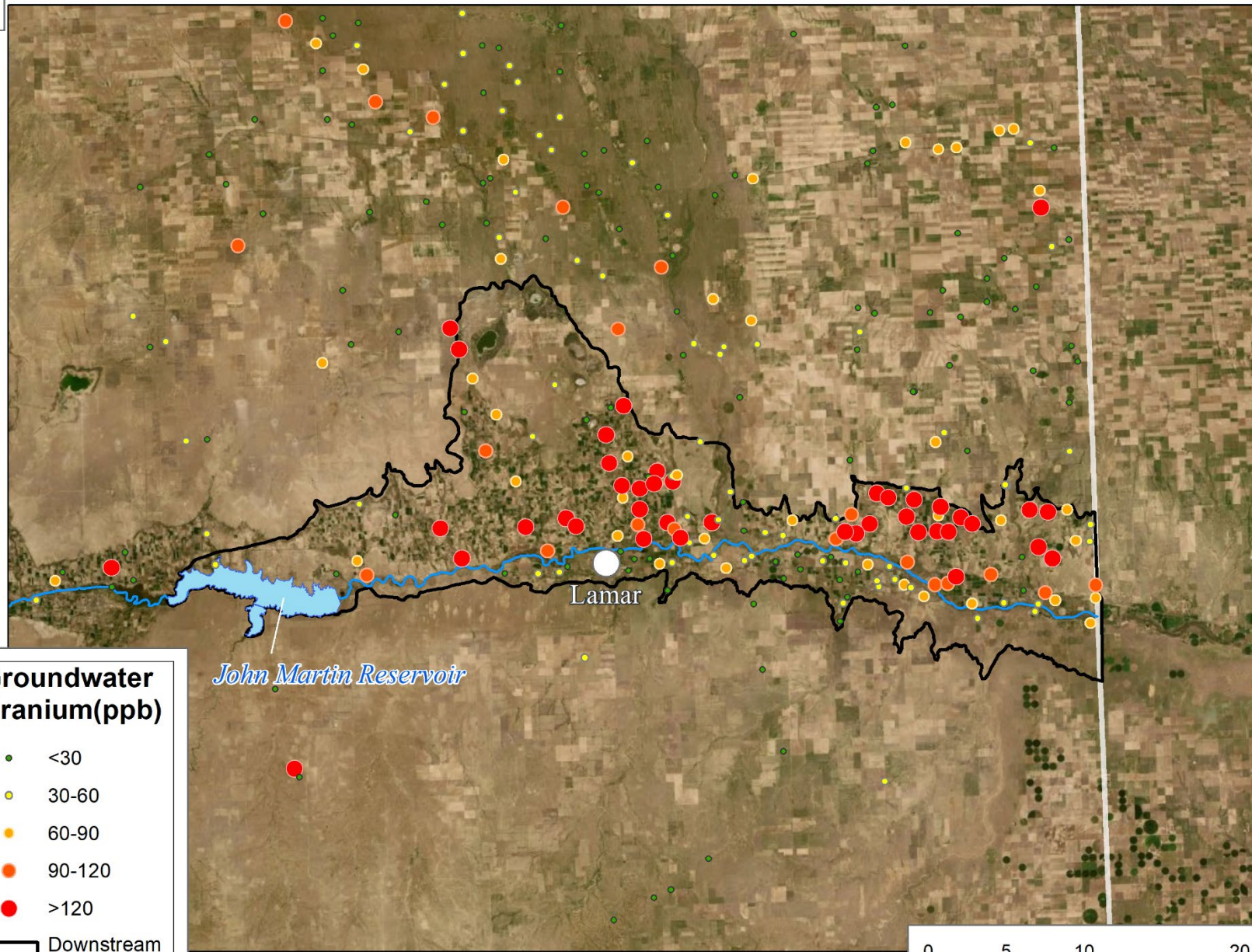
Location of the study area within Colorado.



 Downstream Reach



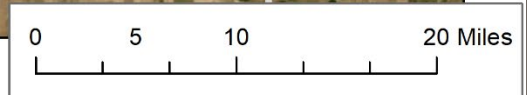
Location of the study area within southeastern Colorado.



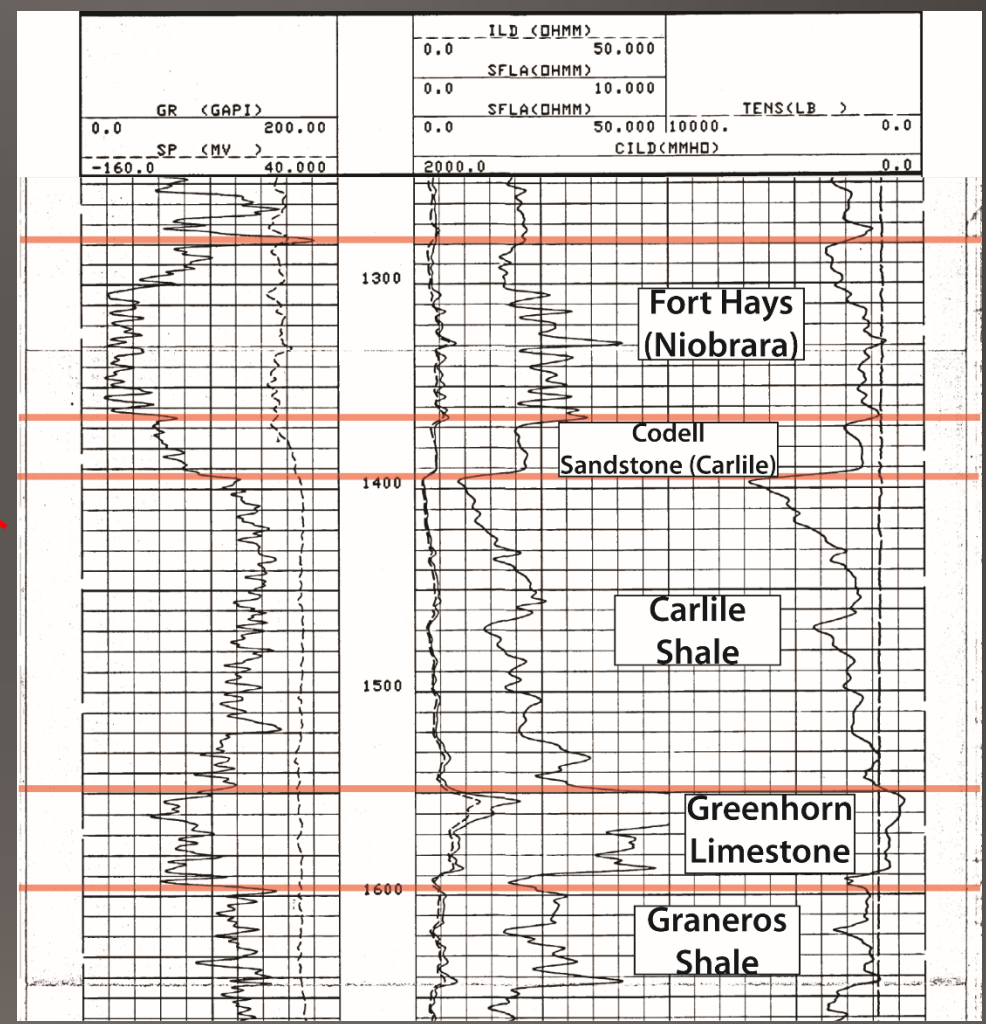
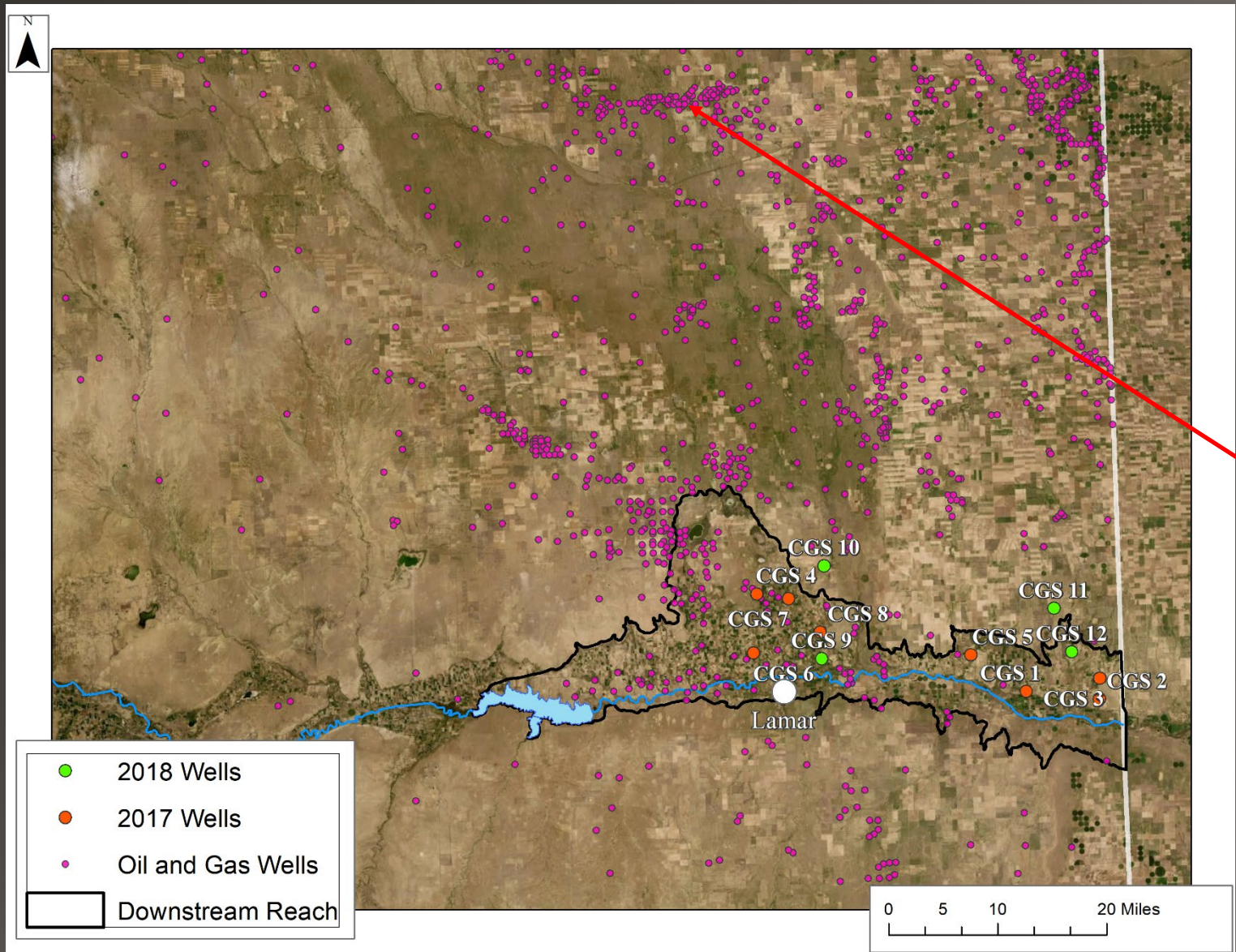
Groundwater Uranium(ppb)

- <30
- 30-60
- 60-90
- 90-120
- >120

Downstream Reach



Groundwater uranium (ppb) in Southeastern Colorado (Smith, 1997, and Colorado State University, unpublished)



MPU 44-30 #1, API # 05-017-06523

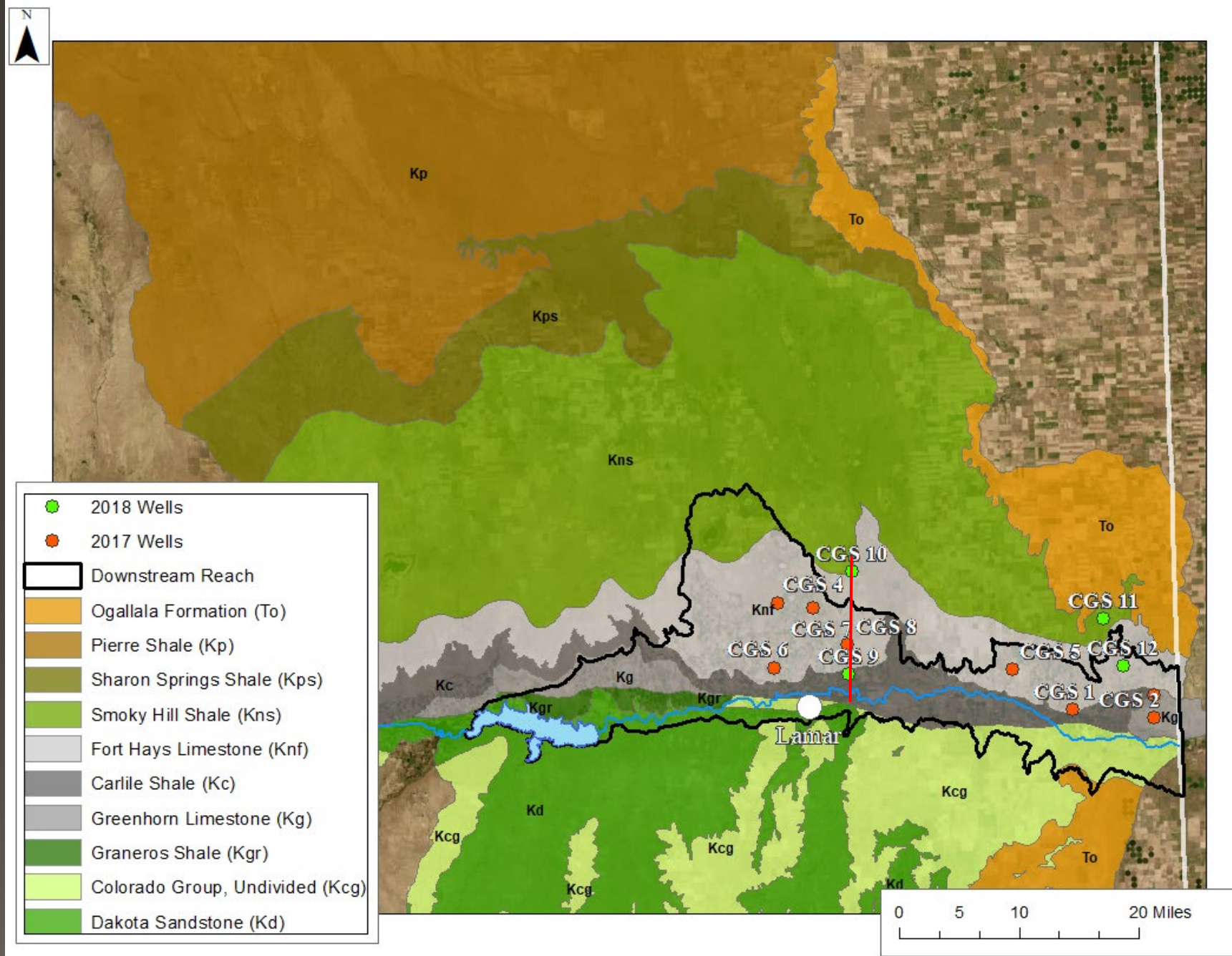
Oil and gas wells (purple) used in this study, and wells drilled by the Colorado Geological Survey



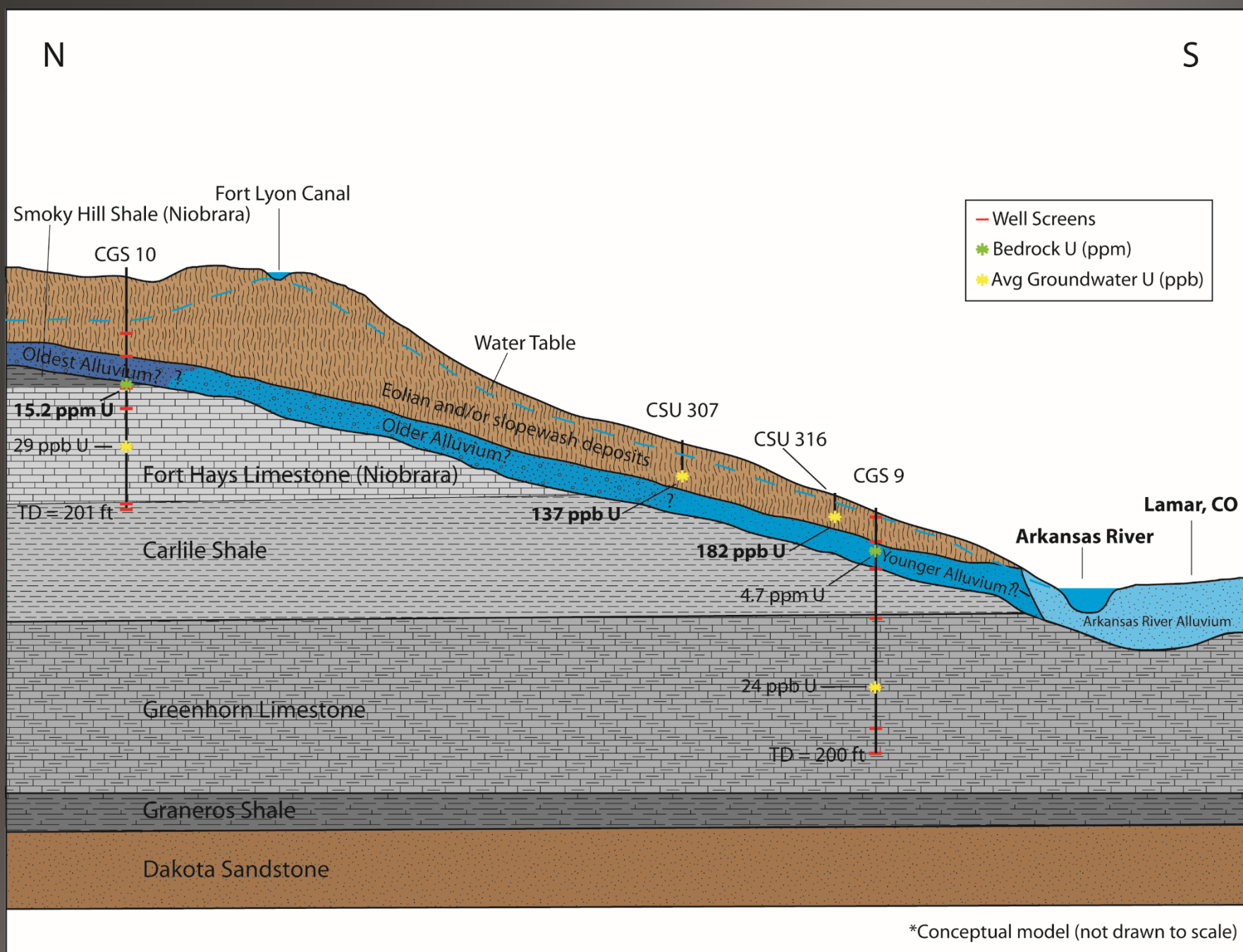
Fort Hays member of the Niobrara Formation, CGS 10



Codell Sandstone Member of the Carlile Shale, CGS 10



Bedrock geologic map constructed from geophysical log data and geologic samples collected in 2017 and 2018



*Conceptual model (not drawn to scale)

Cross section through CGS 9 and CGS 10

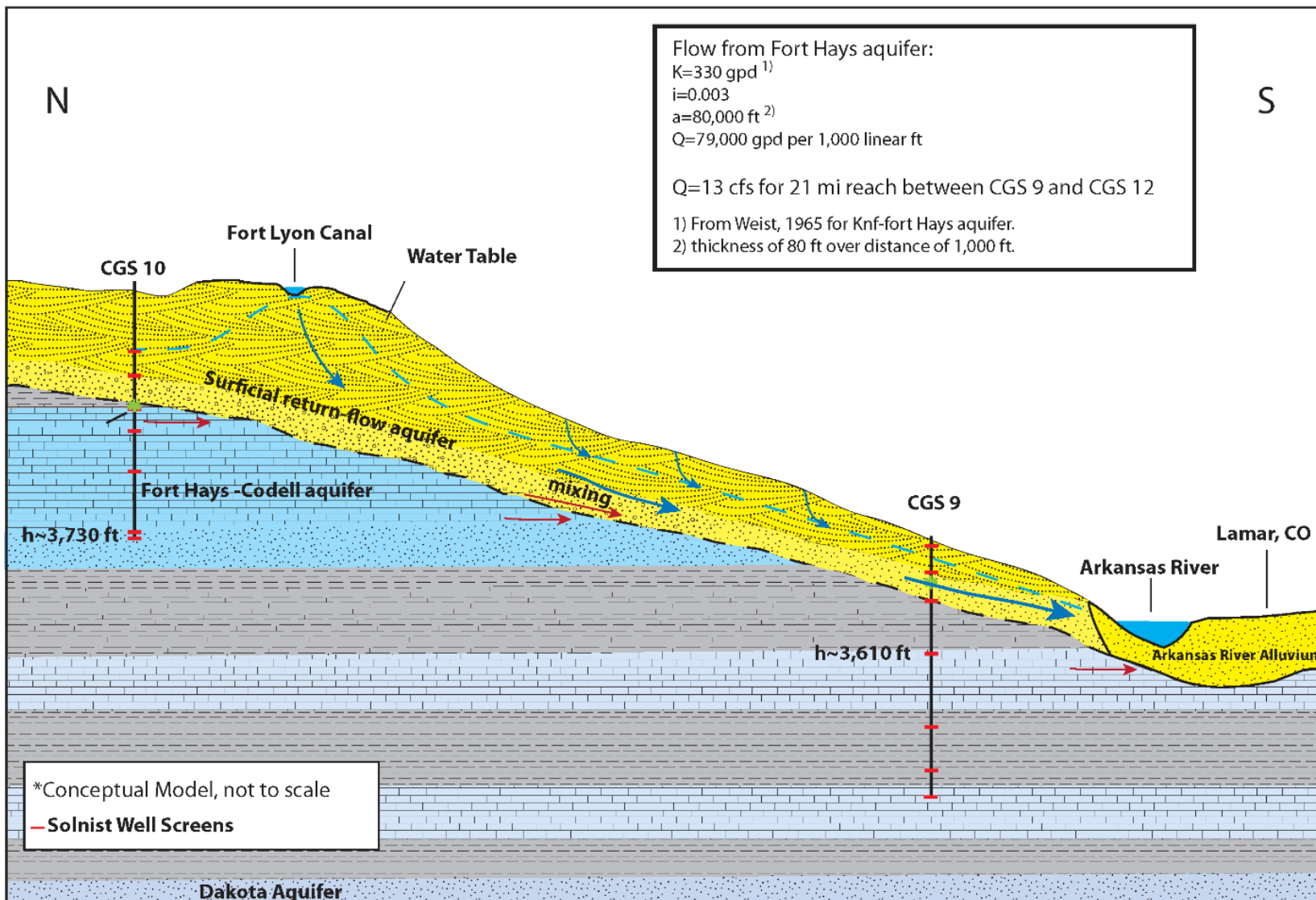
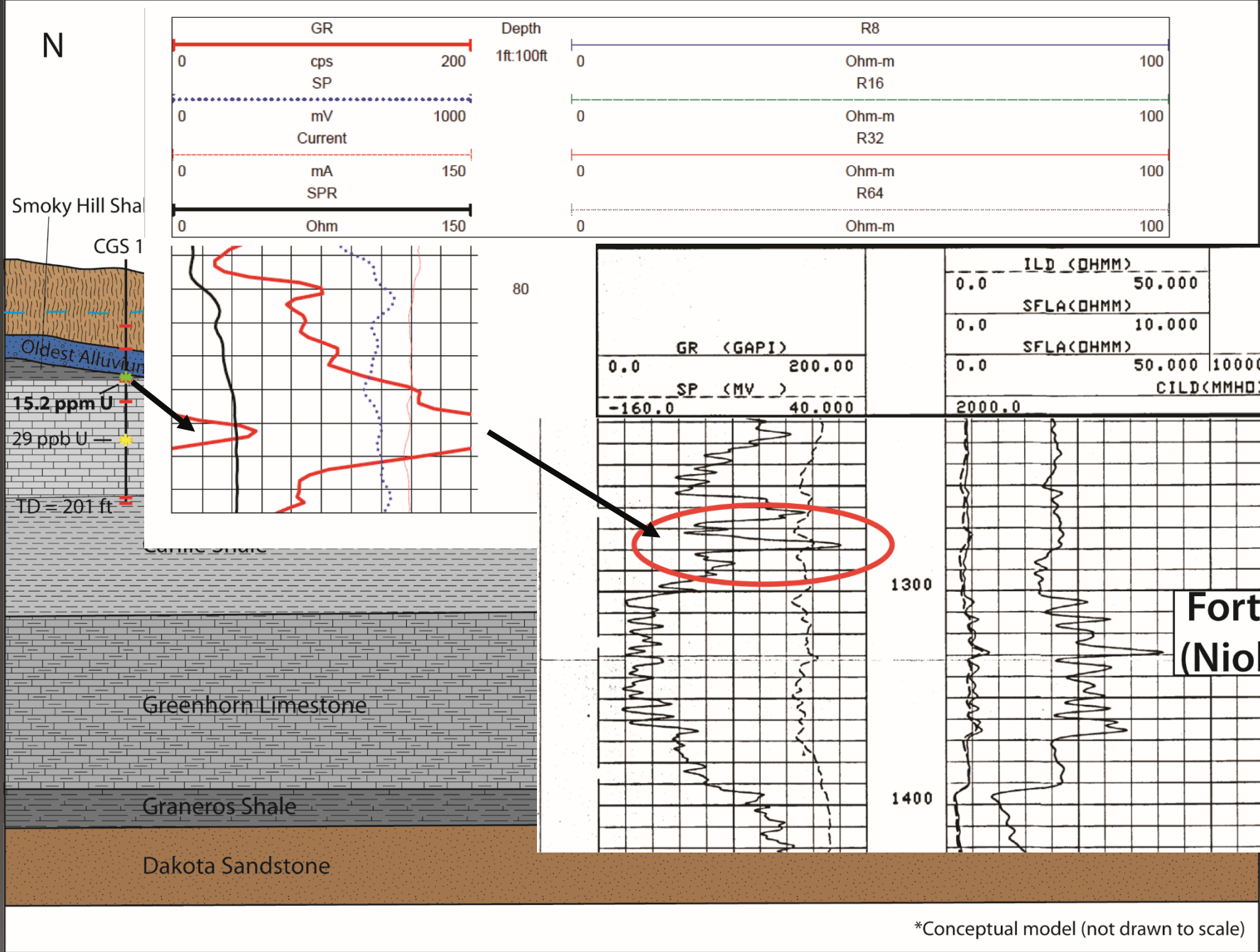


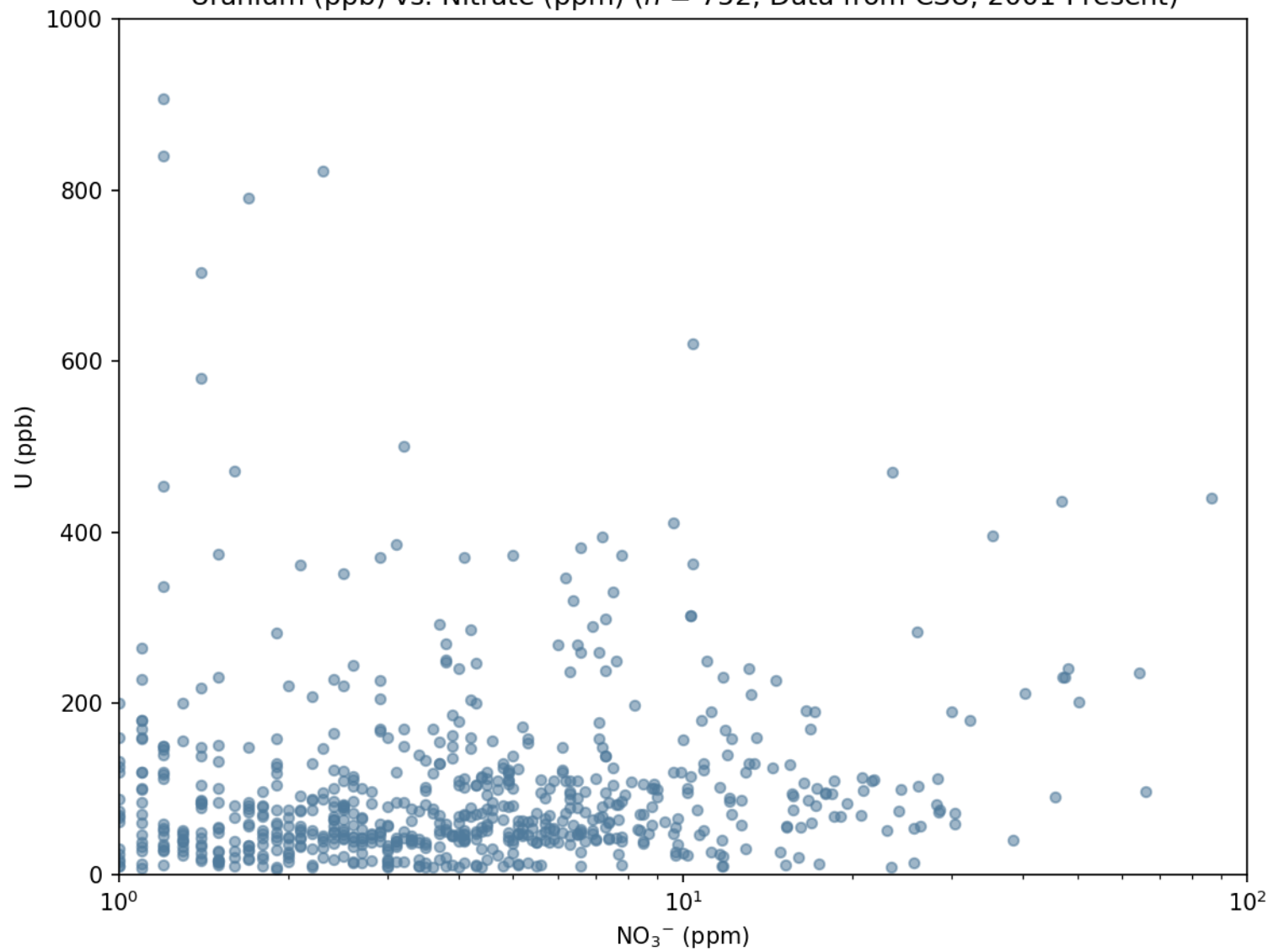
Figure 10. Hydrogeologic Conceptual Model Schematic cross section through wells CGS 9 and 10 showing conceptual groundwater flow paths in the surficial return-flow aquifer and bedrock aquifers. Yellow color indicates surficial aquifer, light blue indicates bedrock aquifer, and gray indicates confining shale layer. Blue arrows indicate flow from surface recharge and orange subsurface flow from bedrock. Head values for Solnist well screens from October 7, 2018.

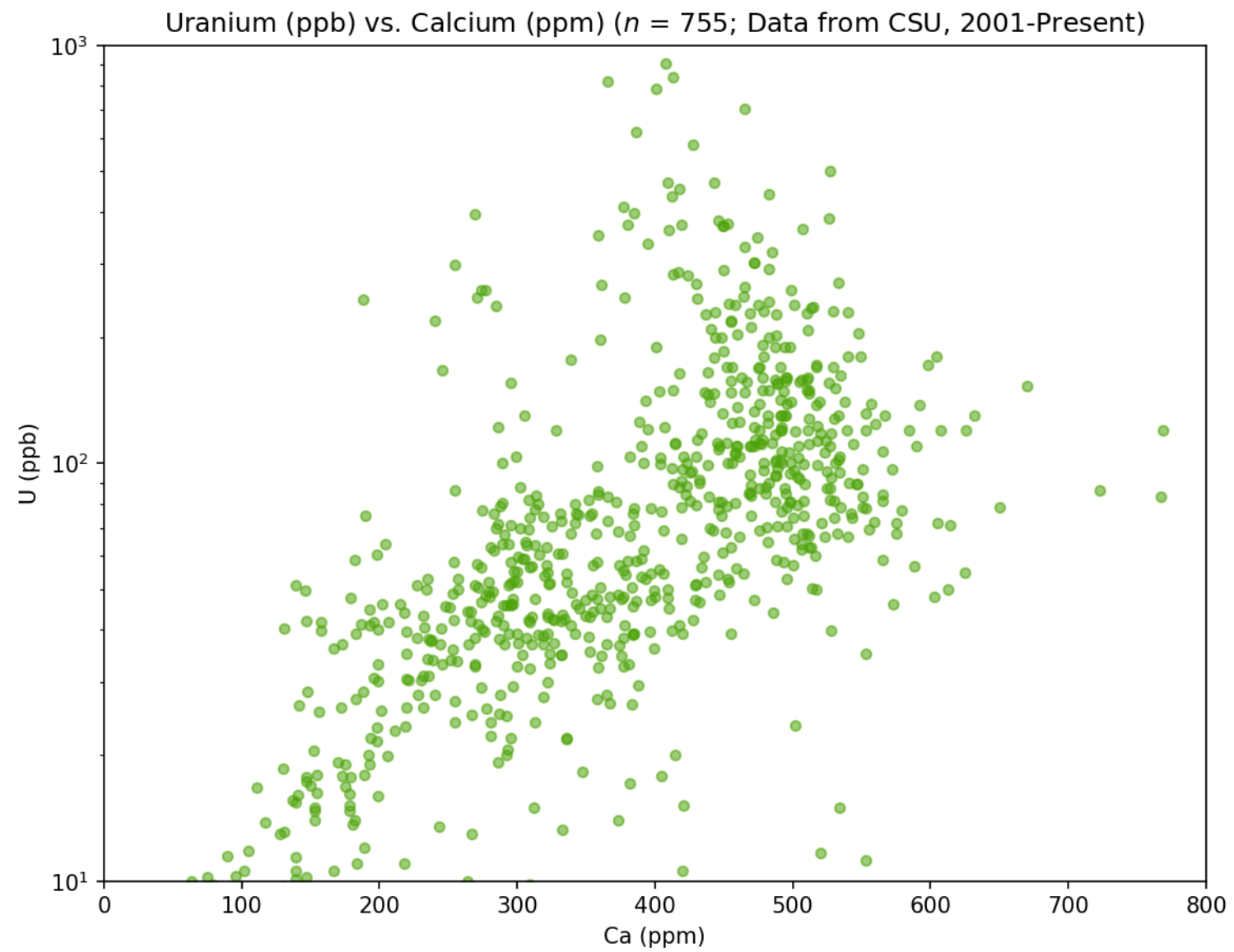


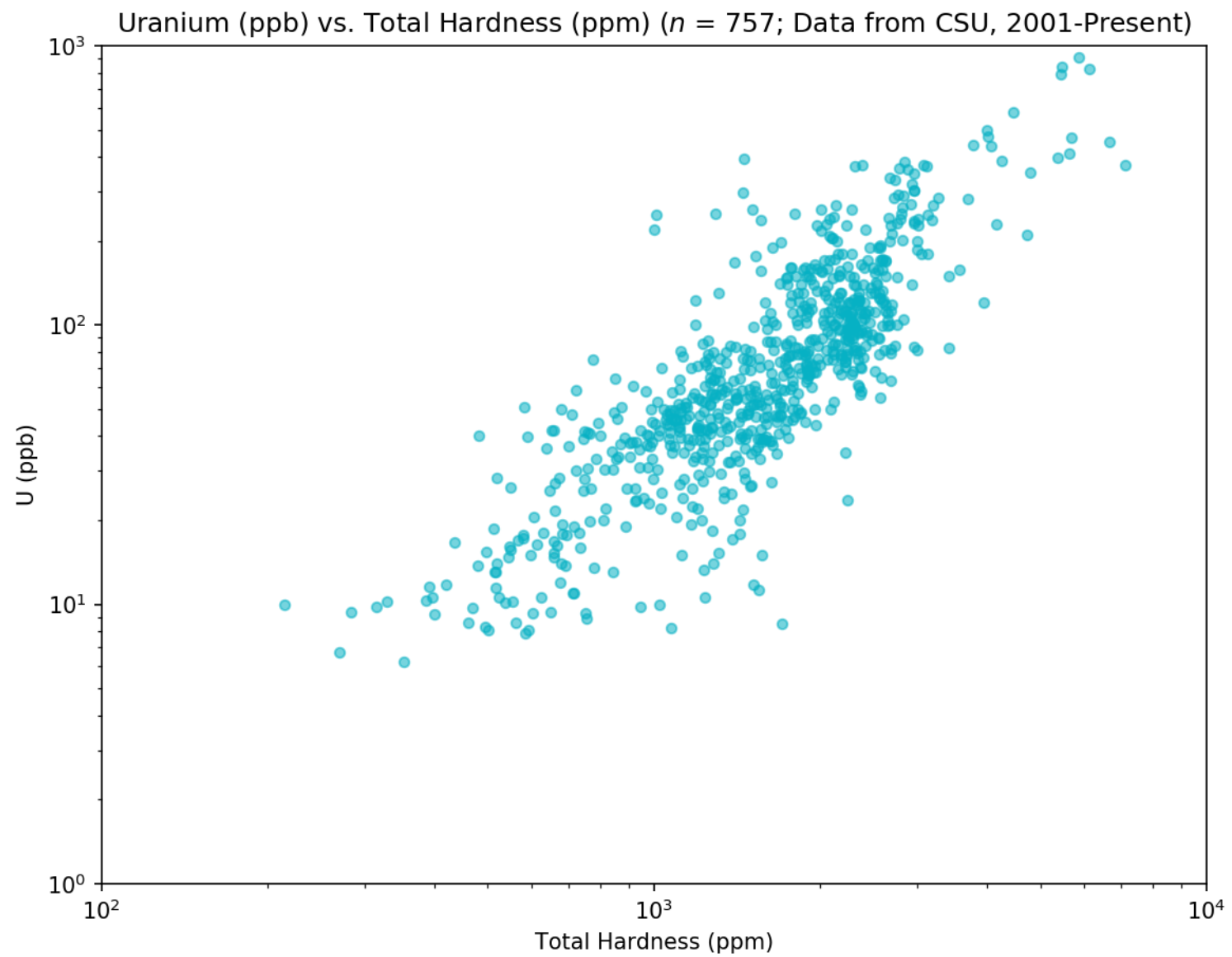
*Conceptual model (not drawn to scale)

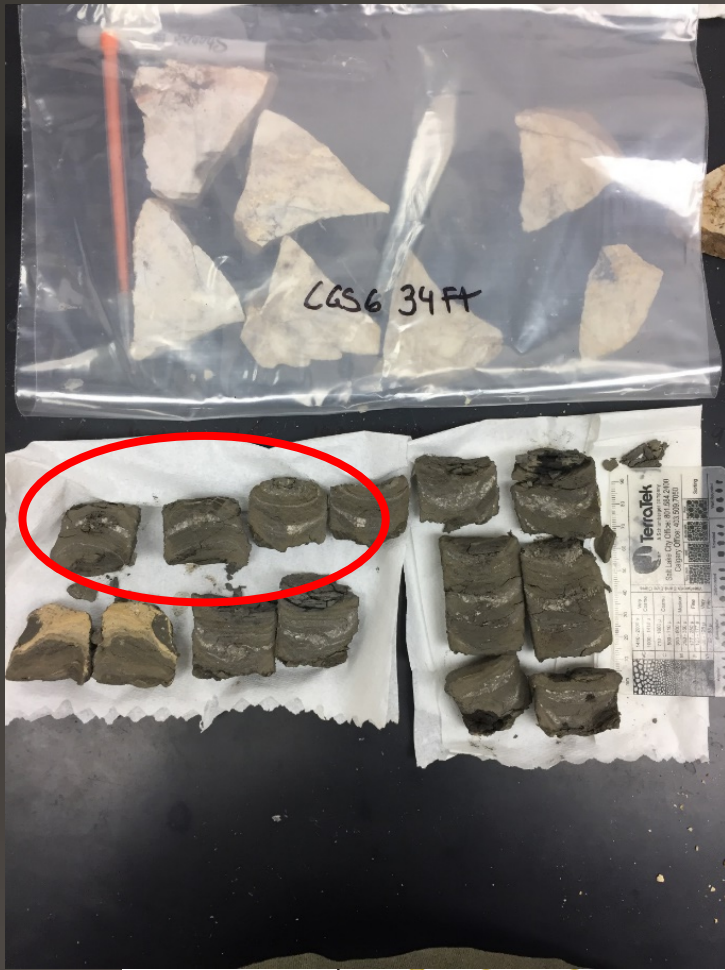
Cross section through CGS 9 and CGS 10

Uranium (ppb) vs. Nitrate (ppm) ($n = 752$; Data from CSU, 2001-Present)

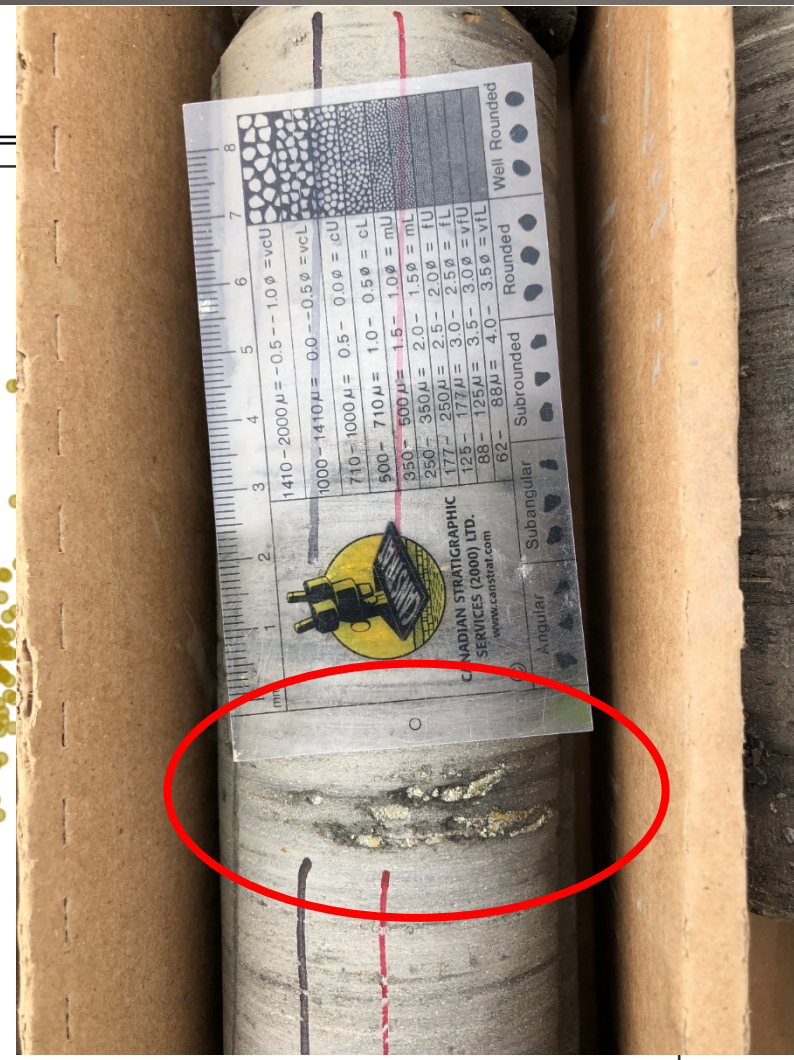
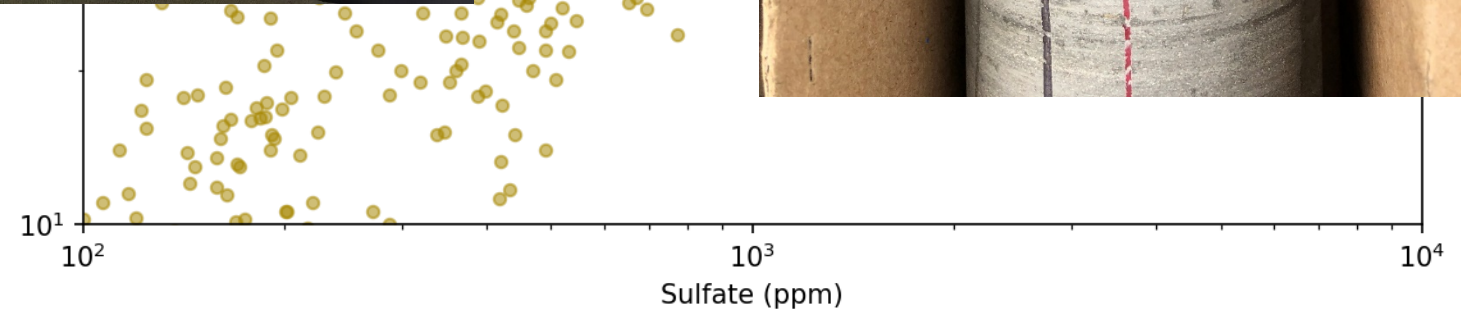


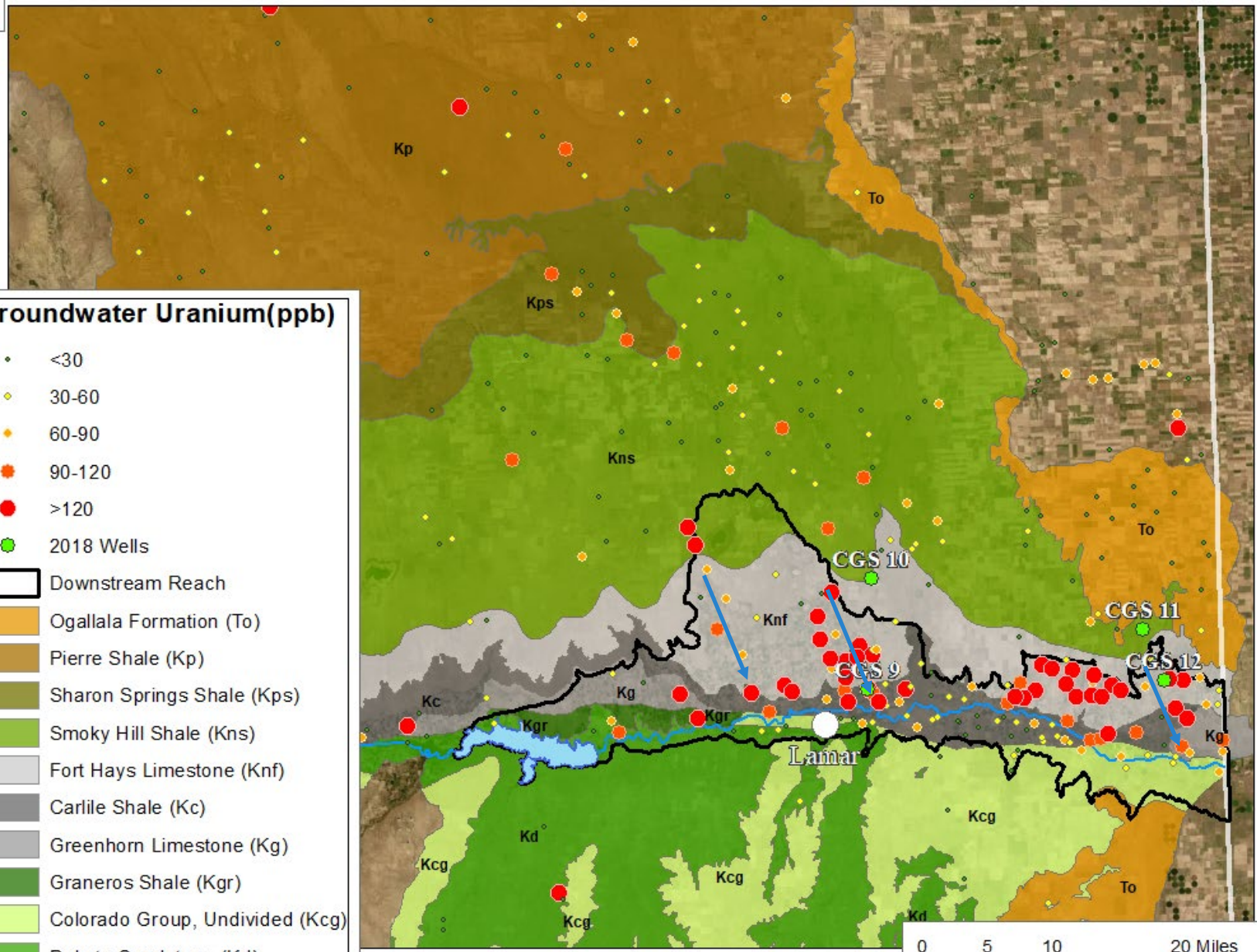






Sulfate (ppm) (n =





Groundwater Uranium(ppb)

- <30
 - 30-60
 - 60-90
 - 90-120
 - >120
 - 2018 Wells
- Downstream Reach
- Ogallala Formation (To)
 - Pierre Shale (Kp)
 - Sharon Springs Shale (Kps)
 - Smoky Hill Shale (Kns)
 - Fort Hays Limestone (Knf)
 - Carlile Shale (Kc)
 - Greenhorn Limestone (Kgf)
 - Graneros Shale (Kgr)
 - Colorado Group, Undivided (Kcg)
 - Dakota Sandstone (Kd)



Bedrock geologic map and groundwater uranium (ppb)

References

Nolan, J., and Weber, K.A., 2015, Natural Uranium Contamination in Major U.S. Aquifers Linked to Nitrate: Environmental Science & Technology Letters 2, 215-220.

Smith, S.M., 1997, National Geochemical Database: Reformatted data from the National Uranium Resource Evaluation (NURE) Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) Program, Version 1.40 (2006): U.S. Geological Survey Open-File Report 97-492, WWW release only, URL: <https://pubs.usgs.gov/of/1997/ofr-97-0492/>.

Whittemore, D., 2017, Estimated Annual Uranium Loads in the Arkansas River Entering Kansas 2012-2016: Kansas Geological Survey Open File Report 2017-2.

Acknowledgements

- **Kenan Diker, Agricultural Water Specialist, Colorado Department of Public Health and Environment**
- **Tim Gates, Professor, Colorado State University, Environmental Engineering Department**
- **Ryan Bailey, Assistant Professor, Colorado State University, Environmental Engineering Department**
- **Erin Underwood, Research Assistant, Colorado State University, Environmental Engineering Department**





Connecting world class research with real-world water challenges

Colorado State University

OWSI Overview

Tyler Wible



AGENDA

- 1** Background: OWSI and Catena
- 2** Background: eRAMS and CSIP
- 3** Overview of Catena Tools

OWSI APPROACH

Outward facing to promote collaboration with local governments, private sector, and non-profits

Entrepreneurial, lean and nimble

Focus on products and commercialization



SERVICE PROVISION → RESOURCE MANAGEMENT





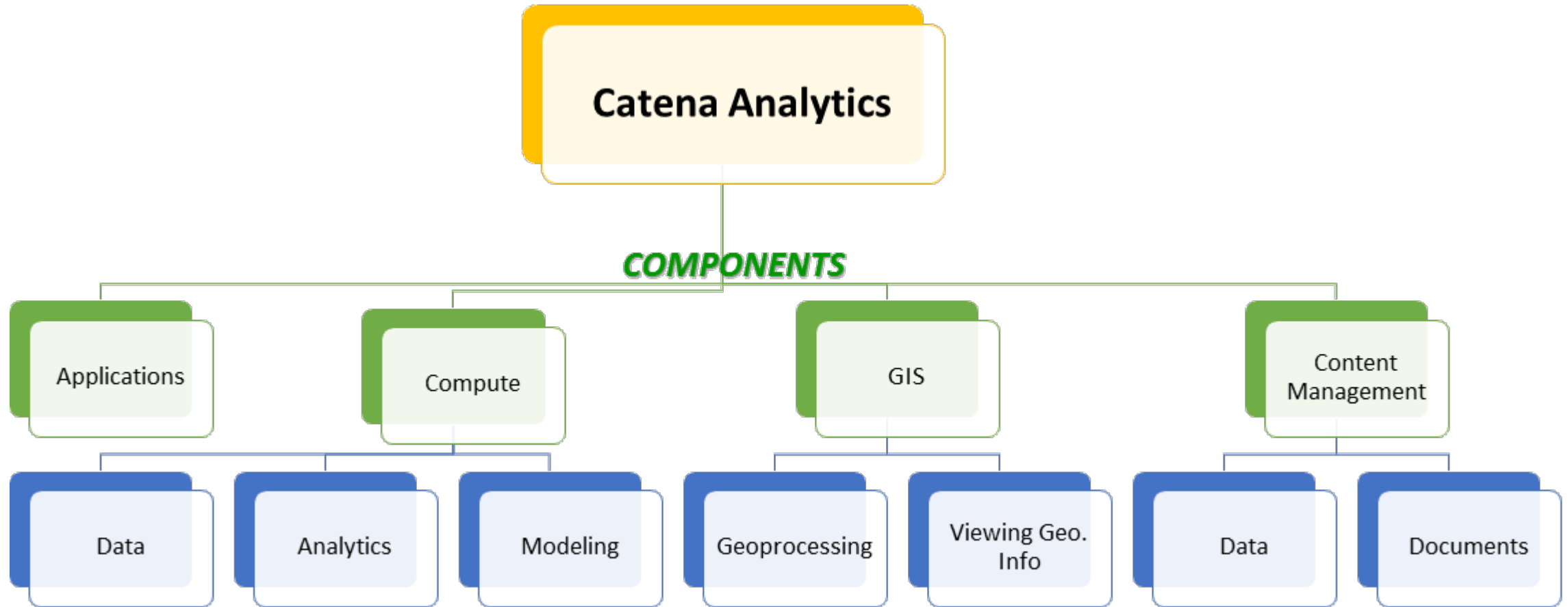
Connecting world class research with real-world water challenges

Colorado State University

The background of the lower half of the slide is a composite image. The top portion shows a city skyline at sunset, with buildings illuminated by warm orange and yellow light against a dark, cloudy sky. The bottom portion shows a vibrant green field in the foreground, suggesting a natural or agricultural setting. A semi-transparent dark grey rectangle is overlaid in the center, containing the text "Catena Analytics".

Catena Analytics

CATENA ANALYTICS – COMPONENTS

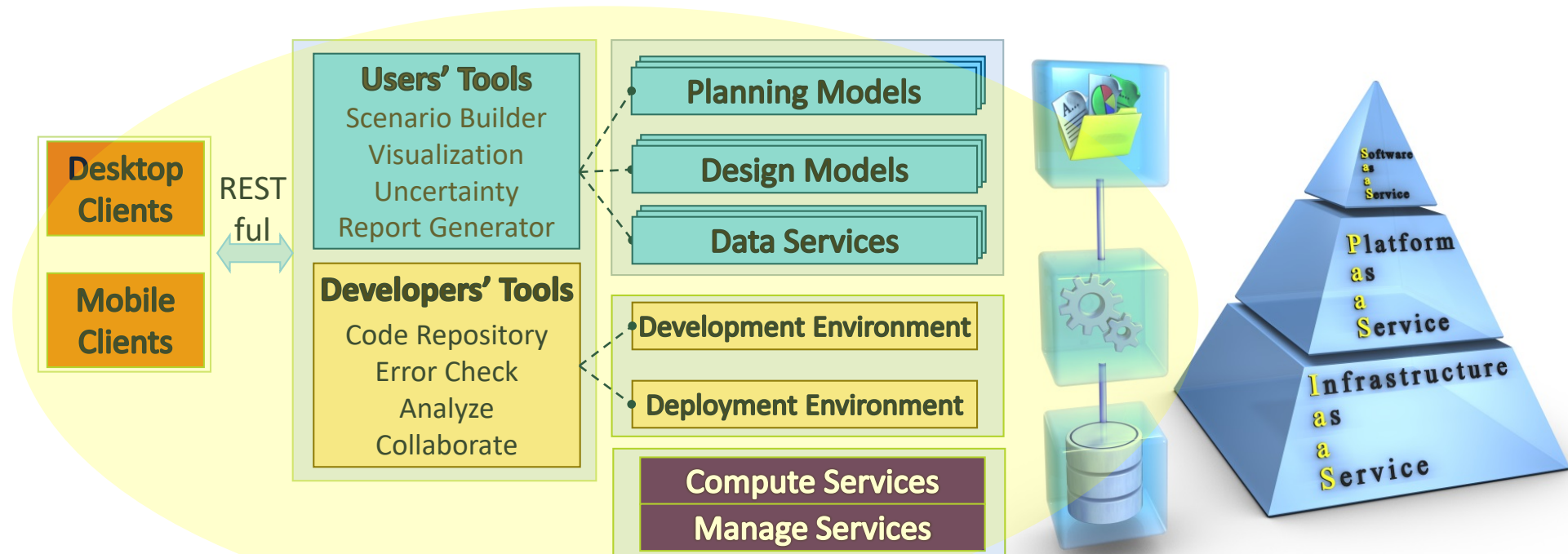


An architecture and user interface for working with multiple Catena services, data, and GIS operations for a specific application

CATENA ANALYTICS – ERAMS

Environmental Resource Assessment & Management System (eRAMS)

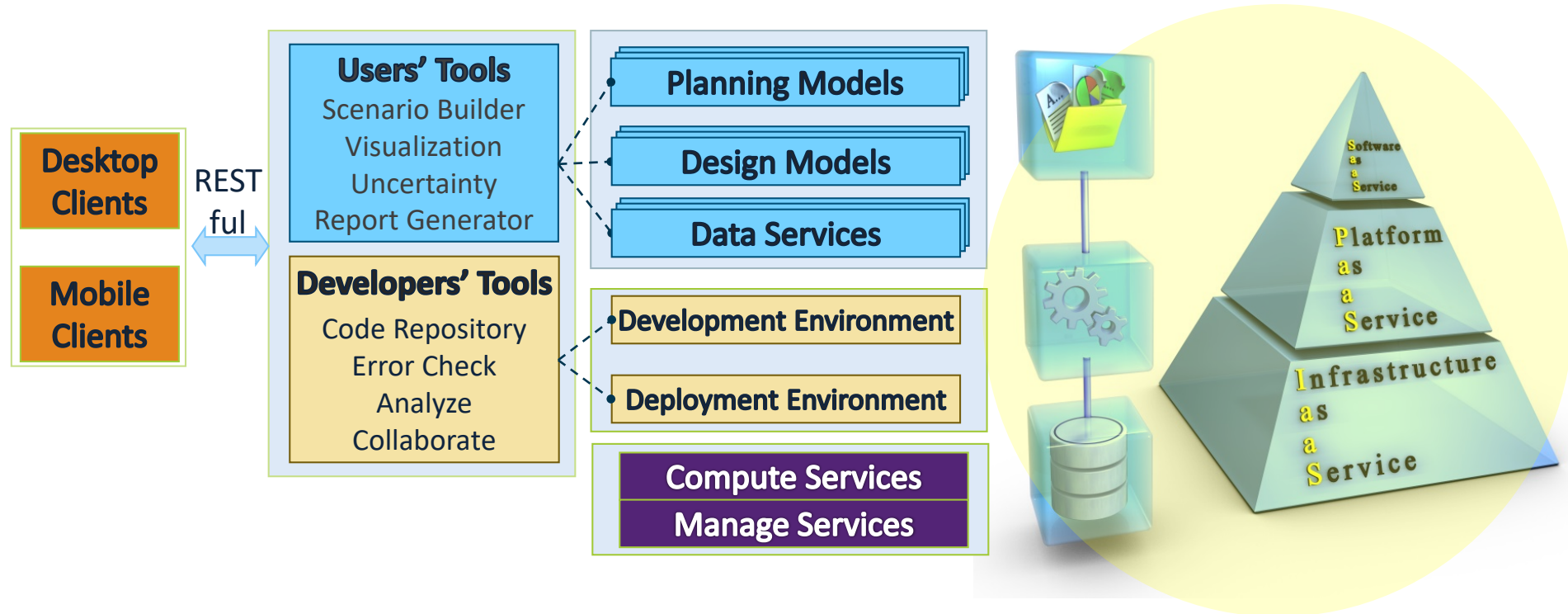
A platform for development and deployment of web-based water analytics:
Computationally scalable and accessible data and analysis tools



CATENA ANALYTICS – CSIP

Cloud Services Integration Platform (CSIP)

A Service-Oriented Architecture (SoA) implementation offering Model-as-a-Service (MaaS) Application Programming Interface (API)





Connecting world class research with real-world water challenges

Colorado State University

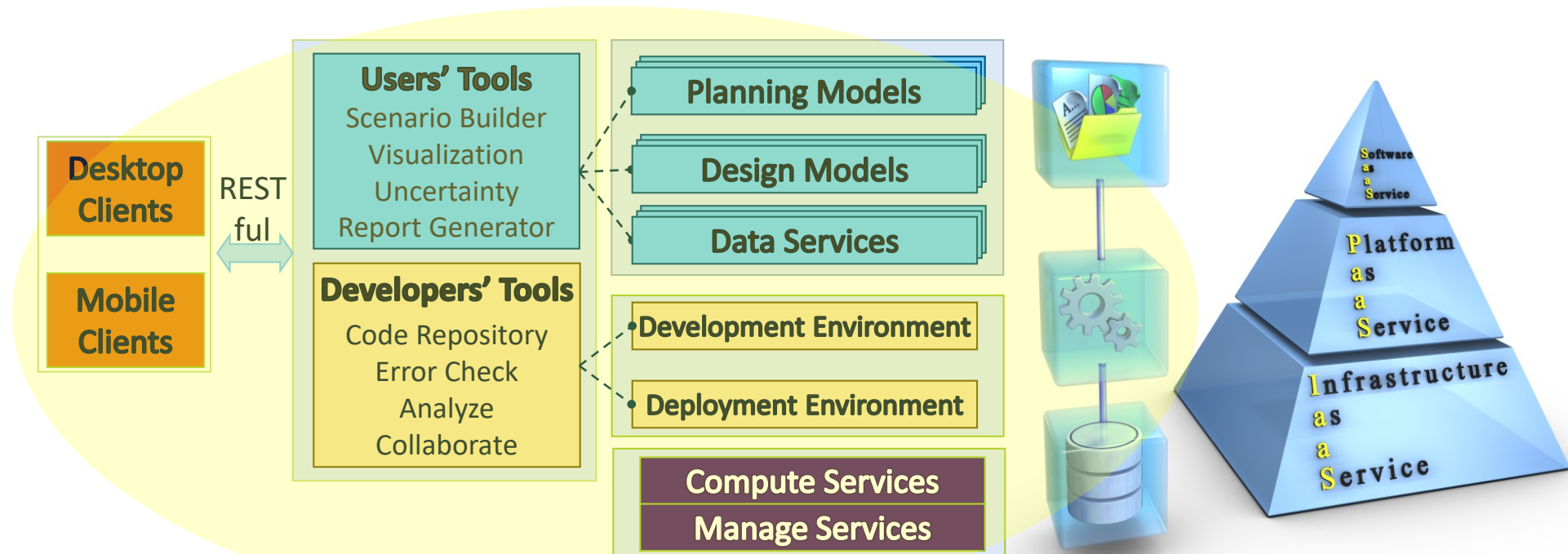
The background of the slide is a composite image. The top half shows a city skyline at sunset with a dark, cloudy sky. The bottom half shows a vibrant green field. A semi-transparent dark grey box is overlaid in the center, containing the title text. Two white horizontal lines with circular endpoints extend from the left and right sides of the text box.

Environmental Resource Assessment and Management System (eRAMS)

CATENA ANALYTICS – ERAMS

Environmental Resource Assessment & Management System (eRAMS)

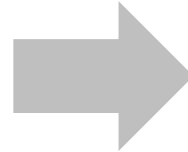
A platform for development and deployment of web-based water analytics:
Computationally scalable and accessible data and analysis tools



ERAMS – FRAMEWORK

Data Sources

- CDPHE
- CO Water Resources
- CDSN
- USEPA – STORET
- USGS
- Land Use
- Climate
- User Supplied



Analysis Modules

WRAP

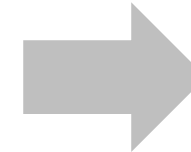
CLEAN

Flow Analysis

Healthy Watersheds

Integrated Urban Water Model

Soil & Water Assessment Tool



Custom Outputs

- ✓ Individual Watershed Reports
- ✓ Watershed Comparison Reports
- ✓ Nutrient Loading Analysis
- ✓ Water Conservation Effectiveness
- ✓ Many more!

Technology Platform



ERAMS – TOOLKIT

- Available Now
 - WRAP
 - CLEAN Dashboard
 - Comprehensive Flow Analysis
- Under Final Review
 - Watershed Planning and Prioritization
 - 303(d) Stream Impairment Assessment
- Future Planning Integration
 - Statewide Water Quality Management Plan
 - Watershed Plans





Connecting world class research with real-world water challenges

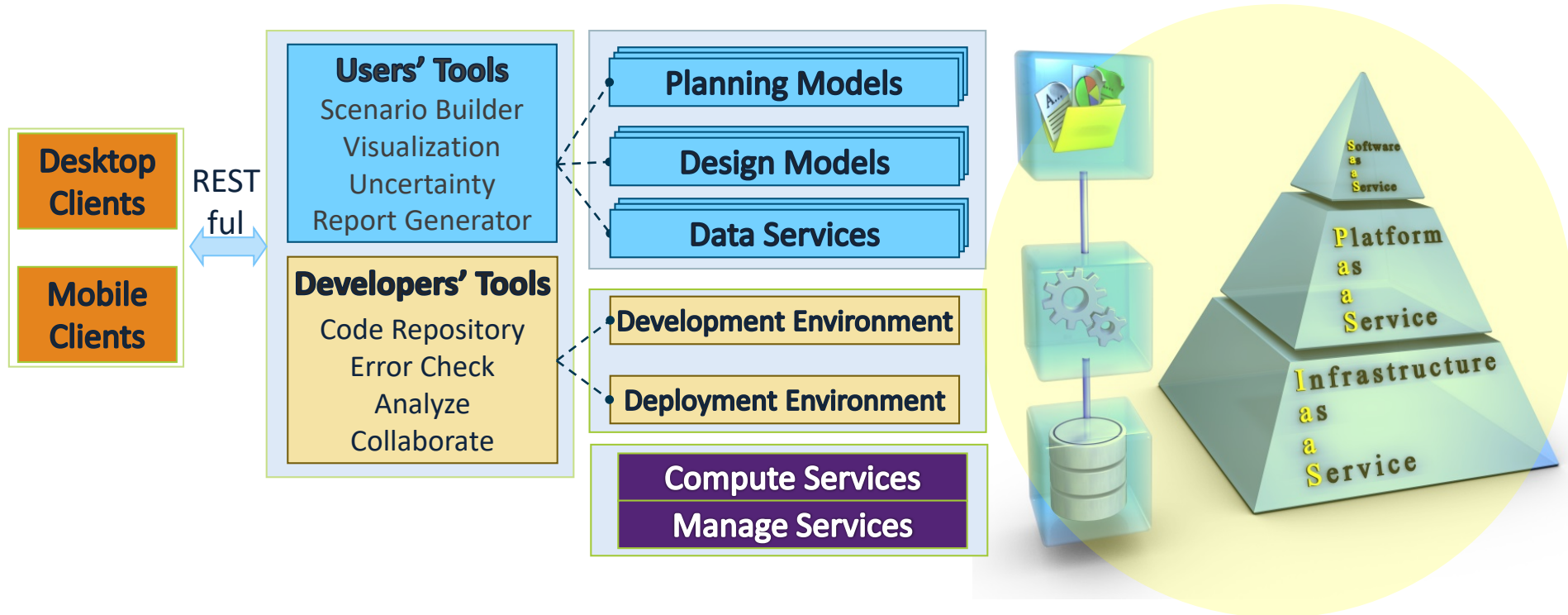
Colorado State University

Cloud Services Integration Platform (CSIP)

CATENA ANALYTICS – CSIP

Cloud Services Integration Platform (CSIP)

A Service-Oriented Architecture (SoA) implementation offering Model-as-a-Service (MaaS) Application Programming Interface (API)



INSTITUTIONS USING OR LEVERAGING CSIP





Connecting world class research with real-world water challenges

Colorado State University

A background image showing a city skyline at dusk or dawn, with buildings illuminated against a dark, cloudy sky. In the foreground, there is a vibrant green field. A semi-transparent dark grey rectangle is overlaid on the middle of the image, containing the text "Catena Analytics - Examples".

Catena Analytics - Examples

ERAMS EXAMPLE – FLOW ANALYSIS (CFA)

Purpose

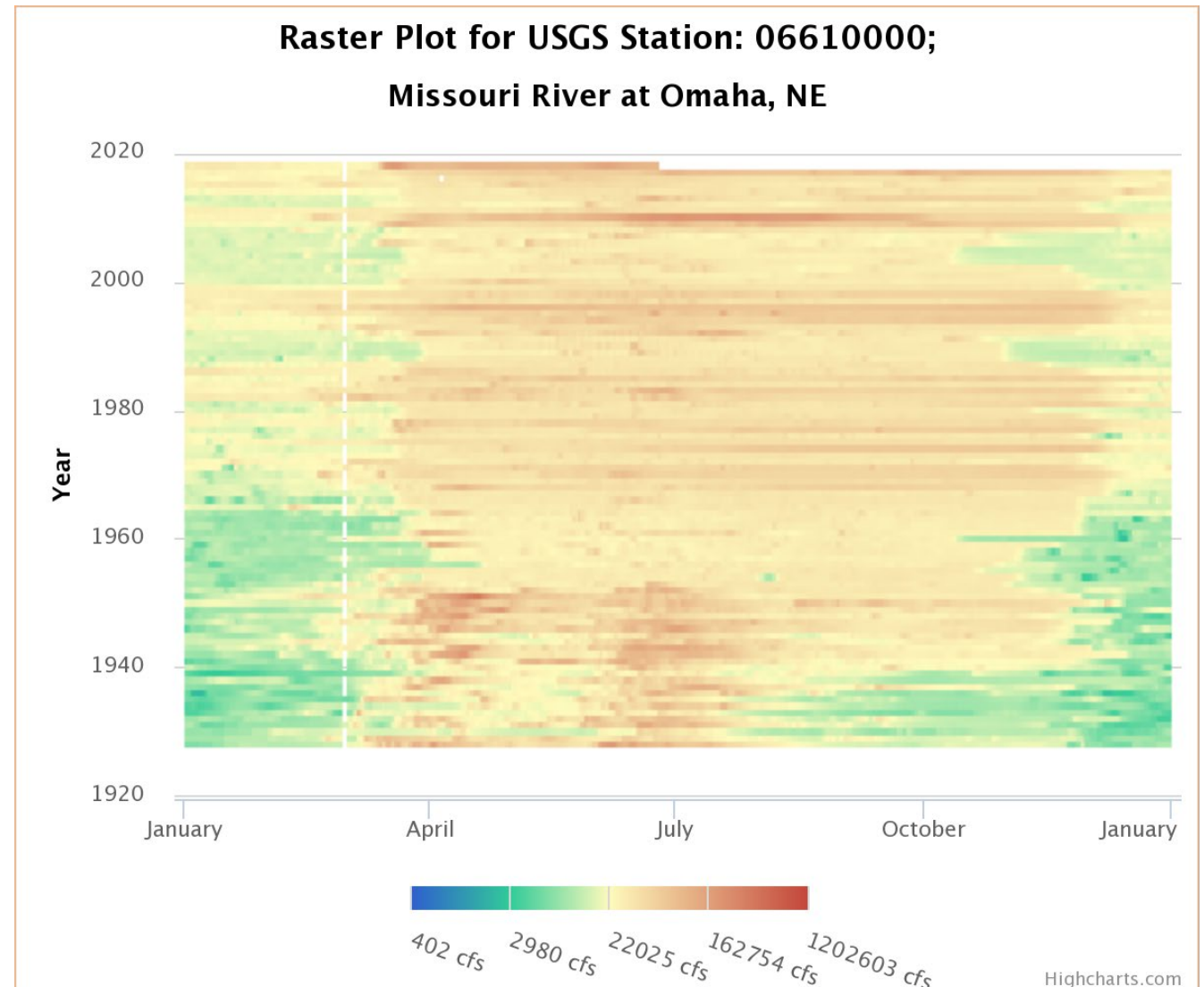
Assessment framework for flow and water quality analysts to examine current water conditions. Data includes USGS, EPA STORET/WQX, Colorado Specific Data Sources. Analyses include extreme events and statistics from models that rely on CSIP services.

eRAMS Analyses

- Statistics Summary
- Flood Frequency Analysis
- Drought Analysis
- Baseflow Separation
- Flow Duration Curves
- Load Duration Curves (TMDLs)
- Load Estimation

CSIP Services

- csip-cfa
- csip-lib-water



ERAMS EXAMPLE – CDPHE DASHBOARD

Purpose

Assessment framework for water quality analysts to examine current water conditions as they relate to stream standards and flow. Statistics and data retrieval rely on CSIP services.

eRAMS Analyses

- Low Flow Analysis
- Reg. 85 Data Analysis
- STORET Data
- Stream Segmentation Database
- Fish Monitoring Sites

CSIP Services

- csip-cfa
- csip-wrap
- csip-datadownloads
- csip-lib-water

Regulation 31 Flow Summary:

Database:	USGS
Station ID:	06759500
Station Name:	SOUTH PLATTE RIVER AT FORT MORGAN, CO
Supervising Agency:	USGS
- Total Observations:	11887
- Start Date:	1943-10-01
- End Date:	2019-06-24
- Units:	cfs

Month	1E3 Acute Monthly Low Flows		7E3 Chronic Monthly Low Flows		30E3 Chronic Monthly Low Flows	
	Year	Flow [cfs]	Year	Flow [cfs]	Year	Flow [cfs]
- Entire Record	-	27.67	-	41.76	-	68.77
- January	1955	141.0	2008	124.0	2008	114.0
- February	2008	95.0	2011	92.0	2011	68.8
- March	2011	29.0	2009	41.8	2009	68.8
- April	2009	27.7	2009	41.8	2009	68.8
- May	2006	27.7	2018	41.8	2011	68.8
- June	1946	35.0	2002	46.0	2002	68.8
- July	1955	34.0	2018	50.0	2002	68.8
- August	2018	29.0	2018	50.0	2002	68.8
- September	2002	46.0	1956	41.8	1956	68.8
- October	1956	27.7	1956	41.8	1956	68.8
- November	1944	77.0	1950	78.0	1956	74.0
- December	1952	81.0	1952	106.0	1950	121.0

- 1E5 Annual Median of Daily Average Flows: 202.0

ERAMS: RIVER HYDRAULIC AND SEDIMENT TRANSPORT

Cumulative Sediment Yield Graph:

Purpose

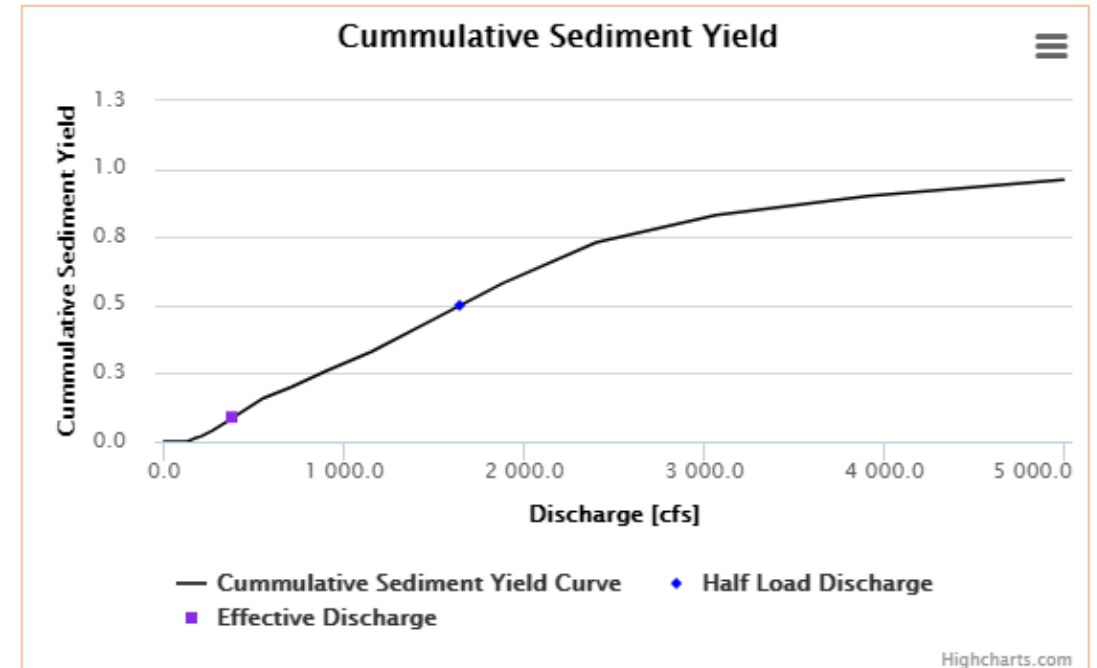
A Stage/discharge cross-section hydraulic calculator for normal, critical, custom depth. Calculates sediment transport based on discharge record and selected transport equation for effective discharge and half-load discharge calculations. Built under project with the U.S. Army Corps ERDC.

Data Categories

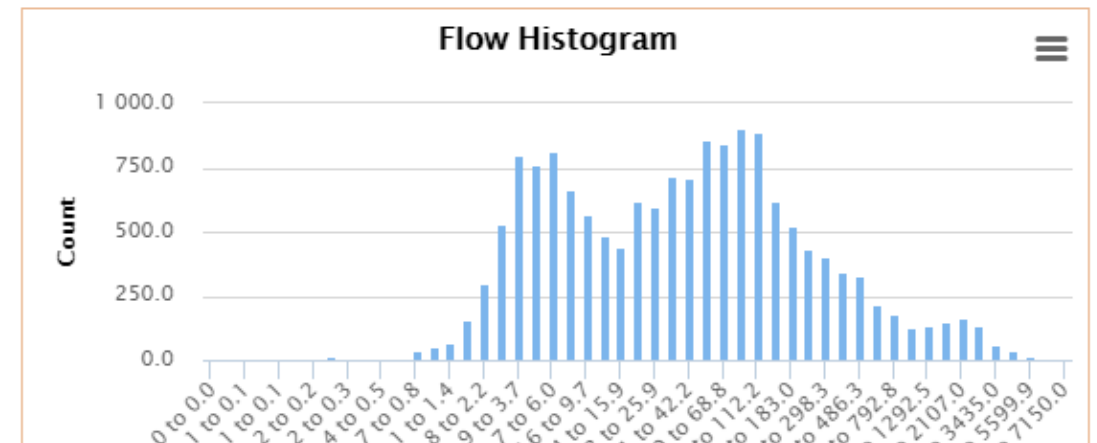
- Hydraulics and Streams
- Sediment Transport
- Other

CSIP Services

- csip-hydraulics
- csip-cfa



Flow Histogram:



ERAMS EXAMPLE – WRAP

Purpose

A summary tool that extracts, organizes, and analyzes data and information at various watershed scales, including HUC 12, HUC 10, and HUC8 levels. Utilizing the extracted data, the WRAP tool calculates a number of watershed health indicators to create an overall summary of the watershed condition.

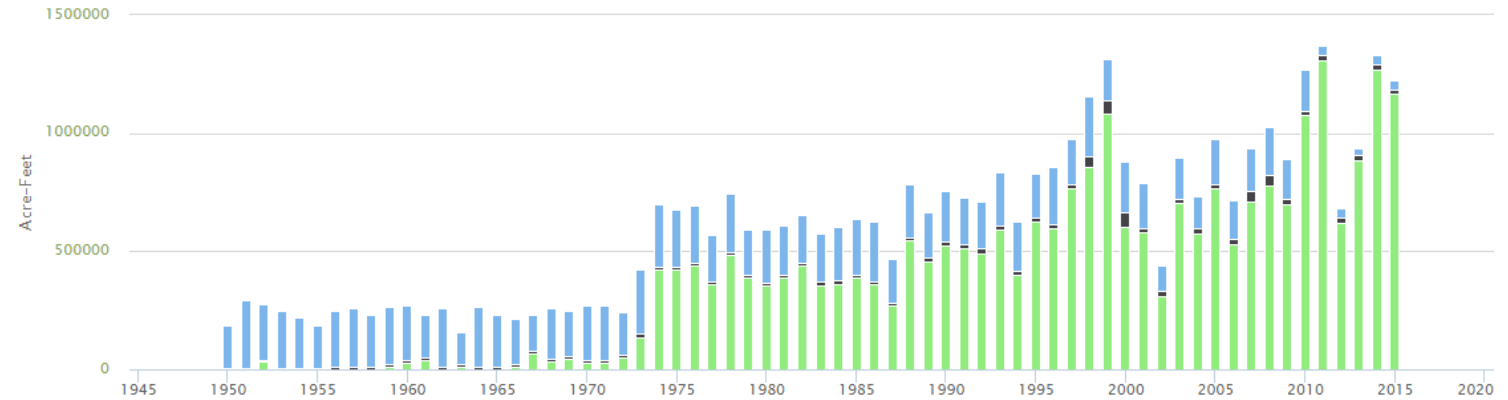
Data Categories

- Climate
- Hydrology and Streams
- Geology and Soils
- Groundwater
- Land Surface
- Other

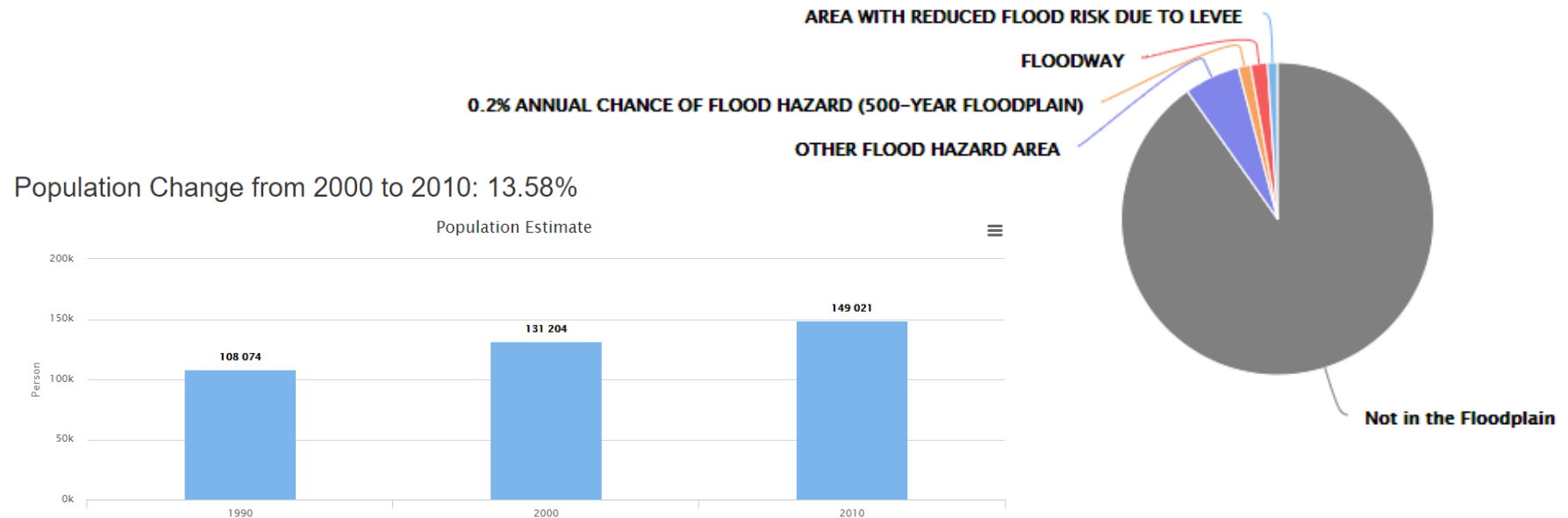
CSIP Services

- csip-climate
- csip-wrap
- csip-cfa

Historic Diversion Volume by Year



Flood Area Percentage



ERAMS EXAMPLE – CLEAN DASHBOARD

Purpose

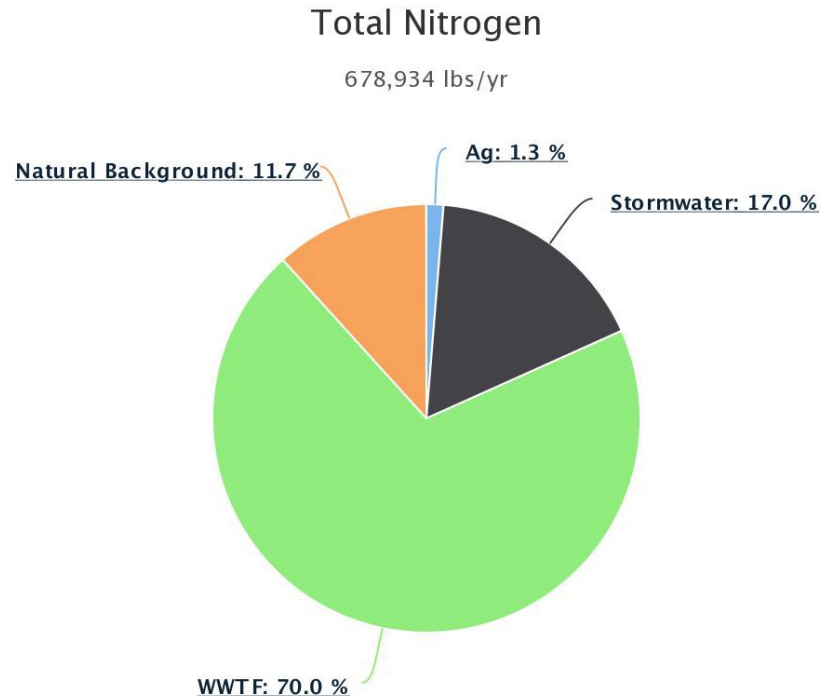
Geospatial User Interface for watershed selection and comparison of management scenarios to summarize average annual nutrient loads by source.

eRAMS Analyses

- Wastewater Treatment Plants Annual Load (EPA STORET/WQX)
- Urban Stormwater Runoff
- Edge of Field Irrigated Agriculture Runoff
- Groundwater Seepage/Discharge (South Platte MODFLOW model)
- Forest and Rangeland runoff (USGS SPARROW)

CSIP Services

- csip-clean
- csip-clean-stormwater
- csip-wrap
- csip-cfa



WATERSHED PRIORITIZATION DASHBOARD

Purpose

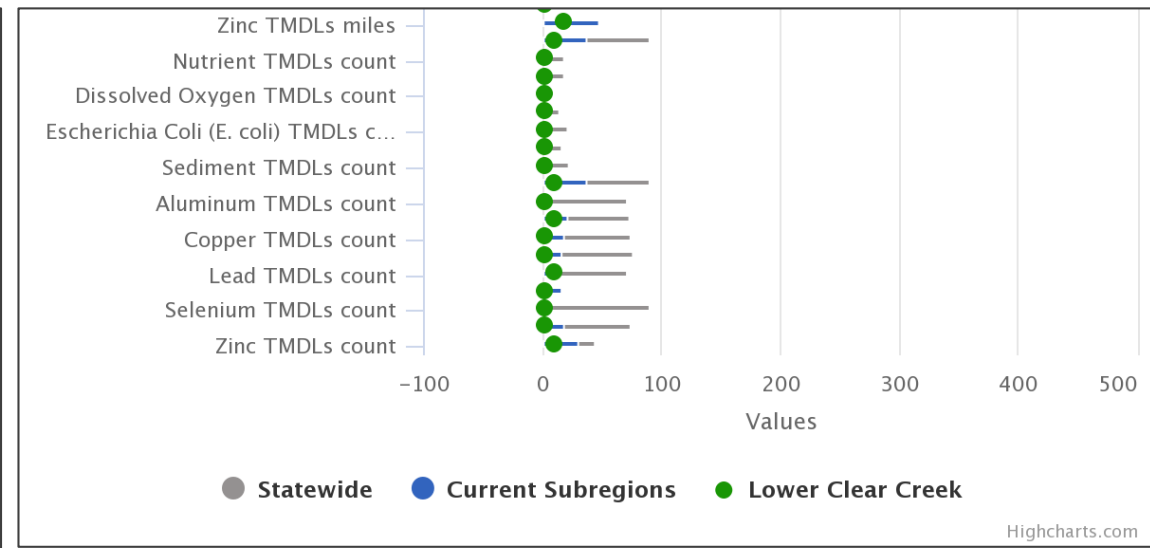
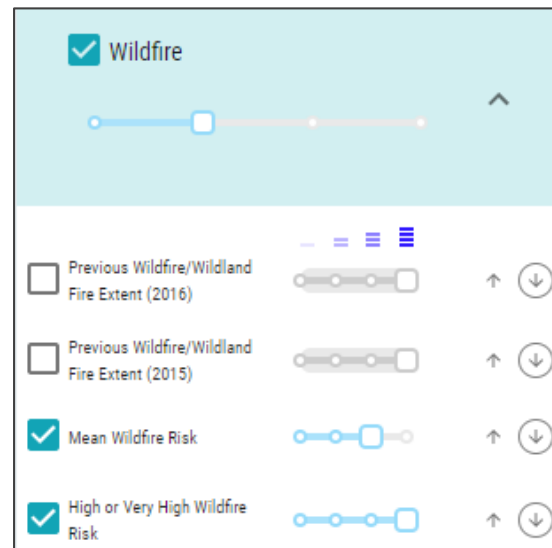
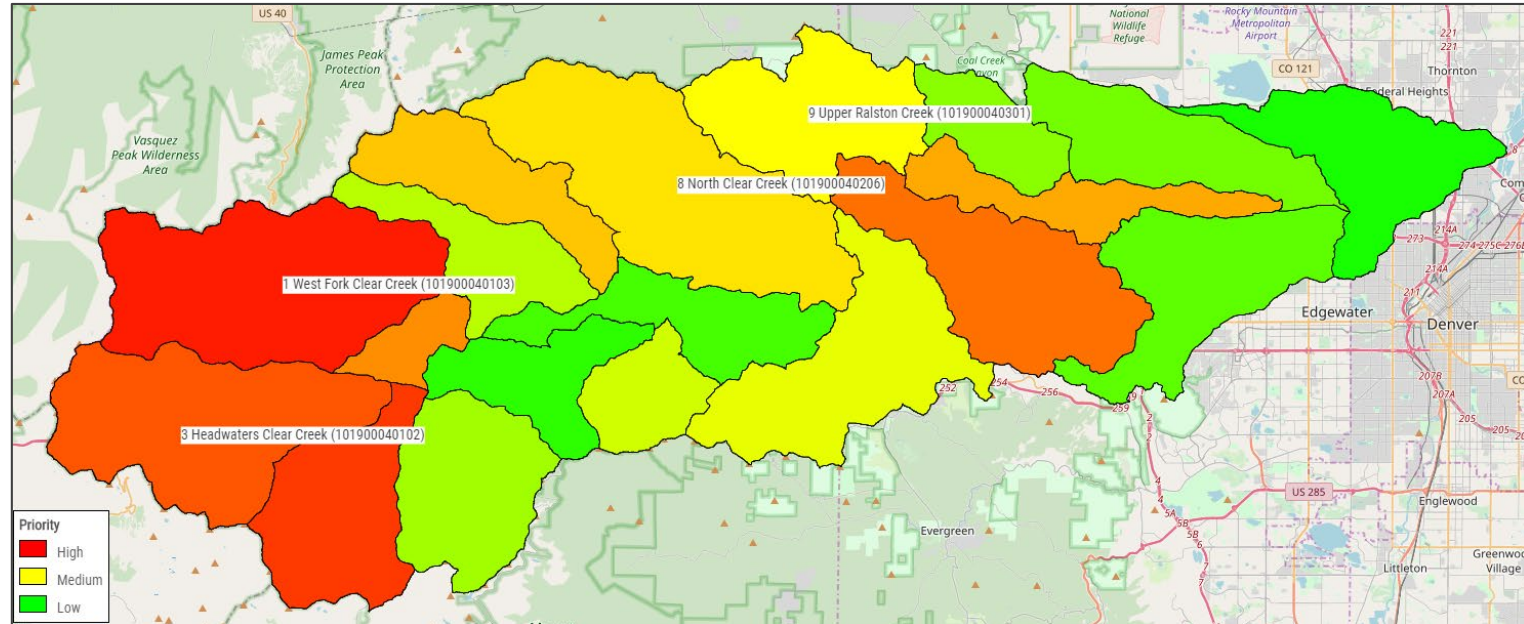
A prioritization tool that extracts and summarizes data and information at various watershed scales, including HUC 12, HUC 10, and HUC8 levels. Watershed health indicators are combined with user preferences to create an overall summary of the watershed condition which is then ranked to identify priority watersheds for restoration, protection, or other project implementation.

Data Categories

- Climate
- Hydrology and Streams
- Geology and Soils
- Groundwater
- Land Surface
- Other

CSIP Services

- csip-watershedpriority
- csip-mcda



Thank you.

• **Tyler Wible**

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SOLUTIONS
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class research with
real world water
challenges

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Integrating
management of
water systems with
urban planning



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Sustaining
agricultural
production in a
changing world



Water and Energy

Exploring tradeoffs
among interconnected
water and energy
systems



Ecosystem Services

Improving physical,
chemical, and
biological integrity
of water systems



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