

ASR Applications and Permit Modification Proposal

Drought Resiliency

- ASR Recharge and Recovery Well Applications
- Modification of ASR Minimum Index Levels
 - Current elevations strand recharge credits during extended drought
 - Proposed adjustments and methods used
- Aquifer Maintenance Credits (AMCs)
 - Focus on maintaining the aquifer full during periods of limited physical recharge capacity
 - Utilize Little Arkansas River rather than Equus Beds

Drought Resiliency

- Planning for 1% drought in the future (2060)
- 1% Drought approximated by 1933-1940 conditions

Table 2-3: MODSIM-DSS simulation results for the 1% drought utilizing projected 2060 demands

MODSIM-DSS Variable	Drought Year 1	Drought Year 2	Drought Year 3	Drought Year 4	Drought Year 5	Drought Year 6	Drought Year 7	Drought Year 8
Baseline City Demand (AF)	81,690	81,690	81,690	81,690	81,690	81,690	81,690	81,690
Simulated Calendar Year of Drought	1933	1934	1935	1936	1937	1938	1939	1940
Revised City Demand from Drought Response Plan (AF)	81,262	72,492	71,116	71,890	70,812	70,811	71,116	70,664
City Demand Assigned to EBWF & ASR	34,202	45,651	59,907	46,732	56,579	41,980	39,308	39,491
City Demand Assigned to Cheney Reservoir	47,060	26,841	11,209	25,158	14,233	28,831	31,808	31,173
Cheney % of Conservation Pool 12 Month Average	110%	92%	62%	59%	62%	53%	53%	63%

Modification of ASR Minimum Index Levels

- Minimum Index Levels set lowest groundwater elevation at which recharge credits can be recovered (currently 1993 observed water levels)
- City has utilized groundwater modeling to simulate the effects of projected drought demands on the aquifer
 - Groundwater model developed by USGS
 - Same groundwater model utilized for ASR Accounting
- Groundwater Model results indicate current Minimum Index Level will strand recharge credits during drought

Modification of ASR Minimum Index Levels

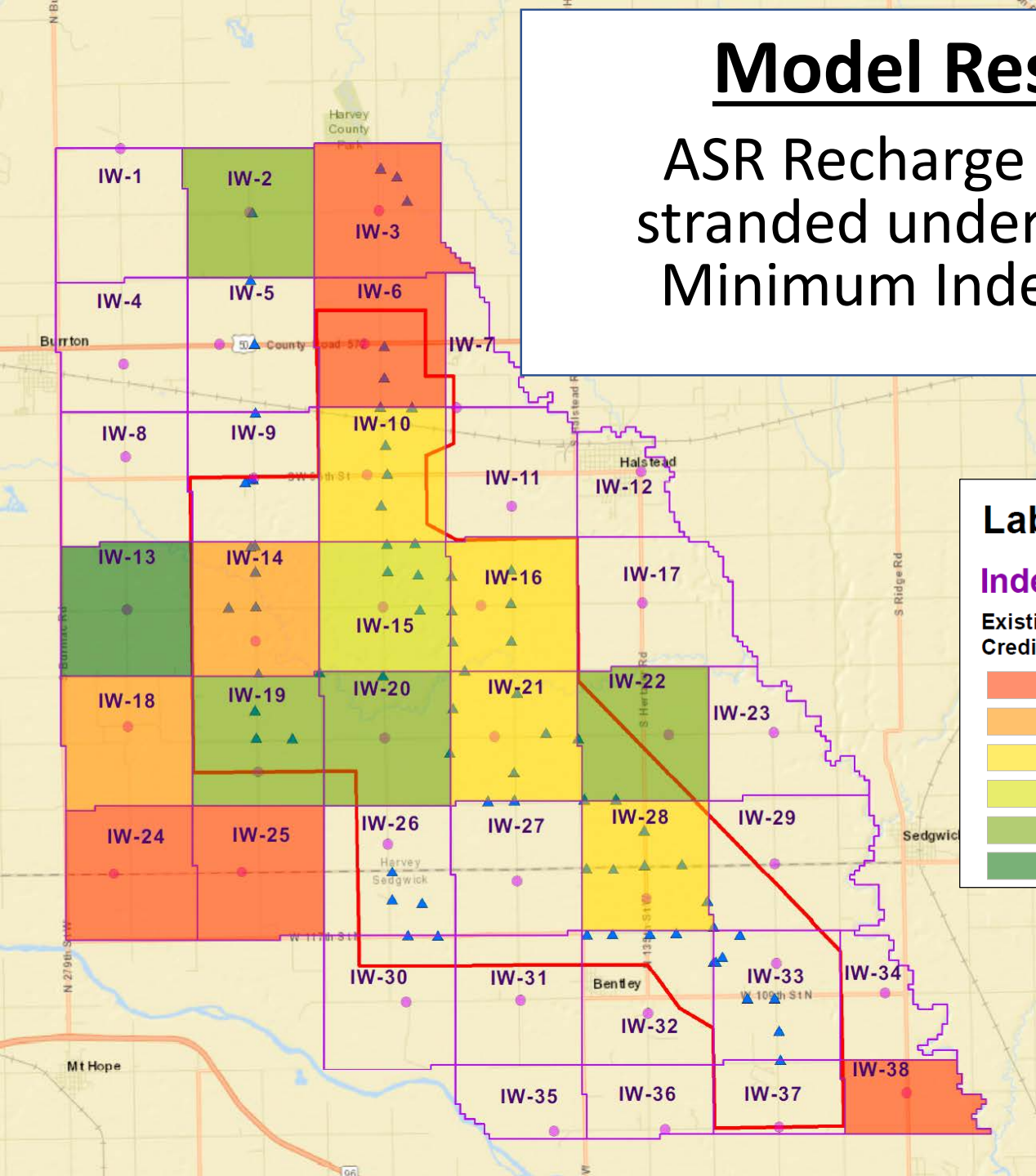
- Starting Conditions ~94% full aquifer
- End of simulated 1% drought ~89%

Table 2-9: Groundwater Modeling Results for 1% Drought Simulation

EBGWM 1% Drought Simulation Statistics	Drought Years								Recovery Years	
	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10
ASR BSA avg Water Level Change from Starting Conditions (ft)	-1.8	-3.4	-5.2	-6.1	-7.3	-7.7	-7.9	-8.2	-6.1	-4.6
CWSA avg Water Level Change from Starting Conditions (ft)	-2.1	-4.4	-7.7	-8.9	-11.0	-11.2	-11.4	-11.6	-8.6	-6.3
ASR BSA Aquifer Condition (% Full)	93%	92%	91%	90%	90%	90%	90%	89%	91%	91%
CWSA Aquifer Condition (% Full)	90%	89%	87%	87%	86%	86%	86%	86%	87%	88%

Model Results

ASR Recharge Credits
stranded under current
Minimum Index Level



Labeling Legend

Index Well Name (IW-#)

Existing ASR Minimum Index Levels
Credit Recovery Restrictions by Drought Year

- ASR Recharge Credits Unavailable Drought Year 1
- ASR Recharge Credits Unavailable Drought Year 2
- ASR Recharge Credits Unavailable Drought Year 3
- ASR Recharge Credits Unavailable Drought Year 4
- ASR Recharge Credits Unavailable Drought Year 5
- ASR Recharge Credits Unavailable Drought Year 6

Modification of ASR Minimum Index Levels

- City is proposing adjustments to ASR Minimum Index Levels based on groundwater modeling results
- Proposed adjustments correlate to:
 - 83% full conditions across the ASR Basin Storage Area
 - Average aquifer saturated thickness 150 feet
 - Average difference between existing levels and proposed levels is 12.84 feet
- Detailed modeling results are available within the report submitted to DWR

Aquifer Maintenance Credits (AMCs)

- City has constructed ASR Phase I and Phase II
- Utilize water from the Little Arkansas River
 - Physical ASR Recharge (wells and basins)
 - To the City to meet demands
- During full aquifer conditions physical ASR recharge capacity is limited, and aquifer levels have recovered to nearly full conditions
- AMCs – flexibility to maintain the aquifer at optimal levels while still accruing the recharge credits needed for drought

Aquifer Maintenance Credits (AMCs)

- Excess water from Little Arkansas River diversions that cannot be physically recharged through ASR would be sent to the City to meet demands
 - Offsets Equus Beds groundwater that would have been pumped to meet the same City demands
- Physical recharge activities will continue when capacity is available in the aquifer
 - City has submitted an operations plan that establishes physical capacity
 - Based on annual water level measurements reviewed by DWR and GMD

Aquifer Maintenance Credits (AMCs)

- Example 1
 - ASR Water Treatment Plant Running - 15MGD
 - ASR Physical Recharge Capacity – 10 MGD
 - LAR water sent to City main treatment – 5MGD
 - Max amount considered for AMC – 5MGD
- Example 2
 - ASR Water Treatment Plant Running - 15MGD
 - ASR Physical Recharge Capacity – 15 MGD
 - LAR water sent to City main treatment – 0 MGD
 - Max amount considered for AMC – None

Aquifer Maintenance Credits (AMCs)

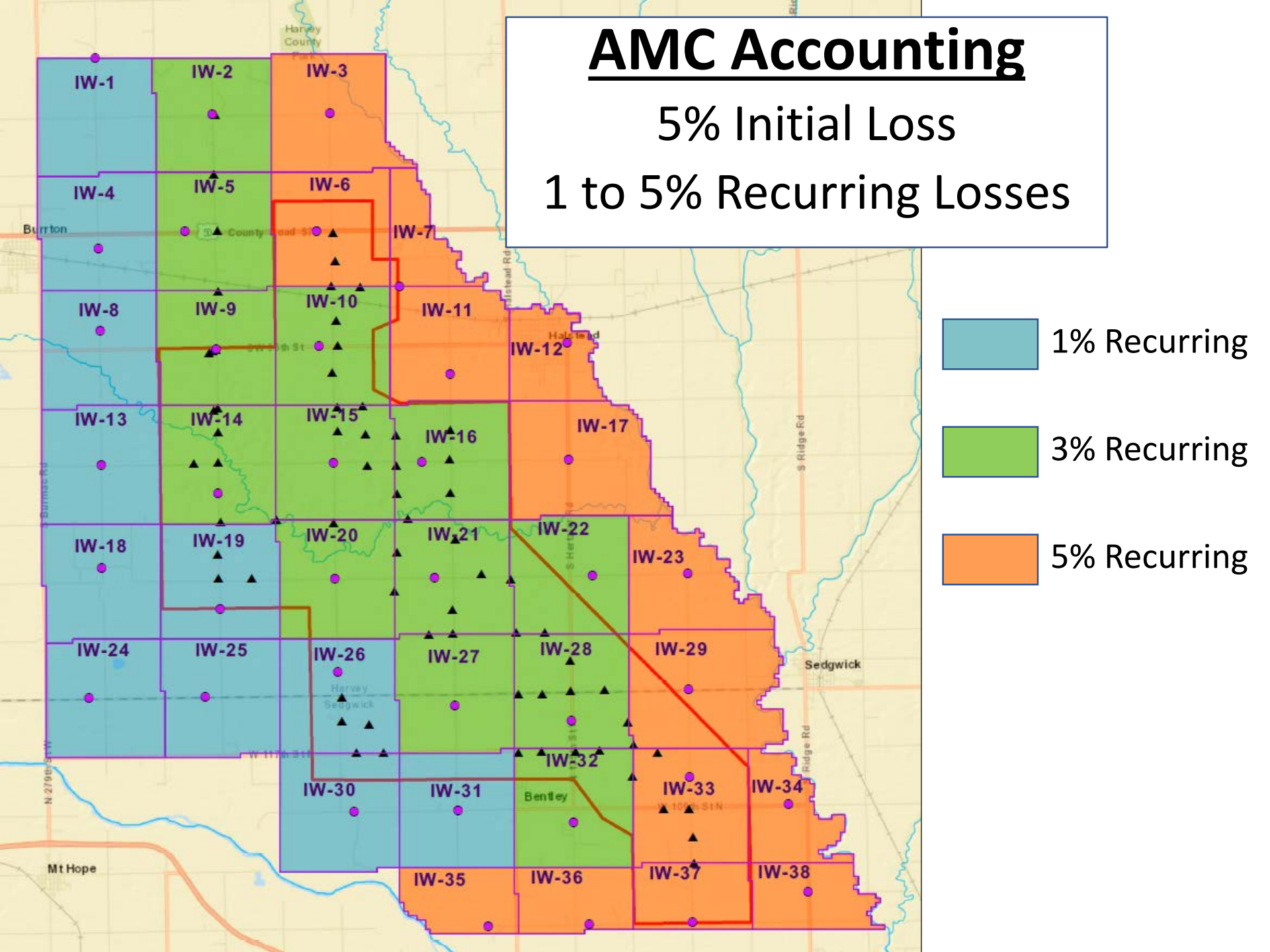
AMC Accounting Process

- Physical recharge credits are tracked through an annual groundwater model and accounting report
- Similar to physical recharge credits AMCs would undergo an annual accounting process
- Need to track the accumulation of credits, use of credits, and loss of credits as water migrates
- Proposed AMC Accounting process:
 - Based off of review of physical recharge accounting process and groundwater modeling
 - Uniform Distribution
 - Initial 5% loss
 - 1 to 5% gradational recurring loss

AMC Accounting

5% Initial Loss

1 to 5% Recurring Losses



Aquifer Maintenance Credits (AMCs)

