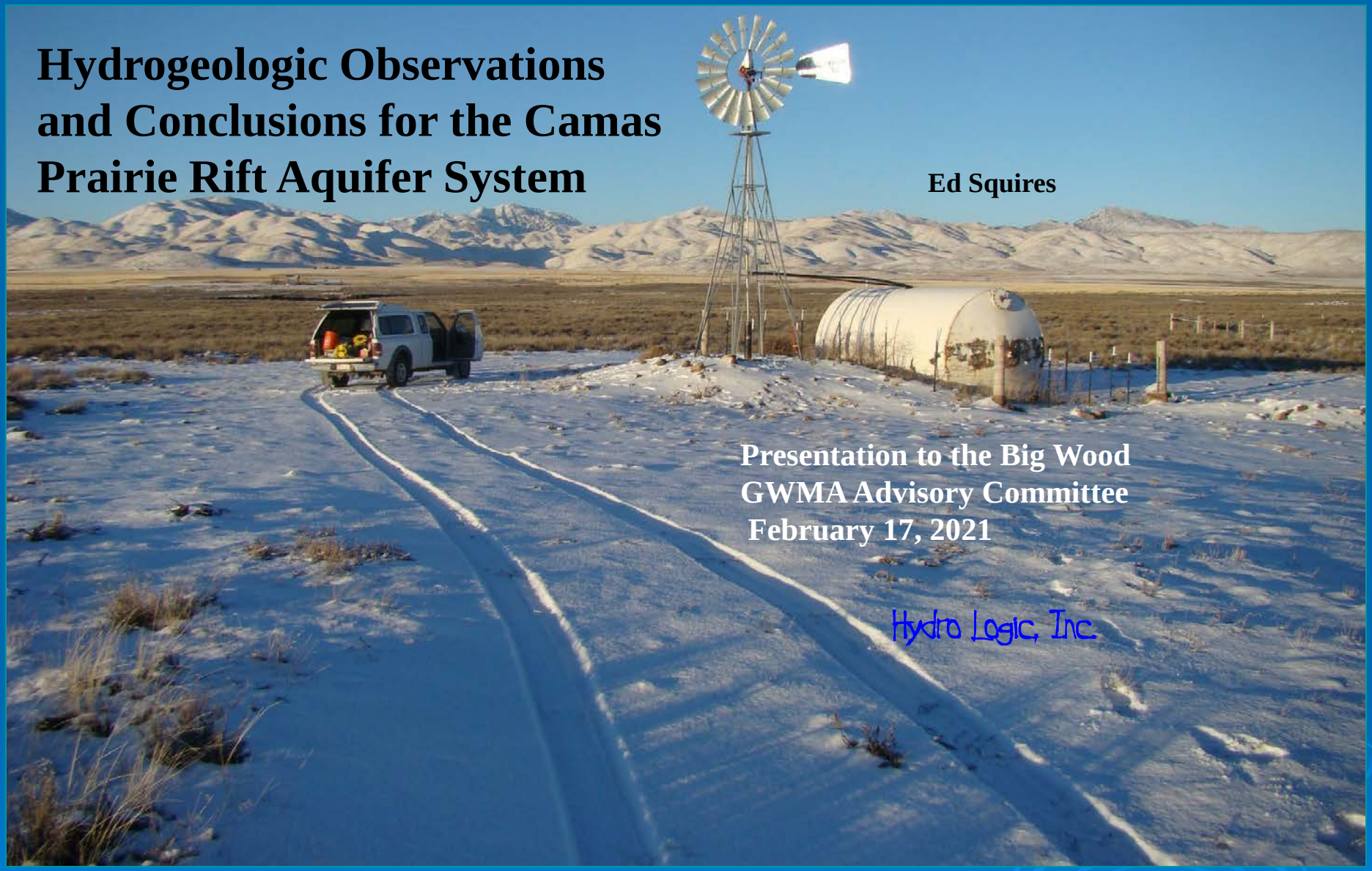
Hydrogeologic Observations and Conclusions for the Camas Prairie Rift Aquifer System

Ed Squires



Presentation to the Big Wood GWMA Advisory Committee
February 17, 2021

Hydro Logic, Inc.

Acknowledgements

Bill Simon
Spencer Wood
Kurt Newbry
Loren Pearson
Rusty Cramer
Dennis Strom
Charlie Honsinger

Frederic Remington

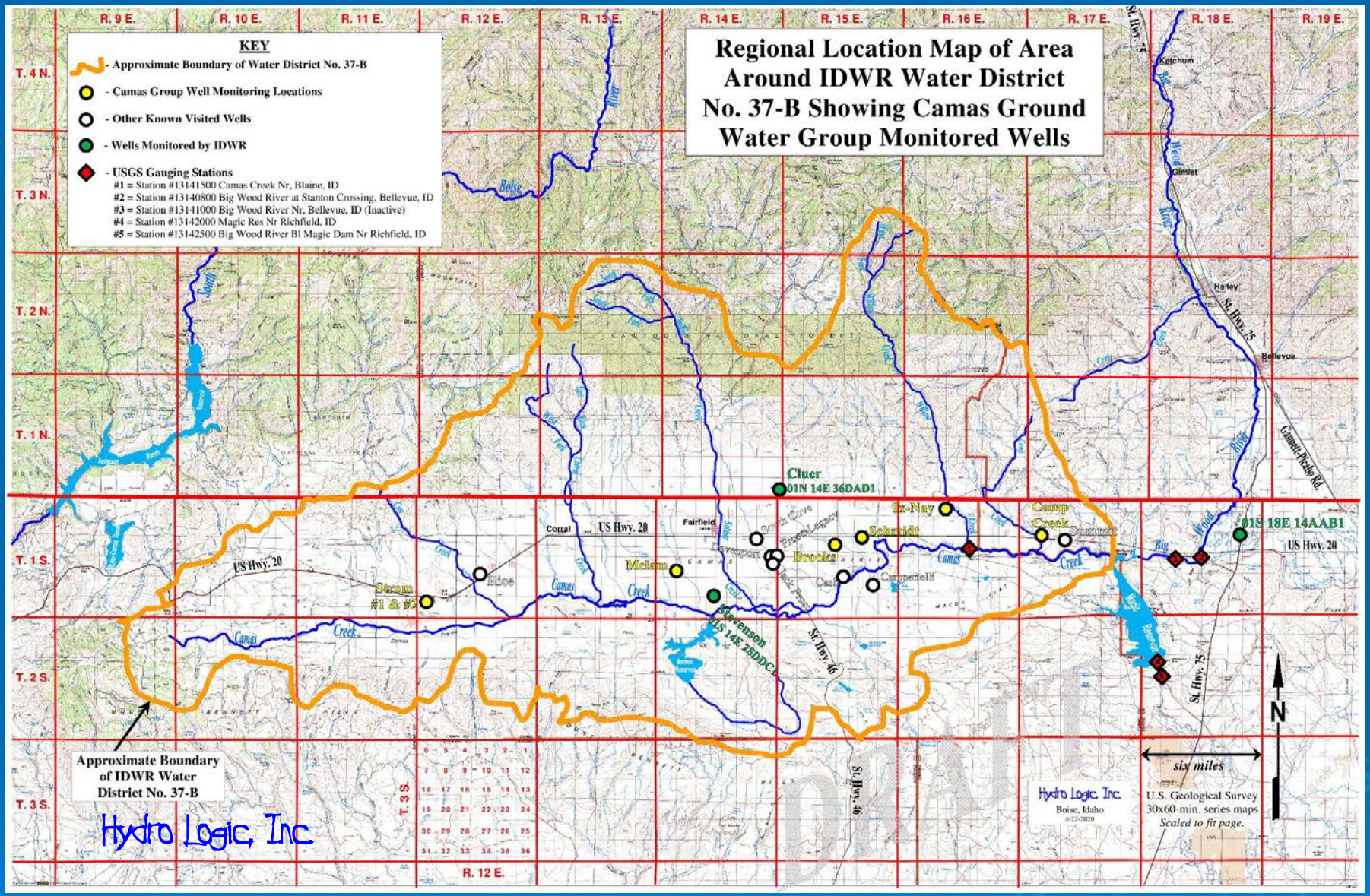
Curtailment of Camas Ground Water Pumping Will Not Result in More Water Storage in Magic Reservoir

1. A credible 1989 study estimates that 273,000 ac-ft of ground water escapes the basin as underflow; partly through thick permeable fractured basalt beneath the base of Magic Reservoir

2. Small perennial stream flows at the lower Camas Creek are from Willow and Camp Creek drainages and not significantly from shallow ground water seepage inflow

3. Effects of 12,000 ac-ft/yr of Camas ground water pumping on ground water underflow beneath the reservoir are so small as to be unmeasureable in the main aquifer flow from NW to SE below Magic

4. Magic Reservoir fills with surface water flows from Camas Creek and the Wood River and predominantly during the spring run off event


Regional Location Map of Area Around IDWR Water District No. 37-B Showing Camas Ground Water Group Monitored Wells
KEY
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- Camas Group Well Monitoring Locations
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R. 9 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
R. 16 E.
R. 17 E.
R. 18 E.
R. 19 E.
T. 4 N.
T. 3 N.
T. 2 N.
T. 1 N.
T. 1 S.
T. 2 S.
T. 3 S.
Ketchum
Gimlet
Hailey
Bellevue
Cluer
01N 14E 36DAD1
Ix-Nay
Camp Creek
Summit
01S 18E 14AAB1
US Hwy. 20
Corral
Fairfield
Schmidt
Brooks
Mclam
Stevenson
01S 14E 28DDC1
Rice
Stroup #1 & #2
Campbell
St. Hwy. 46
St. Hwy. 75
Approximate Boundary of IDWR Water District No. 37-B
Hydro Logic, Inc.
six miles
N
Hydro Logic, Inc.
Boise, Idaho
U.S. Geological Survey 30x60-min. series maps
Scaled to fit page.
DRAFT

The “Cluer” Reports Are the Best Information Available on the Hydrogeology of the Camas Basin

1. Brian and Kelly Cluer, born and raised on Camas Prairie, pursued Camas ground water research because of scientific curiosity

2. Cluer’s Camas paper was accepted into the scientific journal “Ground Water” (**Ground water, 1989, 27(3) 323-332**)

3. Brian Cluer’s hydrogeologic investigation is the only peer-reviewed research paper for the Camas Prairie Rift Basin to date

4. The Cluer reports have been inexplicably overlooked and/or ignored for the last 5 years of regulatory administration of this matter

Walton (1960) and Young (1973) Reports Were Based on Sparse Data With Wrong-Headed Conclusions

1. While it is impressive what these researchers accomplished with no data, there is little supporting science for Walton's conclusions and many Walton projections and estimates have been proven wrong

2. The Walton conclusion that the Fairfield LDS well would decline by 150 –ft from 12,000 ac-ft of ground water withdrawal did not happen. (only < 15-ft after 40-yrs of pumping)

3. The basin is much deeper and larger than Walton/Young envisioned (2,300-ft, Glenn, 2018)

4. There is voluminous ground water underflow discharge from basin

5. Young measured water levels in pumped wells during drought year

The Camas Basin is much larger (Deeper) Than Conceived in 1962 (Walton) and 1978 (Young)

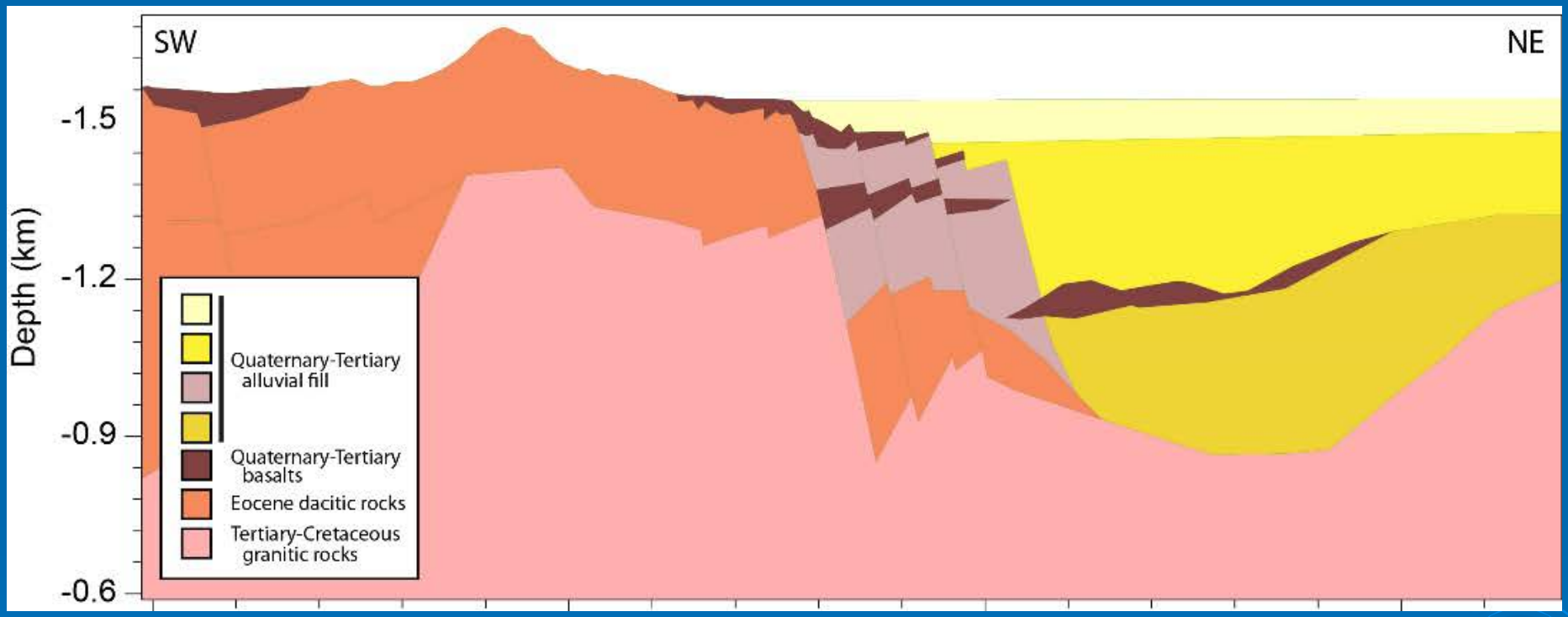
1. Cluer hypothesized a deep basin from his geologic work, his own geophysical gravity surveys, and deeper wells than Walton/Young

2. Cluer's intuition for a much deeper rift valley was proven true with the Play Fairway (Glenn, Mink, Liberty) geophysical studies in 2018

3. The volume of Camas ground water pumping is small (<0.0003) in comparison to the total ground water volume in the Camas Basin

4. The total volume of Camas ground water pumping with respect to Magic Reservoir storage (<0.06) is less than measurement error

Glenn, 2018 Camas Prairie Cross-section



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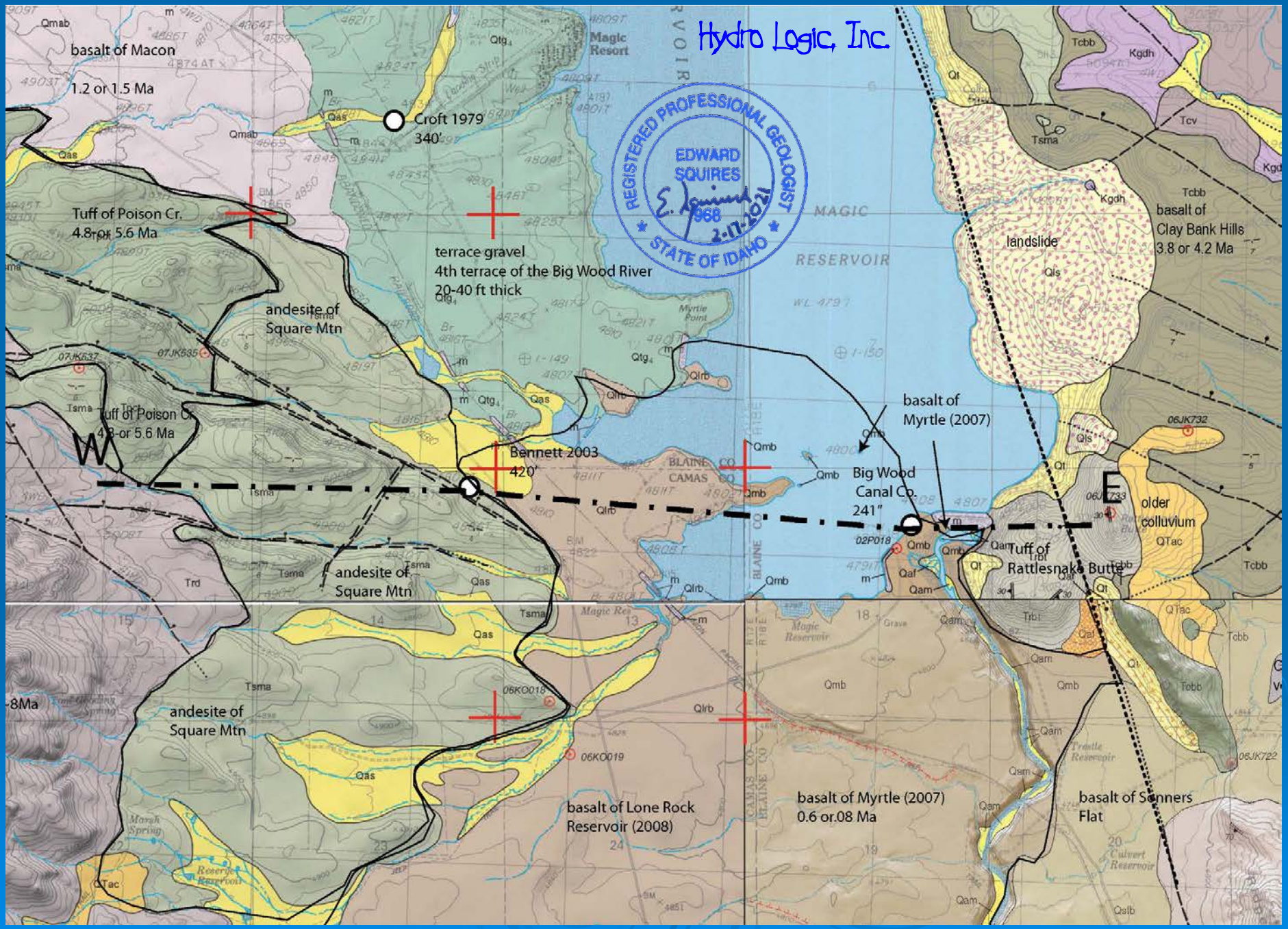
Recharge To, and Discharge From, the Camas Basin is Much Greater than Conceived in 1962 and 1978

1. Cluer envisioned more underflow to balance his basin water budget
2. The same fractured basalts exposed in lower Camas, Willow, and the sides of Magic Reservoir exist in the subsurface of Magic dam
3. The Macon, Lone Rock, and Myrtle basalts, extensively mapped aerially, described in outcrop, and reported on Well Driller's Reports, show thicknesses of hundreds of feet at, and around Magic dam
4. Well Driller's Reports document "breaks", fractures, caving interflow zones, and decreasing potential with depth, suggesting permeability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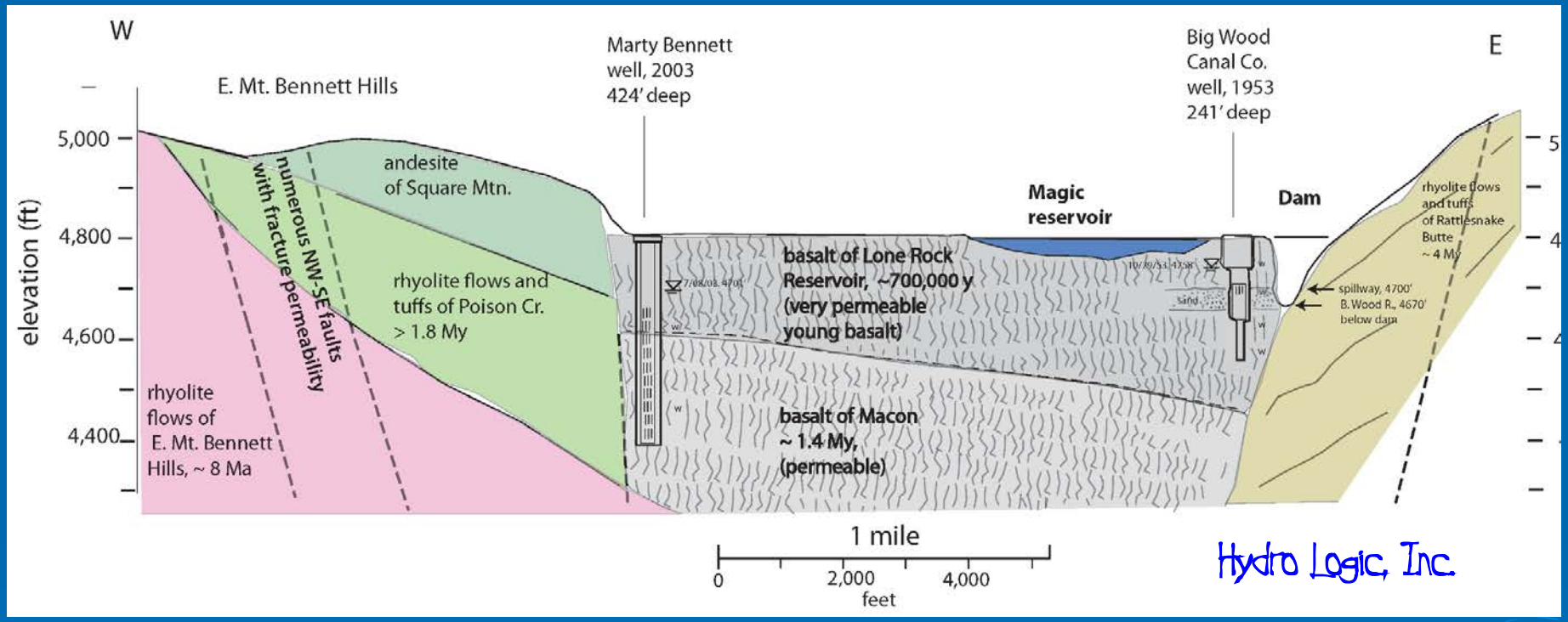
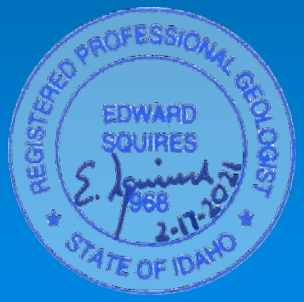
basalt of Macon
1.2 or 1.5 Ma
Croft 1979
340'
Tuff of Poison Cr.
4.8 or 5.6 Ma
terrace gravel
4th terrace of the Big Wood River
20-40 ft thick
andesite of
Square Mtn
Tuff of Poison Cr.
4.8 or 5.6 Ma
Bennett 2003
420'
andesite of
Square Mtn
andesite of
Square Mtn
basalt of Lone Rock
Reservoir (2008)
basalt of Myrtle (2007)
basalt of
Myrtle (2007)
Big Wood
Canal Co.
241"
Tuff of
Rattlesnake Butte
landslide
basalt of
Clay Bank Hills
3.8 or 4.2 Ma
older
colluvium
basalt of Sanners
Flat
MAGIC
RESERVOIR
Magic
Resort
REGISTERED PROFESSIONAL GEOLOGIST
EDWARD
SQUIRES
968
2-17-2021
STATE OF IDAHO

Sub-surface Cross-Section by S.H. Wood Near Magic Reservoir Dam





Recharge/Discharge To/From the Camas Basin is Greater than Conceived in 1962/1978 (continued)

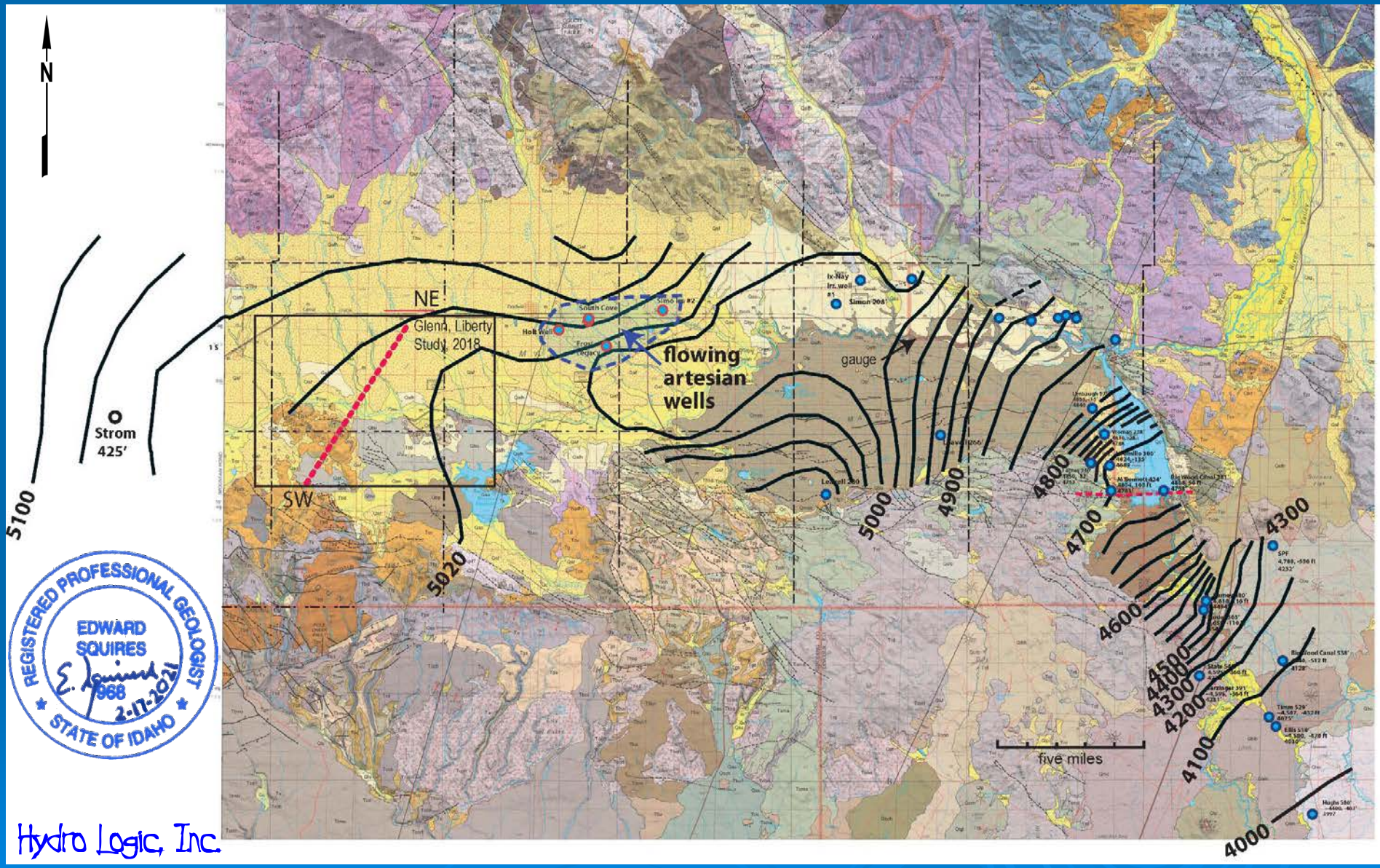
1. Large capacity wells (several cfs) have been completed into these basalt aquifers in the lower Camas Prairie Rift Basin Aquifer

2. Potentiometric surface maps show the ground water flow gradient past and under Magic Reservoir and out of the Camas Basin

3. Water levels in wells confirm the water table is below Magic Res

4. Well Driller's Reports SE of Magic dam document decreasing head potential with depth (downward vertical ground water flow (not up)

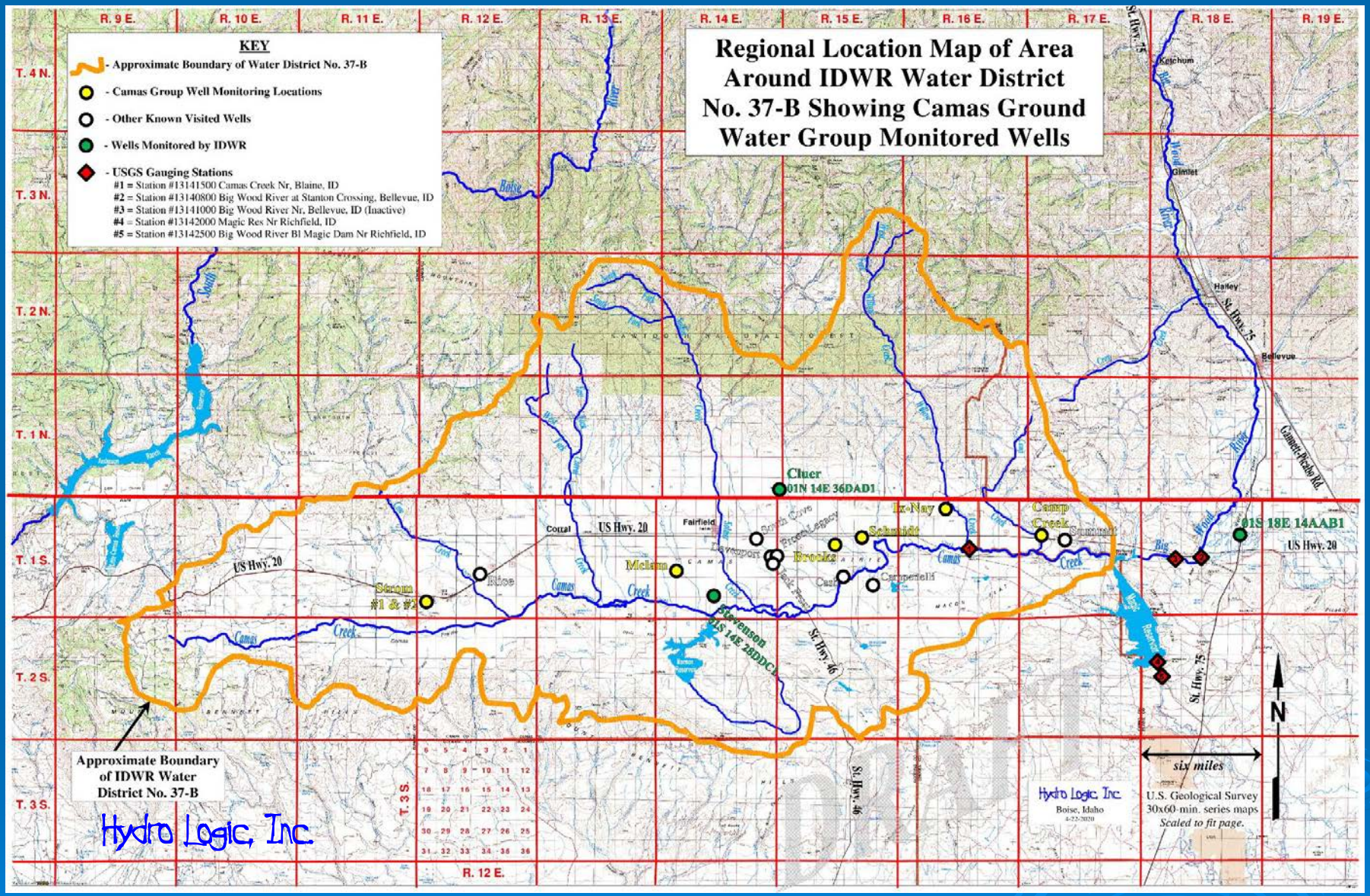
5. The volcanic rocks at the east end of Mt. Bennett Hills coursed by NW/SE structural geologic faults with likely increased permeability



Potentiometric Surface Map of Camas Prairie

Camas Ground Water Basin is Not a Closed Basin

1. There are no data that show Camas Basin to be a closed basin
2. There exists significant evidence of hydrogeologic conditions that demonstrate ground water should, and does, leave the Camas Basin
3. Potentiometric surface maps illustrate the direction and gradient of underflow beneath the base of Magic Reservoir through basalts
4. Water levels in wells on rim confirm water table is below Magic
5. Fractured/permeable basalts exist to transport the underflow
6. These fractured basalts are the same units of the “Camas arm” of Magic Reservoir, Macon Flat, and lower Willow Creek of known permeability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R. 18 E.
R. 19 E.
T. 4 N.
T. 3 N.
T. 2 N.
T. 1 N.
T. 1 S.
T. 2 S.
T. 3 S.
Ketchum
Gimlet
Hailey
Bellevue
Cluer
01N 14E 36DAD1
Ix-Nay
Camp Creek
Summit
01S 18E 14AAB1
US Hwy. 20
Corral
Fairfield
Schmidt
Brooks
Mclam
Stevenson
01S 14E 28DDC1
Rice
Stroup #1 & #2
Campbell
St. Hwy. 46
St. Hwy. 75
Approximate Boundary of IDWR Water District No. 37-B
Hydro Logic, Inc.
six miles
N
Hydro Logic, Inc.
Boise, Idaho
U.S. Geological Survey 30x60-min. series maps
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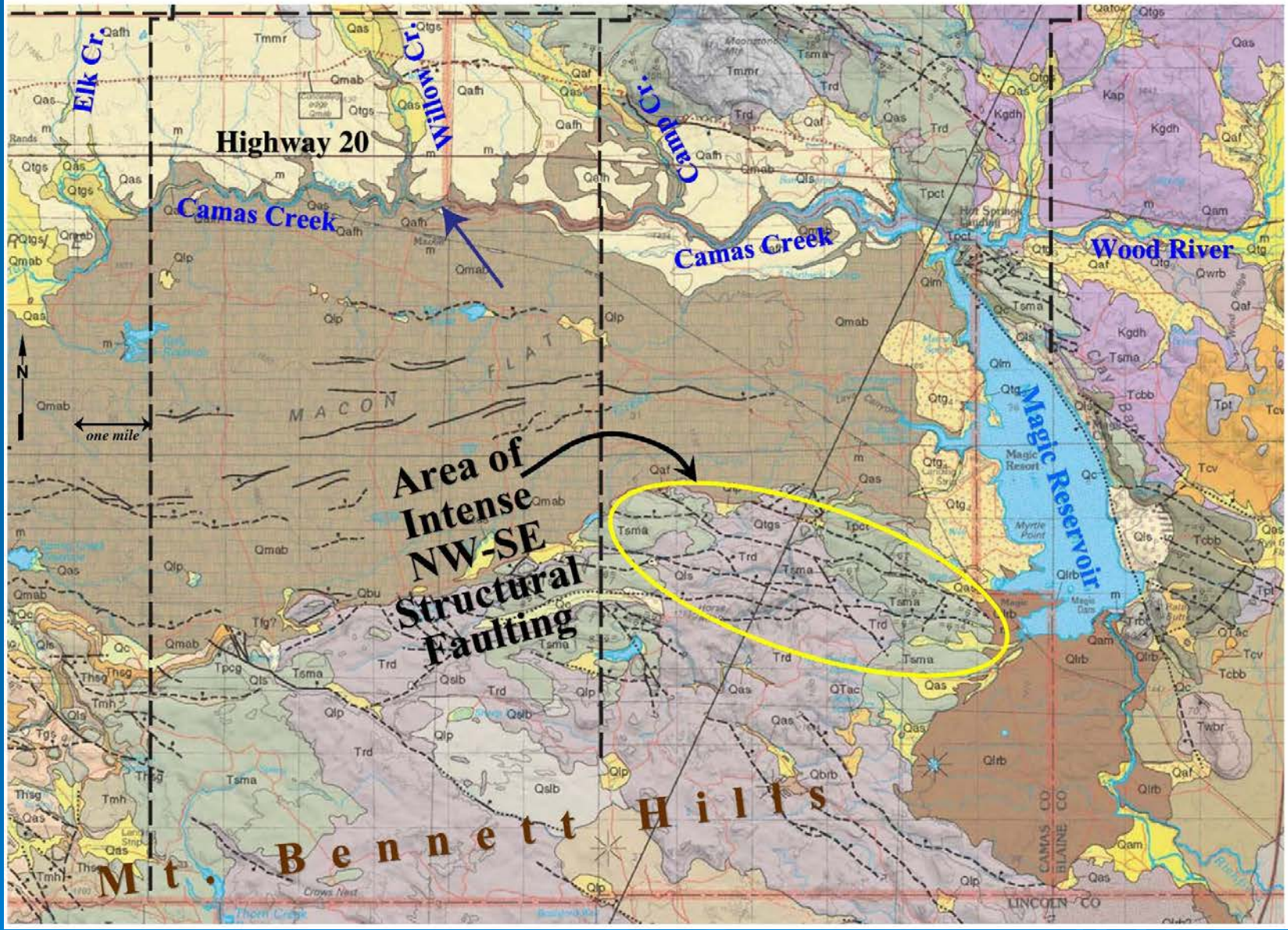
DRAFT



Area of Intense Structural Faulting Near Magic Valley Reservoir

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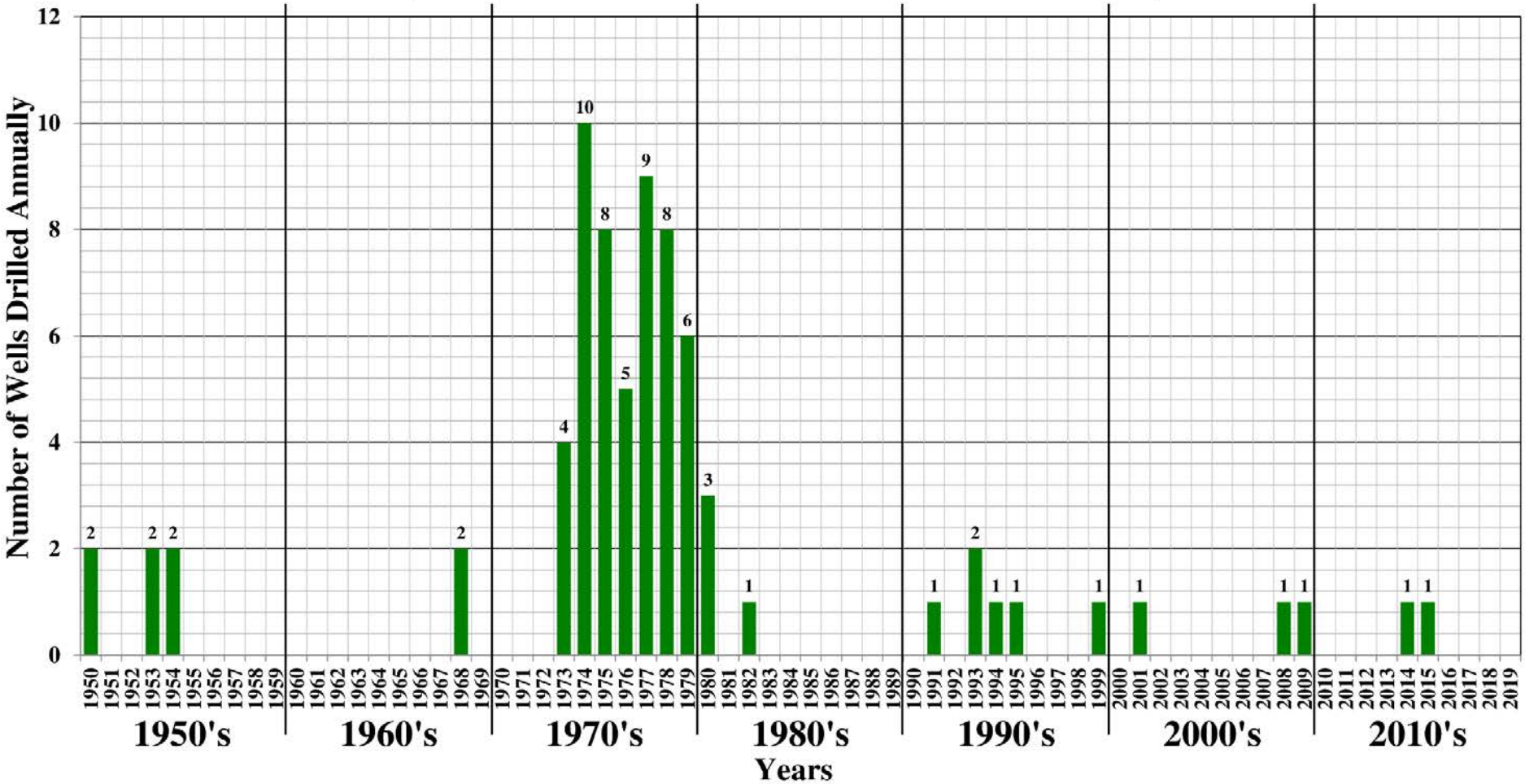
Camas Prairie Rift Basin Ground Water Levels are Long-Term (~40-years) Stable

1. Virtually all the Camas irrigation wells were constructed during the 8-year period 1973-1980
2. After 40-years of pumping, there has not been a water call until now
3. The Camas ground water withdrawals have remained constant
4. Many Camas wells continue to flow at land surface under the same small above ground artesian pressures noted by Walton and Young
5. The Strom irrigation Well #1 water level recovers to within a few feet of its initial (at well completion) water level after 38-years of pumping

Number of Irrigation Wells Drilled Annually In Water District No. 37-B (Camas Prairie)



Bar graph showing the number of irrigation water wells drilled within the Camas Prairie (Ground Water Basin 37-B) by year. Of the 73 irrigation wells completed during the 70-year period, 53 (73 per cent) were constructed during the eight-year period from 1973-to-1980. Only twelve irrigation wells have been constructed over the last 33 years since 1981, many of which are replacement wells. Data is from the IDWR's on-line well database.

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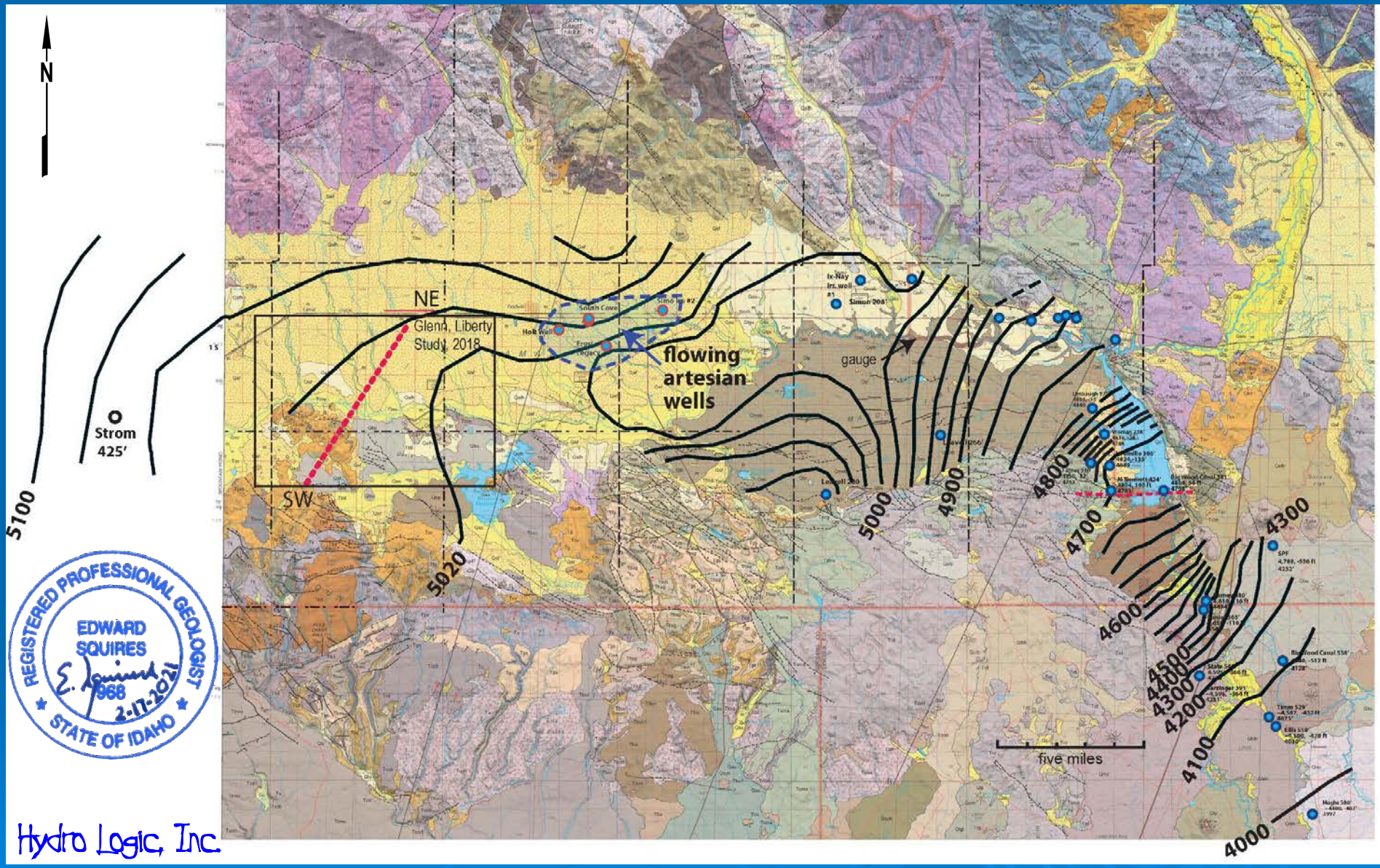
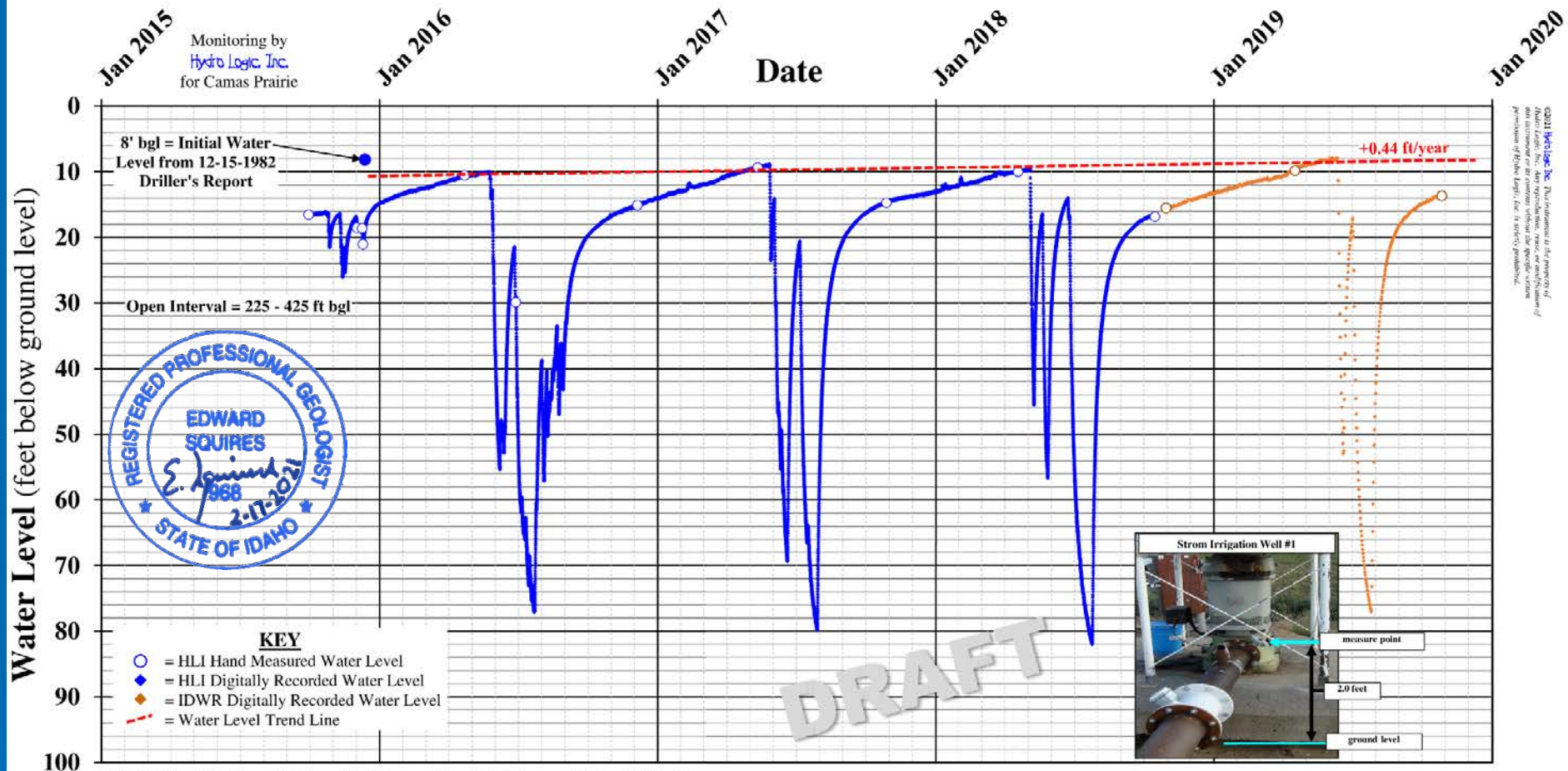


Potentiometric Surface Map of Camas Prairie

Strom Irrigation Well #1 (Well Number 1S 12E 31ACA1) Water Levels

T. 1 S., R. 12 E., Section 31, SW¼, NE¼ and Latitude 43° 17' 38.41", Longitude 115° 4' 29.03"; Well completed December 1982.



IDWR data shifted down 2 feet to match HLI ground level. No datum specified on IDWR data.

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Water District 37-B Groundwater Volume Totals

(via 4-16-2020 email to Ed Squires from Rusty Kramer)

YEAR	VOLUME (ac-ft)
2014	14,152.22
2015	11,900.74
2016	12,844.89
2017	10,742.25
2018	13,337.79
2019	9,933.37

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South Cove Well (south) with ~ 5-ft of above ground artesian head

Natural artesian flow over top of Frostensen Legacy irrigation well casing 5/12/2017

Natural above ground artesian flow over well casing of the Davenport irrigation well 5/12/2017

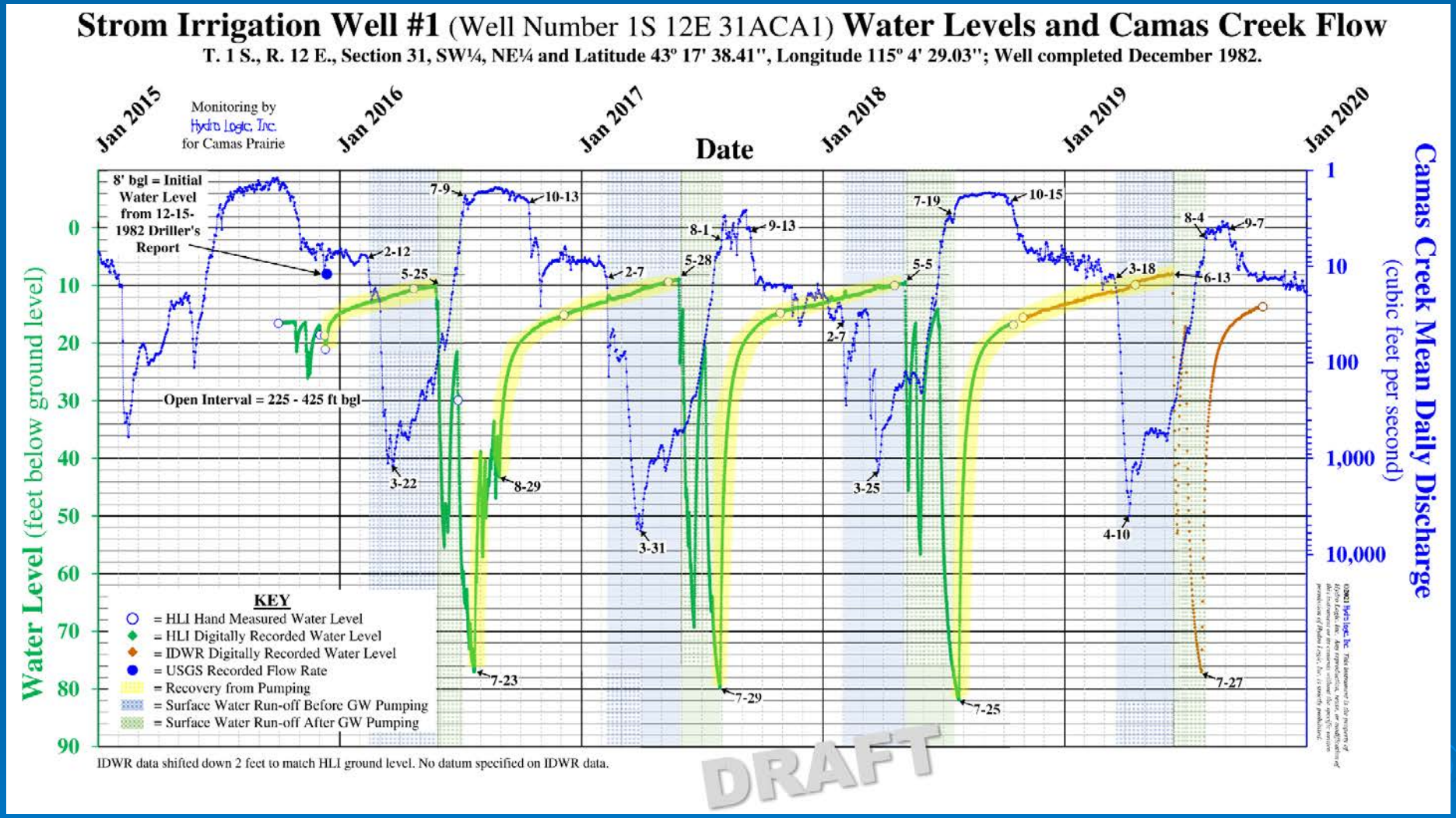
Camas Prairie Rift Basin Ground Water Levels are Long-Term Historically Stable (continued)

1. The Strom Well #1 water level continues to rise (recover) until the pumping season commences each year (as all Camas wells do)

1. The South Cove “north” well exhibits perennial above ground heads even though South Cove “south” well is a large pumping center

1. The recovery ground water levels fluctuate slightly, rising during wet years (ground water storage increases) and decline in wet periods

2. Much of the historical Camas ground water level record is not helpful because the two-per-year spot measurements in Camas wells were not timed to be near the seasonal highs or lows



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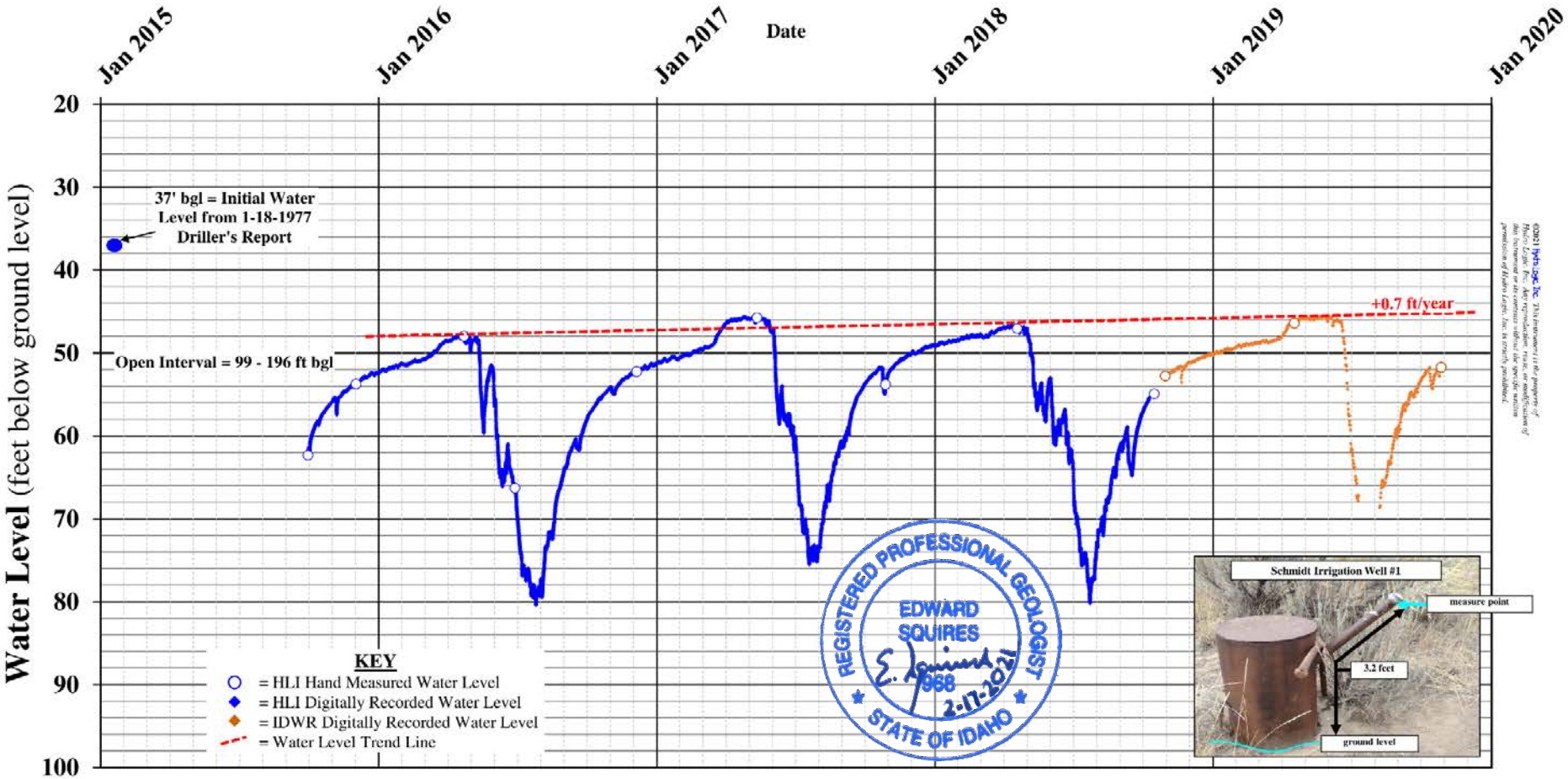
Schmidt Irrigation Well #1 (Well Number 1S 15E 14BBA1) Water Levels

T. 1 S., R. 15 E., Section 14, NW¼, NW¼ and Latitude 43° 20' 31.33", Longitude 114° 38' 54.13"; Well completed January 1977.



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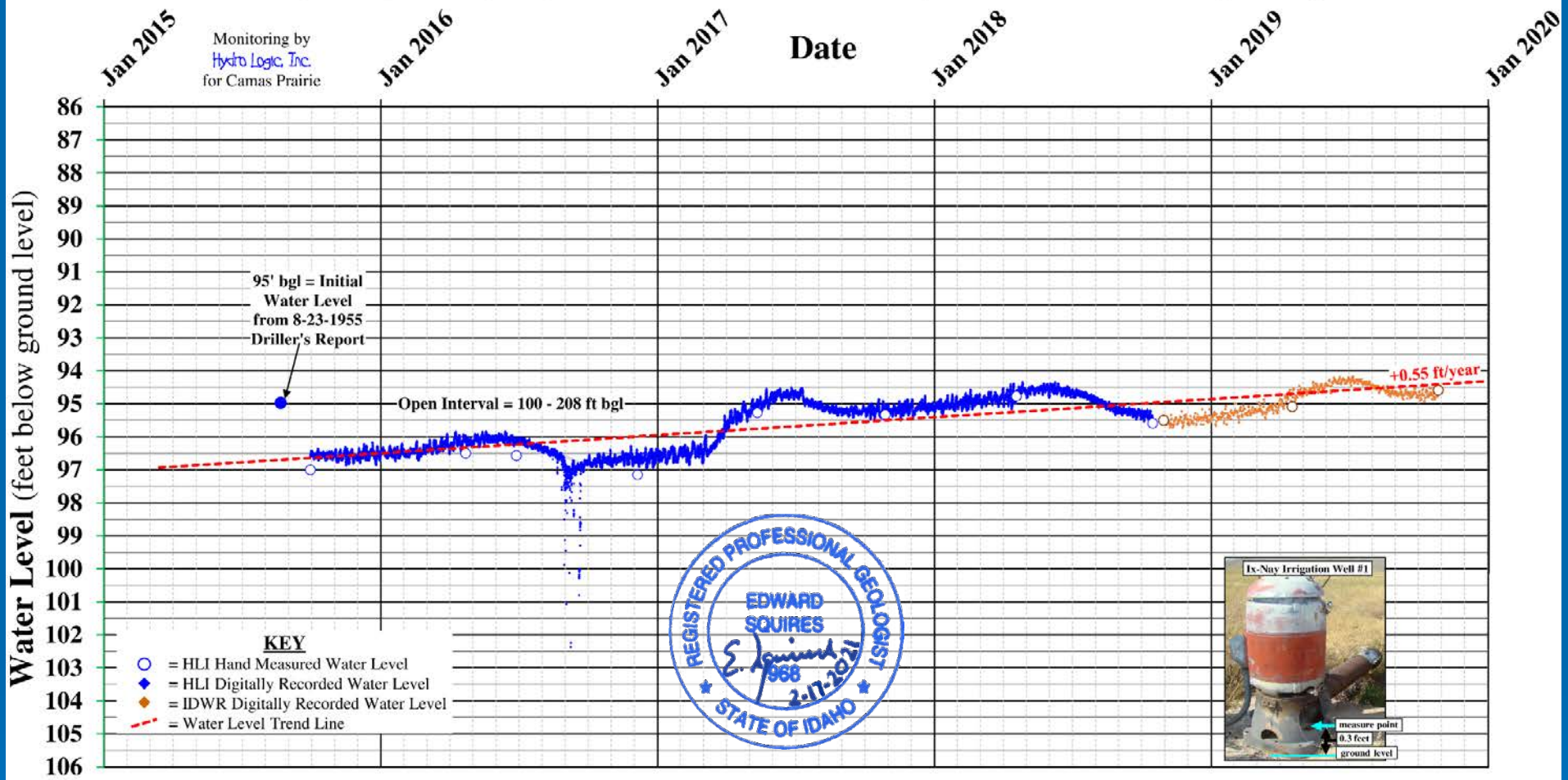
Ix-Nay Irrigation Well #1 (Well Number 01S 16E 04CDB1) Water Levels

T. 1 S., R. 16 E., Section 4, NE¼, SW¼ and Latitude 43° 21' 36.88" Longitude 114° 34' 1.77"; Well completed August 1955.



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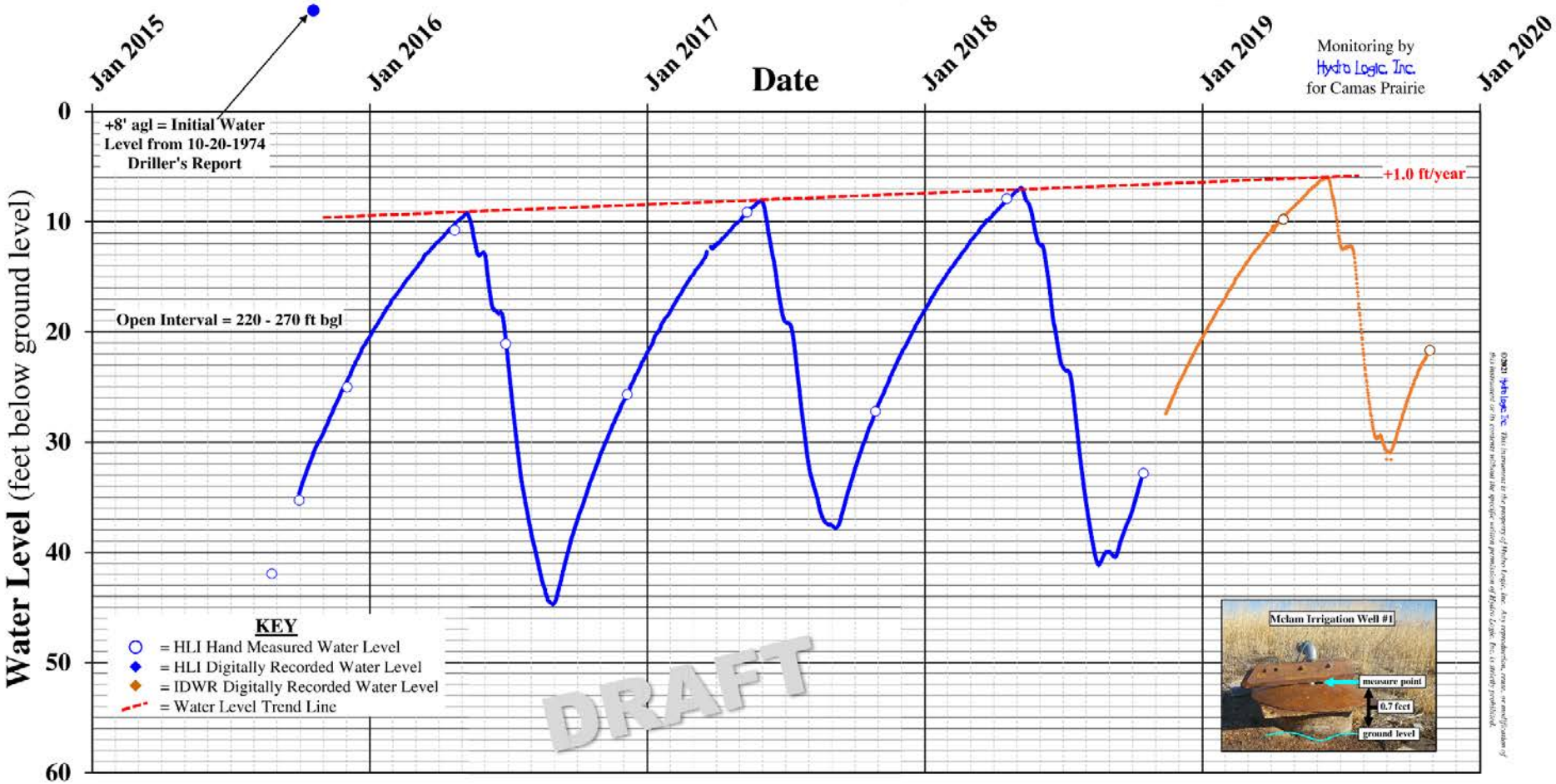
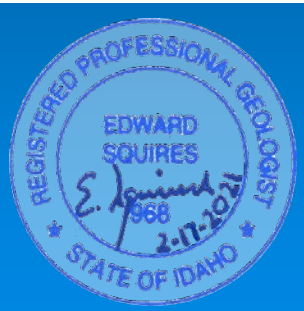
McLam Irrigation Well #1 (Well Number 1S 14E 19DAA1) Water Levels

T. 1 S., R. 14 E., Section 19, NE¼, SE¼ and Latitude 43° 19' 3.92", Longitude 114° 49' 54.24"; Well completed October 1974.





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Strom Irrigation Well #1 (Well Number 1S 12E 31ACA1) Water Levels

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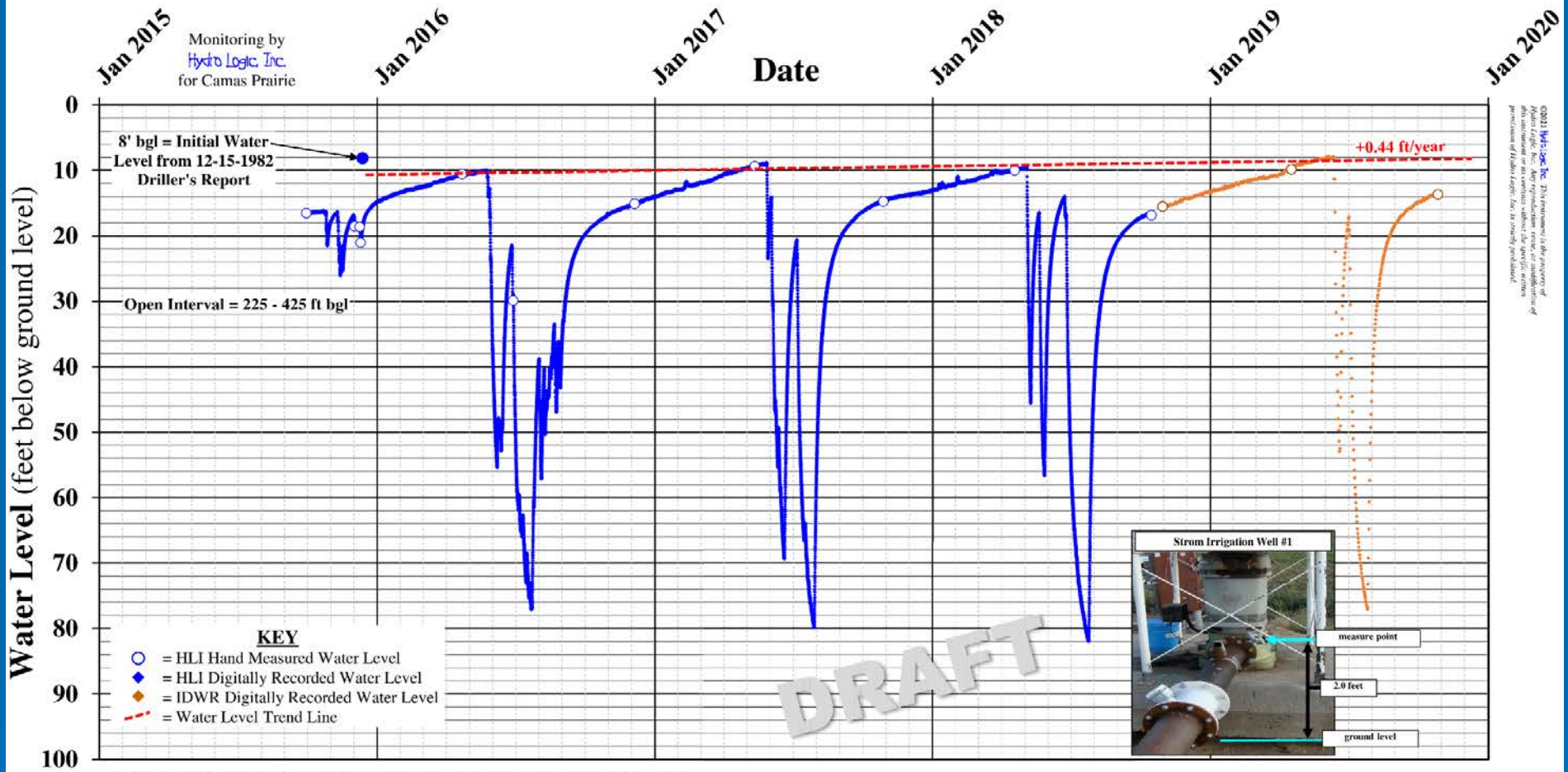

IDWR data shifted down 2 feet to match HLI ground level. No datum specified on IDWR data.

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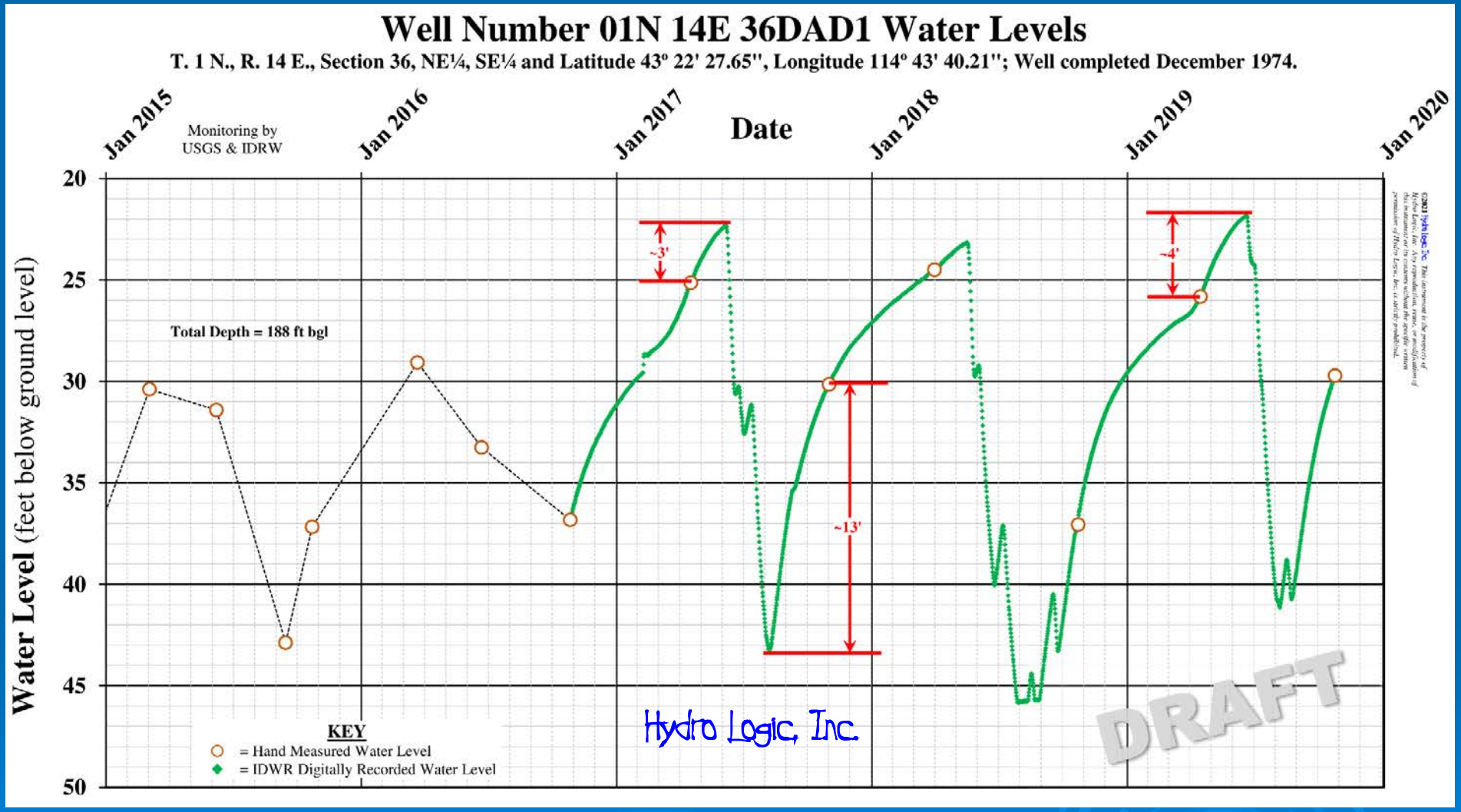
Well Number 01N 14E 36DAD1 Water Levels
T. 1 N., R. 14 E., Section 36, NE¼, SE¼ and Latitude 43° 22' 27.65", Longitude 114° 43' 40.21"; Well completed December 1974.
Date
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Monitoring by
USGS & IDRW
Water Level (feet below ground level)
20
25
30
35
40
45
50
Total Depth = 188 ft bgl
~3'
~13'
~4'
KEY
= Hand Measured Water Level
= IDWR Digitally Recorded Water Level
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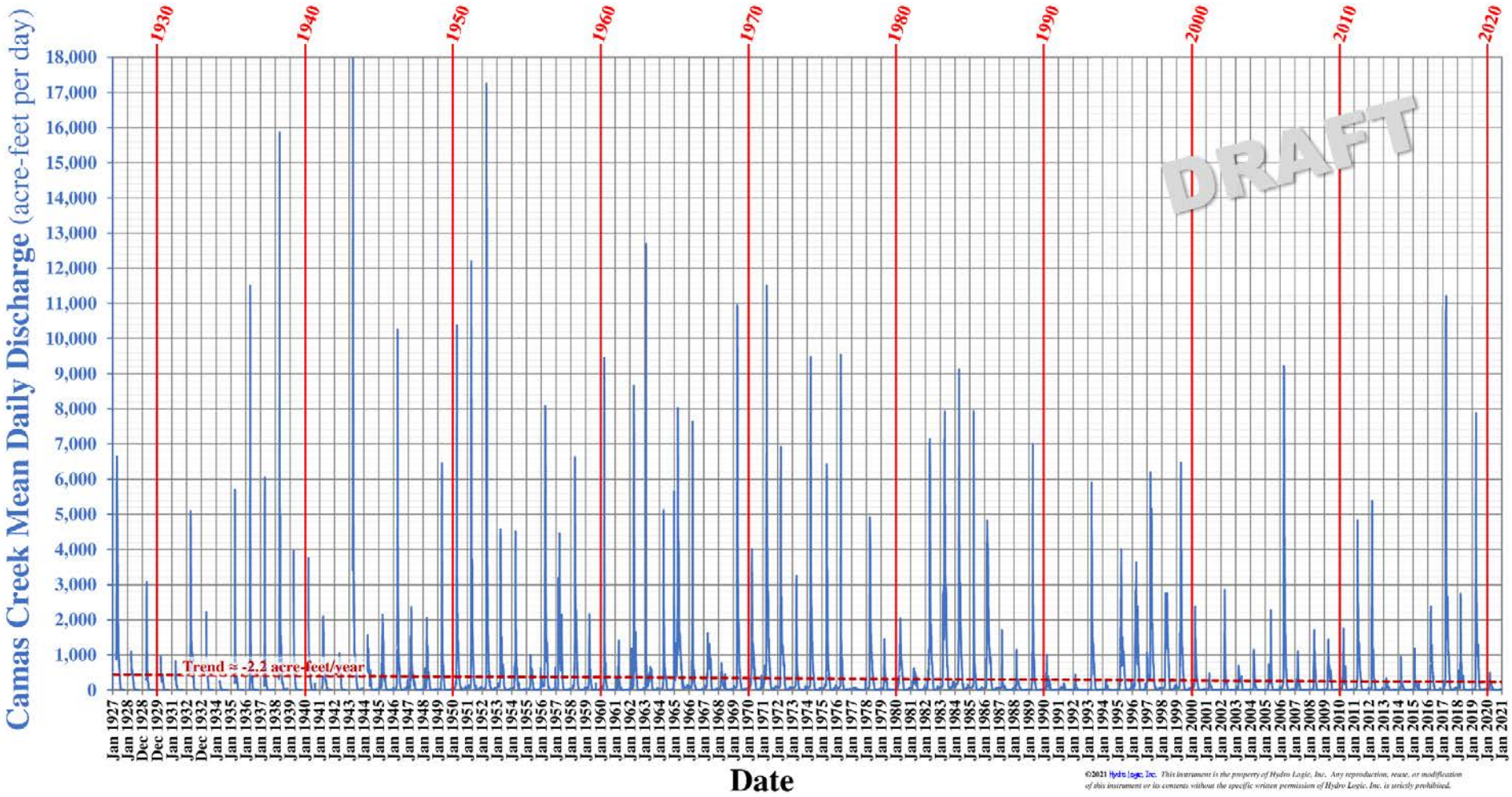
Camas Creek Stream Flows are Long-Term Stable

1. Mathematical regression of 90 years of Camas Creek discharge data shows a statistical decline of 0.88 ac-ft/year (~90 ac-ft in 40-years)

2. Regression of 1970-to 2020 Camas Creek discharge (50-years) shows statistical decline of ~5 ac-ft/year (250 ac-ft in 50-years)

Camas Creek Daily Discharge Near Blaine, Idaho 1927-2020



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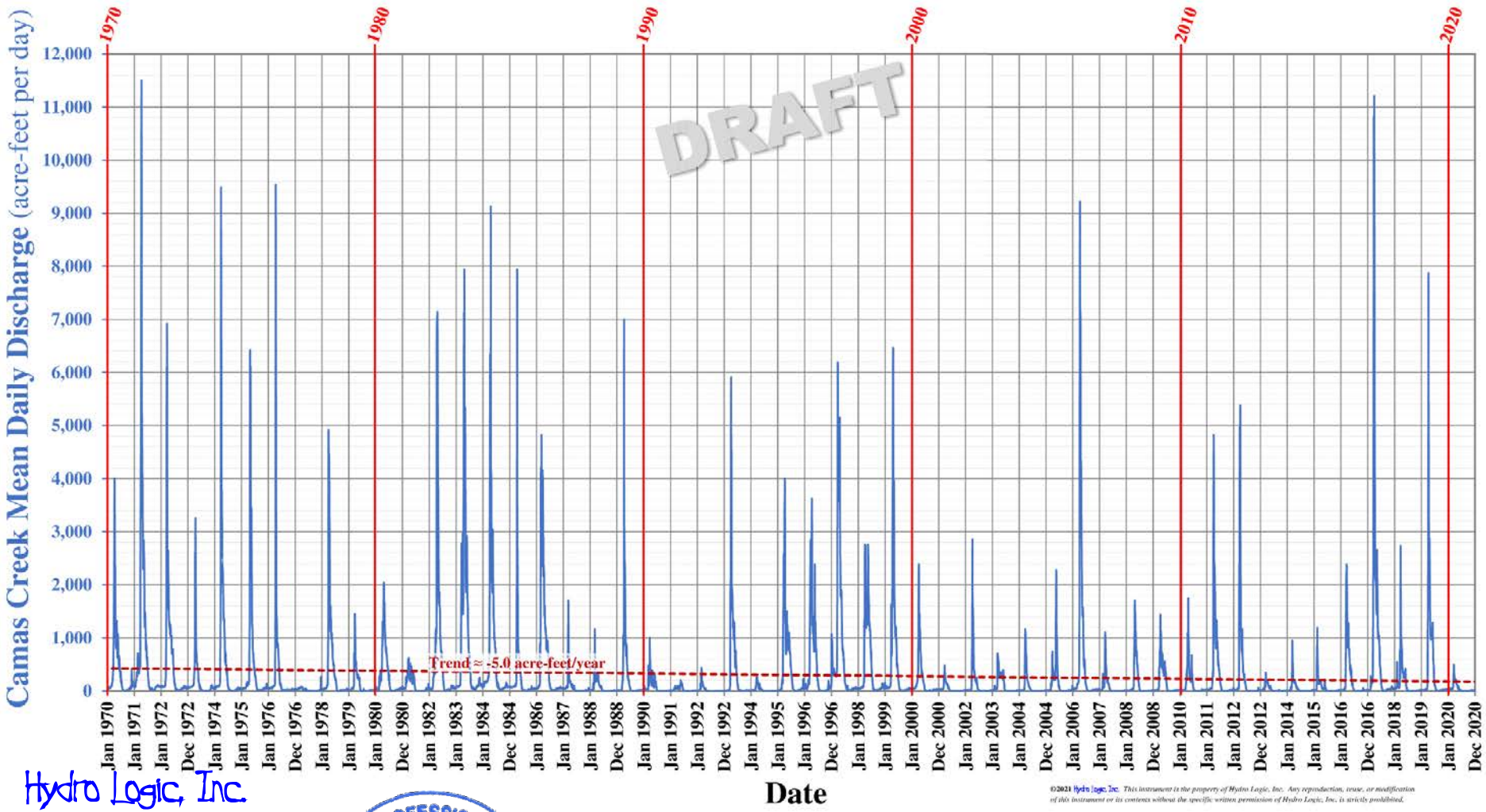
Camas Creek Daily Discharge Near Blaine, Idaho 1970-2020



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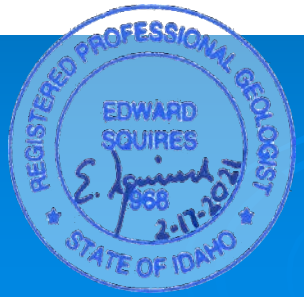
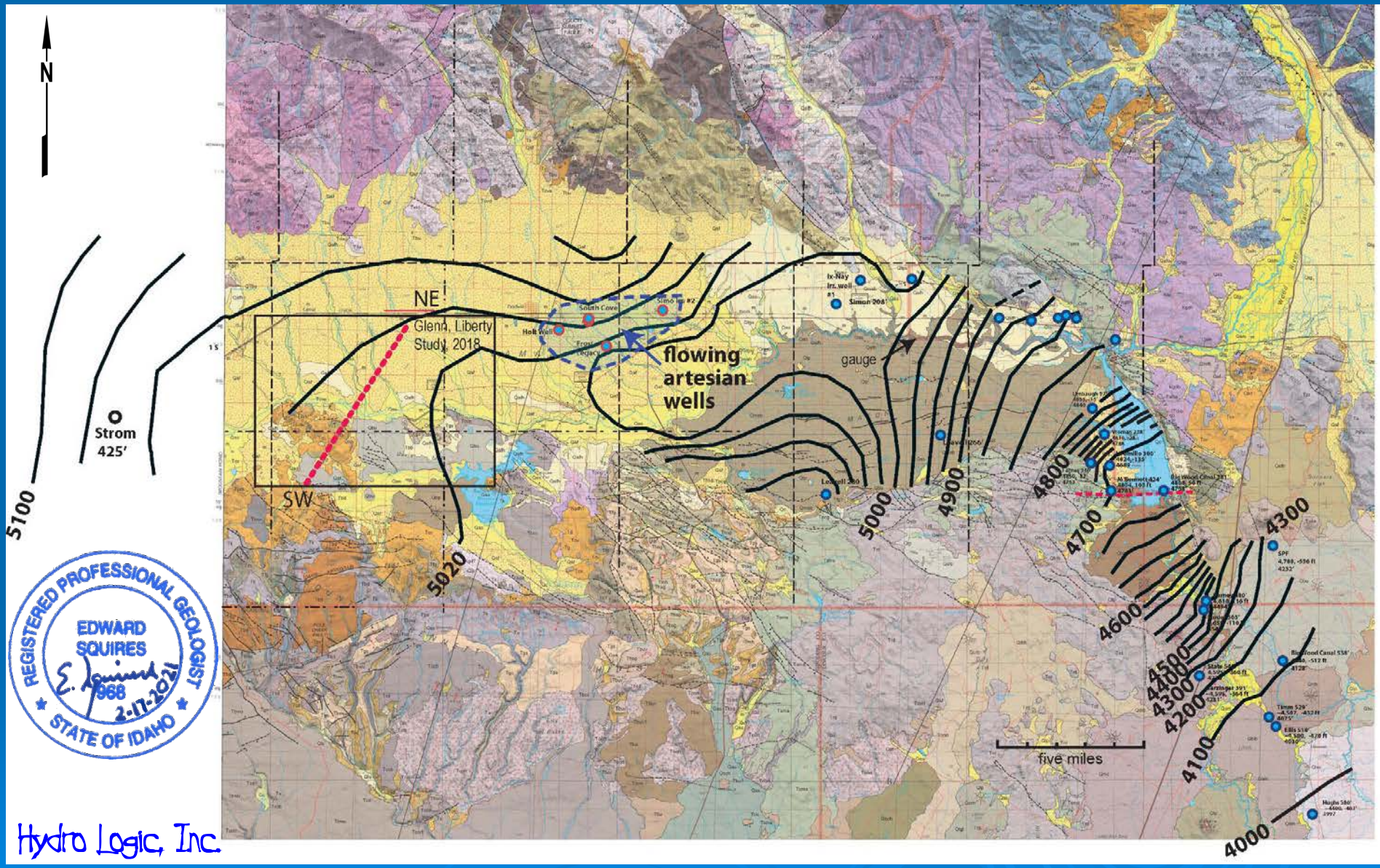


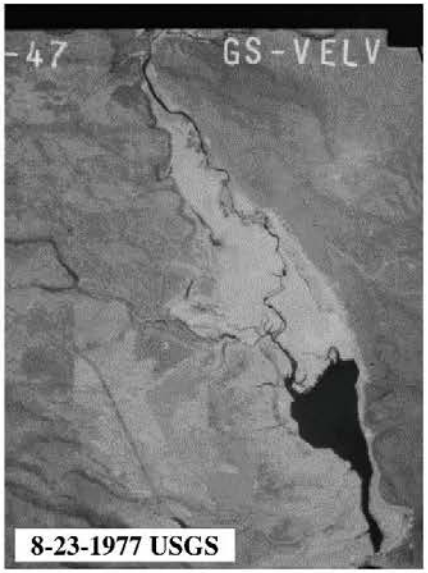
The Late Season Flows in Lower Camas/Willow Creeks Do Not Represent Main Aquifer Discharge

1. Potentiometric maps do not show main aquifer flow in that direction
2. There is often no flow in Camas Cr. above confluence w/ Willow Cr.
3. The main “Thalweg” of ground water flow through the basin is southeast toward the basin outlet west and south of Magic dam
4. If Camas ground water pumping were to affect any component of basin flow, it would be the underflow through basalt under Magic
5. Aquifer discharge is likely relatively constant year-round beneath the base of Magic (aquifer does not drain like reservoir in one year)
6. Pool remaining in Magic in every drought is likely the water table

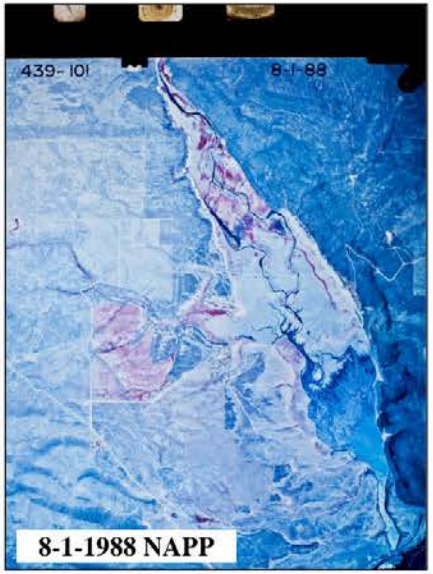


Potentiometric Surface Map of Camas Prairie

Historical Photos of Low Water Levels in Magic Reservoir



8-23-1977 USGS



8-1-1988 NAPP

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Boise, Idaho

12-31-2003 USDA

6-15-2004 USDA

7-20-2013 USDA

Available aerial photographs of the Magic Reservoir area of Camas Prairie over the period 1977-to-2013. In general, the photo dates are later in the irrigation year and the top three frames are from severe drought years. Evident in the photographs is that, even on the most severe drought year of 1977, a portion of Magic Reservoir remains filled with water. Studies by HLI for the Camas Ground Water Uses Group, suggest that the remaining water in the reservoir is actually the expression of the regional ground water table. According to Water Master Kevin Lakey, the remaining water in Magic is not due to any water right circumstance and the water cannot be emptied from the reservoir by gravity means using the existing diversion works. The time series of photographs suggests that the water table of Camas Prairie has not declined significantly (if at all) in response to Camas ground water pumping or drought cycles.

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The Camas Prairie Rift Basin Is Complex and Has Not Been Adequately Studied To Understand and/or Model

1. There are no regional scale aquifer tests (or any aquifer tests)
2. The geologic section has not been characterized beyond well driller reports and no drill-cuttings have been sampled and/or described
3. Cluer's hypothesis that large volumes of ground water leave the basin as underflow through permeable basalts not investigated
4. No long-term designated monitoring wells have been drilled and constructed at key locations
5. Camas ground water withdrawals are so minute compared to total basin discharge that they would not be able to be measured

Camas Aquifer System Evens Out Climate Variability to Provide a Dependable Irrigation Water Supply

1. In multi-year wet to dry climate cycles, aquifer storage increases during wet years and provides sustainable supply in dry cycles

2. Cluer's reports deserve increased review and scrutiny because they appear to be well thought through and make good scientific sense

3. Surface water availability and Magic Reservoir storage is undependable and short-lived based on precipitation and temperature climate variations year-to-year (as it has always been)

4. During dry years, and extended multiple low-water year cycles, Camas senior surface water rights use more water, for longer periods, such that less water flows to Magic Reservoir

The BWCC Has Not Shown Injury to Surface Water Rights from Camas Ground Water Pumping

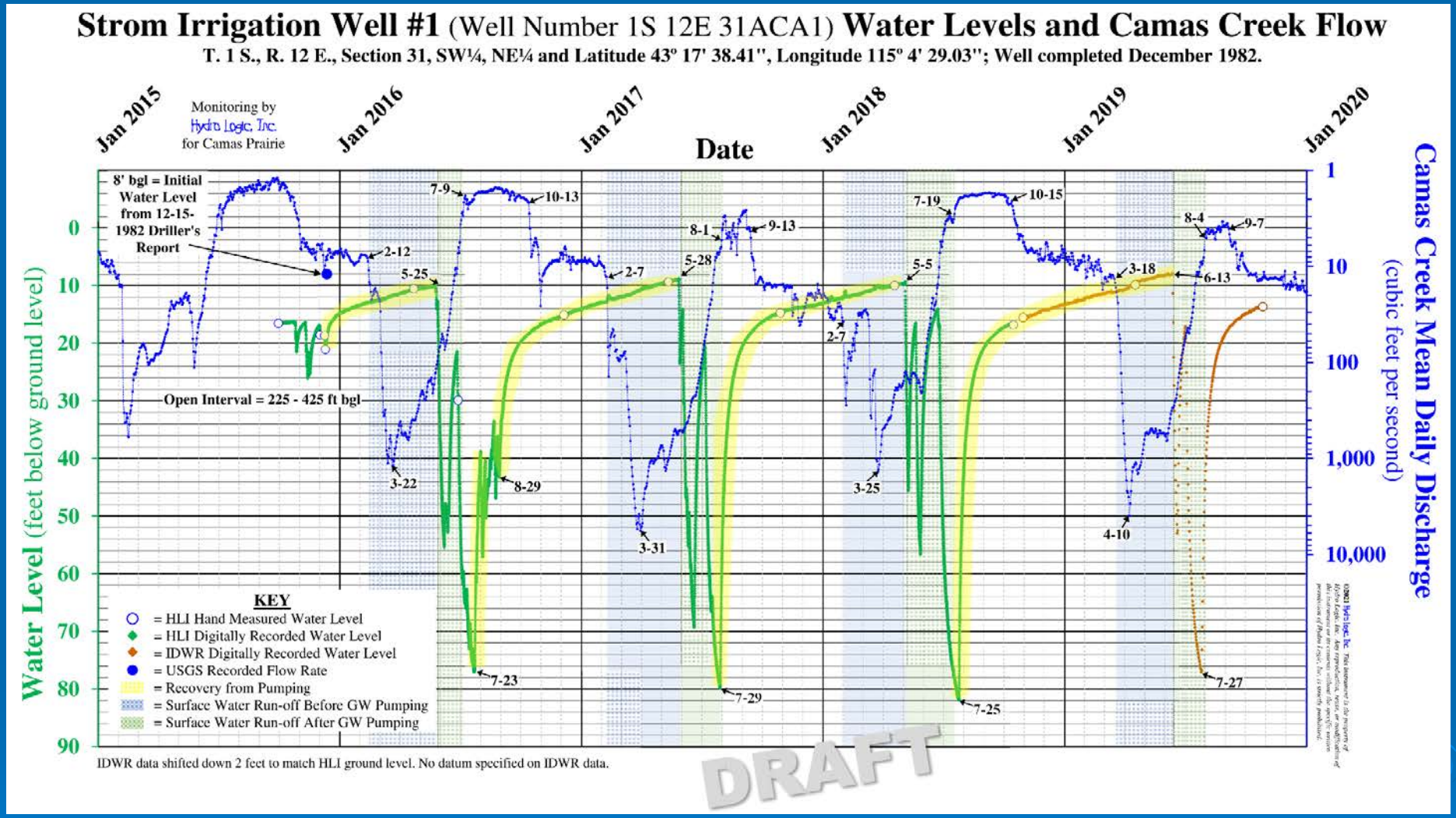
1. The preponderance of Magic Reservoir storage is derived from surface water stream flows during a flash spring runoff

2. Climate variability remains the single largest determinant of Magic Reservoir storage volume (same variability since dam constructed)

3. Magic fills when ground water levels are highest (before pumping)

4. There are no apparent indications of a direct hydraulic connection between ground water and surface water in well hydrographs

5. Camas ground water pumping hasn't prevented senior surface water diverters on Camas from getting their full rights (which has always dried up Camas Creek above Willow Creek most years)



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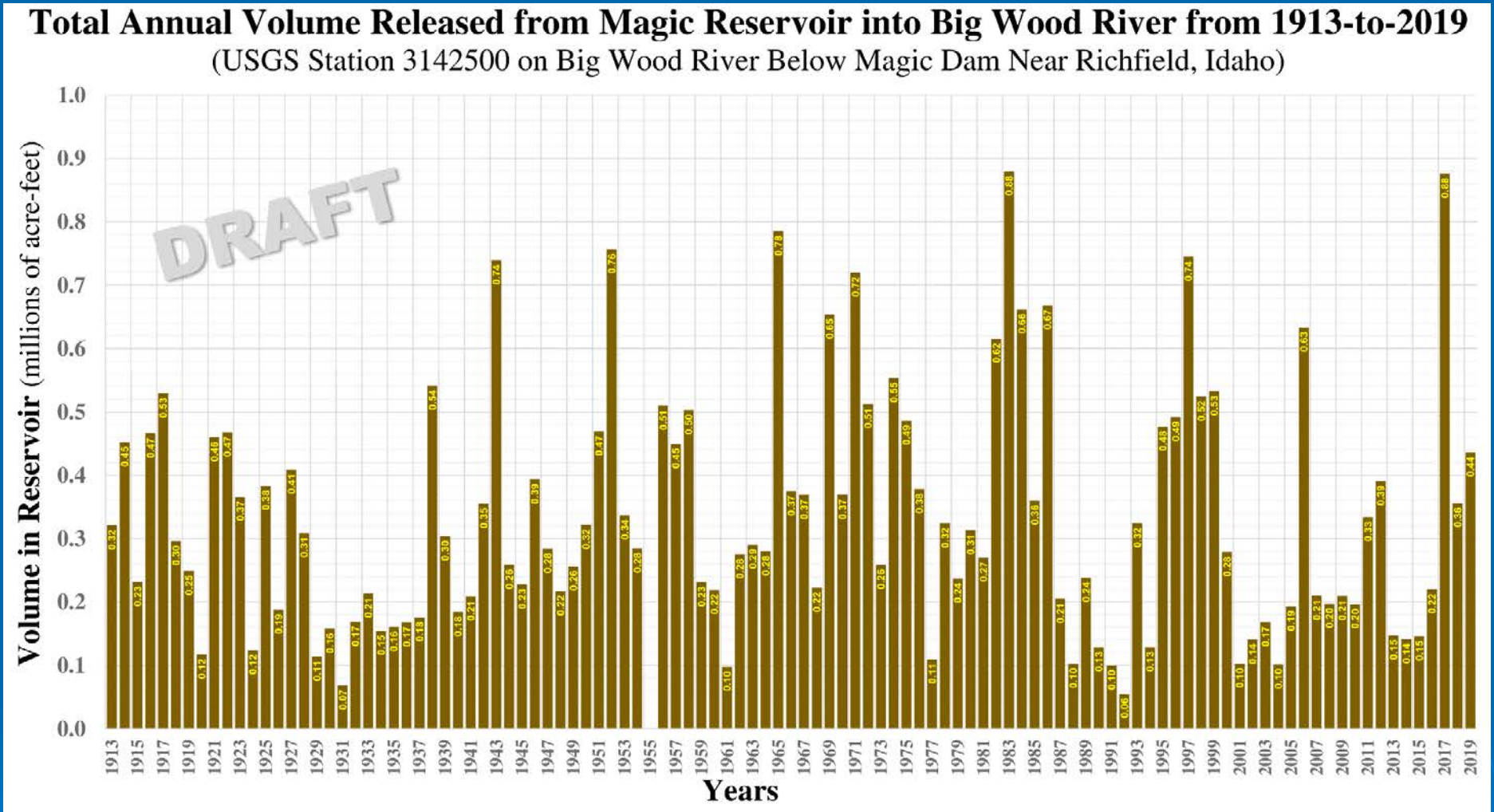

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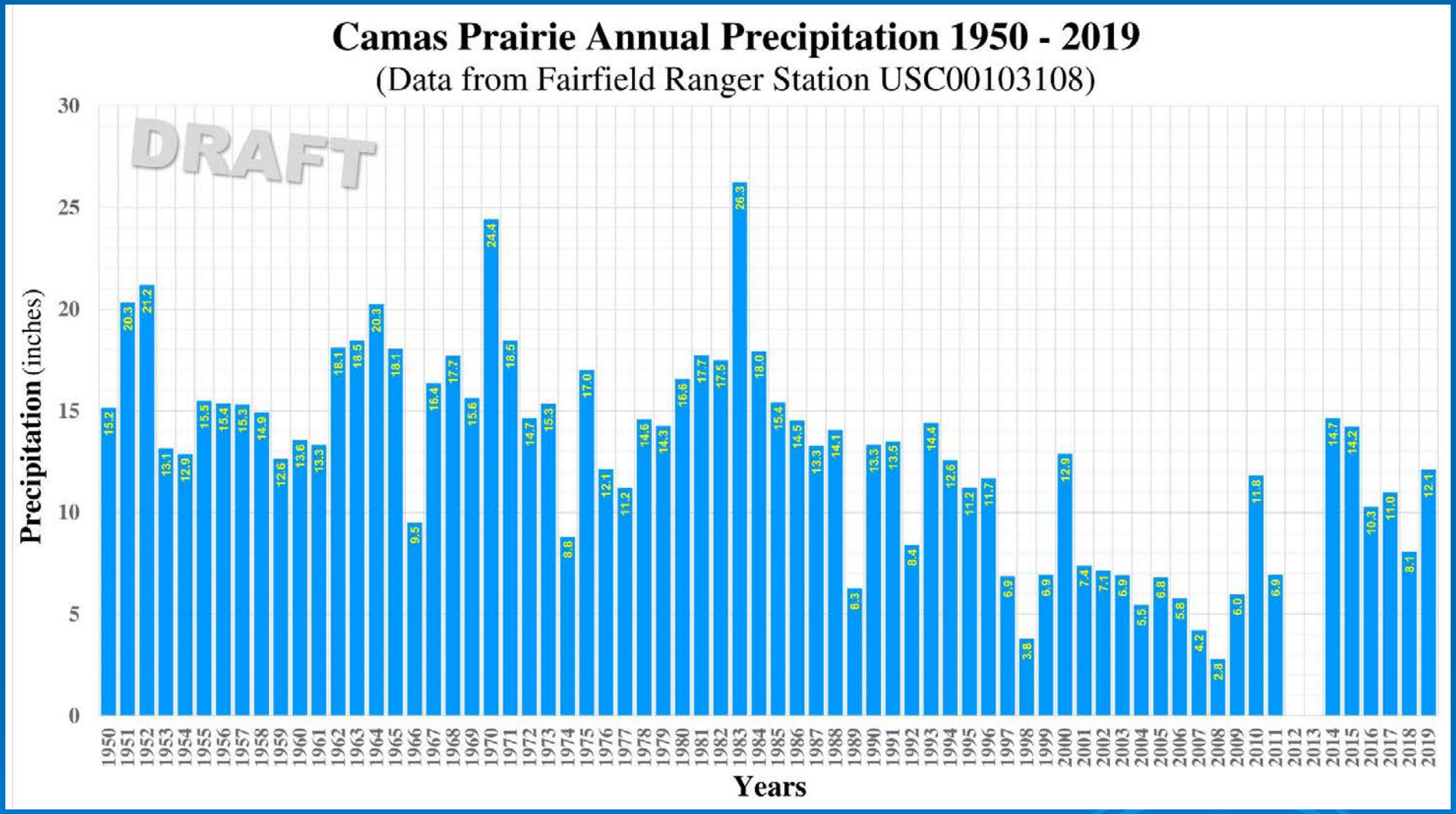

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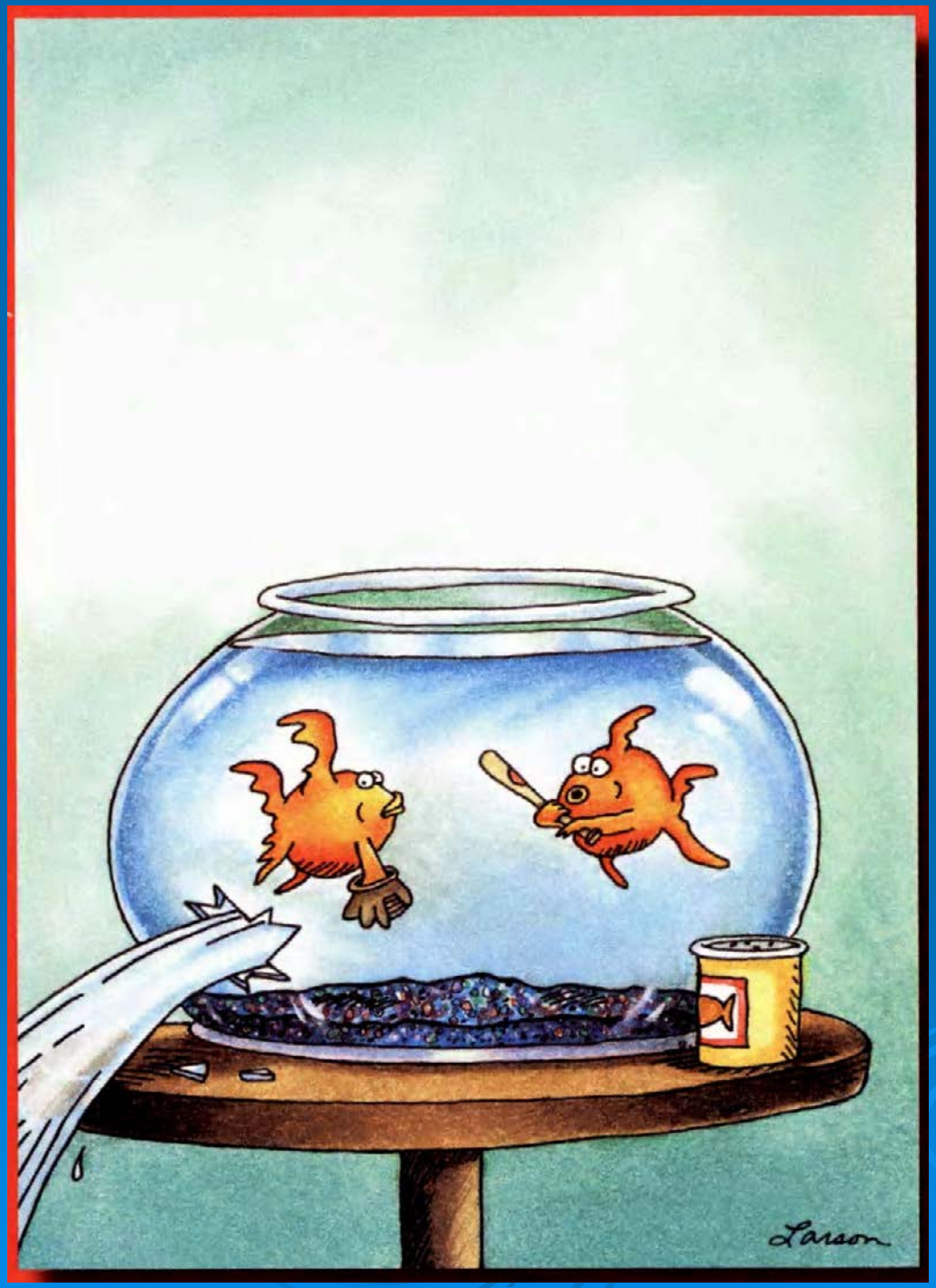
Preliminary Recommendations

1. Fund/commence the ground water studies outlined by the Camas Ground Water Group seeking IDWR research grant funding in 2018

2. Drill, construct, and measure specially designed long-term monitor wells at key locations for needed gradient and potentiometric data

3. Fully investigate and measure the residual stream flows in lower Willow and Camas Creeks during low flow months as to source

4. Fully investigate the hydrogeologic circumstances and physical controls on the remaining pool in Magic Reservoir when empty


Larson