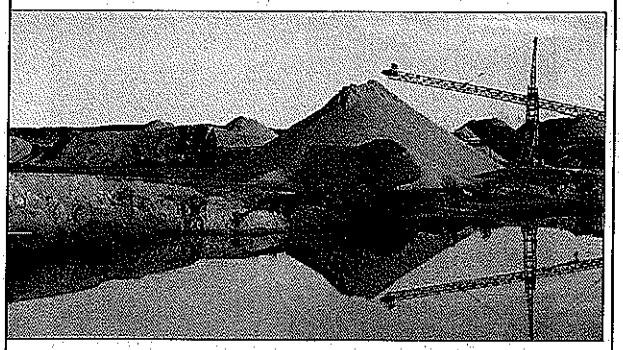
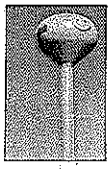
Iowa's Water Resources

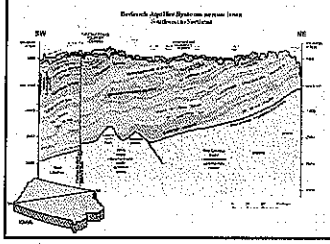


Bob Libra – Iowa DNR – Geological Survey

Water-Key Resource for a Sustainable Economy

- What Are Our Water Resources?
- How Much Water Do We Have?
- How Much Water Do We Use?
- Who Gets it and How?



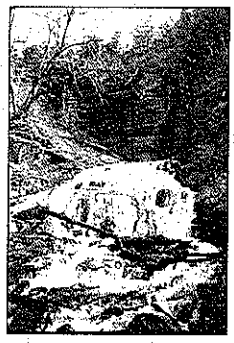


Kinds of Water Sources

surface water

Wapsipinicon River Linn Co.

ground water



Dunnings Spring
Winneshiek Co.

Groundwater

Fills the spaces in porous earth materials.

Water Table

Marks the top of water-saturated earth materials. Seen as lakes and streams on the land surface.

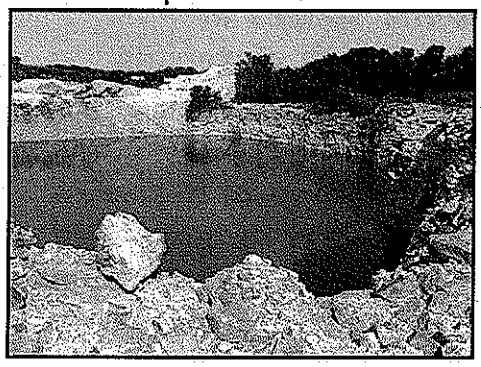
surface expression of water table

Des Moines River Van Buren Co.

surface expression of water table

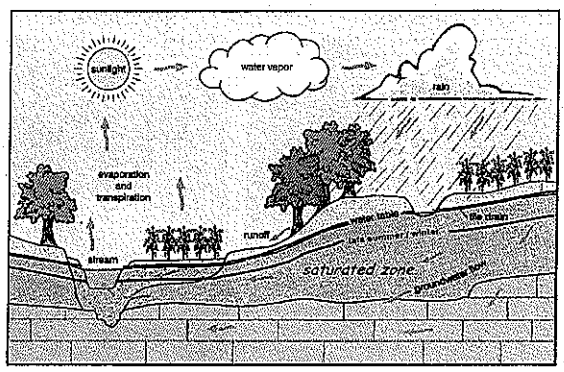
kettle lakes Polo Alto Co.

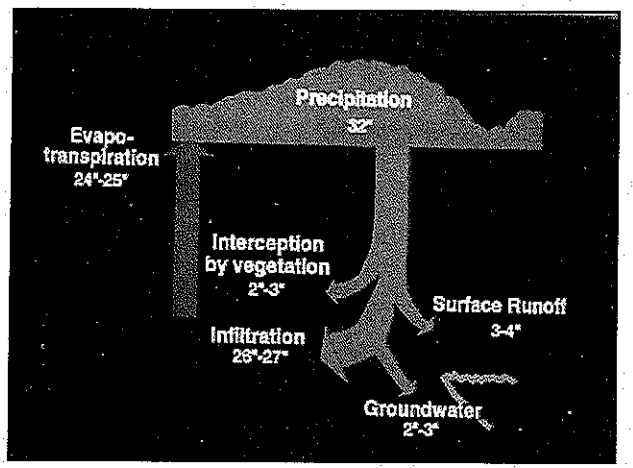
surface expression of water table



Nelson Quarry, Des Moines Co.

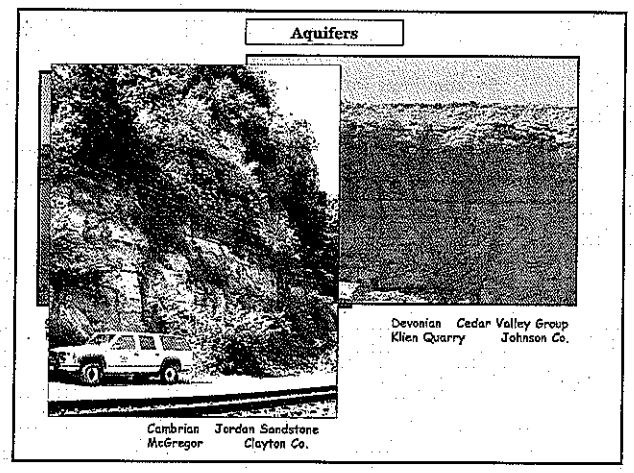
THE HYDROLOGIC CYCLE

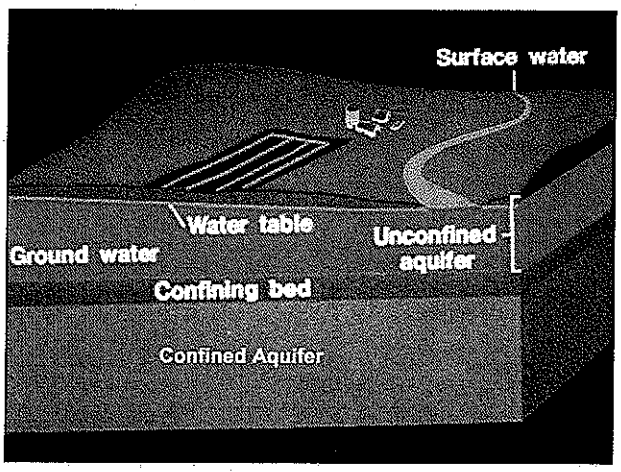




Aquifer
Zone or strata of porous earth material that yields enough water to supply wells and springs.

Confining layer
Dense, compact earth material that blocks the easy passage of water.





How Much Water Do We Have?

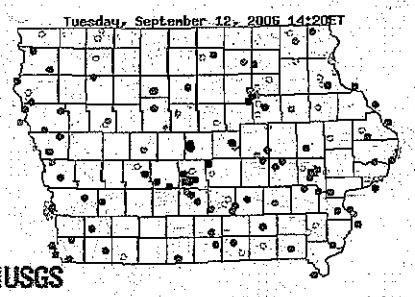
It Depends……

--It depends on where you are.

--It depends on when you need it.

--It depends on what quality you need.

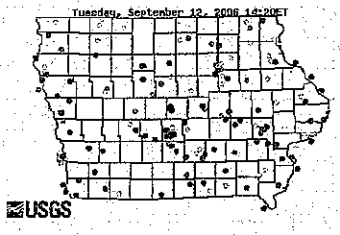
How Much Surface Water: Flow Volumes are Measured At Stream Gages



Quality Assessed at many Gages as well.

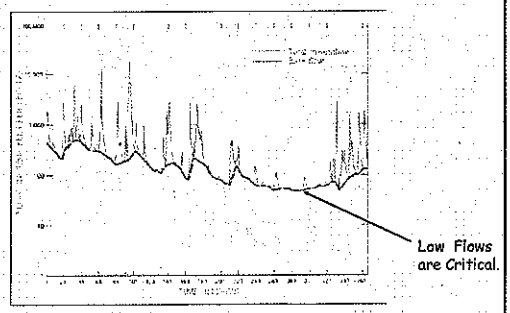
Measurements Paid for by a Variety of Entities for a Variety of Reasons

- ~ 56,000 sq miles, ~ 72,000 Miles of Streams, ~ 130 gages
- DNR Supports ~ 25
- Flood Forecasting
- Wastewater Load Allocations
- Water Quality Assessments
- And others….including Water Supply Allocation
- Additional Gages Needed for Water Allocation

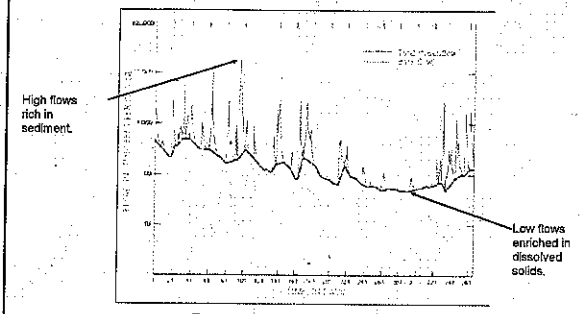


Gages Are Essential:

Stream Flow Rates are Highly Variable

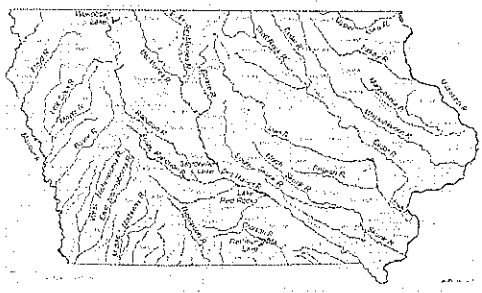


Water Quality Varies with Flow Rates



Temperature varies with flow and seasonally

Lower Reaches of Major Rivers will have the Highest Sustained Flows



Are Storage Reservoirs Needed? Where can they be built?

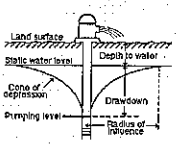
Groundwater is below us everywhere, but…

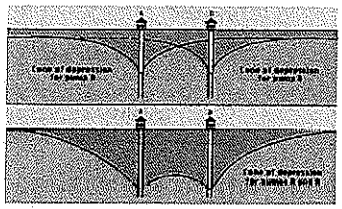
- **Quantity**--Is there "enough" for our purpose?
  --Will it impact other users?
- **Quality**--Is it "good enough"?
- **Sustainability**--Is it dependable for the long haul?
  --Will there be "enough" in the future?

Groundwater Quantity—Well Yields

How much can the aquifer supply?

Will that withdrawal of water impact other wells?





What do we know about aquifer yields and well interference?

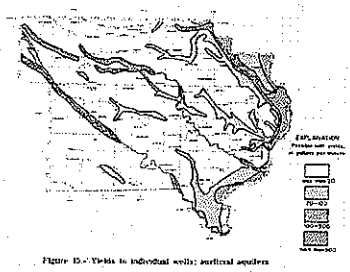


Figure 15.--Yields to individual wells; surficial aquifers

A fair amount, but aquifer studies are well out of date

Major Aquifer Characterization Studies Date from the Mid-'60s to mid-'80s

- Major Data Compilation Needed
- Allows for Improved Methods for Modeling and Predictive Capabilities

THE WATER STORY IN CENTRAL IOWA

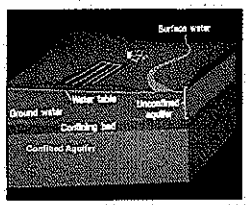
Groundwater Quality -- Is it good enough for:

- Human Consumption?
- Livestock Watering?
- Boilers/Cooling Water?
- Industrial Processes?
- Irrigation?
- Discharge?

Quality affected by both natural constituents and "contaminants".

Decent database on GW Quality--Analysis of Data Needed

Is it Sustainable for the Long Term?



Water Table (Unconfined) Aquifers

- Readily replenished and drained
- Susceptible to Drought - periodically not sustainable

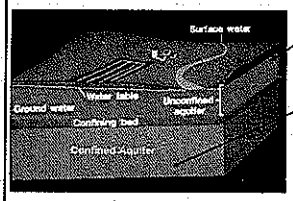
Confined Aquifers

- Not readily replenished or drained
- Water can be thought of as "in storage"
- Drought Resistant
- Over-use = "Groundwater Mining" = not sustainable

Is it Sustainable for the Long Term?

Water Table Aquifers – Think Checking Account
- Streams are part of this account

Confined Aquifers – Think One-Time Windfall Investment

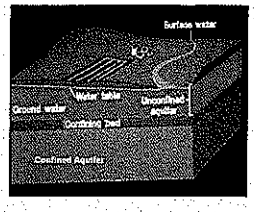


Checking - Not much stored their, it goes fast, but OK if the paychecks keeps coming.

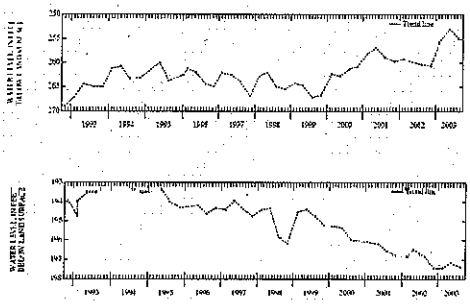
Investment - Plenty stored there, but once withdrawn, it will be replaced slowly.

Is it Sustainable for the Long Term?

- Sustainability Assessments Largely Lacking.
- Information needed on GW Recharge Rates.
- Drought Known to Affect Water Table Aquifers and Streamflows.
- Declines in Confined Aquifers are Known in a Variety of Locales.
- Deep Jordan Aquifer—Regional Declines of about 3 feet/year but Varying Locally with Use.
- Groundwater Level Monitoring is Analog to Stream Gauging -- Discontinued in 2004.

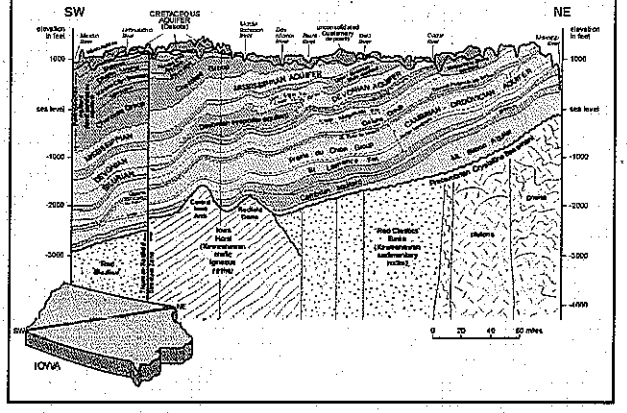


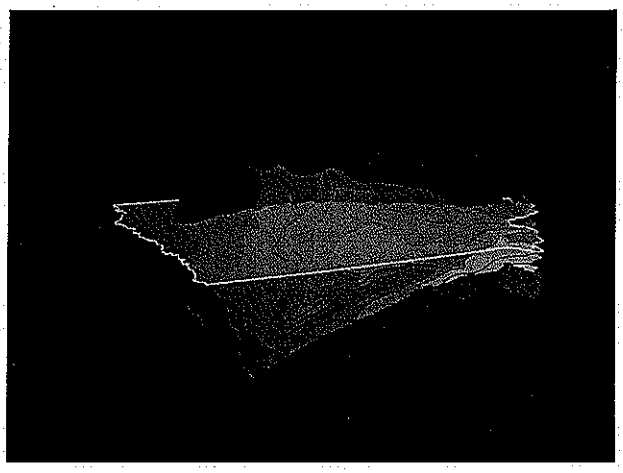
Water Level Monitoring Essential to Assess Trends For Good Decisions



Bedrock Aquifer Systems across Iowa

Southwest to Northeast





How Much Water Do We Use?

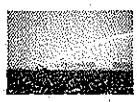
- Consumed vs. Withdrawn
- Consumptive Use is the water that is evaporated, transpired, or incorporated into a product. Water that is not returned to a source that can readily be used again. Typically discharged to a stream.
- Withdrawn means how much is actually removed from a stream or aquifer.
- Total maximum permitted withdrawals are known, but estimates by source are over 10 years out of date.
- Actual withdrawals by source not adequately tracked.

Water Withdrawals in Iowa

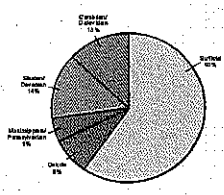
(Millions of gallons/day)

Purpose	GW	SW	Total
Livestock	82	27	109
Commercial	18	25	43
Domestic	45	0	45
Industrial	74	184	258
Irrigation	35	4	39
Mining	1	42	43
Power Generation	15	2110	2125
Public Water Supplies	257	116	373
Total	528	2510	3038

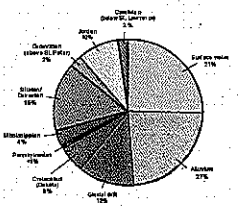
Estimates are From USGS, 1995.



GW Withdrawals By Source Aquifer



Drinking Water By Source



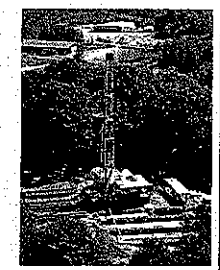
1995 Estimates

How Do We Allocate Water?

IA Code -- All waters are "public waters and public wealth" of Iowa citizens. Iowa statute provides an allocation system based on "beneficial use". Waste, unreasonable use, and unreasonable methods of water use are prevented.

Permit System -- Withdrawals in excess of 25,000 gallons/day (from streams or aquifers) require a permit from the state.

Permit Reviews and Evaluations - Cursory in many cases. Are we getting it right for the long term?



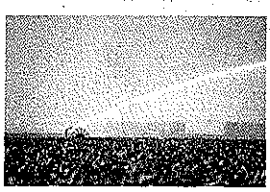
Who Gets It? From 1985 Water Plan:

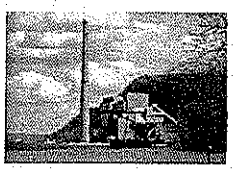
- Permitting and Drought Allocation Priorities -

1. **Self-supplied domestic:** non-regulated, self-supplied withdrawals with limited ability to seek water elsewhere.
2. **Domestic fraction of regional rural water and municipal systems:** water for the preservation of human life and welfare.
3. **Livestock:** water for the preservation of animal life.
4. **Power:** water used incidental to the generation of power.
5. **Industrial:** water used by commercial and industrial facilities.
6. **Non-traditional irrigation:** water for fruit, vegetables and other newly introduced crops.
7. **Irrigation of traditional Iowa crops:** water for soybeans, corn, alfalfa and others.
8. **Recreation and leisure:** water for lawn and golf course watering, car washing and other incidental uses.
9. **Out of state export:** water exported to another state for use.

Developing Issues--Water Supply

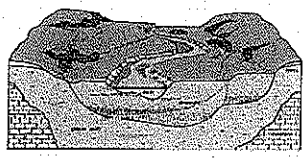
- Energy - Water Connections
- Concentration of Water Demand
- Sustainable Allocations
- Water and Climate
- Water Resource Management Program Needs

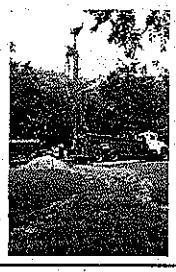




Energy and Water

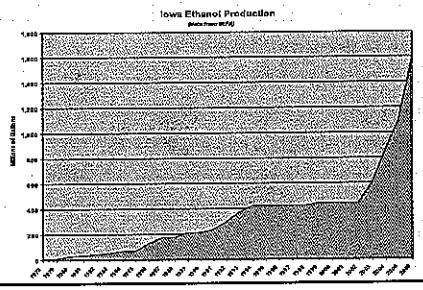
- Traditionally Cooling Water for Power Plants, Supplied by Surface Water
- Growing Demands for Ethanol and Geothermal, Supplied by Groundwater
- High Energy Prices Will Impact Water Demand in Ways we don't Fully Appreciate.





Ethanol Production

- Current Capacity ~1.6B gallons/year, ~1.4B "in construction", ~2.0B "planned"
- ~ 4 Gallons Water per Gallon Ethanol
- Development breeds development: Ethanol plants + Cattle operations + ?
- Today, a small part of groundwater demand, but a growing one:

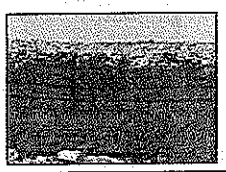


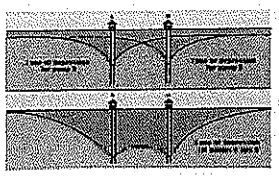
Ethanol and other Energy-Related Water Demands won't "Dry Up" the State --

-- But they are Raising Questions Regarding Sustainability and Our Water Management System.

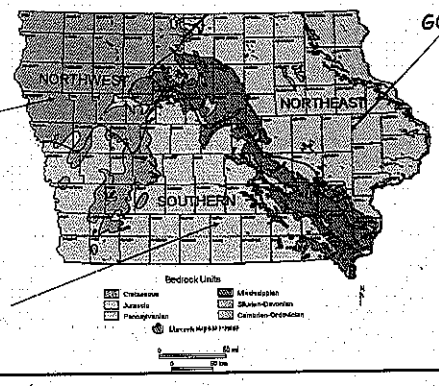
Concentration of Water Demand

- Ethanol is a concentrated demand—large volumes needed locally, potentially attracting livestock and other water users.
- We have seen a concentration in "People" in larger cities and surrounding areas, and a resulting concentration in industrial and other users.
- We have undergone a concentration in the Livestock Industry.
- We have seen an expansion is water use by Rural Water Systems, again concentrating demand from a source.





Groundwater Supply and Demand are *not* Equally Distributed

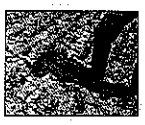


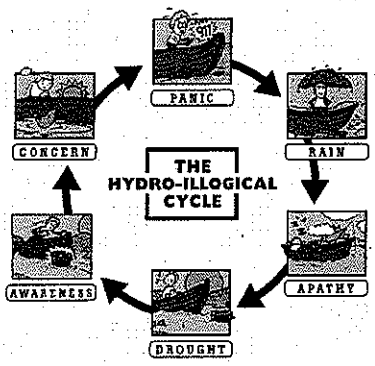
Climate Change – Implications for Our Water Resources?

--Questions about what it means in the middle of the continent.

--Wetter.....Drier.....Warmer.....Colder?

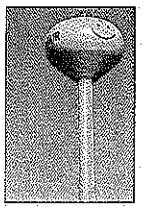
--And what that means regarding future water supplies.





Water Management-What's Needed to Do It Right

- Updated Assessment of Current Demand:
  -- Last Major Use Assessments, by Aquifer and Watershed, in 1995.
- Resume and Enhance Groundwater Level Monitoring:
  -- Regional Aquifer Trends and Local Hotspots.
- Add and Maintain Additional Stream Gages:
  -- Gages needed for accurate surface water allocation, reservoir studies.
- Updated Assessments of Aquifers—Geologic and Hydrologic Properties:
  -- Last Major Efforts in the 1960's - 1980's.
- Upgraded Assessment Techniques:
  -- Need to Utilize Modern Modeling and Predictive Analysis.
- More Thorough Hydrogeologic Reviews of Permits:
  -- Well/Stream Interference and Sustainability Questions. Assistance in Drought and Conservation Planning for Water Supplies.
- Update the State Water Plan—The Road Map for Water Use:
  -- Last update in 1985. Do our rules, regs, approaches need rethinking?



Water is a key *Liquid Asset* for Iowa

Lets make sure it continues to be.

Questions?

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http://www.igsb.uiowa.edu/

Comparison of Water Resource Management Programs

Program Elements	Current Effort	Permitting Enhancement	Resource Management
Permitting			
Permit applications get cursory review; few get detailed review using hydrogeology data, Iowa Geological Survey reviewers	X	X	
Detailed review for all applications; additional support from IGS		X	X
Comprehensive hydrogeologic review and GW modeling			X
Median turnaround time 65 days	X		
Median turnaround time 45 days		X	X
Data Management			
Limited permit info in database; enter record data received	X		
Improved database and tracking		X	X
Comprehensive database and data analysis			X
Compliance			
Reservoir voluntary compliance with reporting requirements	X		
Tracking to improve compliance of reporting requirements		X	X
Individual compliance assistance for restriction requirements			X
Investigate interference complaints and low stream conditions			X
Long Iowa conservation class renewal, no follow up	X		
Technical assistance for permittees to write plans		X	X
Resource Monitoring			
Outdated low flow stream protection criteria	X		
Updated low flow stream protection criteria		X	X
Decreasing number of stream gauging stations	X		
Maintain current gauging stations		X	X
Comprehensive network of gauging stations			X
No groundwater level monitoring (terminated in 2004)	X		
Minimal GW level monitoring network		X	X
Statewide GW level monitoring network			X
Planning			
State Water Plan revised in 1987	X		
Revise State Water Plan every 5 years		X	X
Resource Characterization			
Analysis required by applicant in extreme cases	X		
Detailed analysis of the most critical aquifers		X	X
Comprehensive aquifer assessments by IGS/USGS			X
GW modeling of most critical aquifers			X
FTEs			
Permitting	2.75	3	6
Field Offices			3
IGS		2	6
Program support			1
Contracts		$150,000	$355,000
Total Annual Costs	$255,000	$600,000	$1.45 million

Comparison of Water Resource Management Programs

1/24/2007

Program Element	Current Effort	Permitting Enhancement	Resource Management
Permitting			
Permit applications get cursory review; few get detailed review using hydrogeology data; Iowa Geological Survey review rare	X		
Detailed review for all applications; additional support from IGS		X	X
Comprehensive hydrogeologic review and GW modeling			X
Median turnaround time 65 days	X		
Median turnaround time 45 days		X	X
Data Management			
Limited permit info in database; enter report data received	X		
Improved database and tracking		X	X
Comprehensive database and data analysis			X
Compliance			
Encourage voluntary compliance with reporting requirements	X		
Tracking to improve compliance of reporting requirements		X	X
Individual compliance assistance for reporting requirements			X
Investigate interference complaints and low stream conditions			X
Long term conservation plans required, no follow up	X		
Technical assistance for permittees to write plans		X	X
Resource Monitoring			
Outdated low flow stream protection criteria	X		
Updated low flow stream protection criteria		X	X
Decreasing number of stream gauging stations	X		
Maintain current gauging stations		X	X
Comprehensive network of gauging stations			X
No groundwater level monitoring (terminated in 2004)	X		
Minimal GW level monitoring network		X	X
Statewide GW level monitoring network			X
Planning			
State Water Plan revised in 1987	X		
Revise State Water Plan every 5 years		X	X
Resource Characterization			
Analysis required by applicant in extreme cases	X		
Detailed analysis of the most critical aquifers		X	X
Comprehensive aquifer assessments by IGS/USGS			X
GW modeling of most critical aquifers			X
FTEs			
Permitting	2.75	3	6
Field Offices			3
IGS		2	6
Program support			1
Contracts		$150,000	$325,000
Total Annual Costs	**$255,000**	**$600,000**	**$1.65 million**

Comparison of Water Resource Management Programs

1/24/2007

All Permits

	Permits		Allocation		
Permit Type	Number	% of Ttl	MGY	Ave/Permit	% of Ttl
PWS GW	662	21%	155,609	235	7%
PWS SW	28	1%	72,326	2,583	3%
RWD GW	19	1%	12,308	648	1%
RWD SW	1	0%	3,250	3,250	0%
Ind GW	174	5%	99,086	569	4%
Ind SW	419	13%	1,835,668	4,402	80%
AFO GW	116	4%	3,459	30	0%
AFO SW	9	0%	880	98	0%
Irrigation GW	1295	41%	93,647	72	4%
Irrigation SW	242	8%	15,984	66	1%
Golf GW	155	5%	4,708	30	0%
Golf SW	62	2%	1,560	25	0%
Total	**3182**	**100%**	**2,298,485**		**100%**

GW Only

	Permits		Allocation		
Permit Type	Number	% of Ttl	MGY	Ave/Permit	% of Ttl
PWS GW	662	27%	155,609	235	42%
RWD GW	19	1%	12,308	648	3%
Ind GW	174	7%	99,086	569	27%
AFO GW	116	5%	3,459	30	1%
Irrigation GW	1295	53%	93,647	72	25%
Golf GW	155	6%	4,708	30	1%
Total	**2421**	**100%**	**368,817**		**100%**

SW Only

	Permits		Allocation		
Permit Type	Number	% of Ttl	MGY	Ave/Permit	% of Ttl
PWS SW	28	4%	72,326	2583	4%
RWD SW	1	0%	3,250	3250	0%
Ind SW	419	55%	1,835,668	4381	95%
AFO SW	9	1%	880	98	0%
Irrigation SW	242	32%	15,984	66	1%
Golf SW	62	8%	1,560	25	0%
Total	**761**	**100%**	**1,929,667**	2536	100%