HISTORICAL, CURRENT AND PROSPECTIVE FUTURE SURFACE WATER MANAGEMENT IN THE LITTLE MISSOURI RIVER SCENIC RIVER BASIN

Response to the Request of Governor Burgum for Assessment of Basin Water Management Needs and Policies

Submitted to:
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OVERVIEW

In 1975 the North Dakota State Legislature passed the "Little Missouri State Scenic River Act" (LMSSRA), (N.D.C.C. ch. 61-29), the intent of which (§61-29-02) was *"to preserve the Little Missouri River as nearly as possible in its present state, which shall mean that the river will be maintained in a free-flowing natural condition, and to establish a Little Missouri River commission."*

The North Dakota Act states (§61-29-06) that:

"Channelization, reservoir construction, or diversion other than for agricultural or recreational purposes, and the dredging of waters within the confines of the little Missouri scenic river and all Little Missouri River tributary streams are expressly prohibited."

The LMSSRA was enacted as House Bill 1172 in the 1975 session. Records pertaining to ch. 61-29 indicate that the evident primary reason for the bill was the interest of several energy interests in dams for purposes of coal gasification or electricity generation.[1] The bill intention was described by Jack Neckels, then Director of the State Planning Division, as *"preservation of the free-flowing aspect of the Little Missouri River"*.[2] The concern, therefore, was major alteration of the stream with large impoundments and diversions that would have interrupted natural flows and water uses in large quantities, and for purposes that would have altered its temperatures or otherwise modified its natural physical and chemical state.

House Bill 1020, the Water Commission budget bill in the 2017 legislative session, modified the language of §61-29-06 as follows:

"Channelization, reservoir construction, or diversion other than for agricultural, recreational, or temporary use purposes, and the dredging of waters within the confines of the Little Missouri scenic river and all Little Missouri River tributary streams are expressly prohibited",

to allow for more flexibility in authorizing the use of water from the Little Missouri River basin for industrial purposes.

In signing the bill, Governor Burgum requested that, while allowing for some flexibility of industrial use, the purpose of the Act: *"to preserve the Little Missouri River as nearly as possible*

[1] Presentation by Gary Leppart, State Liaison Officer, State Outdoor Recreation Agency before the Senate State and Federal Government Committee, February 11, 1975.

[2] Comments of Jack Nekels, Director, State Planning Division before the House, State and Federal Government Committee on House Bill 1172 - Little Missouri River Scenic River Act.

in its present [free flowing] state, be preserved in policy. In doing so the governor *"initiated the reinstatement of the Little Missouri River Commission"* authorized under §61-29-02, and requested that the State Engineer provide an interim policy governing the granting of temporary water permits in the Little Missouri River Basin pending further deliberation of the reinitiated Commission. Pending advisory consideration of the re-initiated Commission, the governor requested that the State Engineer curtail all granting of temporary water permits upstream of the Long-X bridge, and provide an interim policy for treatment of temporary water permits downstream of the Long-X bridge. He further requested that the State Engineer provide within 60 days an interim report to *"review, modify and make transparent the process and requirements for any future issuance of temporary use permits for non-agricultural uses, and make public all the available data on the temporary permits that have been issued since 1990"*. Finally, He requested that the State Engineer provide an assessment of the adequacy of current monitoring in the Little Missouri River basin.

The purpose of this report is to comply with the requests of Governor Burgum.

OBJECTIVES

This report will address the following issues:

1. A brief description of water permits and their administration as it pertains to the Little Missouri River;
2. A review of the number of water permits authorized in the Little Missouri River basin since 1990, the quantities of water authorized, the quantities actually used (where reported, otherwise estimated), and a comparison of those quantities with flows of the Little Missouri River in associated river reaches;
3. A description of planned measures for making all data for temporary water permit administration more transparent and available to the public;
4. An assessment of the adequacy of current monitoring within the basin.
5. An interim policy for temporary water permit administration;
6. Suggested options for consideration in deliberation of future policy discussion.

Our objective is to be brief and concise in review and discussion, while being thorough in presentation of all available data for purpose of transparency. To accomplish this, main report discussion will be limited to brief descriptions and overall summary data. However, all data summarized, and ancillary discussion will be appended.

WATER PERMIT ADMINISTRATION IN THE LITTLE MISSOURI RIVER BASIN

In March of 2017, while evaluating temporary water permits for points of diversion in the Little Missouri River basin, a question of consideration of N.D.C.C. §61-29-06 was raised. Upon consideration of the express prohibition of industrial diversions of water within the basin, all applications for water permits were placed on hold. Further enquiries indicated that provisions of the statute had never, from the time of passage of the law, reached or been applied in the permitting of water, which is governed under provisions of N.D.C.C. ch. 61-04, and Article 89-03 of North Dakota Administrative Code. Reasons for the disconnect are complex, speculative, and beyond the purpose of this report.

STATE REGULATION OF WATER USE

According to N.D.C.C. §61-01-01 *"All waters within the limits of the state from the following sources of water supply belong to the public and are subject to appropriation for beneficial use and the right to the use of these waters for such use must be acquired pursuant to chapter 61-04."* Under ch. 61-04 there are two means by which the use of water may be obtained.[3]

1. A water right may be established by applying for and having authorized by the State Engineer, a conditional water permit. The state of North Dakota allocates water under western water law, or the doctrine of appropriations, in which the right to use water is allocated in order of priority of application, subject to provisions of sustainability and accountability defined in ch. 61-04. The water right established is the right of use, and use is the standard of retaining the water right. Once use is established, the conditional water permit is upgraded to a "perfected" water permit, which establishes a right of use until such a time as it may be cancelled for lack of use.[4]
2. Under §61-04-02.1 *"The state engineer may authorize emergency or temporary use of water for periods not to exceed twelve months if the state engineer determines such use will not be to the detriment of existing rights."* A temporary water permit grants temporary permission to use the water for a limited period of time (up to twelve months). It does not establish a water right and can be cancelled at any time should needs and impacts justify its cancellation.

[3] Water appropriation statutes and rules can be obtained at: http://www.swc.nd.gov/pdfs/water_app_8_1_15.pdf, and http://www.swc.nd.gov/info_edu/waterlaws_and_policy/admincode.html.

[4] Ibid, N.D.C.C. §61-04-23 through §61-04-25

Water needed for road and other infrastructure construction and maintenance, dust control, pipeline testing, all oil-field water uses and etc. are classified as industrial water uses.

SUMMARY OF WATER PERMITS ISSUED AND USED WITHIN THE LITTLE MISSOURI RIVER BASIN

The following discussion provides a brief summary of permitted industrial water use within the Little Missouri River Basin. Focus is primarily on industrial use, but limited discussion of irrigation and recreation, fish and wildlife use is included for purpose of comparison. This summary is limited to an overview of use. Annual data, maps, figures, and further discussion are provided in the Appendix as indicated.

Conditional and Perfected Water Permits

One conditional water permit, questionably listed as a tributary, was issued for a "developed spring."[5] No other water rights have been established since 1975. As of April, 2017, there were 15 applications in que for hydrologic evaluation. All applicants have been notified that their applications are on hold, and, pending final discussion and determination, may be denied.

Temporary Industrial Water Use in the Little Missouri River Basin: 1990-2017

Best assessment of past practice indicates that temporary water permits have been authorized from the Little Missouri River and its tributaries without interruption or reference to the 1975 legislation. Database records of temporary water permits were not kept until 1990. Beginning in 1990 records of temporary water permits have been kept, but reporting of temporary water use was not required. Beginning in 2011 reporting was required for water depots but not for other uses (ex. road construction and maintenance). Water Depots must provide written monthly reports of diversions to the Water Appropriation Division while pumping water for the first four months. Thereafter telemetry data is sufficient.

Since 2014 all industrial water depots have been required to monitor their diversions using in-line totalizing flowmeters conditioned to state specifications, and provide real-time data to the SWC staff. Criteria for deployment of a telemetry system are described in a state report.[6] Policy of the State Engineer regarding telemetry requirements is publicly available online.[7] Illegal pumping by water depots is subject to fines of up to $25,000 per day of illegal use[8], and all violations are heavily fined, commensurate with the financial gain incentive for the violation.

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[5] Conditional water permit #5859, for 129 acre feet, was issued from a "developed spring", excavated in the upper Cherry Creek basin. Contemporary published documentation indicates that the source was originally treated by hydrologists as a groundwater source.

[6] Telemetry study report: http://www.swc.nd.gov/pdfs/telemetry_study_report.pdf

[7] Telemetry policy is available at: http://www.swc.nd.gov/pdfs/telemetry_requirements.pdf

[8] Policies and legal citations for violations of state water law are available at: http://www.swc.nd.gov/pdfs/unauthorized_water_use_policy.pdf

In summary: Authorized temporary use has been recorded since 1990 for all temporary water permits. Actual use has been recorded only for oil-field water depots, and only since 2011.

There have been 599 temporary industrial water permits authorized within the Little Missouri River basin, including the main stem and tributaries, from January of 1990 to January of 2017.

Data will be provided and described by two use categories: (1) road construction and infrastructure, and (2) water depot (primarily oil-field use).

Each of these will be discussed for five hydrologic subunits of the Little Missouri River in North Dakota determined primary by U.S. Geological Survey river gage locations, and separated according to subbasin boundaries for streams confluent with the main stem above or below each gage. River reaches and U.S.G.S. Gage locations are described and shown on Figure 1.

Annual Flows in the Little Missouri River

For comparison with annual industrial uses reported, a summary of annual flows at each stream gage is provided on Table 1. Arithmetic mean and standard error parameters are not presented, because they are not meaningful for a log-normal distribution. A detailed annual listing of annual flows is provided in Appendix Table A-1.

Table 1. Summary of total flows in the Little Missouri River recorded at the Marmarth, Medora, and Long-X bridges from 1990 through 2016; and median, maximum and minimum annual flows during that period.

	MARMARTH acre-feet	MEDORA acre-feet	LONG-X acre-feet
Min. Annual	21,502	38,153	48,578
Max. Annual	1,015,000	1,143,900	1,474,700
27-yr sum	6,095,900	4,304,600	9,869,400
Data Years	27	15	27
Median Annual	175,920	192,210	294,220

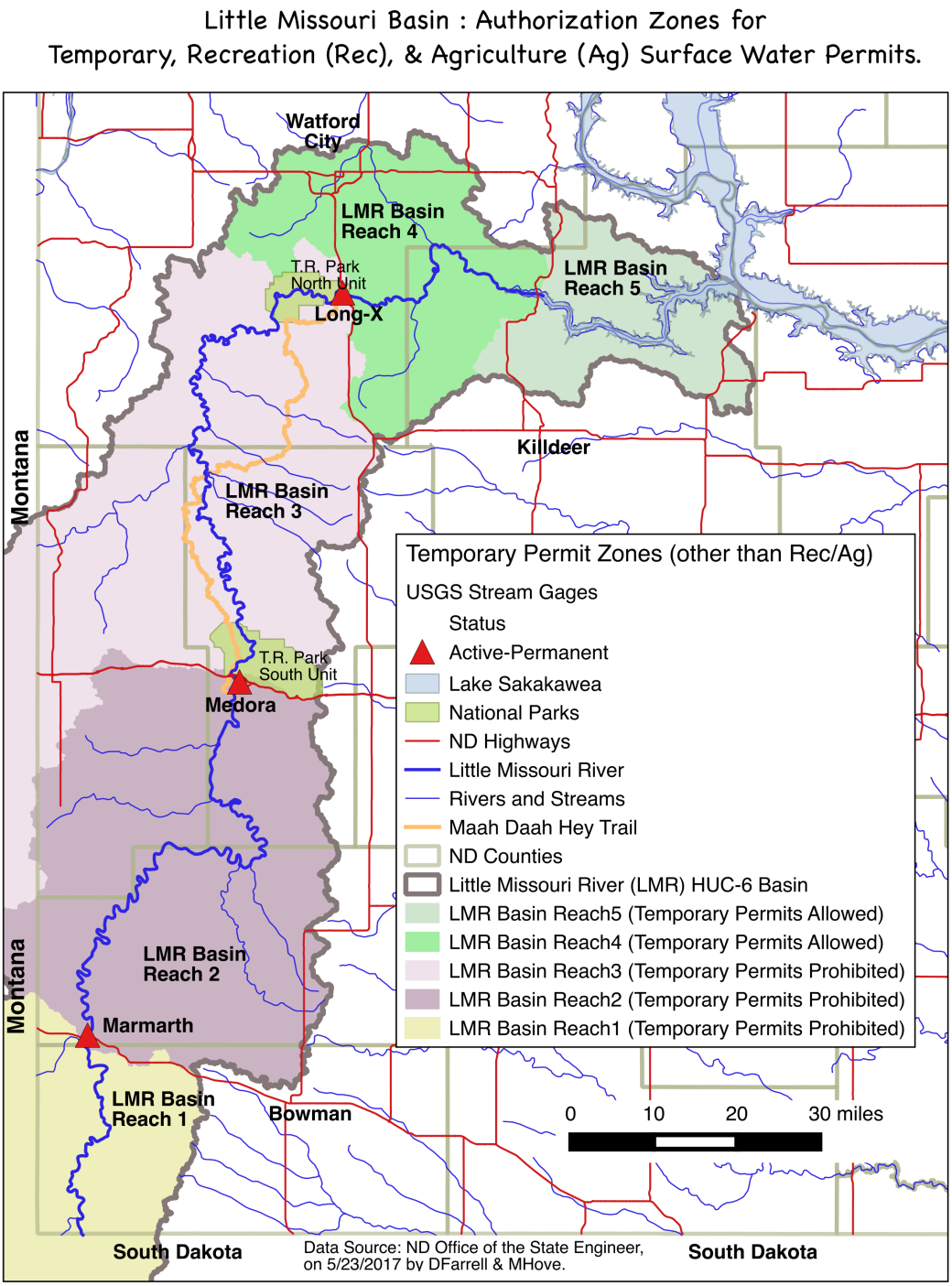


Figure 1. Overview map of the Little Missouri River Basin, with river reaches treated in the report. Reach #1 is from the South Dakota Border to the Marmarth Gage. Reach #2 is from the Marmarth Gage to the Medora gage upstream of Theodore Roosevelt National Park South Unit. Reach #3 is from the Medora Gage to the Long-X bridge gage, downstream of the Theodore Roosevelt National Park North Unit. Reach #4 is from the Long-X bridge gage to HWY 22. Reach #5 is from HWY 22 to Lake Sakakawea.

Industrial Water Use: Road and Infrastructure Construction and Repair

From 1990 through 2016, 267 temporary water permits have been authorized within the Little Missouri River Basin for road and infrastructure work. Total water allocated in each reach for all 27 years is shown on Table 2. Full data tables showing authorized use by reach for each year are provided in Appendix B (Figures B-1 through B-5).

Table 2. Summary of total water allocated for road and infrastructure construction and repair authorized using temporary water permits from 1990 through 2016; and median, maximum and minimum annual use authorized during that period.

	REACH #1 acre-feet	REACH #2 acre-feet	REACH #3 acre-feet	REACH #4 acre-feet	REACH #5 acre-feet
Min. Annual	0	0	0	0	0
Max. Annual	6.3	181.1	49.5	266.6	6.1
27-yr. Total Alloc.	24.1	513.7	124.9	989.5	17.5
Data Years	27	27	27	27	27
Med. Annual.	0.3	2.8	0.2	3.7	0.0

Actual water use was not reported for temporary road and infrastructure industrial uses. However, government road agencies and construction companies commonly file for water permits from multiple points of diversion to assure adequate supply near work sites, and usually use less than allocated. Best professional estimate of percent use is about 35%. Table 2 shows the distribution of estimated use from 1990 through 2016. Full data tables showing estimated actual use by reach for each year are provided in Appendix Table B-1.

Table 3. Estimated water used for road and infrastructure construction and repair temporary water permits from 1990 through 2016; and median, maximum and minimum annual estimated actual use during that period.

	REACH #1 acre-feet	REACH #2 acre-feet	REACH #3 acre-feet	REACH #4 acre-feet	REACH #5 acre-feet
Min. Annual	0	0	0	0	0
Max. Annual	2.2	63.4	17.3	93.3	2.1
27-yr. Total Use	8.6	179.8	43.7	346.3	6.0
Data Years	27	27	27	27	27
Med. Annual	0.1	1.0	0.1	1.3	0.0

Estimated actual annual industrial use for road construction as a percent (fraction x 100) of annual flow at the upstream gage was also calculated (see Appendix Table B-2 for each year and river reach). Only two reaches (1# and #2) and two years (1991 and 1992) which were drought years,

exceeded an estimated use threshold of one hundredth of one percent. The maximum was 0.15 percent of annual flow at the Marmarth Gage for Reach #2 in 1991. Industrial use for road construction and infrastructure relative to annual flows was negligible.

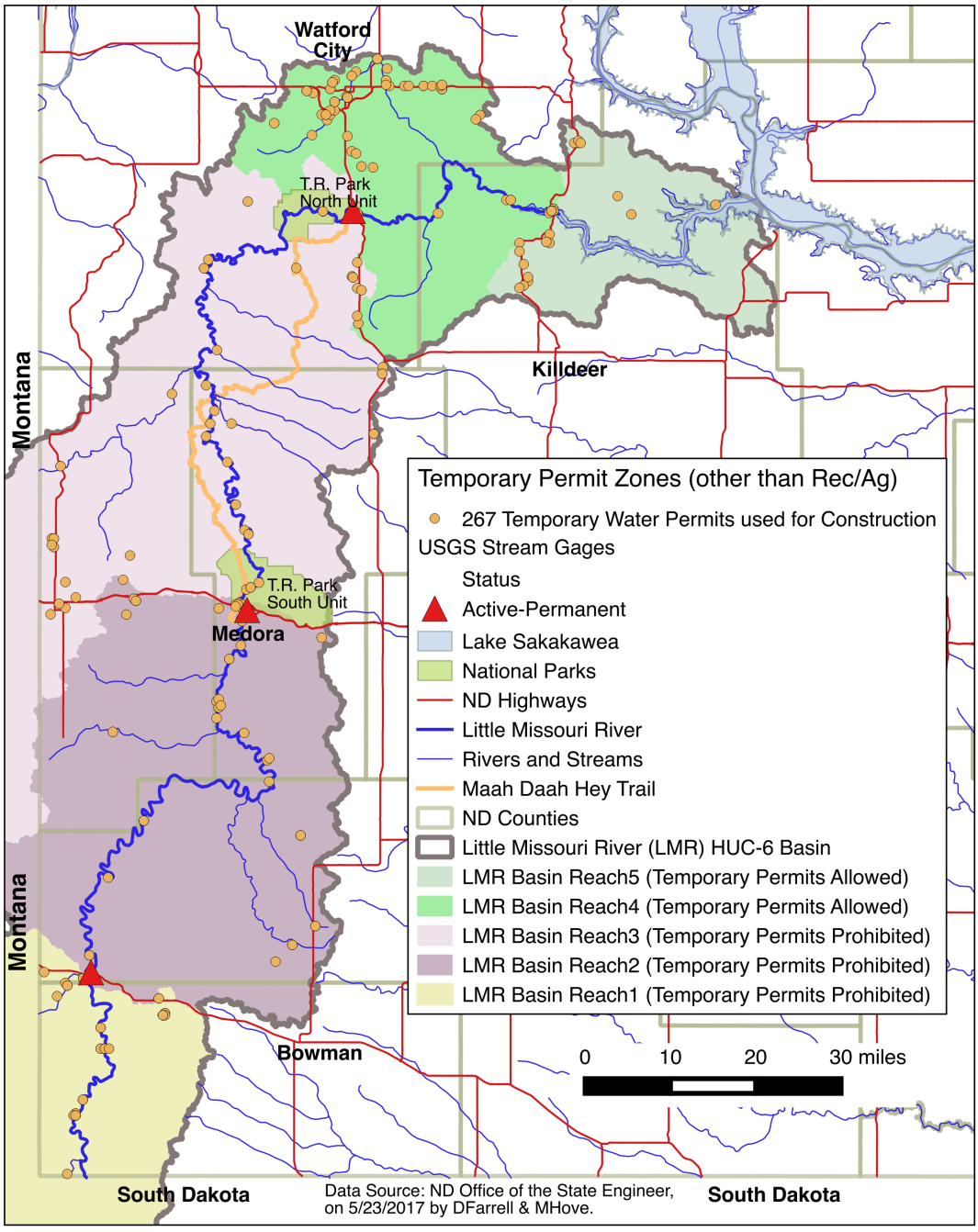


Figure 2. Locations of all temporary industrial water permit for construction use from 1990 through 2016.

Industrial Water Use: Water Depots

With the acceleration of the Bakken Play in 2010, a critical situation developed in the Bakken Region. Large water demands for oil-field water use, limited available groundwater, and last minute restrictions placed by the U.S. Army Corps of Engineers on access to the Missouri River in the Garrison Reservoir stretch resulted in a large increase in truck transport over long distance. This, in turn, caused a chaotic situation which resulted in extensive road damage and an increase in road accidents, injuries, and fatalities; sometimes by as much as an eight-fold increase in high-activity regions. Efforts to provide a well-distributed water supply to allay regional problems included the accelerated use of temporary water permits from surface-water sources. Further discussion of conditions referenced is provided in Appendix C.

Because the amounts of water being diverted and financial incentives that encouraged illegal diversion, stringent measures of accounting and accountability were deployed. These included the requirement that all water depots deploy in-line totalizing flow meters meeting state standards, monthly reports of water pumped, and the deployment of telemetry which would provide real-time visibility of pumping to the regulatory staff of the State Engineer. Measures also included stringent penalties designed to remove the profitability of illegal use, as described above. Water use data for water depot temporary water permits, was thus collected beginning in 2011.

Locations of all water depots since 1990 are shown on Figure 3. A brief summary of water depot permit allocations and use in the Little Missouri River basin is provided on the tables below. The tables provide a summary of median, maximum, and minimum uses, and a summary of all use for each of the river reaches over all of the years combined. Detailed annual temporary water permit numbers and allocations by year and reach, including a map summarizing all water depot locations by reach are provided in Appendix D.

Numbers of Industrial Temporary Water Permits for Water Depots:

The total number of temporary water permits issued for water depots since 1990 are shown for each Reach (described on Fig. 1) on Table 4.

Table 4. Total number of water permits issued for water depots in each river reach from 1990 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
Min. Annual	0	0	0	0	0
Max. Annual	5	1	10	46	13
28-yr. Total	28	3	54	151	46
Years	27	27	27	27	27
Med. Annual.	0	0	1	0	0

Table 4a and table 4b show the numbers of water permits for water depots before and after the Bakken play expansion. A total of 282 industrial temporary water permits for water depots were issued; 47 before 2011, and 235 after 2011.

Table 4a. Total number of water permits issued for water depots in each river reach from 1990 through 2010.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
Min. Annual	0	0	0	0	0
Max. Annual	5	1	6	1	0
28-yr. Total	28	2	15	2	0
Years	21	21	21	21	21
Med. Annual	0	0	0	0	0

Table 4b. Total number of water permits issued for water depots in each river reach from 2011 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
Min. Annual	0	0	5	1	1
Max. Annual	0	1	10	46	13
28-yr. Total	0	1	39	149	46
Years	6	6	6	6	6
Med. Annual	0	0	5.5	28	8

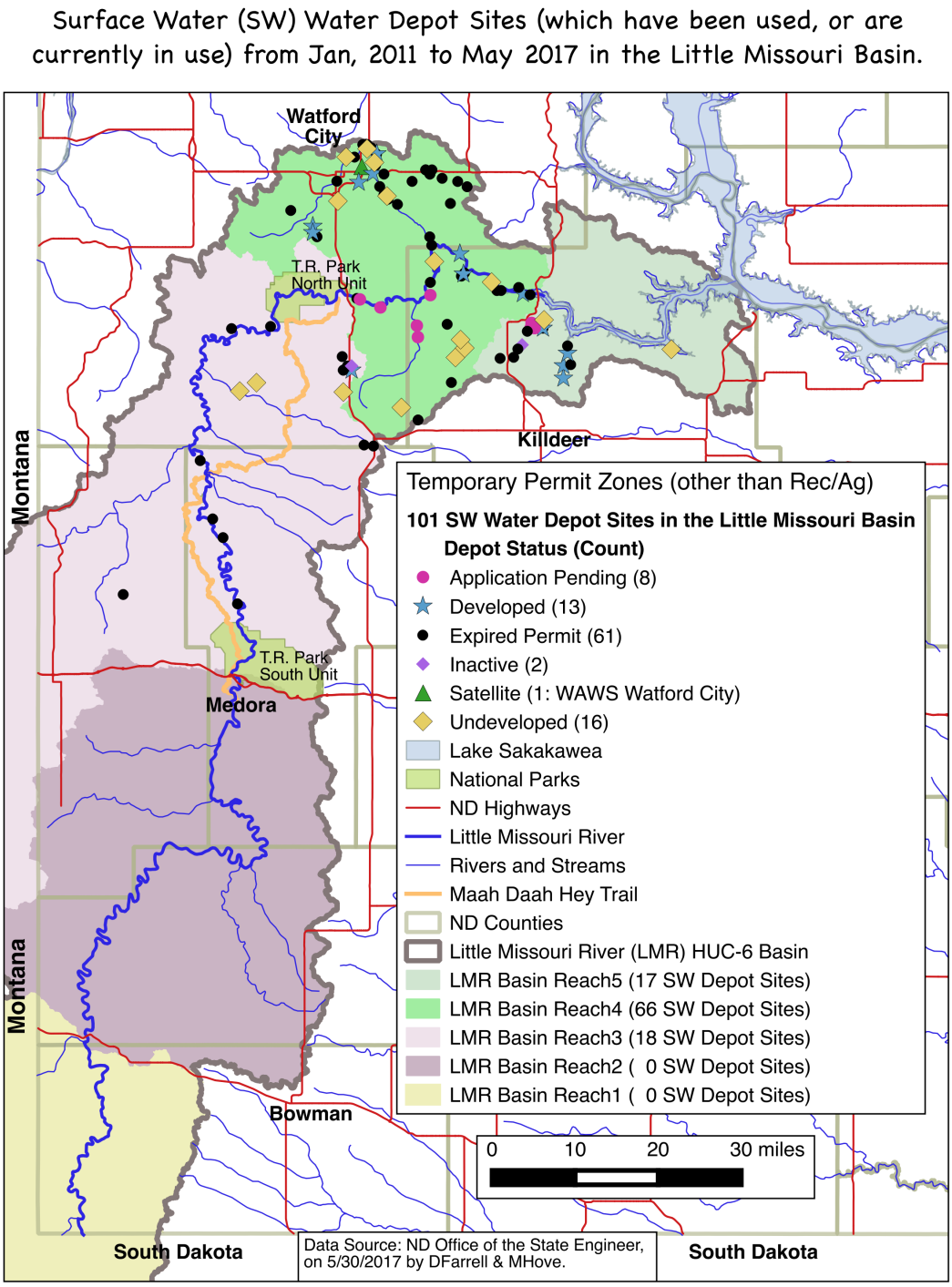


Figure 3. Locations of all temporary industrial water permit for water depot use from 1990 through 2016.

Water Allocations for Water Depot Temporary Water Permits:
Water allocated in temporary water permits are summarized on Table 5 (total water depot allocations since 1990), Table 5a (1990 through 2010), and Table 5b (2011 through 2016). Water permit numbers and allocations are shown for each reach and year, including summary maps of depot locations (Figures D-1 through D-5), in Appendix D.

Median values for all years combined were 1 acre foot or less, and 0 for 1990 through 2011. For 2011 through 2016 (after Bakken expansion) there were no allocations for Reach #1 upstream of the Marmarth Gage and only one allocation for 70 acre feet from Reach #2 between Marmarth and Medora. Substantial allocations were issued for Reaches #3, #4, and #5 (Table 5b). However, actual uses were much lower (Table 6).

Table 5. Summary of temporary water permit allocations for industrial water depot use in each river reach from 1990 through 2016.

	REACH #1 acre-feet	REACH #2 acre-feet	REACH #3 acre-feet	REACH #4 acre-feet	REACH #5 acre-feet
Min. Annual	0	0	0	0	0
Max. Annual	54	70	688	22,511	3,091
27-yr. Total Alloc.	169	78	2,202	67,125	6,995
Data Years	27	27	27	27	27
Med. Annual	0	0	1	0	0

Table 5a. Summary of temporary water permit allocations for industrial water depot use in each river reach from 1990 through 2010.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
	acre-feet	acre-feet	acre-feet	acre-feet	acre-feet
Min. Annual	0	0	0	0	0
Max. Annual	54	7	50	12	0
21-yr. Total Alloc.	169	8	77	14	0
Data Years	21	21	21	21	21
Med. Annual	0	0	0	0	0

Table 5b. Summary of temporary water permit allocations for industrial water depot use in each river reach from 2011 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
	acre-feet	acre-feet	acre-feet	acre-feet	acre-feet
Min. Annual	0	0	162	6	160
Max. Annual	0	70	688	22,511	3,091
6-yr. Total Alloc.	0	70	2,125	67,111	6,995
Data Years	6	6	6	6	6
Med. Annual	0	0	300	11,776	982

Actual Water Use for Temporary Water Permits Issued for Water Depots:
While substantial amounts of water were issued for water depot use in the Little Missouri River basin following 2011, actual use was much lower. This is because authorization is needed before a water provider can bid on an oil-field water use application, so that multiple permitted uses are competing for the same jobs and only one actually supplies the water. We here summarize the actual reported use, the use percent of permitted uses, and the use percent of annual flows.

Because there are only six years of reported data, the full data set rather than a statistical summary is presented on Table 6. There was no water depot use in Reaches #1 and #2. In Reaches #3, #4, and #5, actual water depot use was a small fraction (16% or less) of the amount allocated (Table 6a). No water was used upstream of the South Unit of Theodore Roosevelt National Park. The total amount used in Reach #3, between the South and North Units of Theodore Roosevelt National Park was only 317 acre-feet over five years, with a maximum of 112 acre feet in 2013. Maximum use was in Reach #4, between the Long-X bridge and the HWY 22 bridge.

Table 6. Reported annual industrial water depot water use for each reach of the Little Missouri River from 2011 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
2011	0	0	53	5	0
2012	0	0	90	75	105
2013	0	0	112	132	68
2014	0	0	5	1,662	319
2015	0	0	34	1,370	323
2016	0	0	25	986	329
Total	0	0	317	4,231	1,145

Table 6a. Reported annual industrial water depot water use as a percent of the amount allocated (Table 5a) for each reach of the Little Missouri River from 2011 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
2011	None Used	None Used	32	80	0
2012	None Used	None Used	30	17	9
2013	None Used	None Used	38	3	36
2014	None Used	None Used	1	9	39
2015	None Used	None Used	11	6	10
2016	None Used	None Used	4	5	21
Total	None Used	None Used	15	6	16

Actual water depot use, as a percent of annual flows (100 x use/flow), is shown on Table 6b. Average annual use is less than five one hundredths of a percent for reaches #3, #4, and #5. The largest single use was about one percent for Reach #4 in 2016. Actual water use in terms of annual totals was thus negligible in relation to flows.

Table 6b. Reported annual industrial water depot water use as a percent of the annual flow at the nearest upstream gage (Appendix Table B1) for each reach of the Little Missouri River from 2011 through 2016.

	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
2011	-	-	0.005	<0.0001	0
2012	-	-	0.146	0.081	0.113
2013	-	-	0.051	0.043	0.022
2014	-	-	0.001	0.218	0.042
2015	-	-	0.018	0.466	0.110
2016	-	-	0.033	0.906	0.302
Total*	-	-	0.007	0.043	0.012

*Total calculated as total six year use for each reach divided by total six year flows at the nearest upstream gage x 100.

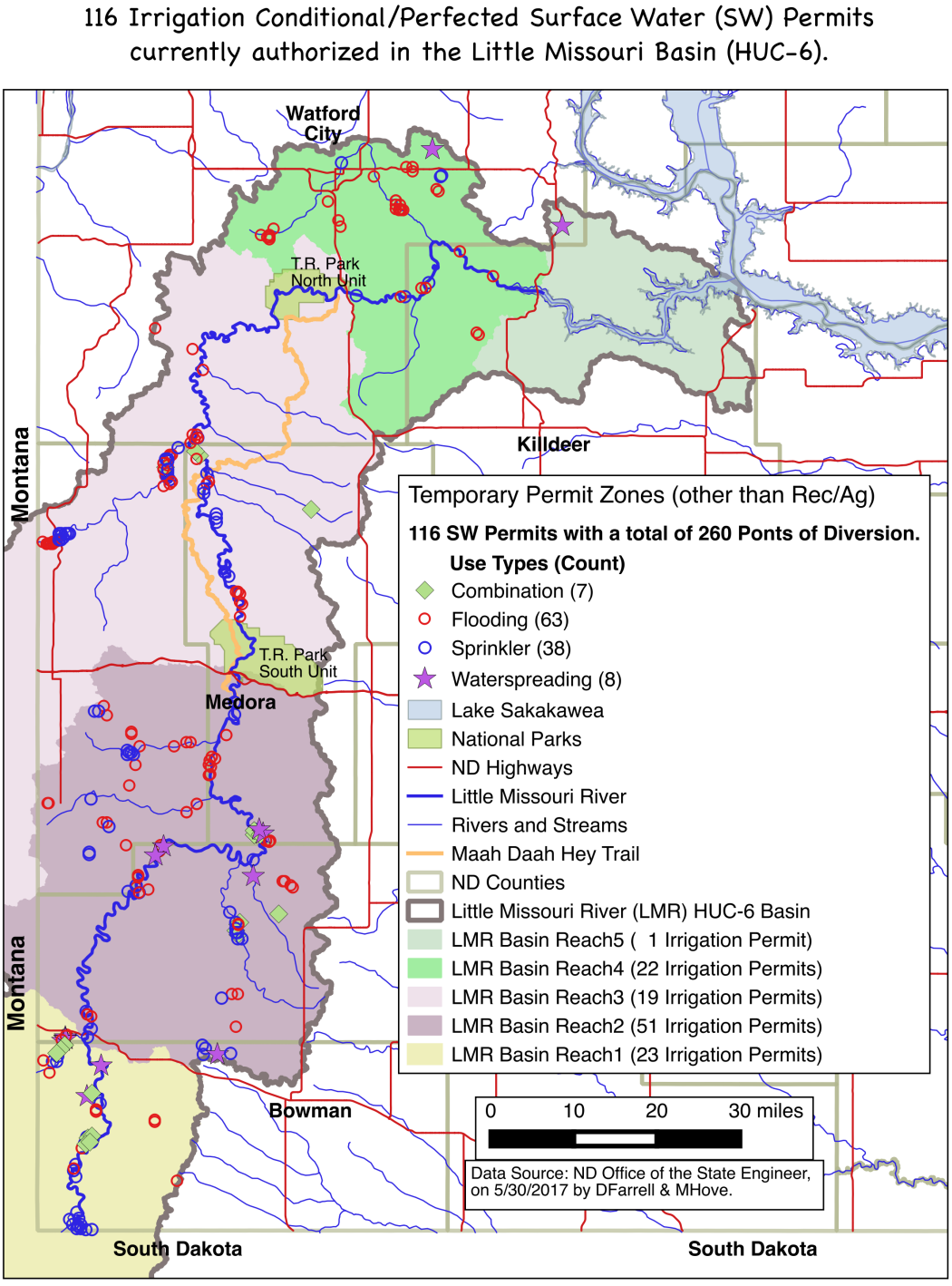


Figure 4. Locations of all Irrigation water permits issued for the Little Missouri River Basin.

Comparison of Industrial Uses with Irrigation Use; and Livestock, Fish and Wildlife, and Recreation Use

Agricultural use and recreational use are allowed in the Little Missouri State Scenic River Act, and are not the primary focus of this report. Fish and wildlife use is not specified under the Act, but is normally classified with recreation in the state priority system. However, for purpose of comparison, a summary of permitted irrigation, livestock, fish and wildlife and recreation use data are presented.

Irrigation: Locations of irrigation permits are shown on Figure 4. Bar charts comparing irrigation and water depot uses for each river reach and each year are provided on Figure 5. Scales are the same for comparison between regions. Although water depot use was only recorded after 2010, the full time-period summary of irrigation use (conditional and perfected water permits from surface water) is provided to give a full sense of relative total use over time. A few significant observations are: (a) largest use was for irrigation south of Medora; (b) in Region #3 irrigation combined with depot use following 2010 was substantially lower than irrigation use alone from 1993 through 2009; (c) water depot use was the largest single application for any time period in Reach #4; and (d) water depot use was largest in Reach #5, but nonetheless very small. Reported irrigation water use since 1977 is provided in Appendix E.

Livestock, Fish and Wildlife and Recreational Use: Total permitted livestock, recreation, and stock water use from surface water throughout the entire Little Missouri River basin is less than 1,500 acre feet per year. The number of permits and quantities for each use are summarized on Table 7. None of the diversions are located on the main stem of the river. Water use is not reported for these uses, but most permitted use in these three categories consists of estimated annual evaporative loss from impoundments.

Table 7. Fish and wildlife, recreation, and stock water permitted in the Little Missouri River basin.

	Fish and Wildlife	Recreation	Stock	Total
Minimum	5	5	6.6	-
Maximum	175	249	110.3	-
Total acre-feet	335.5	609	537.5	1,482
No. Permits	9	10	16	35
Median	16.3	16.5	29.7	-

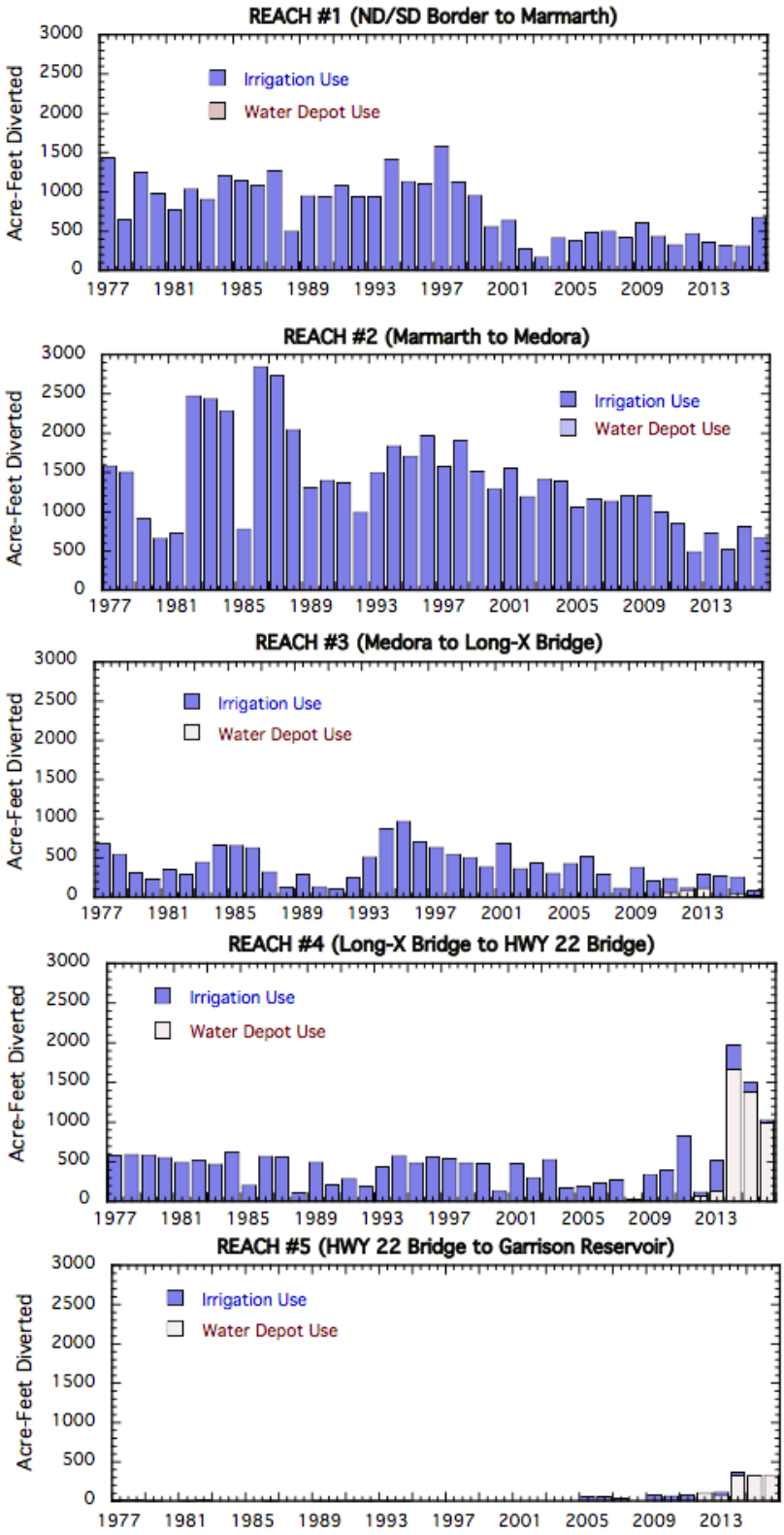


Figure 5. Comparison of annual irrigation and water depot water use for each river reach.

Summary and Conclusions on Basin Temporary Industrial Water Use

- One conditional industrial water permit was issued for a "developed spring" within the Little Missouri River Basin in the period following enactment of the Little Missouri River Scenic River Act. No other industrial water rights have been established from surface water. The classification of the excavated spring as a surface water was questionable. [9]
- Temporary industrial water permits for road and infrastructure construction and maintenance were offered throughout the period following enactment of the Little Missouri State Scenic River Act. Temporary allocations have only been recorded since 1990. Although use was not reported, best proxy estimates based on reported allocations and common percent usage of allocations indicated that diversions in all reaches since 1990 were negligible, exceeding one tenth of one percent of flows in only one year, and exceeding one hundredth of one percent in only two locations and two years.
- Temporary water permits for industrial oil-field use has been recorded since 1990, but annual use has only been reported since 2011. Forty-seven (47) temporary permits were issued before 2011, and 235 were issued from 2011 through 2016.
- Industrial water use has been reported for water depots since 2011, following acceleration of the Bakken oil play. Total depot water use in the basin during that time period for all reaches of the river was 5,693 acre feet; of which none was diverted upstream of Medora (Reaches #1 and #2), 300 acre feet were diverted between Medora and the Long-X bridge (Reach #3), 4,231 acre feet were diverted between the Long-X bridge and HWY 22 (Reach #4), and 1,145 acre-feet was diverted between HWY 22 and the Garrison Reservoir (Reach #5).
- All reported annual water depot use was below one percent of annual flows at the nearest upstream gage. Almost all were a fraction of a percent. In Reach #3 (between Theodore Roosevelt National Park South and North Units), only one year exceeded (by a small margin) a tenth of a percent of annual flows. (Note: It might be argued that because diversions are cumulative, comparison of local with the nearest upstream gage should be calculated by rather than summing diversions down the river. However, this would not be appropriate, as flows at each gage are measured downstream of diversions, and measured flows, therefore, include upstream diversions.)
- Industrial use downstream of the Long-X bridge was the largest use following 2010. However, it averaged only four one-hundredths of a percent of annual upstream flow over that time period in Reach #4, and one one-hundredth of a percent of annual upstream flow in Reach #5.
- All data used in computations is provided in the Appendix as noted in the discussion.

[9] Ref. footnote 5, p5.

CURRENT AND FUTURE PUBLIC INFORMATION

Full transparency for the temporary water permit process has been requested by the governor. The following measures have been taken with respect to information availability.

Temporary water permit information is currently available on the SWC web site, and is posted and updated for each step of the permit process. The following link provides access to the selectable permit menu:

http://www.swc.nd.gov/info_edu/map_data_resources/tempwaterpermits/

Screening options are shown on the following example of the selectable menu (Figure 6).

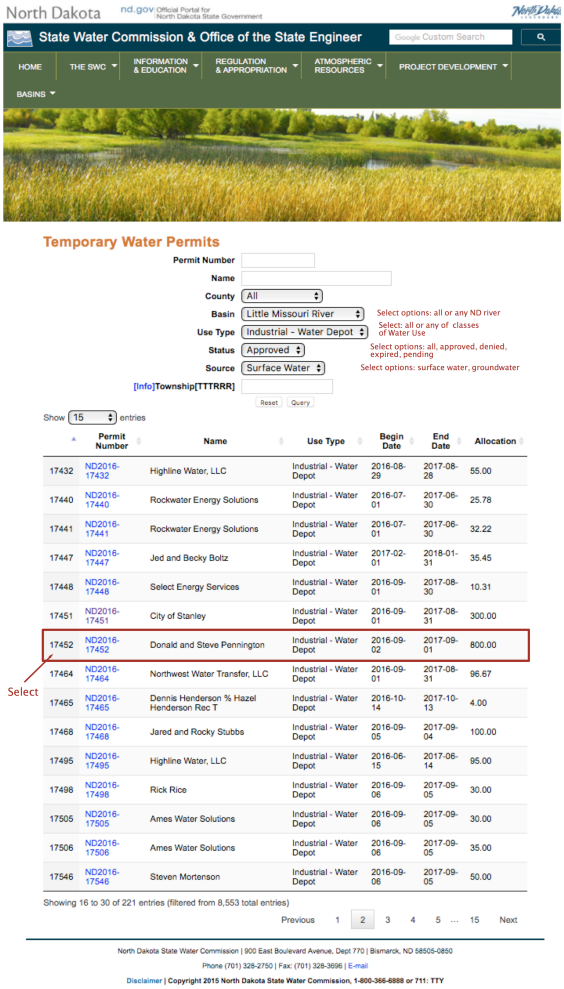


Figure 6. Selectable menu for reference to temporary water permit applications. Options are shown in red on the figure are added for illustration.

For improvement of transparency, in addition to summary information previously provided, access to full documentation of work current to each application has been added and is currently accessible, as illustrated on the Figure 7. Interested parties need only select from the document list (in blue) to obtain a copy of the desired documents. Full information is only available for current water permit information already scanned, and for future documents.

The information may also be accessed through the North Dakota State Water Commission MapServices site:

http://mapservice.swc.nd.gov

But use of the site is more complex for those unfamiliar with it. Commission staff would be more than happy to demonstrate its use to any of the public wishing to use it.

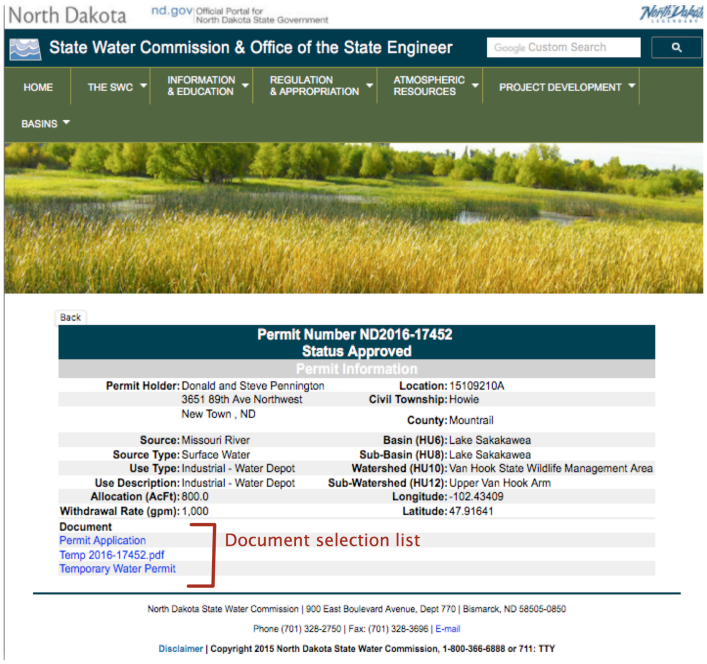


Figure 7. Information delivered for selected temporary water permit applications. Reference (in red) to the document selection list is added for illustration. The document selection list can be used to retrieve pdf copies of any current documents generated with respect to the water permit (redacted for exclusion of security of personal financial data of the applicant).

STREAM FLOW GAGES AND MONITORING REQUIREMENTS ON THE LITTLE MISSOURI RIVER

The Little Missouri River Basin drains 9,515 square miles in northeast Wyoming, western South Dakota, southeastern Montana and western North Dakota. Originating west of the Devils Tower in Crook County of northeast Wyoming, the Little Missouri River flows northeasterly draining some 721 square miles of northeast Wyoming. The river then continues northeasterly into southeast Montana, where the river and its tributaries drain approximately 3,480 square miles of southeastern Montana. The river enters North Dakota about six miles east of the southwest corner of the state. From there it flows north through the Badlands of North Dakota, turning east about mid-state and emptying into the Missouri River system.

Stream flow gaging on the Little Missouri River is an important tool for properly managing this important resource in the state of North Dakota. The U.S. Geological Survey has established a series of four (4) stream flow measuring gages along the Little Missouri River main stem and two (2) seasonal on tributaries to the Little Missouri River. The four main stem gages are located at Camp Crook, SD; Marmarth, ND; Medora, ND and near Watford City ND, at the Long X Bridge. Historical discontinued gages, currently monitored gages, and potential future gages will be discussed for: (1) the main stem of the Little Missouri River, and (2) tributaries of the Little Missouri River. Figure 8 provides a map of the gage locations to be discussed below.

Stream Gage Stations of the U.S. Geological Survey (USGS) and N.D. Office of the State Engineer (OSE) in the Little Missouri River (LMR) Basin.

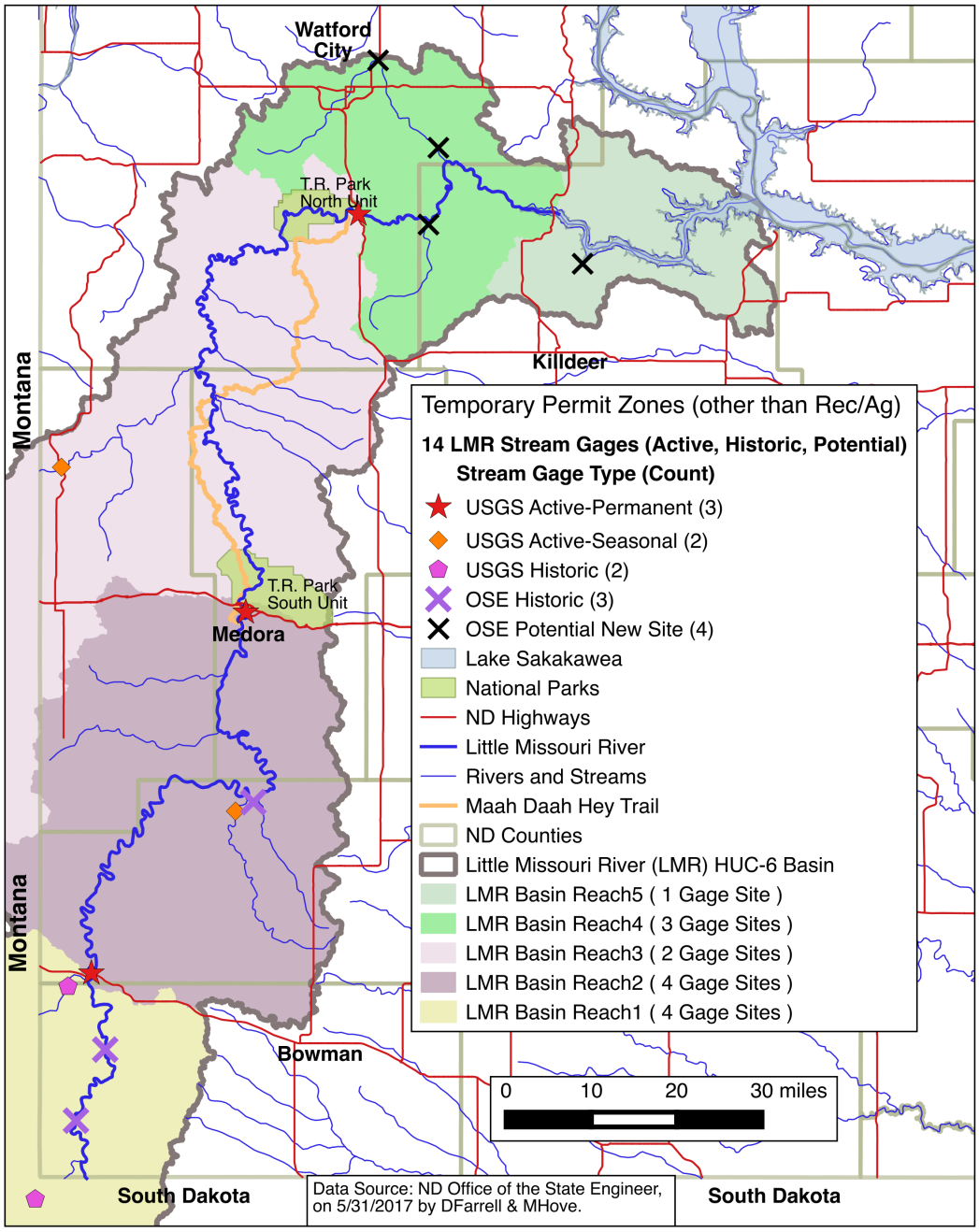


Figure 8. Locations of Little Missouri River basin gages, including discontinued historical gages and potential future gages.

Main Stem gages

Historical Discontinued Main Stem Gages

A seasonal staff gage was maintained on the main stem of the Little Missouri River for several years by the Office of the State Engineer (OSE). This seasonal gage was located at a ford of the Little Missouri River, locally known as Hanson's Crossing, in the southwest quarter of the southeast quarter of the northeast quarter of Section 17, Township 136 North, Range 102 West of Slope County. The staff gage was monitored on a monthly basis generally during the months of April through November over a period from 1985 through 1993.

Two other seasonal sites were temporarily monitored on the main stem of the Little Missouri River. These two sites were observed on September 2011 as part of a larger study. One site was in the southwest quarter of Section 13, Township 131 North, Range 106 West of Bowman County. The other site was located in the northeast quarter of Section 32, Township 130 North, Range 106 West of Bowman County.

Currently Monitored Main Stem Gages

The Camp Crook gage is located on the east side of Camp Crook, SD. This gage is referenced with the North Dakota gages through the use of global positioning. The camp Crook gage was initially established in September 1903 and operated until November 1906. The gage was re-established in May 1956 at the request of the South Dakota Department of Natural Resources in response to a major flood in 1952 and has operated continuously since. This gage is located at River Mile 262 (estimated) and monitors the stream flow from a drainage area of 1,966 square miles.

The next stream flow monitoring gage on the main stem Little Missouri River is the gage at Marmarth, in Slope County, North Dakota. The Marmarth gage has operated continuously since March 1938. This gage is located at River Mile 384 (estimated) and monitors the stream flow from a drainage area of 4,640 square miles.

The USGS stream flow monitoring gage at Medora, Billings County, North Dakota is the next main stem monitoring station on the Little Missouri River. The gage has operated continuously since March 2001. This gage was operational for periods since 1903; specifically, from May 1903 through October 1908; May 1923 through September 1924; October 1928 through September 1934; and October 1945 through September 1975. The Medora gage has operated continuously from March 2001 to the present time.

The stream flow monitoring gage identified as the Little Missouri river near Watford City, McKenzie County, ND, is the next gage on the main stem of the Little Missouri river. The gage has operated continuously since October 1934 to the present period. Review of the daily flow measurements from October 1994 to the present date indicated that the flow has fallen below 50

cubic feet per second for 13.6% of the observations, and below 30 cubic feet per second for about 8% of the observations.

Potential Future Main Stem Gages

Current gages on the Main Stem of the Little Missouri River are considered adequate for effective management. There are, therefore, no current plans to increase the amount of stream flow monitoring on the main stem of the Little Missouri River. Vigilance on the monitoring program is recommended to be emphasized, as the proposed 2018 fiscal year budget indicates a substantial reduction in programs sponsored by the U.S. Geological Survey.

Tributary gages

A recent emphasis within the Water Appropriation Division of the Office of the State Engineer has been more effective management of tributaries, which are most highly prone to depletions in dry years, and are subject to poorly predictable climate fluctuations.

Historical (Discontinued) Tributary Gages

Little Beaver Creek empties into the Little Missouri River near Marmarth, North Dakota. The drainage area for the Little Beaver Creek encompasses approximately 587 square miles from the former gage site and about 623 square miles at the confluence with the Little Missouri River. The stream flow monitoring unit on the Little Beaver Creek operated continuously from April 1938 to October 1979.

Boxelder Creek empties into the Little Missouri River near the South Dakota-North Dakota border. This creek has a drainage area of 1,097 square miles, primarily in Montana. A stream flow monitoring gage was formerly installed on Box Elder Creek near the confluence with the Little Missouri River and was operational from 1960 through 1975.

Current Tributary Gages

A stream flow monitoring station is present on a tributary between the Marmarth gage and the Medora gage. The stream flow monitoring gage on Deep Creek is a seasonal gage; operating during the periods of May through October. Deep Creek upstream of the gage has drainage area of 250 square miles. The gage has a record of 40 years of seasonal data.

Another seasonal tributary stream flow monitoring gage is located on Beaver Creek. This creek empties into the Little Missouri River downstream of the Medora gage. The stream flow monitoring gage is located several miles upstream on the tributary close to Highway 16 near Trotters, ND. The drainage area at the gage is about 616 square miles, whereas the drainage area is 871.77 square miles at the confluence with the Little Missouri River. This gage records stream flow data during the period from May through October. This gage has seasonal data from 1977 to the present, or about 40 years.

Potential Future Tributary Gages

Additional locations for stream flow monitoring gages have been considered to properly manage the tributaries. Four potential monitoring sites are discussed below.

Two potential useful stream flow monitoring sites are located in the Cherry Creek watershed of the Lower Little Missouri River sub-basin. One of these sites could be located in the southeast quarter of Section 34, Township 151 North, Range 98 West of McKenzie County. This location is about three miles northeast of Watford City and would assist in the proper resource management of several water depots in the upper portion of the Cherry Creek watershed.

The second location within the Cherry Creek watershed is in the northeast quarter of Section 26, Township 149 North, Range 97 West. This location is about two miles upstream of the confluence of Cherry Creek with the Little Missouri River.

A third potential location for additional stream flow monitoring is on Crosby Creek, in the northwest quarter of the northwest quarter of Section 8, Township 147 North, Range 97 West.

A fourth possible useful location for additional streamflow monitoring on a tributary to the Little Missouri River is on Jim Creek, in the northwest quarter of the southwest quarter of Section 32, Township 147 North, Range 94 West.

These locations would aide in the proper management of the incoming waters to the Little Missouri River and the operational review of several water depots in the respective watersheds.

Effect of Water Use Trends on Gaging Needs

The gages presently existing on the Little Missouri River have proven to be an adequate resource for the management of the riverine system for seasonal uses, such as irrigation. Many of the irrigation permits issued by the North Dakota State engineer were initially water spreading and water flooding permits, using the high flows from the spring snowmelt runoff and runoff from large precipitation events that would normally occur throughout the summer. As the economy changed, so did the need to better manage the water resource and the economics of irrigation. Many of the soil types found in the Little Missouri river valley responded much better to a rainfall type of irrigation rather than a flooding style. A large percentage of the irrigation systems now in the Little Missouri River basin have made the change from flooding type of irrigation to the sprinkler type. This irrigation change has improved the efficiency of the irrigation and lessened the need for large volumes of water in the spring and late summer. Several irrigators have added off-stream storage to take advantage of the high springtime flows. Water is withdrawn during these high flows and directed into the off-stream storage units, where the water can be more precisely metered out over the remainder of the irrigation season.

Future Monitoring Recommendations

The following conclusions and recommendations are offered for monitoring of the Little Missouri River:

- Current gages on the mainstem are adequate for effective management.
- Additional gages on some of the tributaries, particularly those in Reaches #4 and #5 having high activity and demand, and sensitive to fluctuations in climate would be beneficial for more effective management. Tributaries recommended for consideration of further monitoring include:
    - Cherry Creek (Reach #4)
    - Crosby Creek (Reach #4)
    - Jim Creek (Reach #5)

INTERIM LITTLE MISSOURI RIVER WATER APPROPRIATION POLICY

In signing the Water Commission Appropriation bill (HB 1020) which broadened water appropriation authority to include "temporary" water uses from the Little Missouri River, Governor Burgum requested that the State Engineer deploy a temporary limited use policy pending revival of the Little Missouri River Commission and further examination of the issue for a final policy. The interim limited use policy was deployed on May 3, 2017. In general, the policy includes: (1) no conditional or perfected water permits for industrial use issued anywhere within the basin; (2) no temporary industrial water permits issued upstream of the Long-X bridge; (3) aesthetic conditions added for temporary industrial water permits issued on the Little Missouri River mainstem downstream of the Long-X bridge. The full policy and signed policy statement is included on the next page.

State of North Dakota
Office of the State Engineer

900 EAST BOULEVARD AVE. • BISMARCK, ND 58505-0850
(701) 328-2750 • FAX (701) 328-3696 • http://swc.nd.gov

Interim Policy for issuing Temporary Industrial Water-Depot Permits
in the Little Missouri River Basin
Developed by the Water Appropriation Division of the Office of the State Engineer
May 3, 2017

This policy will be used in the interim period until a formal policy is adopted by the State Engineer after consultation with the Little Missouri River (LMR) Commission and the Governor's Office, which is expected to occur by July 15, 2017.

The Office of the State Engineer will continue to process temporary water permit applications for locations in the Little Missouri River Basin that drain into the LMR downstream (generally east) of the Highway 85 crossing (Long X bridge). The following condition will be added to all the temporary water permits issued:

1) This permit is subject to cancellation or curtailment if it is deemed to significantly impact the free-flowing natural state of the Little Missouri River.

If the proposed withdrawal is directly from the mainstem or within 100' of the confluence with the mainstem of the LMR, the following conditions shall be added to the permit.

1) Precautions shall be taken to minimize the visual and audible disruption to the scenic Little Missouri River valley.
2) The shorelines in and around intake locations shall be kept free of construction debris and litter.
3) Pumps and motors shall be sheltered from view for those wishing to travel along the waterway.
4) Pumps and motors shall be set back from the shoreline sufficient distance to ensure any fluids or oils that may leak from these will be contained before they have a chance to enter the stream. Portable containment for pump and motor fluid leakage may be required upon order of the State Engineer.
5) Internal combustion motors shall be muffled to maintain the tranquility and ambiance and minimize audible disruption of the scenic river experience.

New temporary industrial permits will not be issued upstream of the Highway 85 Long X Bridge.

Approved by:

Garland Erbele, P.E.
State Engineer

Date: May 5, 2017

GARLAND ERBELE
SECRETARY AND STATE ENGINEER

RECOMMENDED FUTURE POLICY OPTIONS

Future policy restrictions on issuance of temporary water permits for industrial use will be issued by the State Engineer in cooperation with the North Dakota State Water Commission and with advisory input from the Little Missouri River Commission.

The office of the State Engineer and State Water Commission are distinct entities, both possessing statutory regulatory control over the waters of the state. The Office of the State Engineer has the primary regulatory authority for the appropriation of the waters of the state under chapter N.D.C.C. ch. 61-04. However, N.D.C.C. §61-02-14 establishes the duties and powers of the Commission as including: *"To control the low-water flows for streams of the state"* (§61-02-14.1.a); and *"To define, declare, and establish rules and regulations ... for the full and complete supervision, regulation, and control of the water supplies within the state"* (§61-02-14.2.b). Policy and regulation for the appropriation of water is normally established and administered by the office of the State Engineer. However, in some rare cases having broad consequences, involvement of the Commission in setting macro-policy is invoked. Because of the complexity and weight of issues treated in the Little Missouri River Scenic River Act, temporary water permitting policy for industrial use in the Little Missouri River watershed warrants the involvement of the Water Commission. The role of the Little Missouri River Commission is advisory to the Office of the State Engineer and the State Water Commission.

Included among considerations will be: (1) the Little Missouri State Scenic River Act (N.D.C.C. ch. 61-29), its requirements, purpose and intent; (2) public interest water requirements for road and infrastructure construction; (3) public interest requirements for a well-distributed water supply system when large water supplies for oil-field use are transported within the basin, including safety and road damage consideration; and (4) recreation, wildlife and aesthetic considerations within the basin.

Current Interim policy is shown on the previous page (p. 30). The following condition was cited in that policy:

1) *"This permit is subject to cancellation or curtailment if it is deemed to significantly impact the free-flowing natural state of the Little Missouri River."*

Current standard operating procedures for implementing this condition downstream of the Long-X bridge are:

1. Maximum pumping rate is 1,000 gpm from the mainstem of the river, and,
2. All pumping is curtailed when flows at the nearest upstream gage are below 30 cfs (about 10% of the median flow).

The following options are offered for consideration:

1. The current interim (May 3, 2017) policy of the State Engineer outlined above, with minimum flow restrictions and maximum pumping rates appropriate to river flow conditions and protection of downstream uses.
2. The same policy as (1) with the additional allowance of temporary water use diversions for road and infrastructure construction and repair only, upstream of the Long-X bridge. This would allow for state, county and township use of small diversions for necessary public infrastructure needs.
3. The same policy as 2, but allowing for limited seasonal industrial use by water depots upstream of the Long-X bridge, from September 15 through May 15[10], outside of the tourist and irrigation season.
4. Other possible options proposed by the commissions.

Note: For purposes of consideration by the Commission, an e-mail correspondence from Jan Swenson representing the Badlands Conservation Alliance to Cassandra Torstenson, of the Governor's office, expressing several concerns is appended (APPENDIX G). Satellite images indicating the upstream confluence of the Little Missouri River with Lake Sakakawea are shown on Figures G-1, G-2 and G-3.

[10] Differences between suggested options downstream and upstream of the Long-X bridge are due entirely to the critical importance of the River to two national parks, the mah da hey trail, and other recreational and agricultural uses in the upstream reach of the river.

APPENDIX A. Flow Records for The Marmarth, Medora and Long-X Gages

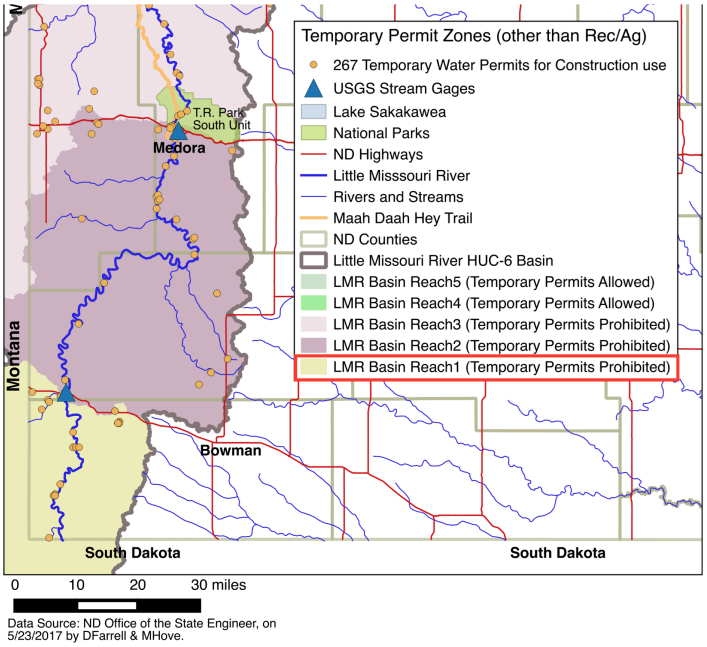
Table A-1. Total Annual Flow (acre-feet per year) at the Marmath, Medora, and Long-X gages.

	USGS STREAM-MONITORING GAGES		
YEAR	**MARMARTH**	**MEDORA**	**LONG X**
1990	79,709.10		130,604.19
1991	41,121.50		106,134.00
1992	22,877.45		48,578.39
1993	314,420.17		432,282.49
1994	249,986.84		355,396.87
1995	364,953.28		540,081.62
1996	446,472.30		688,785.06
1997	326,148.49		624,713.71
1998	123,292.09		192,069.24
1999	316,664.48		456,825.07
2000	39,528.76		72,903.78
2001	255,851.00		549,493.23
2002	21,501.91	38,153.22	77,102.81
2003	53,718.57	90,785.84	140,015.80
2004	69,863.11	97,591.16	132,848.50
2005	94,622.88	161,662.50	243,471.11
2006	221,390.03	262,656.32	350,763.47
2007	145,083.59	167,743.85	219,145.72
2008	316,302.49	293,931.82	292,049.50
2009	476,010.28	579,537.99	719,770.97
2010	299,795.98	373,568.52	452,770.84
2011	1,015,005.94	1,143,872.60	1,474,726.89
2012	46,840.86	61,537.45	93,030.15
2013	175,924.71	219,724.90	308,990.40
2014	395,866.80	545,800.98	763,788.35
2015	130,821.38	192,214.04	294,221.41
2016	52,125.84	75,799.66	108,885.09

APPENDIX B: Temporary Industrial Water Permit Allocations for Construction from the Little Missouri River

Figure B-1. Temporary industrial water permit allocations for construction in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #1).

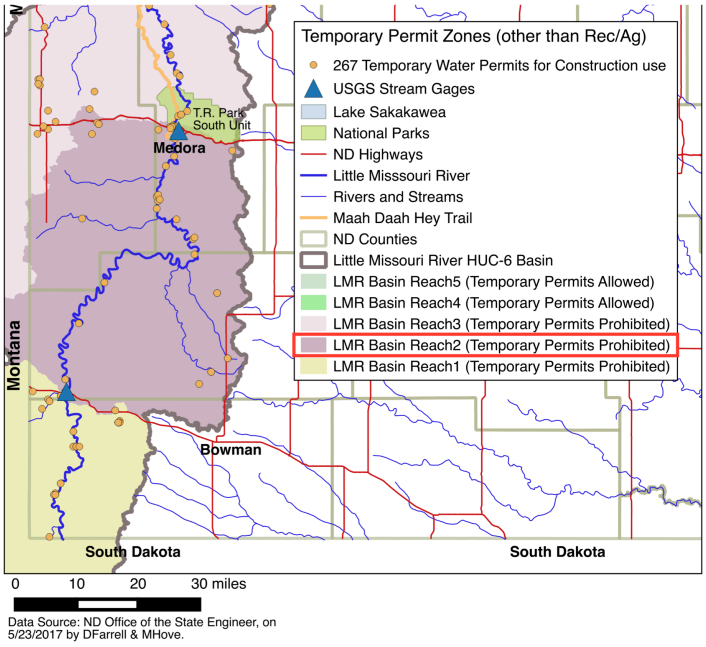
Begin Year	Permit Count	Reach #1 Construction Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	0	0.0	None	None
1992	1	3.8	3.8	3.8
1993	0	0.0	None	None
1994	0	0.0	None	None
1995	0	0.0	None	None
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	1	0.2	0.2	0.2
1999	2	31.3	0.6	30.7
2000	3	7.5	0.8	5.5
2001	0	0.0	None	None
2002	6	7.4	0.2	5.5
2003	2	12.3	6.1	6.1
2004	1	0.5	0.5	0.5
2005	3	2.3	0.5	1.1
2006	2	1.8	0.3	1.5
2007	3	3.2	0.3	1.8
2008	4	54.1	0.3	50.0
2009	2	50.5	0.5	50.0
2010	9	107.4	0.5	49.8
2011	4	95.8	1.1	41.1
2012	4	22.7	0.8	10.1
2013	2	18.0	6.3	11.8
2014	3	51.5	0.8	50.0
2015	3	2.3	0.8	0.8
2016	8	119.5	0.3	50.0
Grand Totals	**63.0**	**592.2**		



Data Source: ND Office of the State Engineer, on 5/23/2017 by DFarrell & MHove.

Figure B-2. Temporary industrial water permit allocations for construction in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #2).

Begin Year	Permit Count	Reach #2 Construction Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	1	3.8	3.8	3.8
1991	6	181.1	3.3	55.2
1992	4	12.3	3.1	3.1
1993	1	4.2	4.2	4.2
1994	1	14.3	14.3	14.3
1995	2	6.5	1.5	5.0
1996	1	0.6	0.6	0.6
1997	2	1.5	0.7	0.7
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	1	1.5	1.5	1.5
2001	3	3.4	0.3	1.5
2002	6	27.3	0.1	7.7
2003	1	2.8	2.8	2.8
2004	1	12.2	12.2	12.2
2005	0	0.0	None	None
2006	1	0.1	0.1	0.1
2007	1	1.2	1.2	1.2
2008	0	0.0	None	None
2009	0	0.0	None	None
2010	2	33.7	6.1	27.6
2011	6	90.6	0.5	41.1
2012	2	1.7	0.0	1.7
2013	0	0.0	None	None
2014	2	3.8	0.8	3.1
2015	0	0.0	None	None
2016	7	111.1	0.1	50.0
Grand Totals	**51.0**	**513.7**		



Data Source: ND Office of the State Engineer, on 5/23/2017 by DFarrell & MHove.

Figure B-3. Temporary industrial water permit allocations for construction in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #3).

Begin Year	Permit Count	Reach #3 Construction Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	3	7.9	2.6	2.6
1991	5	49.5	0.0	21.6
1992	4	65.7	1.2	30.7
1993	0	0.0	None	None
1994	3	30.0	1.3	14.3
1995	0	0.0	None	None
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	1	16.8	16.8	16.8
1999	3	62.5	1.1	30.7
2000	0	0.0	None	None
2001	4	8.4	0.8	3.1
2002	2	12.4	0.1	12.3
2003	1	4.4	4.4	4.4
2004	5	3.8	0.7	0.8
2005	0	0.0	None	None
2006	2	10.5	0.2	10.4
2007	1	0.8	0.8	0.8
2008	3	2.5	0.0	1.5
2009	5	49.6	0.2	41.4
2010	6	3.3	0.0	1.5
2011	7	56.5	3.5	14.0
2012	5	14.7	0.0	8.4
2013	2	13.5	3.2	10.3
2014	2	1.5	0.0	1.5
2015	0	0.0	None	None
2016	2	0.0	0.0	0.0
Grand Totals	**66.0**	**414.2**		

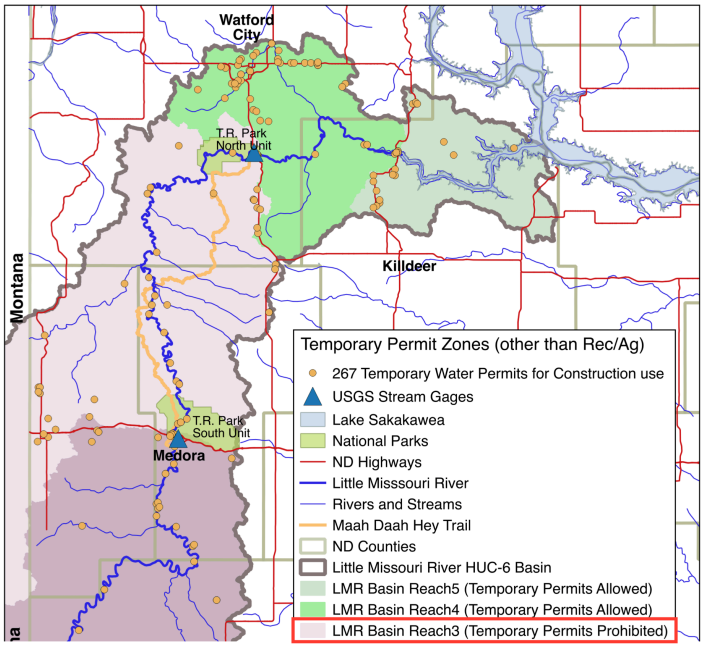


Figure B-4. Temporary industrial water permit allocations for construction in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #4).

Begin Year	Permit Count	Reach #4 Construction Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	1	53.5	53.5	53.5
1992	1	6.0	6.0	6.0
1993	5	151.4	3.1	46.4
1994	4	7.9	1.7	2.8
1995	1	2.5	2.5	2.5
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	2	26.0	9.2	16.8
1999	1	3.1	3.1	3.1
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	1	0.3	0.3	0.3
2003	1	0.1	0.1	0.1
2004	2	10.7	1.5	9.2
2005	0	0.0	None	None
2006	0	0.0	None	None
2007	0	0.0	None	None
2008	0	0.0	None	None
2009	1	3.7	3.7	3.7
2010	3	6.3	0.0	3.2
2011	7	28.9	0.4	14.0
2012	10	67.1	0.8	30.7
2013	4	76.9	0.9	28.0
2014	15	266.6	3.1	30.7
2015	4	98.3	0.0	61.4
2016	6	180.1	0.8	167.3
Grand Totals	**69.0**	**989.4**		

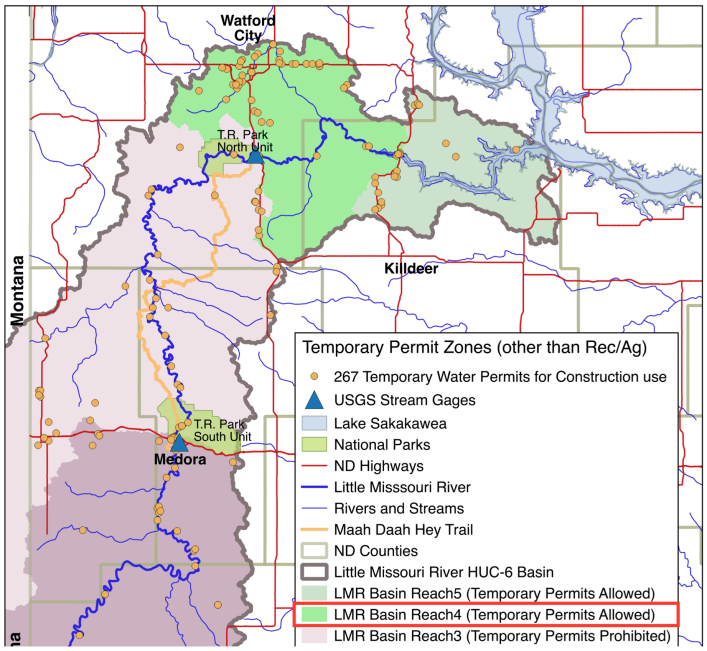


Figure B-5. Temporary industrial water permit allocations for construction in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #5).

Begin Year	Permit Count	Reach #5 Construction Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	1	4.6	4.6	4.6
1992	0	0.0	None	None
1993	0	0.0	None	None
1994	0	0.0	None	None
1995	0	0.0	None	None
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	0	0.0	None	None
2004	2	10.7	1.5	9.2
2005	0	0.0	None	None
2006	0	0.0	None	None
2007	0	0.0	None	None
2008	1	0.5	0.5	0.5
2009	0	0.0	None	None
2010	0	0.0	None	None
2011	7	76.9	0.1	15.3
2012	3	66.0	6.1	44.5
2013	4	146.7	4.7	48.7
2014	0	0.0	None	None
2015	0	0.0	None	None
2016	0	0.0	None	None
Grand Totals	**18.0**	**305.4**		

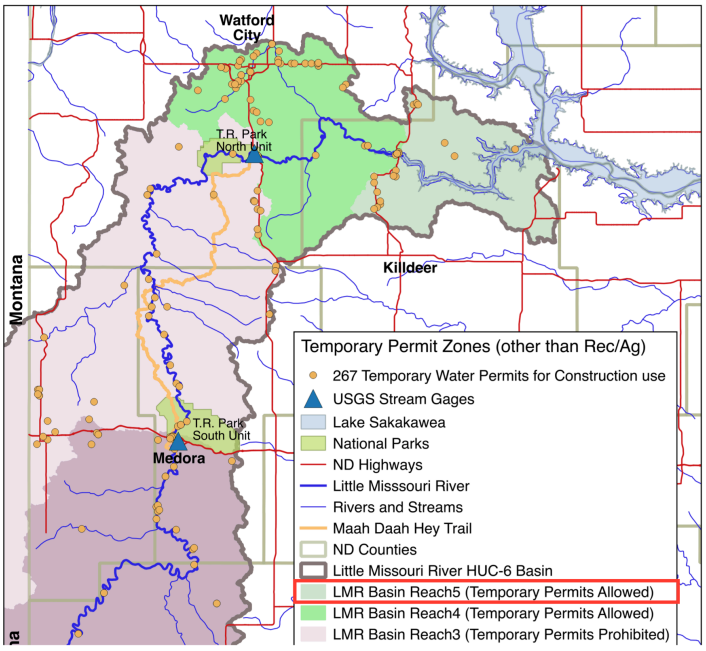


Table B-1. Estimated annual water use for temporary permitted industrial water use (acre-feet per year) for road repair and construction for river reaches 1-5. Calculated as 35% of allocations on tables in Figures B-1 through B-5.

ESTIMATED ACTUAL CONSTRUCTION USE (X 0.35)					
YEAR	REACH #1	REACH #2	REACH #3	REACH #4	REACH #5
1990	0.0	1.3	2.8	0.0	0.0
1991	0.0	63.4	17.3	18.7	1.6
1992	1.3	4.3	2.0	2.1	0.0
1993	0.0	1.5	0.0	53.0	0.0
1994	0.0	5.0	10.5	2.8	0.0
1995	0.0	2.3	0.0	0.9	0.0
1996	0.0	0.2	0.0	0.0	0.0
1997	0.0	0.5	0.0	0.0	0.0
1998	0.1	0.0	5.9	9.1	0.0
1999	0.2	0.0	0.4	1.1	0.0
2000	0.3	0.5	0.0	0.0	0.0
2001	0.0	1.2	0.3	0.0	0.0
2002	0.1	9.6	0.0	0.1	0.0
2003	2.1	1.0	1.5	0.0	0.0
2004	0.1	4.3	0.2	3.8	0.5
2005	0.1	0.0	0.0	0.0	0.0
2006	0.1	0.0	0.1	0.0	0.0
2007	0.1	0.4	0.3	0.0	0.0
2008	0.1	0.0	0.0	0.0	0.2
2009	0.2	0.0	0.1	1.3	0.0
2010	0.2	11.8	0.0	2.2	0.0
2011	0.4	31.7	1.2	10.1	0.0
2012	0.3	0.6	0.0	23.5	2.1
2013	2.2	0.0	1.1	26.9	1.6
2014	0.3	1.3	0.0	93.3	0.0
2015	0.3	0.0	0.0	34.4	0.0
2016	0.1	38.9	0.0	63.0	0.0

Table B-2. Estimated annual water use for temporary permitted industrial water use, as percent of annual flow at the nearest upstream gage. *Reach #1 is percent of the nearest downstream (Marmarth) gage, because there is no upstream gage in North Dakota.

ANNUAL ESTIMATED USE (% OF FLOW)				
YEAR	REACH #1*	REACH #2	REACH #3	REACHS #4&#5
1990	0.00	0.00	-	0.00
1991	0.00	0.15	-	0.00
1992	0.01	0.02	-	0.00
1993	0.00	0.00	-	0.00
1994	0.00	0.00	-	0.00
1995	0.00	0.00	-	0.00
1996	0.00	0.00	-	0.00
1997	0.00	0.00	-	0.00
1998	0.00	0.00	-	0.00
1999	0.00	0.00	-	0.00
2000	0.00	0.00	-	0.00
2001	0.00	0.00	-	0.00
2002	0.00	0.04	0.00	0.00
2003	0.00	0.00	0.00	0.00
2004	0.00	0.01	0.00	0.00
2005	0.00	0.00	0.00	0.00
2006	0.00	0.00	0.00	0.00
2007	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	0.00
2011	0.00	0.00	0.00	0.00
2012	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00
2014	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00
2016	0.00	0.07	0.00	0.00

APPENDIX C: Transitional Water Appropriation Policy and Oil Field Water Use During the Bakken Play

Water Appropriation policy during the expansion of the Bakken Play was governed by several factors, including but not limited to:

- Limited groundwater and surface water availability in western North Dakota
- Unprecedented large demands for water
- Concerns over depletion of the Fox Hills regional aquifer
- Federal reservoir policy, and
- Needs for a well distributed water supply to allay a regional crisis in human safety and welfare caused by road and infrastructure damage and over use for delivery of water over long distances.

In brief summary:

Water Demand

At the beginning of the Bakken Play, estimating 1,500 to 1,800 hydraulic fracturing jobs per year at 2 to 6 acre-feet per well, resulted in projected annual water use of 15,000 to 30,000 acre-feet per year.[1] Actual recorded use is shown on Figure F-1.

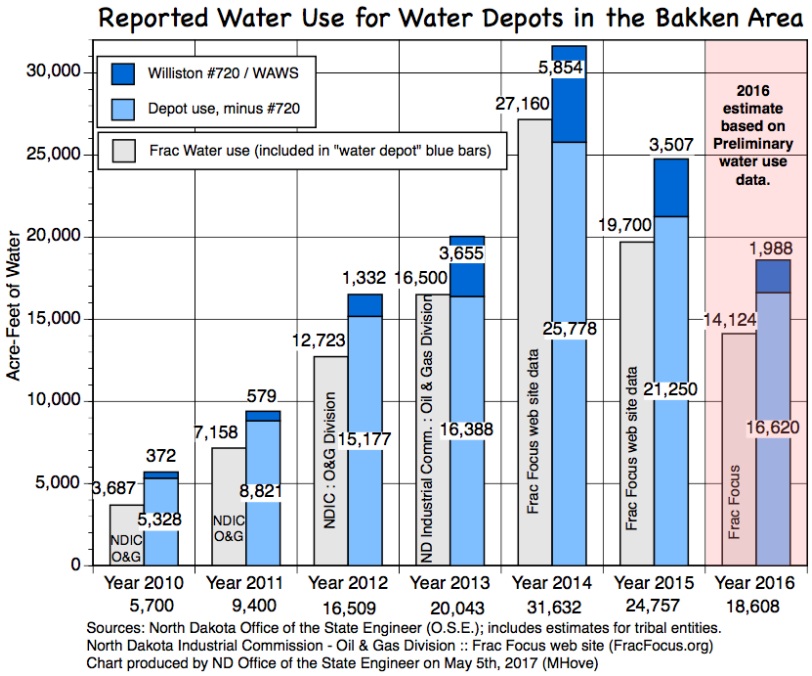


Figure C-1. Water depot use from 2010 through 2016: all units in acre-feet.

[1] Schuh, W.M. 2010. Current Water Appropriation Requirements, Current Water Use, & Water Available for Energy Industries in North Dakota: a 2010 Summary. Pp. 42-43. Download available at: http://www.swc.nd.gov/info_edu/reports_and_publications/pdfs/wr_investigations/wr49_report.pdf.

The numbers of hydraulic factures for each year since provides demonstrates the intensity of oil-field activity, but not necessarily water use. With the development of "slick fracing", which uses much larger amounts of water, future water demand is expected to be increasing as activity increases. This is shown by the increase in average water use per hydraulic fracture (Figure F-2). Future pressure on limited local water could be challenging for the region.

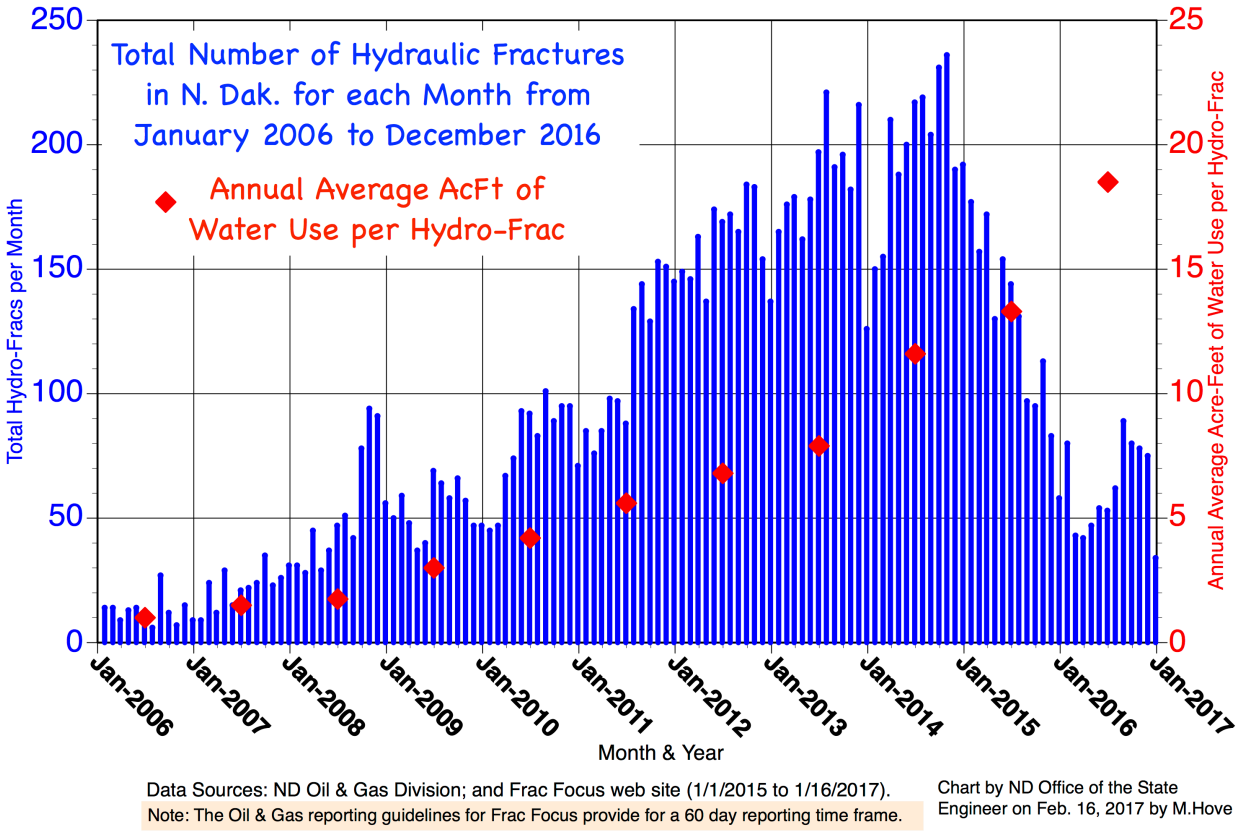


Figure C-2. Trends in the numbers of hydraulic fractures and the amount of water used per hydraulic fracture.

Water supply limitations

Water available for industrial use in western North Dakota was summarized by the North Dakota State Water Commission Water Appropriation Division Staff (2010). [2]

Surface water: The only large supply of unappropriated surface water in western North Dakota is the Missouri River.

Groundwater: North of the Missouri River, in the Missouri Coteau and Coteau Slope Physiogrpahic Regions, there are some glaciofluvial aquifers, but much of the available water is either of poor quality, or has been appropriated for irrigation use.

[2] Ibid, Schuh

Fox Hills Restrictions

Regional aquifers include the Dakota Aquifer (approx. 3,500 to 6,000 feet below land surface), which has very saline and sodic water; and the Fox Hills-Hell Creek aquifer (approx. 1,100 to 2,000 feet below land surface in the Bakken region); and the Sentinal Butte Formation overlying the Fox Hills aquifer , from which water of inconsistent quality can be pumped, usually at low rates (5 to 200 gpm). The Sentinel Butte aquifer is unable to supply water at adequate rates for many oil-field uses. Water quality of the Dakota aquifer limits its usefulness. The only large-scale groundwater supply with substantial supply capability is the Fox Hills aquifer. The Fox Hills aquifer, however, has some serious limitations as a large-scale water supply.

The Fox Hills aquifer is an artesian aquifer that supplies ranchers in isolated areas with livestock water through flowing wells. In the 1980s concerns were raised over falling pressure head in the livestock wells, resulting from use. Recent studies have confirmed that the trend of decreasing pressure head will cause many of the wells to cease flowing in the following decades.[3] To preserve this water source a restrictive policy on industrial water use of the Fox Hills aquifer was initiated in the 1980s.[4]

Federal Policy

In January of 2009, anticipating a large acceleration of the Bakken Play in 2010, Bob Shaver, then Director of the Water Appropriation Division, wrote a memorandum to the State Engineer stating that the only large water supply available for oil-field development in western North Dakota is the Missouri River system. On December 9 of 2009, a planning meeting at the Ramkota Inn in Bismarck, which included oil industry personnel, then Governor Hoeven, several state legislators, and state and local officials, was apprised of the water limitations.

In May of 2010, just as the accelerated oil-field activity began, Asst. Secretary of the Army Jo Ellen Darcy announced that a 3 to 7-year hiatus on diversions from the Missouri River in the Lake Sakakawea segment would be put in place. This cut off one of the main supplies of water for oil-industry use.

Water Supply Distribution and Public Safety

Federal restrictive policies caused a water supply crisis in western North Dakota, which resulted in long-distance truck hauling of large quantities of water. This resulted in severe damage to road infrastructure, and a large increase in accidents, injuries, and fatalities in northwestern North Dakota. Accidents approximately tripled (Figure C-3), injuries increased by more than five times (Figure C-4), and fatalities increased by as many as 8 times predevelopment rates (C-5). County and State Road damage expenditures increased ten-fold in the Bakken Play counties (Table C-1)

To lessen truck traffic density, a well-distributed water supply was needed. Short term measures included:

- Widespread use of temporary industrial water permits. This was greatly assisted by the flood year of 2011.

[3] Fox Hills Policy and documentation can be downloaded at: http://www.swc.nd.gov/pdfs/fox_hills_policy.pdf

[4] Ibid

- Long-distance piping of water from Missouri River sources west of the reservoir.
- Emergency use of water permitted for irrigation for temporary industrial use (the "In Lieu of Irrigation" program which ended in Sept. of 2016).
-

Long-term measures included:

- Development of the Western Area Water Supply Project (WAWS). The WAWS portion of the Bakken Water Supply is shown on Fig. F-1.
- Gradual relaxation federal restrictions on industrial water use from the Garrison Reservoir.

Temporary water permits provided an important component of water supply distribution throughout the Bakken Region.

The Little Missouri River Basin in Reaches #4 and #5 was included in the temporary water permit component of the Bakken water supply effort.

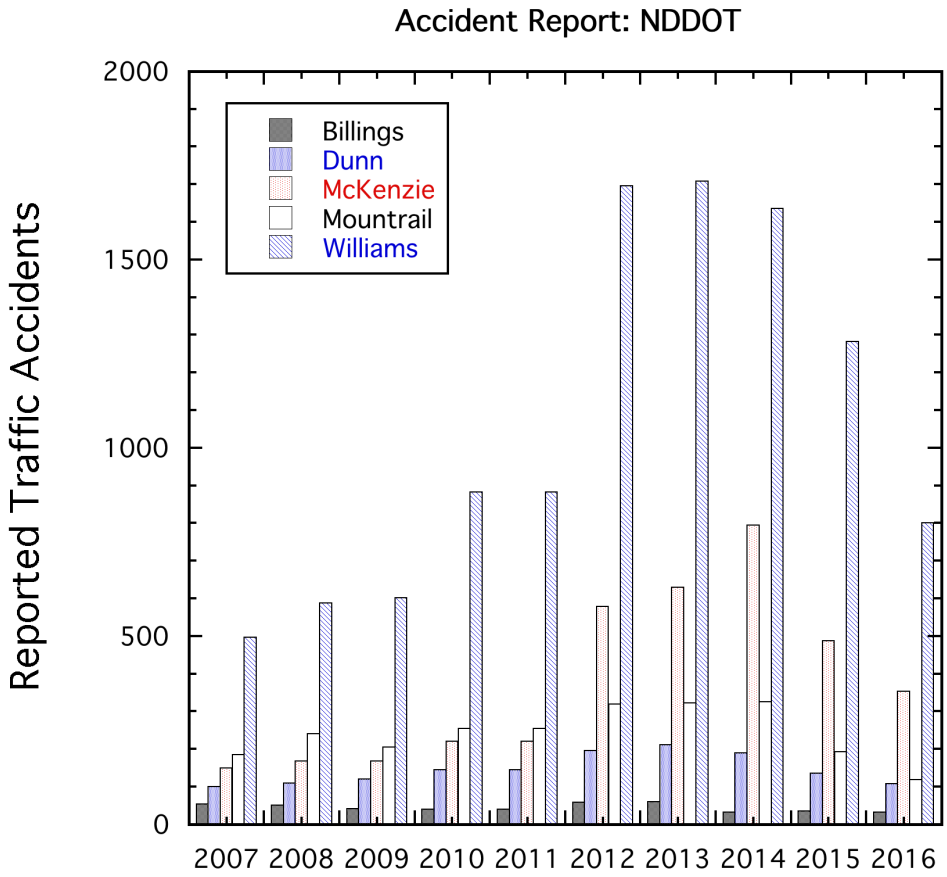


Figure C-3 Accident report summary for northwestern North Dakota. (Data provided by Lynn Heinert, Traffic Records Manager, FARS Analyst, North Dakota Department of Transportation, May 23, 2017).

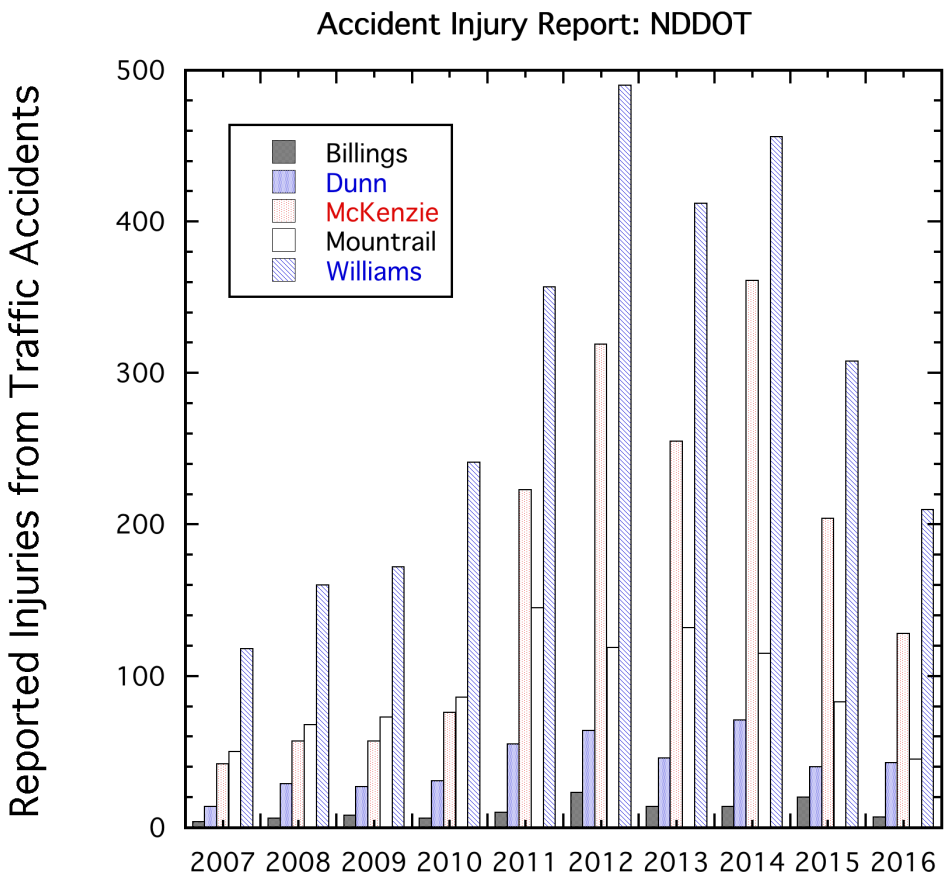


Figure C-4. Accident report injury summary for northwestern North Dakota. (Data provided by Lynn Heinert, Traffic Records Manager, FARS Analyst, North Dakota Department of Transportation, May 23, 2007).

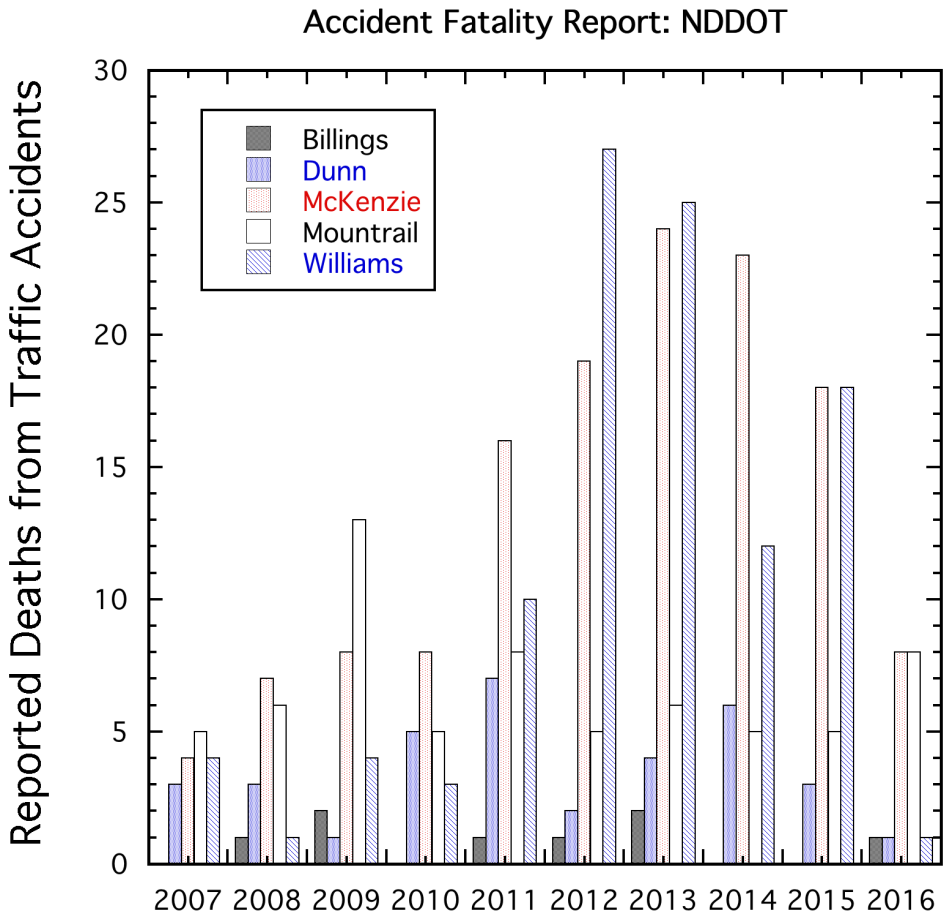


Figure C-5 Accident report fatality summary for northwestern North Dakota. (Data provided by Lynn Heinert, Traffic Records Manager, FARS Analyst, North Dakota Department of Transportation, May 23, 2007).

Table C-1. Annual county road repair cost trends from 2005 through 2016 in the Bakken Play region. Data provided by Phill Murdoff, North Dakota Department of Transportation.

NDDOT

Rural and Urban Road Construction
Construction Years 2005 - 2017

Construction Year	Billings	Dunn	McKenzie	Mountrail	Williams	Totals
2005 - Rural	$975,000	$4,108,000	$4,514,000	$17,683,000	$2,436,000	$29,716,000
2005 - Urban					$600,000	$600,000
2006 - Rural			$2,741,000	$6,755,000	$11,550,000	$21,046,000
2006 - Urban					$1,715,000	$1,715,000
2007 - Rural	$7,566,000	$2,849,000		$14,832,000	$9,444,000	$34,691,000
2007 - Urban					$989,000	$989,000
2008 - Rural		$2,579,000	$7,761,000	$10,511,000	$7,143,000	$27,994,000
2008 - Urban					$353,000	$353,000
2009 - Rural	$1,527,000	$4,119,000	$7,551,000	$11,501,000	$9,906,000	$34,604,000
2009 - Urban					$1,886,000	$1,886,000
2010 - Rural	$2,986,000		$25,052,000	$6,551,000	$3,243,000	$37,832,000
2010 - Urban				$78,000	$2,169,000	$2,247,000
2011 - Rural	$11,694,000	$39,001,000	$76,863,000	$51,396,000	$1,546,000	$180,500,000
2011 - Urban					$1,840,000	$1,840,000
2012 - Rural	$852,000	$48,741,000	$61,471,000	$44,074,000	$60,504,000	$215,642,000
2012 - Urban					$1,861,000	$1,861,000
2013 - Rural	$26,006,000	$75,462,000	$177,738,000	$89,880,000	$106,548,000	$475,634,000
2013 - Urban					$13,572,000	$13,572,000
2014 - Rural	$305,000	$5,446,000	$221,755,000	$37,871,000	$107,003,000	$372,380,000
2014 - Urban				$122,000	$24,886,000	$25,008,000
2015 - Rural	$14,642,000	$57,712,000	$93,212,000	$36,533,000	$83,484,000	$285,583,000
2015 - Urban					$1,012,000	$1,012,000
2016 - Rural	$26,088,000	$54,882,000	$59,155,000	$4,001,000	$21,340,000	$165,466,000
2016 - Urban		$327,000			$1,058,000	$1,385,000
2017 - Rural	$7,557,000	$15,857,000	$18,798,000	$61,781,000	$29,288,000	$133,281,000
2017 - Urban					$17,301,000	$17,301,000
Totals - Rural	$100,198,000	$310,756,000	$756,611,000	$393,369,000	$453,435,000	$2,014,369,000
Totals - Urban	$0	$327,000	$0	$200,000	$69,242,000	$69,769,000

Data extracted from Pacer and RIMS databases

Amounts represent construction contracts and construction engineering

No change orders are included

Multiple county projects are allocated to the primary county

As of 5-24-2017
Revised on 5-25-2017

Table C-2. Annual federally funded State road construction costs for McKenzie, Williams, Billings, Mountraill and Dunn Counties from 2006 through 2016. Data provided by Phil Murdoff, North Dakota Department of Transportation.

McKenzie County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
New Construction	$987,871	$1,850,195	$1,641,276	$2,557,703	$1,763,362	$957,936	$22,394,876	$27,330,109	$27,989,260	$59,979,264	$54,052,085	$201,503,936
Road Maintenance	$5,672	$22,192	$167,745	$504,884	$2,248,280	$11,083,340	$14,893,433	$12,113,010	$13,895,586	$9,505,823	$6,512,398	$70,952,363
Surfacing Materials	$431,501	$190,627	$41,516	$521,261	$1,084,319	$279,272	$743,976	$739,088	$1,754,813	$3,357,905	$3,782,150	$12,926,429
Total	$1,425,044	$2,063,015	$1,850,537	$3,583,848	$5,095,961	$12,320,547	$38,032,284	$40,182,207	$43,639,659	$72,842,992	$64,346,633	$285,382,728

Williams County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
New Construction	$1,098,316	$619,459	$1,779,645	$1,292,587	$1,395,232	$349,187	$11,786,536	$19,448,413	$29,239,345	$48,696,998	$17,045,630	$132,751,346
Road Maintenance	$805,391	$971,231	$1,020,628	$1,501,819	$1,806,750	$3,813,339	$4,287,092	$4,456,002	$3,612,607	$4,186,531	$3,740,664	$30,202,054
Surfacing Materials	$156,790	$243,478	$-	$25,943	$57,129	$1,306,057	$2,945,189	$2,055,012	$2,751,235	$585,499	$2,950,354	$13,076,687
Total	$2,060,496	$1,834,167	$2,800,273	$2,820,349	$3,259,111	$5,468,583	$19,018,817	$25,959,426	$35,603,188	$53,469,028	$23,736,648	$176,030,087

Billings County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
New Construction	$948,352	$677,080	$723,258	$1,335,409	$2,709,978	$3,601,651	$2,677,954	$3,163,044	$5,170,352	$5,396,703	$10,360,814	$36,764,595
Road Maint & Surfacing	$367,878	$725,185	$331,107	$900,820	$1,348,268	$770,463	$3,465,775	$1,921,938	$1,979,372	$2,221,446	$594,471	$14,626,724
Total	$1,316,230	$1,402,265	$1,054,366	$2,236,230	$4,058,246	$4,372,114	$6,143,730	$5,084,982	$7,149,724	$7,618,148	$10,955,285	$51,391,318

Table C-2 (Cont.). Annual federally funded State road construction costs for McKenzie, Williams, Billings, Mountraill and Dunn Counties from 2006 through 2016. Data provided by Phil Murdoff, North Dakota Department of Transportation.

Mountrail County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
New Construction	$486,665	$13,456	$48,106	$1,235,264	$2,785,099	$9,290,964	$37,556,860	$34,890,305	$33,585,710	$28,918,296	$13,307,342
Road Maintenance	$885,746	$1,087,908	$2,132,235	$4,972,052	$7,480,641	$7,554,044	$8,955,461	$11,571,068	$11,626,307	$10,334,107	$5,702,817
Surfacing Materials	$153,273	$177,826	$231,311	$148,452	$769,234	$1,162,915	$1,084,127	$2,106,817	$1,759,575	$3,148,350	$2,993,249
Township Asst.	$-	$-	$41,143	$270,577	$98,518	$6,464	$-	$44,945	$1,261,881	$2,190,712	$447,023
Total	$1,525,685	$1,279,190	$2,411,651	$6,355,767	$11,034,975	$18,007,923	$47,596,448	$48,568,190	$46,971,592	$42,400,753	$22,003,408

Dunn County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
New Construction	$672,360	$459,717	$446,398					$645,966	$261,176	$268,918	$424,302
Road Maintenance											
Surfacing Materials											
Total	$672,360	$459,717	$446,398	$-	$-	$-	$-	$645,966	$261,176	$268,918	$424,302

APPENDIX D: Temporary Industrial Water Permit Allocations and Use for Water Depots From the Little Missouri River

Figure D-1. Temporary water permit allocations from water depots in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #1).

Begin Year	Permit Count	Reach #1 Industrial (D&O) Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	0	0.0	None	None
1992	0	0.0	None	None
1993	0	0.0	None	None
1994	0	0.0	None	None
1995	3	3.9	1.3	1.3
1996	2	1.4	0.5	0.9
1997	5	53.7	0.9	19.3
1998	3	4.5	0.6	2.6
1999	3	51.6	12.9	19.3
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	2	16.0	3.1	12.9
2004	2	6.1	3.1	3.1
2005	2	7.1	3.1	4.0
2006	3	9.2	3.1	3.1
2007	3	15.7	0.2	12.9
2008	0	0.0	None	None
2009	0	0.0	None	None
2010	0	0.0	None	None
2011	0	0.0	None	None
2012	0	0.0	None	None
2013	0	0.0	None	None
2014	0	0.0	None	None
2015	0	0.0	None	None
2016	0	0.0	None	None
Grand Total	**28**	**169.1**		

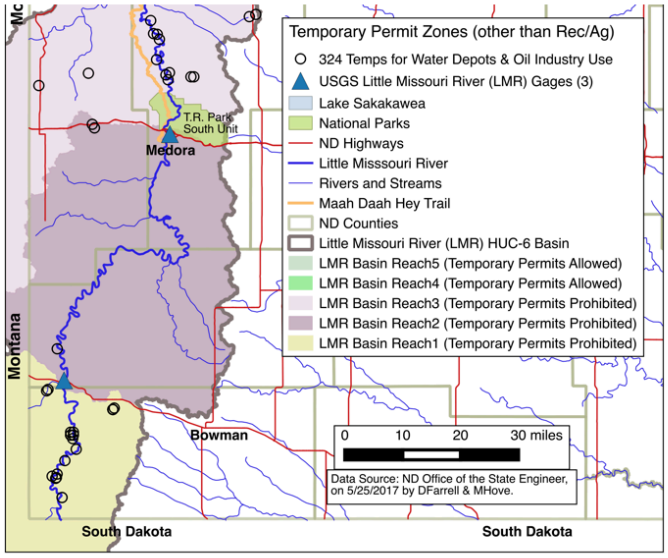


Figure D-2. Temporary water permit allocations from water depots in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #2).

Begin Year	Permit Count	Reach #2 Industrial (D&O) Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	0	0.0	None	None
1992	0	0.0	None	None
1993	0	0.0	None	None
1994	0	0.0	None	None
1995	0	0.0	None	None
1996	1	1.3	1.3	1.3
1997	0	0.0	None	None
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	0	0.0	None	None
2004	0	0.0	None	None
2005	0	0.0	None	None
2006	0	0.0	None	None
2007	0	0.0	None	None
2008	0	0.0	None	None
2009	0	0.0	None	None
2010	1	6.6	6.6	6.6
2011	0	0.0	None	None
2012	0	0.0	None	None
2013	0	0.0	None	None
2014	1	70.0	70.0	70.0
2015	0	0.0	None	None
2016	0	0.0	None	None
Grand Total	**3**	**77.9**		

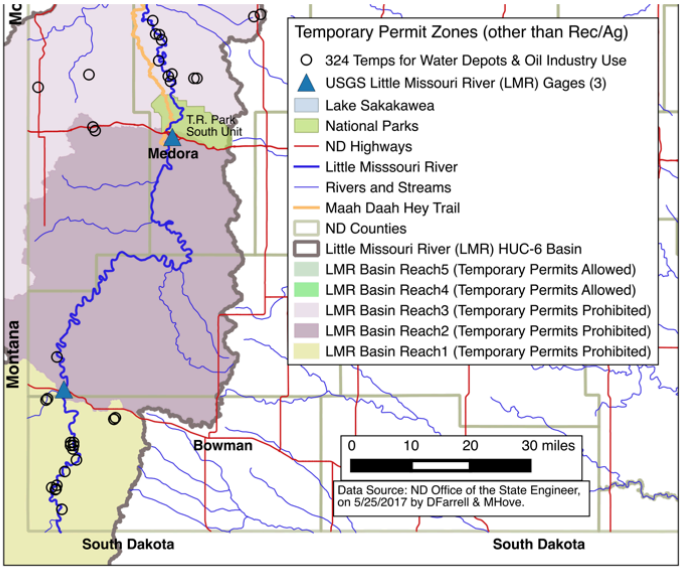


Figure D-3. Temporary water permit allocations from water depots in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #3).

Begin Year	Permit Count	Reach #3 Industrial (D&O) Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	6	11.6	1.3	2.6
1991	1	0.6	0.6	0.6
1992	1	0.6	0.6	0.6
1993	0	0.0	None	None
1994	2	2.6	1.3	1.3
1995	1	0.1	0.1	0.1
1996	0	0.0	None	None
1997	1	1.0	1.0	1.0
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	1	50.0	50.0	50.0
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	0	0.0	None	None
2004	0	0.0	None	None
2005	0	0.0	None	None
2006	1	1.5	1.5	1.5
2007	0	0.0	None	None
2008	0	0.0	None	None
2009	0	0.0	None	None
2010	1	6.6	6.6	6.6
2011	5	161.9	11.9	50.0
2012	6	301.8	6.4	150.0
2013	8	291.1	2.6	58.5
2014	10	383.6	7.9	100.0
2015	5	298.1	20.0	103.1
2016	5	687.8	20.0	260.0
Grand Total	**54**	**2199.1**		

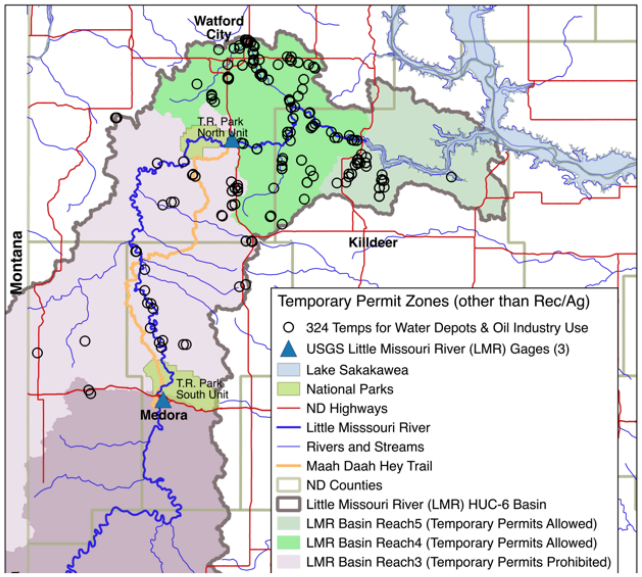


Figure D-4. Temporary water permit allocations from water depots in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #4).

Begin Year	Permit Count	Reach #4 Industrial (D&O) Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	0	0.0	None	None
1992	0	0.0	None	None
1993	1	1.9	1.9	1.9
1994	0	0.0	None	None
1995	0	0.0	None	None
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	0	0.0	None	None
2004	0	0.0	None	None
2005	0	0.0	None	None
2006	0	0.0	None	None
2007	0	0.0	None	None
2008	0	0.0	None	None
2009	1	12.3	12.3	12.3
2010	0	0.0	None	None
2011	1	6.0	6.0	6.0
2012	4	432.6	55.2	200.0
2013	14	4759.5	1.1	3000.0
2014	42	18792.0	2.6	3000.0
2015	42	22510.6	2.4	4500.0
2016	46	20608.8	20.0	2400.0
Grand Total	**151**	**67123.7**		

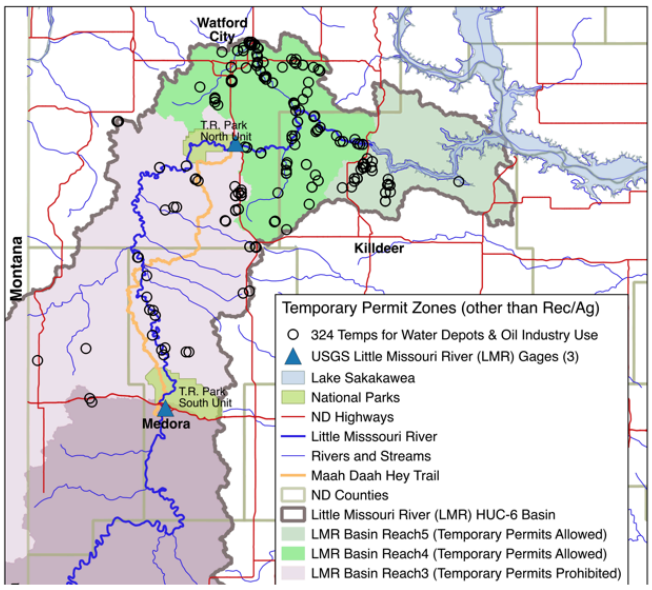
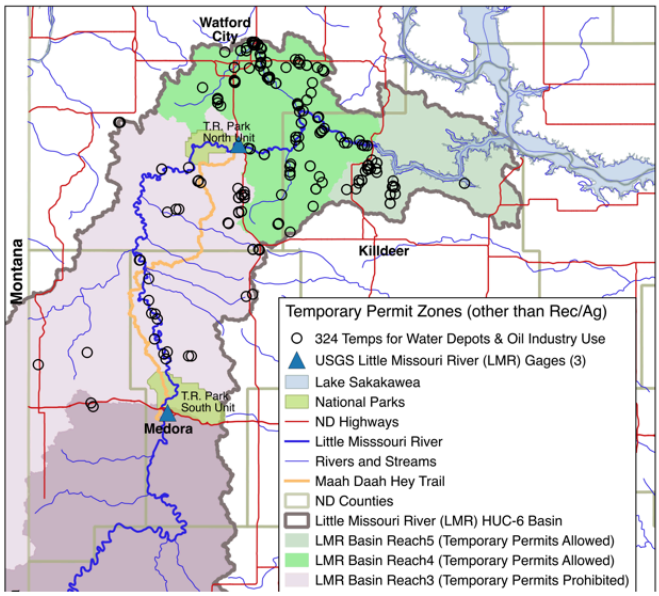


Figure D-5. Temporary water permit allocations from water depots in each of the five Little Missouri River Reaches (Ref. Fig. 1) from 1990 through 2016 (Reach #5).

Begin Year	Permit Count	Reach #5 Industrial (D&O) Permit Allocation Total AcFt	Min AcFt	Max AcFt
1990	0	0.0	None	None
1991	0	0.0	None	None
1992	0	0.0	None	None
1993	0	0.0	None	None
1994	0	0.0	None	None
1995	0	0.0	None	None
1996	0	0.0	None	None
1997	0	0.0	None	None
1998	0	0.0	None	None
1999	0	0.0	None	None
2000	0	0.0	None	None
2001	0	0.0	None	None
2002	0	0.0	None	None
2003	0	0.0	None	None
2004	0	0.0	None	None
2005	0	0.0	None	None
2006	0	0.0	None	None
2007	0	0.0	None	None
2008	0	0.0	None	None
2009	0	0.0	None	None
2010	0	0.0	None	None
2011	1	160.0	160.0	160.0
2012	7	1135.0	15.0	700.0
2013	3	190.0	15.0	160.0
2014	9	829.2	15.0	300.0
2015	13	3091.2	11.0	1500.0
2016	13	1590.0	15.0	500.0
Grand Total	**46**	**6995.5**		



APPENDIX E: Irrigation Water Use in the Little Missouri River Basin.

Table E-1. Annual reported irrigation water use in the Little Missouri River basin.

YEAR	REACH #1* acre-feet	REACH #2 acre-feet	REACH #3 acre-feet	REACH #4 acre-feet	REACH #5* acre-feet	Total acre-feet
1977	1426	1582	682	575	10	1436
1978	641	1500	548	589	8	1462
1979	1241	910	318	586	2	1430
1980	986	655	234	550	0	1689
1981	777	726	346	491	2	1024
1982	1032	2471	286	514	8	2256
1983	905	2436	443	467	0	2088
1984	1207	2283	659	618	0	2609
1985	1150	777	655	204	0	1756
1986	1084	2842	628	568	0	2207
1987	1271	2730	320	557	0	2436
1988	494	2039	128	112	0	2099
1989	947	1303	285	488	1	2278
1990	933	1396	132	208	0	2536
1991	1079	1370	101	284	0	2123
1992	945	987	244	183	1	3350
1993	945	1497	509	430	1	2371
1994	1412	1833	874	572	1	3446
1995	1129	1704	963	487	-	4060
1996	1110	1960	706	560	-	4321
1997	1573	1576	633	539	-	4336
1998	1121	1908	548	484	-	4283
1999	952	1512	504	479	-	4690
2000	555	1292	386	138	-	3382
2001	636	1549	690	476	-	2359
2002	269	1192	361	301	0	2835
2003	164	1417	430	525	0	2669
2004	413	1392	300	174	0	3024
2005	382	1056	425	186	50	2773
2006	482	1164	510	233	47	4878
2007	495	1129	289	265	30	5123
2008	417	1201	112	26	0	2786
2009	604	1204	378	342	80	4767
2010	432	991	205	395	65	4252
2011	326	846	181	823	80	4310
2012	467	489	26	42	0	2342
2013	363	725	181	377	42	2425
2014	310	516	260	302	42	3056
2015	308	802	221	131	0	3286
2016	675	672	54	36	0	4274

APPENDIX F: Flow Distribution of the Little Missouri River at the Long-X Bridge Since 1994

Examination of the temporal distribution of flows at the USGS Long-X Gage is helpful in evaluating the impact of setting a minimum flow for industrial diversion of water downstream of Long-X. The 30 cfs example shown on the figure would result in suspension of diversion about 8 percent of the time. Historical periods of sub-threshold flows since 1994 included:

- July through October, 2000
- May through June, 2002
- June through September, 2004
- April, and August through October, 2005
- July through August, 2006
- August through November, 2007
- August through September, 2012

All other time periods would have provided sufficient flow for some diversion.

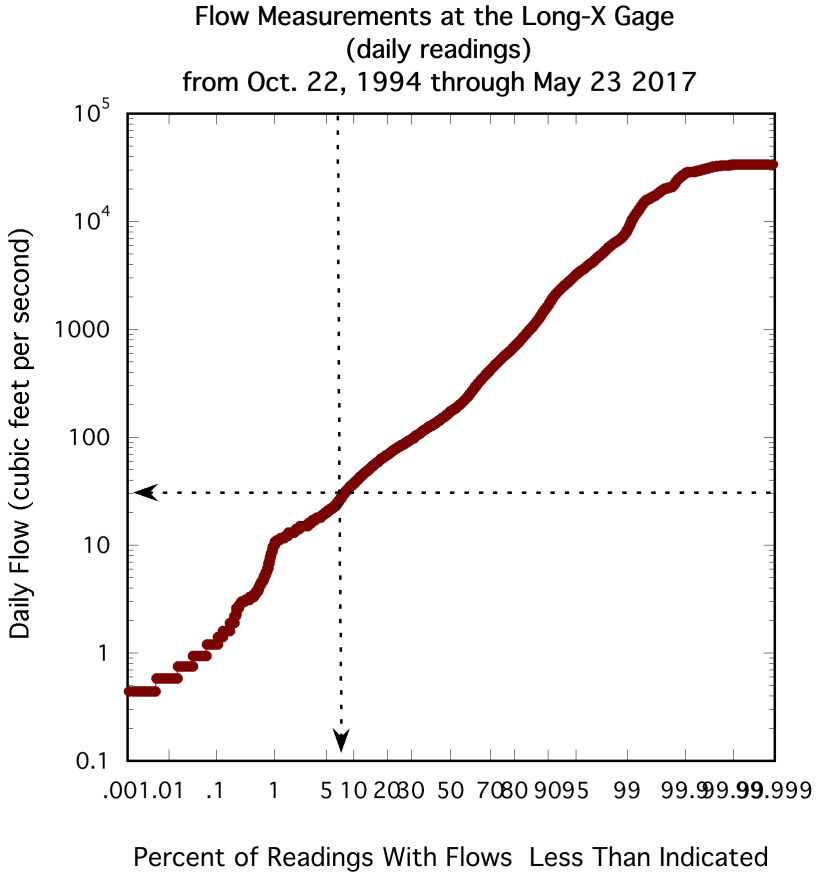


Figure F-1. Probability distribution of measured flows at the Long-X bridge USGS Gage in 15-minute measurement increments. The distribution is approximately log normal, with the skewed upper segment weighted by the 2011 flood.

Appendix G: Requests for consideration of the Missouri River Commission from the Badlands Conservation Alliance.

Wednesday, May 17, 2017 at 10:13:50 AM Central Daylight Time

Subject: FW: Little Missouri State Scenic River-Thanks to Governor
Date: Wednesday, May 17, 2017 at 8:32:52 AM Central Daylight Time
From: Erbele, Garland G.
To: Patch, Jon C., Schuh, Bill M.
CC: Paczkowski, John A.

fyi

From: "Torstenson, Cassandra L." <ctorstenson@nd.gov>
Date: Friday, May 12, 2017 at 11:10 AM
To: "Erbele, Garland G." <gerbele@nd.gov>
Subject: FW: Little Missouri State Scenic River-Thanks to Governor

Garland,

Please take note of the below comments as we work towards addressing water use from the Little Missouri River.

Cassandra

From: Jan Swenson [mailto:bcajan@bis.midco.net]
Sent: Friday, May 12, 2017 10:43 AM
To: Torstenson, Cassandra L. <ctorstenson@nd.gov>
Subject: Little Missouri State Scenic River-Thanks to Governor

CAUTION: This email originated from an outside source. Do not click links or open attachments unless you know they are safe.

Hi Cassandra,

First and foremost, Badlands Conservation Alliance extends our thanks to Governor Burgum for the depth and thoughtfulness of his May 3, 2017 response to North Dakotans concerned about HB 1020 and the amendment to the Little Missouri State Scenic River Act. It was much appreciated. It is also our hope that the Governor's comments may suggest newly open ground for future "public discourse about our conservation heritage and legacy."

I do feel the need to note on behalf of Badlands Conservation Alliance, however, a number of remaining concerns:

- **We believe to release the downstream reach of the Little Missouri River from full consideration is inadvisable.** While we are grateful for the considerations and actions outlined for the Little Missouri State Scenic River from the border with South Dakota to the Long X Divide Bridge, the Act does define the Scenic River as "terminating at its juncture with Lake Sakakawea, with such juncture defined as the bridge crossing of state highway twenty-two in section thirty-four, range ninety-five west, township one hundred forty-eight north, with boundaries established as the natural channels of the river to the low watermark."

  The general public may not be as familiar with this portion, but it remains the Little

Missouri State Scenic River.

One of the wonders of the North Dakota Badlands is the continuum of ever changing landscape as one ranges the length of the river. Here, the deeply cut river valley is some of the most dramatically beautiful country in our state. It is rich in wildlife, and a combination of state, federal and multi-generational ranch ownership has kept it delightfully wild. Its rugged terrain is notably utilized by elk, bighorn sheep, mule deer, and multiple species of raptor, including the golden eagle. Bear Den/Burr Oak RNA, one of the few Research Natural Areas managed by the Dakota Prairie Grasslands, lies within the area.

- It is also a current hot spot for oil and gas development and has been for some years. Industrial transformations have been considerable. It is not uncommon to see miles of temporary pipeline and hear the noise of compressors and pumps that serve them. Truck traffic is common.

  One cannot dismiss out of hand the bulleted benefits of temporary use permits the Governor cites. **However, we are concerned that this amendment and the Governor's proposal to look only at the southern portion of the Little Missouri frees up industry to ask, and the State Water Commission to grant, a growing number of permits.**

  If one reviews the more recent SWC applications, the number of acre-feet requested is increasing and there are multiple such applications currently pending or in process that are ripe for this amendment. One such application lies within the same section as the entrance to the North Unit of Theodore Roosevelt National Park and may have potential to be sited east of the Long X Divide Bridge. That should not be allowed to happen.

- BCA asks that as the State Water Commission moves forward with the requests made by the Governor, that **the State Water Commission also provide to the public equivalent data on the downstream portion as quoted for upstream in point #5 of the Governor's letter.**

- We also ask that **consideration be given to temporary or permanent water depots located just outside the Little Missouri breaks that might provide adequate sourcing for development of temporary pipeline systems without tapping Little Missouri waters.** Having attended the May 1, 2017 ND Industrial Commission meeting, I am aware that the Western Area Water Supply Authority is in need of serving additional industrial customers to meet their financial obligations. Perhaps such a system could provide relief for both Scenic River and WAWSA.

- Finally, BCA asks **what happens upstream of the Long X Divide Bridge as oil and gas development moves into that area at the pace that we currently sees east of the Long X Divide Bridge? What precedents might we be setting?**

  1) We are already seeing new Bakken/Three Forks development along the Little Missouri and East River Road north of the South Unit of Theodore Roosevelt National Park up to and well past the Elkhorn Ranch.
  2) A Wyoming company is looking to re-work the Tyler Formation in the southern Badlands from Tracy Mountain to the river using both old and new wells.
  3) The January 2017 issue of the ND Department of Mineral Resources GEO NEWS is touting the potential in Bowman, Slope, Golden Valley and Billings counties for the "under-explored Red River Formation."
  4) That same article cites 17 other productive formations in western North Dakota waiting to be explored and developed.

While current technology for the Tyler and Red River does not require the amount of water usage we see in the Bakken/Three Forks, there is no guessing where advances or new formations may lead.

BCA applauds the Governor's reinstatement of the Little Missouri River Commission and looks forward to release of the report of the State Engineer. We urge as well that the Governor's office consult with the ND Game and Fish Department and federal agencies managing surface acreage reliant upon the Little Missouri River. Too often significant issues and actions in North Dakota are not addressed with the level of consultation and collaboration, and the attention to cumulative impacts, that would result in best solutions.

Again, BCA deeply appreciates Governor Burgum's engagement on this issue. Please, share our comments with the Governor as you see best.

Respectfully,
Jan

Jan Swenson, ED
Badlands Conservation Alliance
701-255-4958
bcajan@bis.midco.net

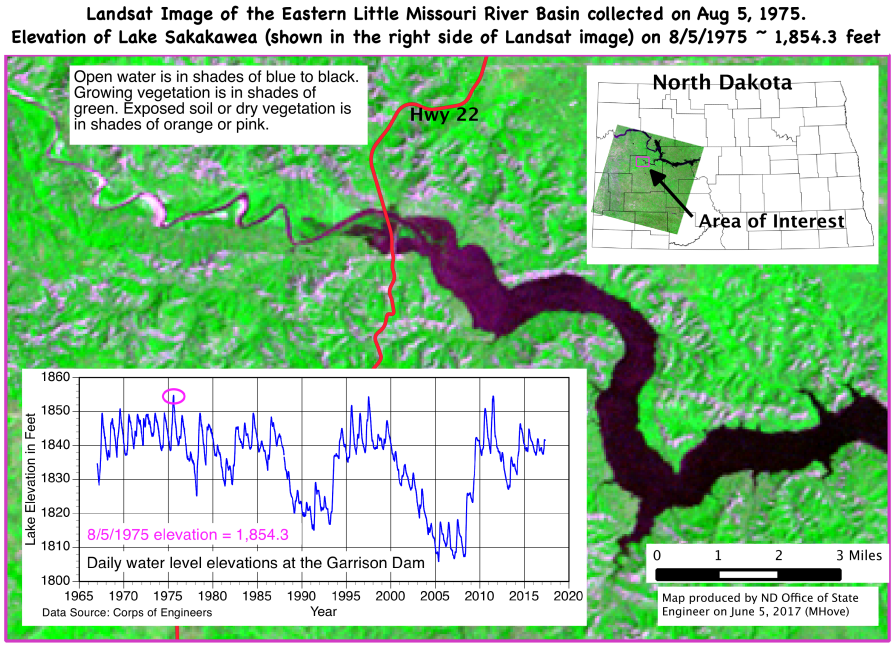


Figure G.1. Illustration of the Little Missouri River confluence with Lake Sakakawea in 1975.

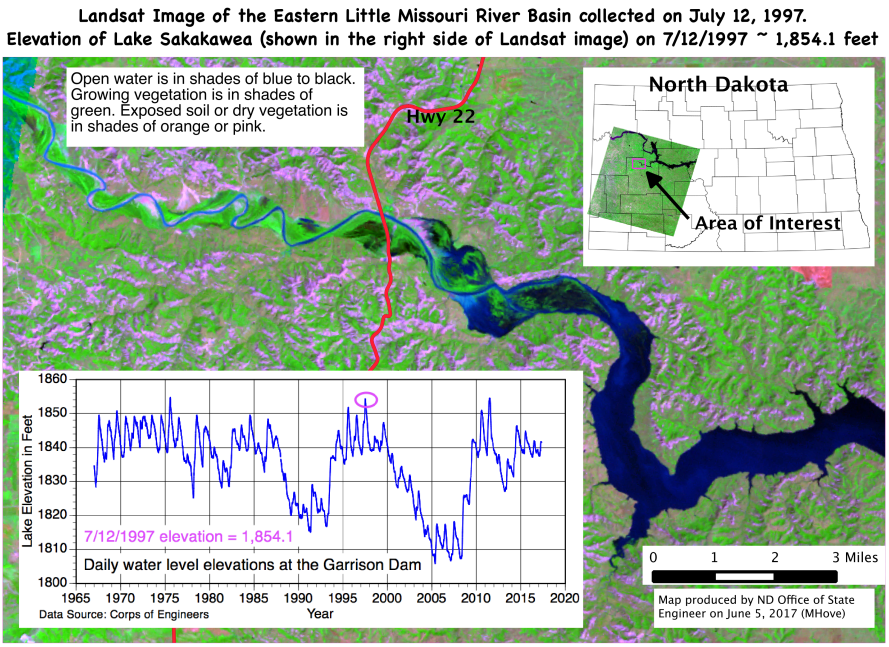


Figure G.2. Illustration of the Little Missouri River confluence with Lake Sakakawea in 1997.

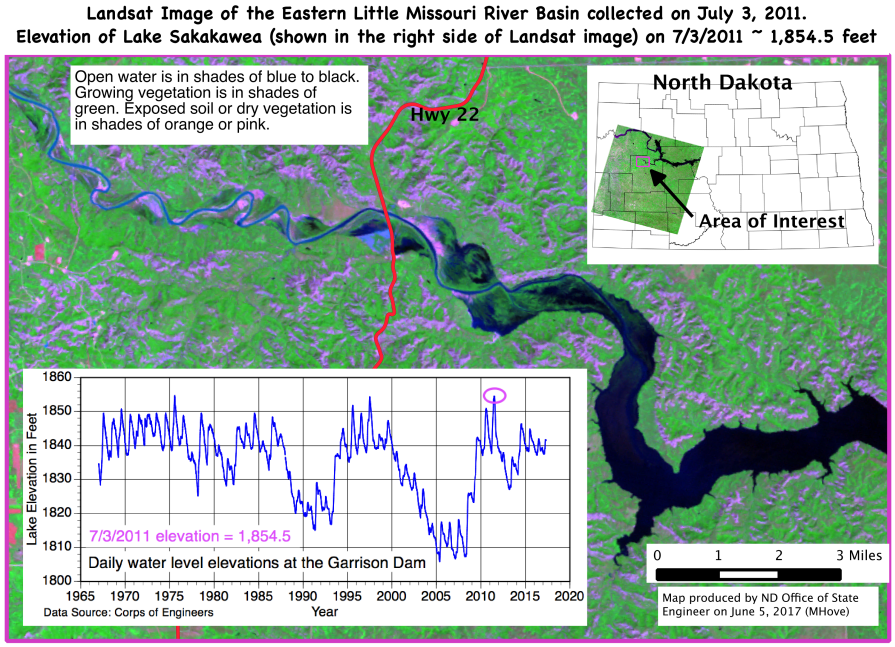


Figure G.3. Illustration of the Little Missouri River confluence with Lake Sakakawea in 2011.