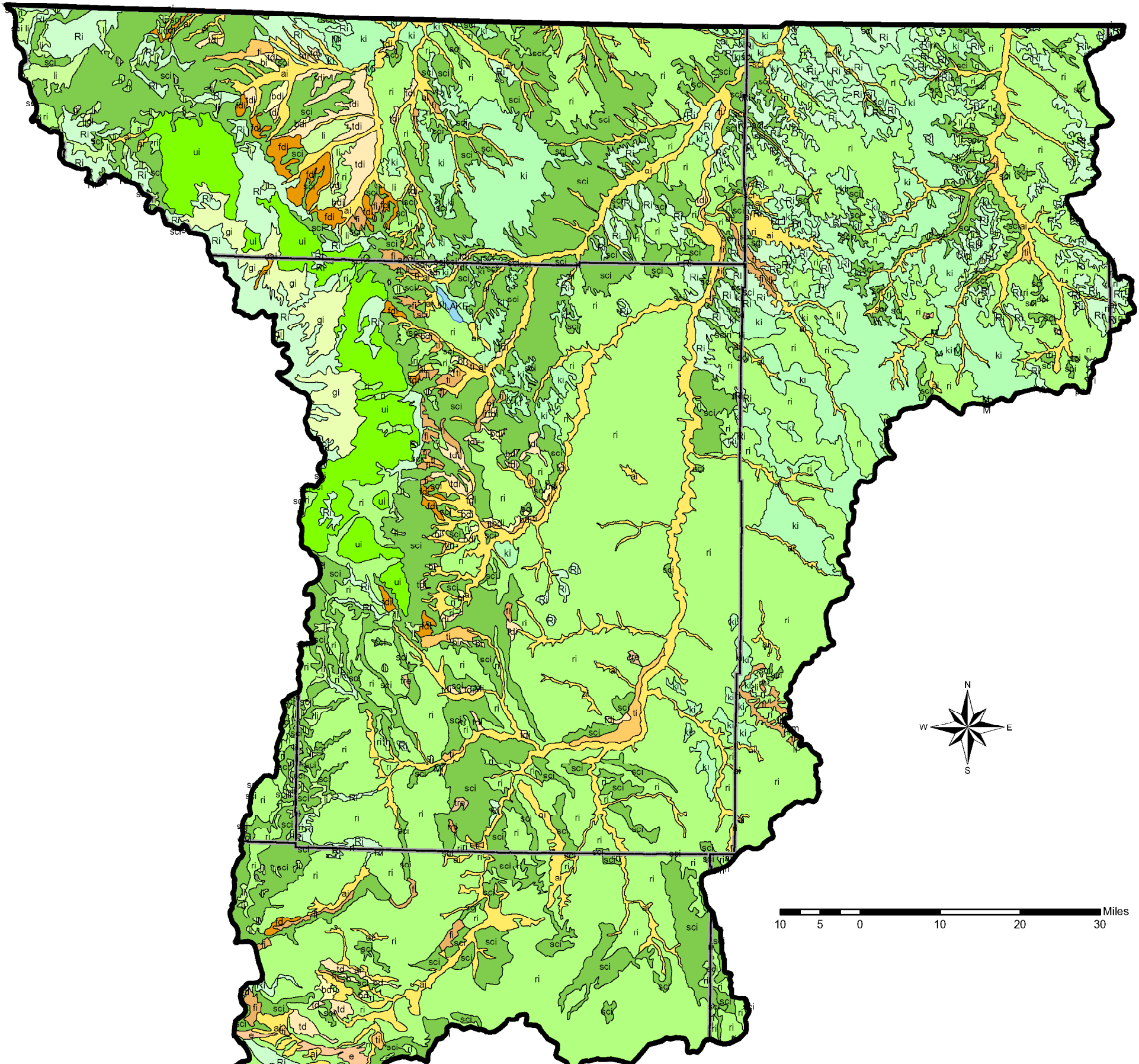



















APPENDIX B

**Geology and Ground Water Use Plates,
Powder/Tongue River Basin Plan Area**



Legend

	Lake Body of Water		ei Eolian Deposits
	ai Alluvium		oai Glacial Outwash and Alluvium
	bi Bench Deposits		gi Glacial Deposits
	bdi Dissected Bench Deposits		li Landslide
	tdi Dissected Terrace Deposits		pea Playa Deposits
	ti Terrace Deposits		sci Slopewash and Colluvium
	tre Shallow Terrace Deposits		ri Residuum
	fi Alluvial Fan and Gradational Fan Deposits		ui Grus
	fdi Dissected Alluvial Fan and Gradational Fan Deposits		Ri Bedrock and Glaciated Bedrock
	mi Mesa		Mi Mined Areas
			ki Clinker

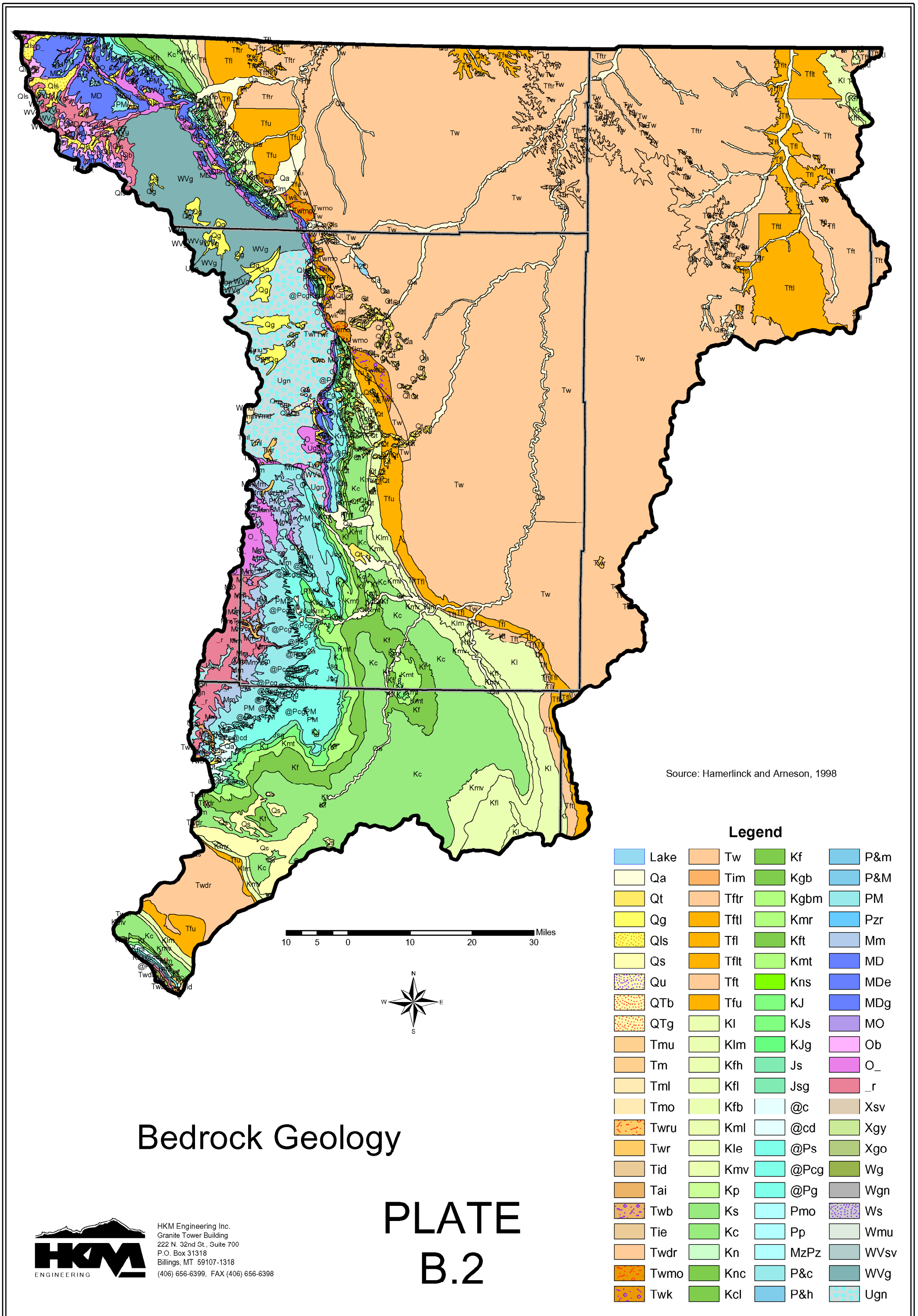
Source: Hamerlinck and Arneson, 1998

Surficial Geology



HKM Engineering Inc.
 Granite Tower Building
 222 N. 32nd St., Suite 700
 P.O. Box 31318
 Billings, MT 59107-1318
 (406) 656-6399, FAX (406) 656-6398

PLATE B.1



Source: Hamerlinck and Arneson, 1998

Bedrock Geology

PLATE B.2



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 P.O. Box 31318
 Billings, MT 59107-1318
 (406) 656-6399, FAX (406) 656-6398

	Lake	Bodies of Water		Kf	Frontier Formation
	Qa	Alluvium and Colluvium		Kgb	Greenhorn Formation and Belle Fourche Shale
	Qt	Gravel, Pediment, and Fan Deposits		Kgbm	Greenhorn Formation and Belle Fourche and Mowry Shales
	Qg	Glacial Deposits		Kmr	Mowry Shale
	Qls	Landslide Deposits		Kft	Frontier Formation and Mowry and Thermopolis Shales
	Qs	Dune Sand and Loess		Kmt	Mowry and Thermopolis Shales
	Qu	Undivided Surficial Deposits		Kns	Newcastle Sandstone and Skull Creek Shale
	QTb	Bug Formation (Pleistocene or Pliocene)		KJ	Cloverly Formation (Hartville Uplift) or Inyan Kara Group (Black Hills) and Morrison Formation
	QTg	Terrace Gravel (Leistocene and / or Pliocene)		KJs	Cloverly, Morrison, and Sundance Formations
	Tmu	Upper Miocene Rocks 2		KJg	Cloverly, Morrison, Sundance, and Gypsum Spring Formations
	Tm	Miocene Rocks 2		Js	Sundance Formation
	Tml	Lower Miocene Rocks		Jsg	Sundance and Gypsum Spring Formations
	Tmo	Lower Miocene Rocks and Upper Oligocene Rocks		@c	Chugwater Formation
	Twru	White River Formation: Upper conglomerate member		@cd	Chugwater and Dinwoody Formations
	Twr	White River Formation		@Ps	Spearfish Formation
	Tid	Dacite and Quartz Latite Intrusive and Extrusive Igneous Rocks		@Pcg	Chugwater and Goose Egg Formations
	Tai	Alkalic Intrusive and Extrusive Igneous Rocks		@Pg	Goose Egg Formation
	Twb	Wagon Bed Formation		Pmo	Minnekahta Limestone and Opeche Shale
	Tie	Intrusive and Extrusive Igneous Rocks		Pp	Phosphoria Formation and Related Rocks
	Twdr	Wind River Formation		MzPz	Mesozoic and Paleozoic Rocks
	Twmo	Wasatch Formation: Moncrief Member		P&c	Casper Formation
	Twk	Wasatch Formation: Kingsbury Conglomerate Member		P&h	Hartville Formation
	Tw	Wasatch Formation		P&m	Minnelusa Formation
	Tim	Indian Meadows Formation		P&M	Casper Formation and Madison Limestone
	Tftr	Fort Union Formation: Tongue River Member		PM	Tensleep Sandstone and Amsden Formation
	Tftl	Fort Union Formation: Tongue River and Lebo Members		Pzr	Minnekahta Limestone, Opeche Shale, Minnelusa Formation, Pahasapa and Englewood Limestones, Whitewood Dolomite, and Winnipeg and Deadwood Formations
	Tfl	Fort Union Formation: Lebo Member		Mm	Madison Limestone or Group
	Tflt	Fort Union Formation: Lebo and Tullock Members		MD	Madison Limestone and Darby Formation
	Tft	Fort Union Formation: Tullock Member		MDe	Pahasapa and Englewood Limestones
	Tfu	Fort Union Formation		MDg	Guernsey Formation
	Kl	Lance Formation		MO	Madison Limestone and Bighorn Dolomite
	Klm	Lance Formation, Fox Hills Sandstone, Meeteetse Formation, and Bearpaw and Lewis Shales		Ob	Bighorn Dolomite
	Kfh	Fox Hills Sandstone		O_	Whitewood Dolomite and Winnipeg and Deadwood Formations
	Kfl	Fox Hills Sandstone and Lewis Shale		_r	Gallatin Limestone, Gros Ventre Formation and Equivalents, and Flathead Sandstone
	Kfb	Fox Hills Sandstone and Bearpaw Shale		Xsv	Metasedimentary and Metavolcanic Rocks
	Kml	Meeteetse Formation and Lewis Shale		Xgy	Granitic Rocks of 1,700-Ma Age Group
	Kle	Lewis Shale		Xgo	Granitic Rocks of 2,000-Ma Age Group
	Kmv	Mesaverde Formation		Wg	Granitic Rocks of 2,600-Ma Age Group
	Kp	Pierre Shale		Wgn	Granite Gneiss
	Ks	Steele Shale		Ws	Metasedimentary Rocks
	Kc	Cody Shale		Wmu	Metamorphosed Mafic and Ultramafic Rocks
	Kn	Niobrara Formation		WVsv	Metasedimentary and Metavolcanic Rocks
	Knc	Niobrara Formation and Carlile Shale		WVg	Plutonic Rocks
	Kcl	Carlile Shale		Ugn	Oldest Gneiss Complex

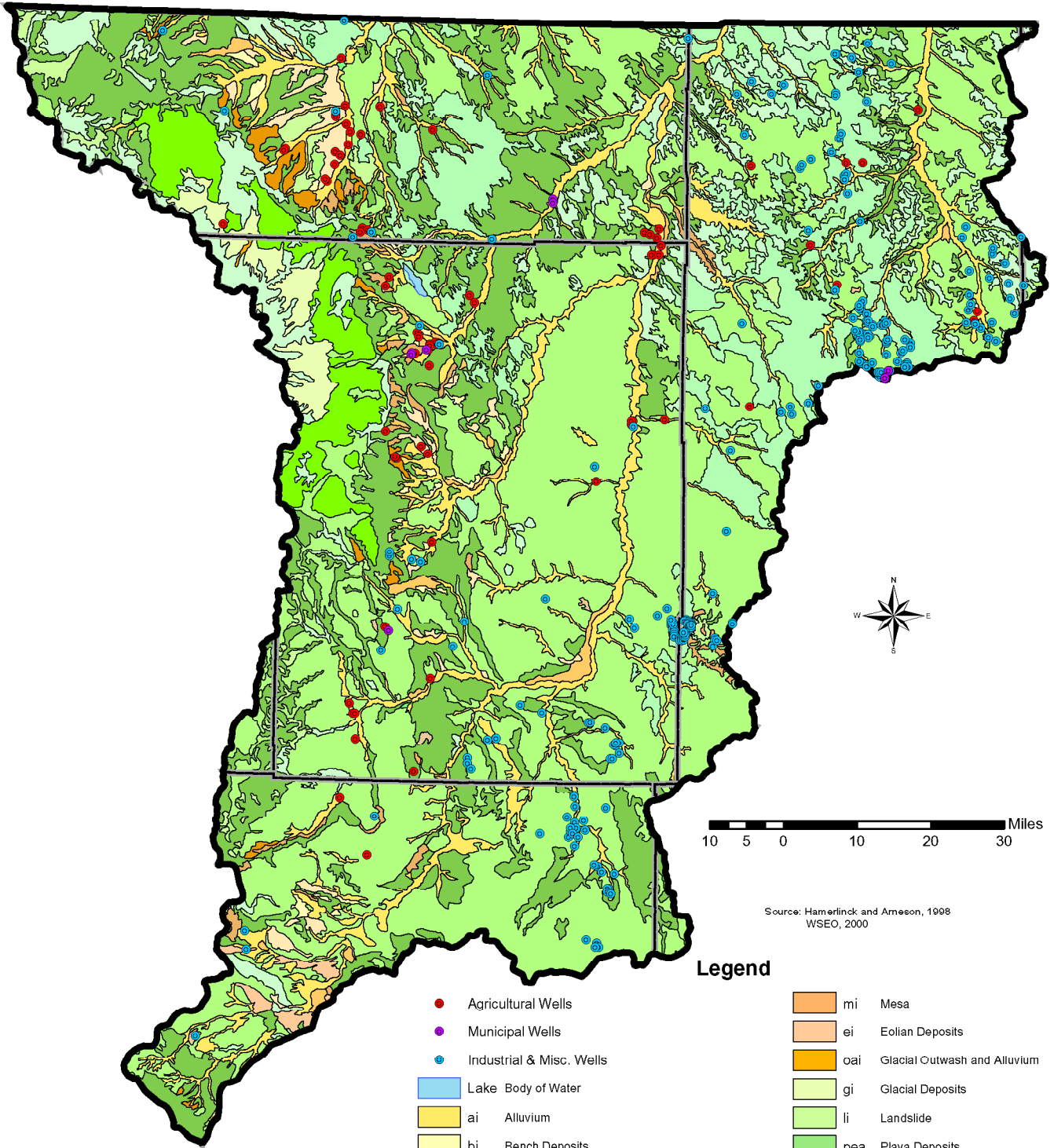
Source: Hamerlinck and Arneson, 1998

Bedrock Geology Detailed Legend



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Granite Tower Building
222 N. 32nd St., Suite 700
P.O. Box 31318
Billings, MT 59107-1318
(406) 656-6399, FAX (406) 656-6398

PLATE B.2.1



Source: Hamerlinck and Ameson, 1998
WSEO, 2000

Legend

- | | |
|---|----------------------------------|
| ● Agricultural Wells | mi Mesa |
| ● Municipal Wells | ei Eolian Deposits |
| ● Industrial & Misc. Wells | oai Glacial Outwash and Alluvium |
| ■ Lake Body of Water | gi Glacial Deposits |
| ■ ai Alluvium | li Landslide |
| ■ bi Bench Deposits | pea Playa Deposits |
| ■ bdi Dissected Bench Deposits | sci Slopewash and Colluvium |
| ■ tdi Dissected Terrace Deposits | ri Residuum |
| ■ ti Terrace Deposits | ui Grus |
| ■ tre Shallow Terrace Deposits | Ri Bedrock and Glaciated Bedrock |
| ■ fi Alluvial Fan and Gradational Fan Deposits | Mi Mined Areas |
| ■ fdi Dissected Alluvial Fan and Gradational Fan Deposits | ki Clinker |

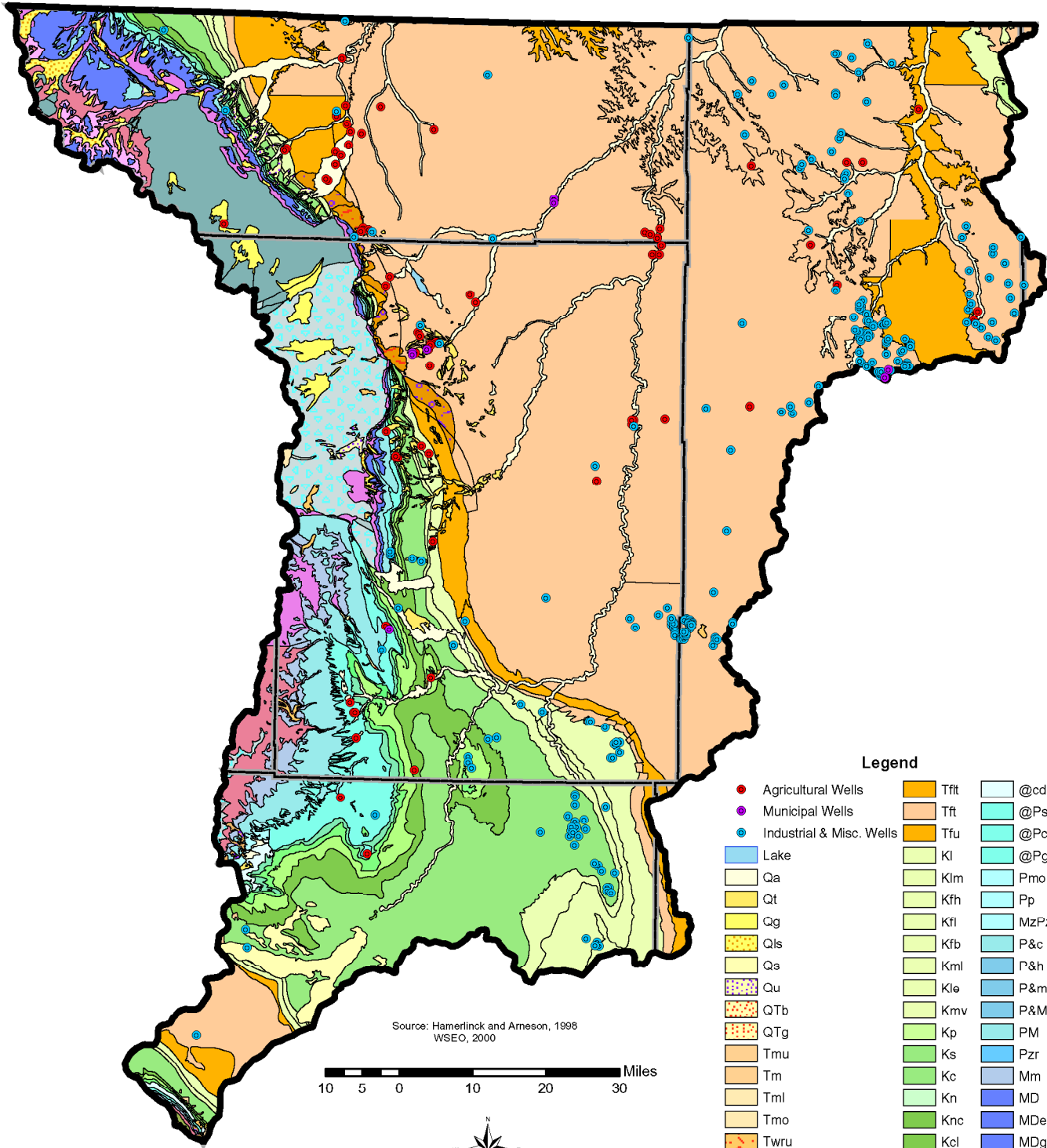
Surficial Geology

with Permitted Active Agricultural, Municipal, Industrial, and
Misc. Wells with Production Rates Greater Than 49 gpm

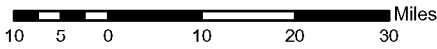


HKM Engineering Inc.
Granite Tower Building
222 N. 2nd St., Suite 700
P.O. Box 31318
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**PLATE
B.3**



Source: Hamerlinck and Arneson, 1998
WSEO, 2000



Legend

● Agricultural Wells	Tft	@cd
● Municipal Wells	Tft	@Ps
● Industrial & Misc. Wells	Tfu	@Pcg
● Lake	Kl	@Pg
Qa	Klm	Pmo
Qt	Kfh	Pp
Qg	Kfi	MzPz
Qls	Kfb	P&c
Qs	Kml	P&h
Qu	Kle	P&m
QTb	Kmv	P&M
QTg	Kp	PM
Tmu	Ks	Pzr
Tm	Kc	Mm
Tml	Kn	MD
Tmo	Knc	MDe
Twru	Kcl	MDg
Twr	Kf	MO
Tid	Kgb	Ob
Tai	Kgbm	O_
Twb	Kmr	_r
Tie	kft	Xsv
Twdr	Kmt	Xgy
Twmo	Kns	Xgo
Twk	KJ	Wg
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Tim	KJg	Ws
Tftr	Js	Wmu
Tftl	Jsg	WVsv
Itl	@c	WVg
		Ugn

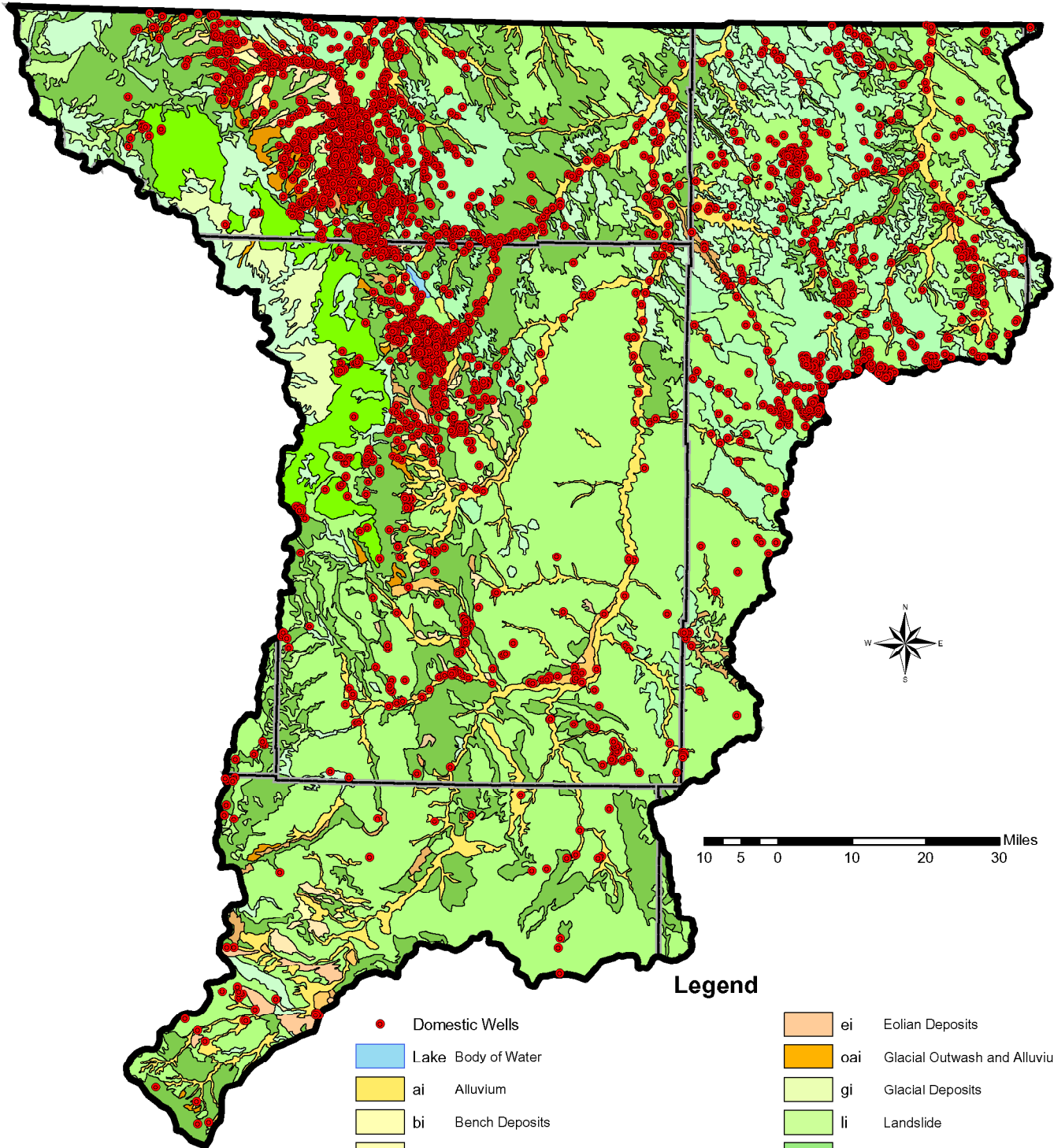
Bedrock Geology

with Permitted Active Agricultural, Municipal, Industrial, and Misc. Wells with Production Rates Greater Than 49 gpm



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222 N. 32nd St., Suite 700
P.O. Box 31318
Billings, MT 59107-1318
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**PLATE
B.4**



Source: Hamerlinck and Ameson, 1998
WSEO, 2000

Legend

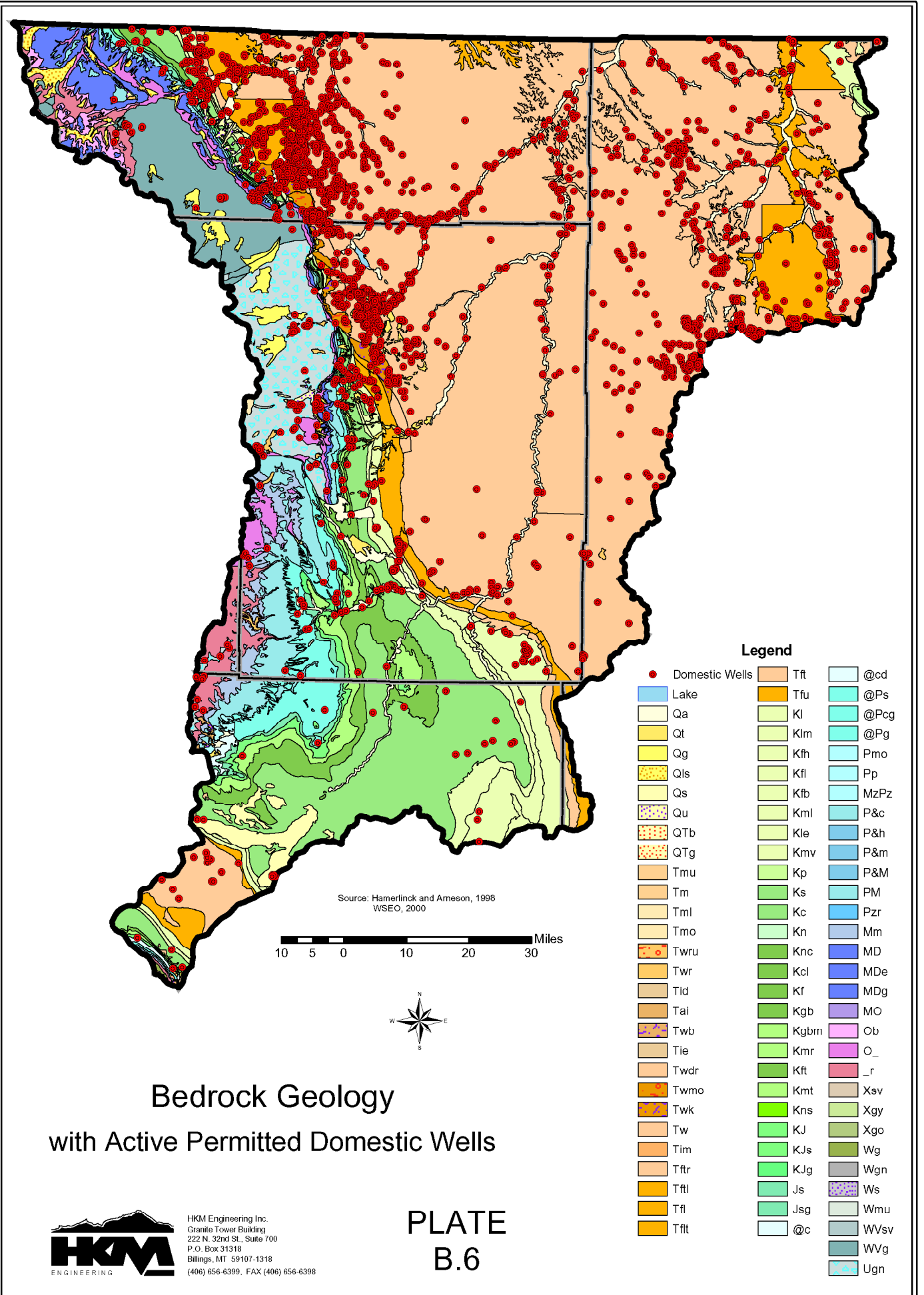
- Domestic Wells
- Lake Body of Water
- ai Alluvium
- bi Bench Deposits
- bdi Dissected Bench Deposits
- tdi Dissected Terrace Deposits
- ti Terrace Deposits
- tre Shallow Terrace Deposits
- fi Alluvial Fan and Gradational Fan Deposits
- fdi Dissected Alluvial Fan and Gradational Fan Deposits
- mi Mica
- ei Eolian Deposits
- oai Glacial Outwash and Alluvium
- gi Glacial Deposits
- li Landslide
- pea Playa Deposits
- sci Slopewash and Colluvium
- ri Residuum
- ui Grus
- Ri Bedrock and Glaciated Bedrock
- Mi Mined Areas
- ki Clinker

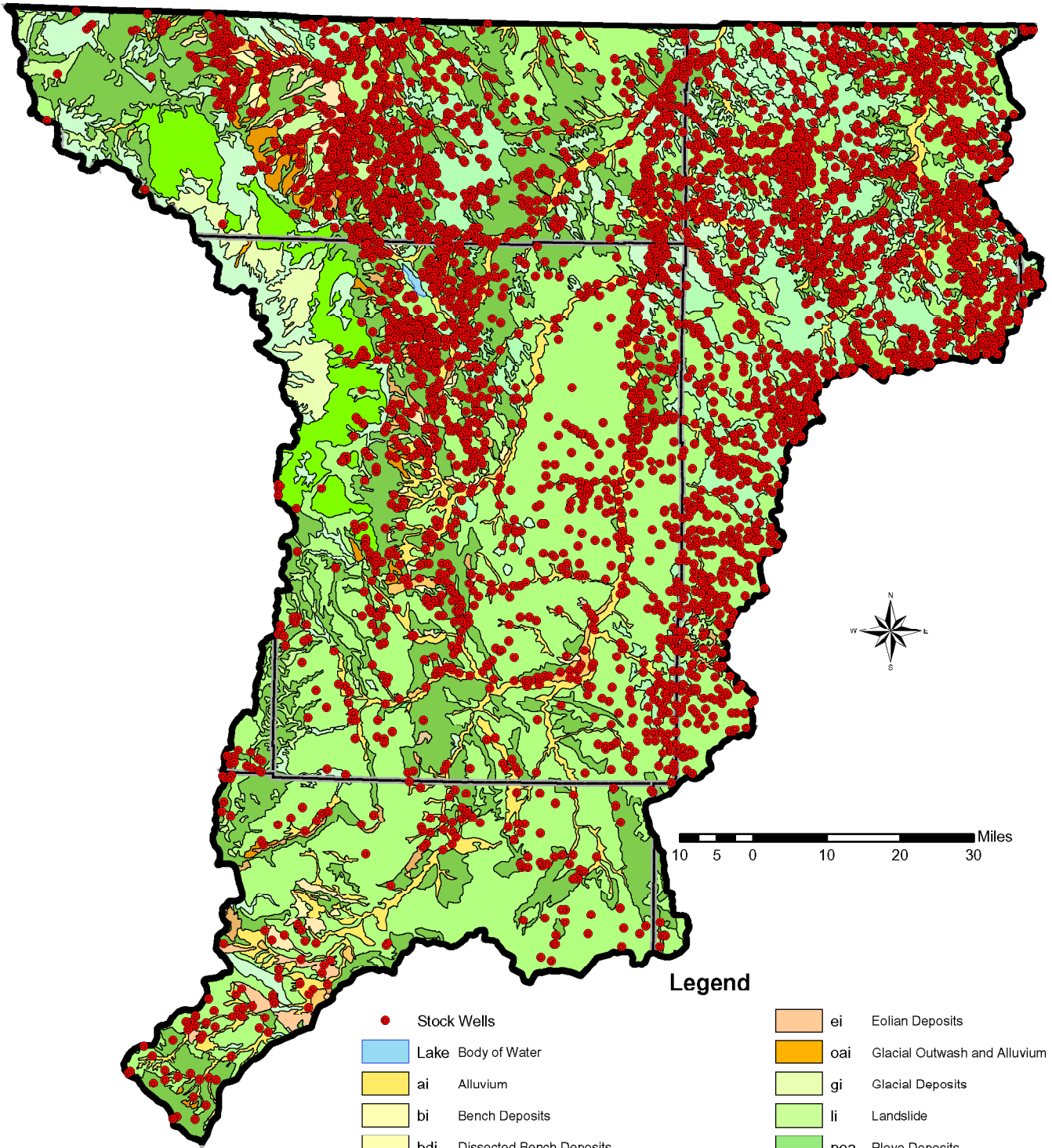
Surficial Geology
with Active Permitted Domestic Wells



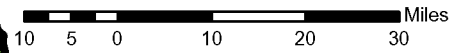
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P.O. Box 31318
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PLATE
B.5





Source: Hamerlinck and Arneson, 1998
WSEO, 2000



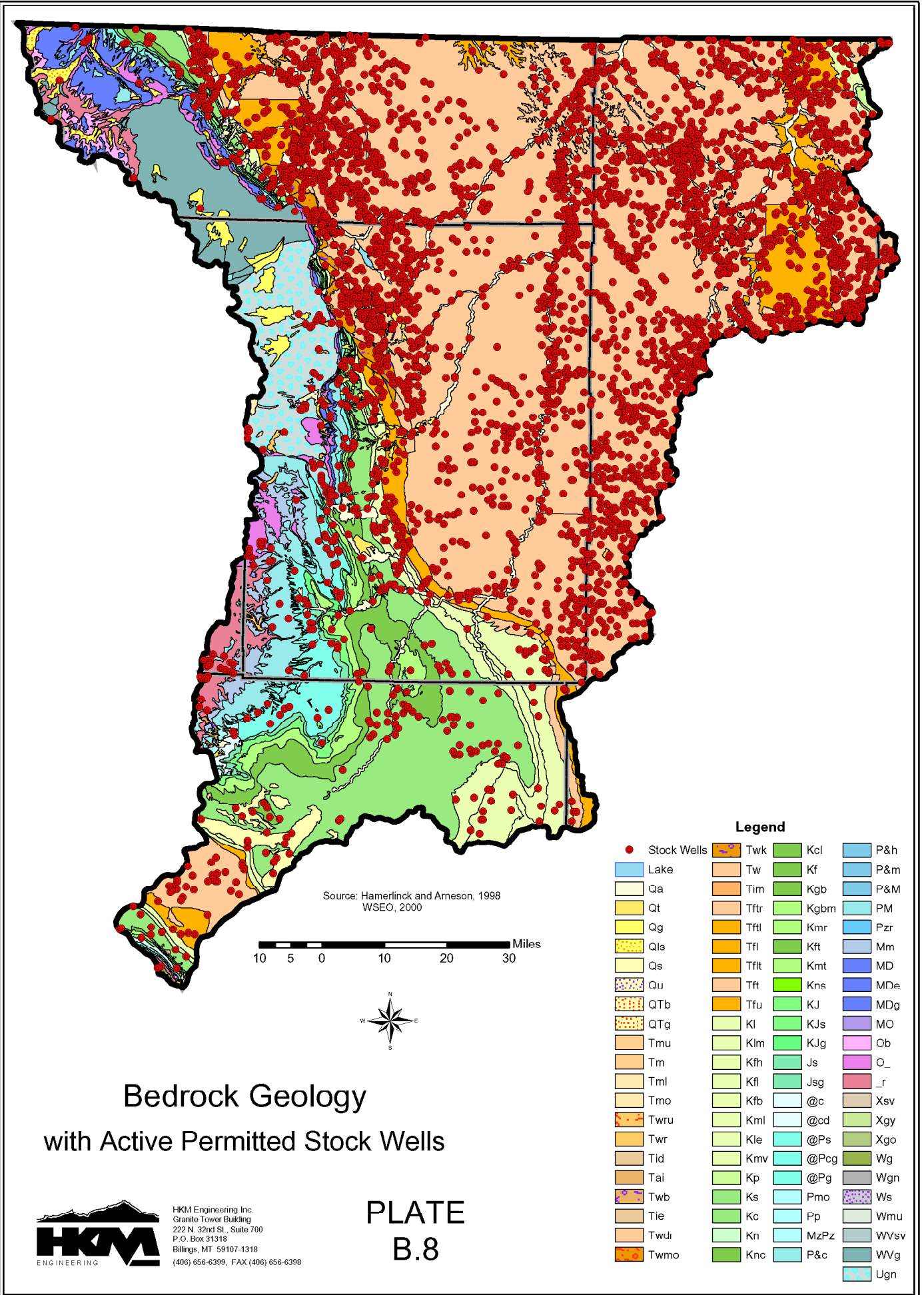
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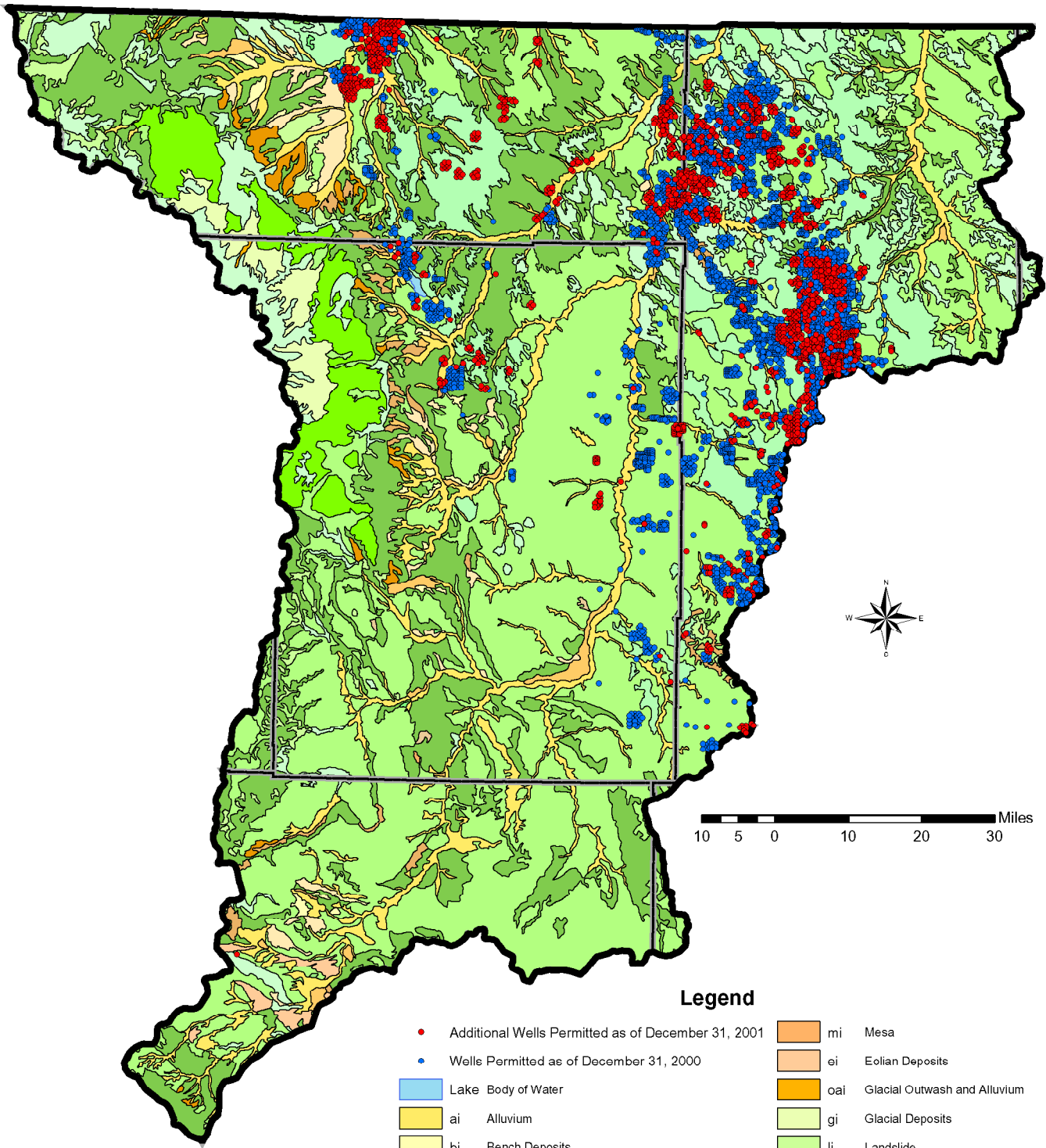
- Stock Wells
- Lake Body of Water
- ai Alluvium
- bi Bench Deposits
- bdi Dissected Bench Deposits
- tdi Dissected Terrace Deposits
- ti Terrace Deposits
- tre Shallow Terrace Deposits
- fi Alluvial Fan and Gradational Fan Deposits
- fdi Dissected Alluvial Fan and Gradational Fan Deposits
- mi Mesa
- ei Eolian Deposits
- oai Glacial Outwash and Alluvium
- gi Glacial Deposits
- li Landslide
- pea Playa Deposits
- sci Slopewash and Colluvium
- ri Residuum
- ui Grus
- Ri Bedrock and Glaciated Bedrock
- Mi Mined Areas
- ki Clinker

Surficial Geology
with Active Permitted Stock Wells

HKM ENGINEERS
HKM Engineering Inc.
Granite Tower Building
222 N. 32nd St., Suite 700
P.O. Box 31010
Billings, MT 59107-1318
(406) 656-6399, FAX (406) 656-6398

PLATE
B.7





Source: Hamerlinck and Arneson, 1998
WSEO, 2001

Legend

- Additional Wells Permitted as of December 31, 2001
- Wells Permitted as of December 31, 2000
- Lake Body of Water
- ai Alluvium
- bi Bench Deposits
- bdi Dissected Bench Deposits
- tdi Dissected Terrace Deposits
- ti Terrace Deposits
- tre Shallow Terrace Deposits
- fi Alluvial Fan and Gradational Fan Deposits
- fdi Dissected Alluvial Fan and Gradational Fan Deposits
- mi Mesa
- ei Eolian Deposits
- oai Glacial Outwash and Alluvium
- gi Glacial Deposits
- li Landslide
- pea Playa Deposits
- sci Slopewash and Colluvium
- ri Residuum
- ui Grus
- Ri Bedrock and Glaciated Bedrock
- Mi Mined Areas
- ki Clinker

Surficial Geology
with Permitted Coalbed Methane Wells



HRM Engineering Inc.
Granite Tower Building
222 N. 22nd St., Suite 700
P.O. Box 31318
Billings, MT 59107-1318
(406) 656-6399, FAX (406) 656-6398

PLATE
B.9

