Drought, Flood, Saving, and Sharing:

A History of Water Resource Supply, Conservation and Distribution in the Musselshell River Basin of Montana

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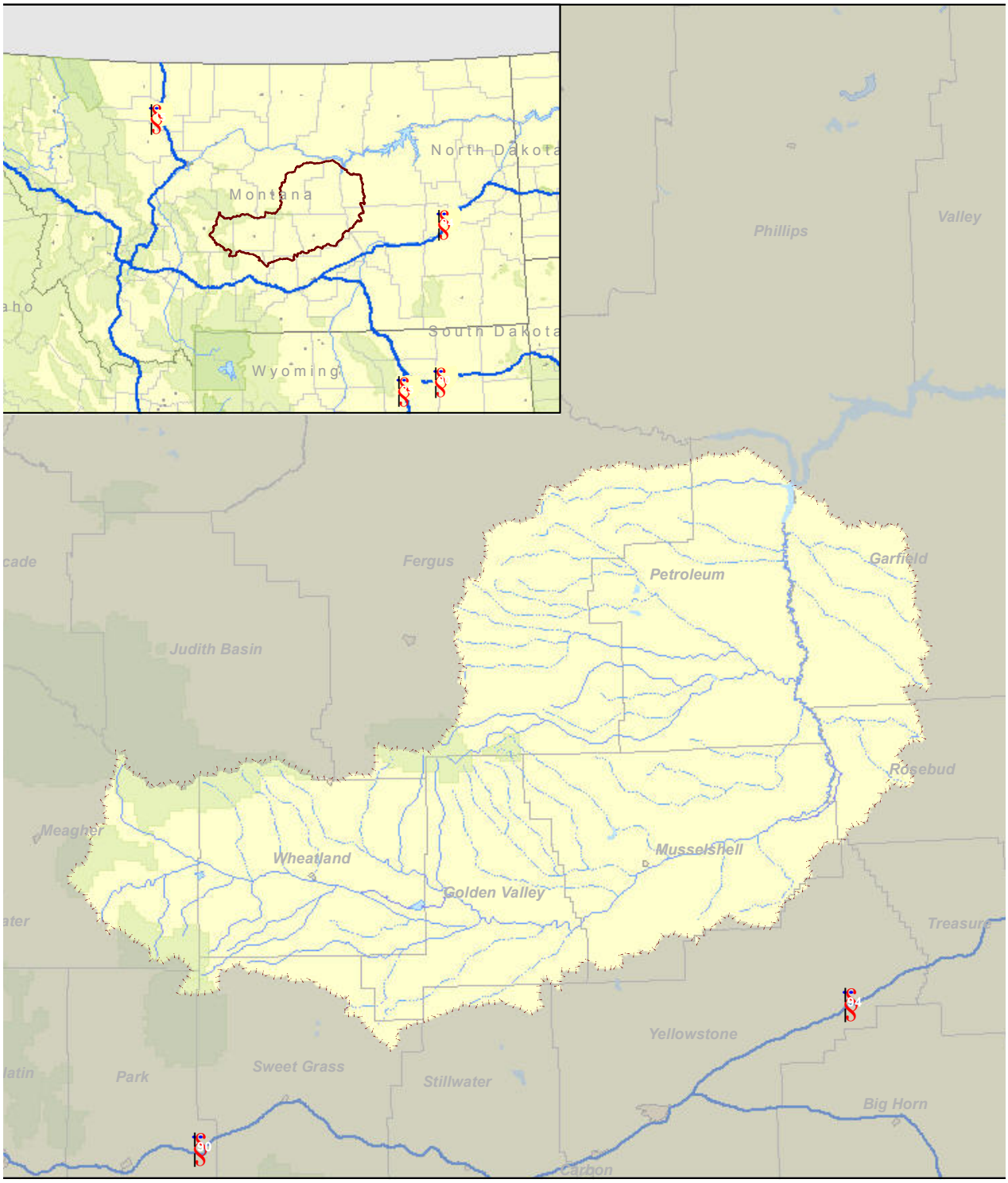


LOCATION MAP:
Musselshell Watershed

Cottonwood and peachtree willow regeneration after 2011 flood, west of Roundup
Photo by Wendy J. Ross Beye

I. Introduction

Montana's most precious natural resource is not gold, silver, palladium, copper, sapphires, coal, or even oil or natural gas. Humans do not need any of these elements to survive, but we must have water. Though the western portion of the state is blessed with a usually sufficient supply of good quality water to meet demands, residents of the arid eastern plains struggle to make do with scarcity and poor quality. The hardy souls who make their living in the Musselshell River basin are acutely aware of the value of water, and they await each year's blessings from the skies with hope for a good harvest.

The earliest water right in the Musselshell River basin was filed in 1869 for stock water on a tributary in the Upper Musselshell; the first filing for irrigation water was nearby, in 1875. As more ranchers settled in and began harvesting hay for their livestock, demands on surface water soon outstripped supply, and the battles began. Political maneuvering at the state Capitol prevailed over common sense management of water rights records, and Montanans are still paying the price while attempts are made to wrap up adjudication efforts.

Progress toward wise water management has occurred in the Musselshell River basin in the past 150 years, mostly due to slowly-developing cooperation among water users who reside along the river and its ephemeral tributaries. A big boost came during the Great Depression, when Franklin Roosevelt's Works Progress Administration (WPA) paid most of the costs of construction of irrigation and flood control projects in the basin. Water users eventually recognized that they needed neutral party water commissioners to make sure available water was distributed fairly. They began to evaluate how their ranching practices affected their neighbors downstream, and made changes when it was feasible for them to do so.

As time passes, and more demands are made on a very limited supply of water in the basin, the lessons of the past can provide guidance for the future. An understanding of our shared history can help us make informed decisions about how we want to proceed toward an uncertain future.

II. The Watershed

The Musselshell River basin is just that – a giant elongated bowl with a lip that pours water into the Lower Missouri at Ft. Peck Reservoir. At the river's source, water collects in small streams flowing from the Crazy Mountains, the Castle Mountains, and the Little Belts. Tributaries gather more water from the Big and Little Snowies and the Bull Mountains. From the headwaters to Harlowton, the drop in elevation averages about 20 feet per straight-line mile, from Harlowton to Roundup, the drop is 14 feet per mile, and by the time the river reaches Melstone, the drop is only about 9 feet per mile. Numerous oxbows allow the river to slow even further as it meanders toward the Missouri.

Geologists hold differing opinions on how the Musselshell River basin was formed. It may have been scooped out by glaciers over multiple ice ages, or eroded by water when that ice repeatedly melted and rushed toward the Gulf of Mexico via the Missouri and Mississippi Rivers. There is certainly fossil evidence that the basin once held warm salty water, and that dinosaurs roamed the area. The vegetation and salt from these periods is layered into coal seams, and there are oil and natural gas deposits deep underground in many areas of the basin.

The Crazy, Castle, Little Belt, and Big Snowy Mountains are made up of porous limestone, and they act as giant sponges that soak up water from winter snows. A series of folds in the rocks channel the collected water into several layers of aquifers. Unfortunately for the people who live along the Musselshell River, much of the water flows underground to the north instead of south into the basin. The Madison Aquifer underlies much of central Montana at depths ranging from the surface at Big Springs near Lewistown and Giant Springs at Great Falls to 7,000 feet deep under the Bull Mountains, A significant percentage of its recharge occurs in the mountains that form the rim of the Musselshell River basin.

A number of shallower aquifers are tapped by domestic wells in the basin, but none of them produce a generous quantity nor a high quality water, even if they are artesian. As water percolates down through the soil toward the aquifers, it collects salt and other minerals from the layers formed by ancient seabeds. Some of the aquifers even follow coal seams. As a result, much of the water drawn from the ground must be filtered before it is palatable.

Surface water in the basin also suffers from the salt in the soil. As small tributaries erode their way through coal and salt, water quality declines and the minerals accumulate in the river as it flows downstream. By the end of summer, the concentrations can be so high in the lower river reaches that the water can no longer be used to irrigate crops. In the Winnett area, stock watering reservoirs have periodically sickened cattle with very high concentrations of sodium sulfate. Small communities along the river have difficulty meeting water quality standards for their residents whether they draw from the river or from wells.

Careless Creek after 2011 flood
Photo by Wendy J. Ross Beye

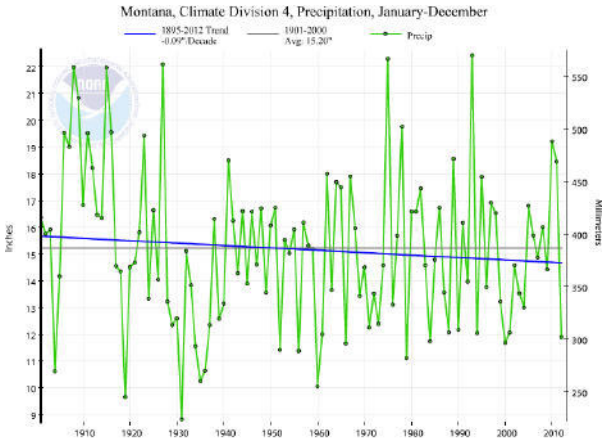
III. Climate

The Upper Musselshell watershed is blessed with winter snow and spring rains that translate into a more generous supply of surface water than is available downstream. Annual precipitation at Martinsdale averages 15.5 inches. High elevations in the headwaters area allow snow to accumulate, especially when heavy drifts form, storing water until spring run-off occurs. At Harlowton, the average drops to 13 inches. Storms moving into the basin from the south, southwest, west, northwest, and north drop most of their moisture on the mountain range upslopes outside the basin, so Musselshell denizens do not enjoy much benefit from them. Martinsdale receives some spillover precipitation, but Harlowton is in the drier "rain shadow" of the mountains.

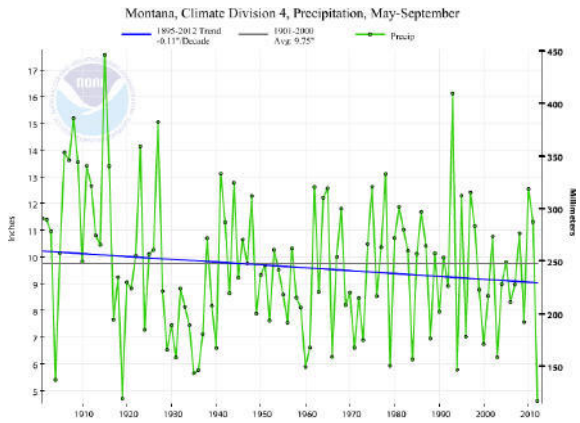
The middle area of the basin sees even less annual precipitation. At Ryegate, the average is 12.8 inches, and at Roundup, 12.5 inches. The Bull Mountains provide enough uplift of the atmosphere to squeeze more moisture out of storms, sometimes in the form of cloudbursts that cause flood damage. Tributaries arising in the Bull Mountains carry water more consistently than do those between Ryegate and Roundup. Snowcover does not generally remain on the plains along the river throughout the winter, and chinook winds flowing downslope from the mountain ranges melt what little does manage to accumulate. If the ground is frozen, the water runs downstream rather than soaking into the soil.

The Lower Musselshell borders the west edge of an area of Montana known as "The Big Dry." Average annual precipitation at Melstone is 13.9 inches, and at Mosby is 13.2 inches. Mosby sometimes benefits from a boost of precipitation run-off in the river from the Little Snowy Mountains via Flat Willow Creek, but the source is not completely dependable. Many other tributaries are ephemeral, seeing water only in the wettest spring months.

The NOAA's National Climate Data Center's Division 4 of Montana generally mirrors the Musselshell River basin, although it does also include the surrounding mountainous areas. Records from 1901 to 2013 indicate that precipitation in the division has been declining, with a decrease of slightly more than an inch over 112 years of climate history. Data for the five-month period from May through September, coinciding with the irrigation season, shows an even greater decline in average rainfall of 1.6 inches in 112 years. There is no sign that the trend is reversing. The two graphs below show wild swings in precipitation from year to year, with the blue lines representing average annual precipitation trends sloping down from left to right. The drought periods of 1928-39, 1969-74 and 1999-2005 are easy to identify on the graphs.



Graph 1, Annual precipitation 1901-2012
Div. 4, National Climate Data Center



Graph 2, 5-month precipitation 1901-2012
Div. 4, National Climate Data Center

IV. Settlers and Agriculture

When stockmen trailed livestock herds all the way to eastern Montana from Texas, Iowa, and Oregon in the early 1860s, they thought they had found heaven. Their bony longhorns and hungry sheep thrived on nutritious belly-deep grass during the green season, and in the winter, wind swept snow from ridges, uncovering forage that lasted the animals untilspring. Periodic chinooks even melted snow and made the weather tolerable to man and beast. There was plenty of water for stock, at least in the Upper Musselshell, and their cows and sheep wandered freely across the landscape with minimal attention.

The Homestead Act of 1862 allowed ranchers to choose a 160-acre tract, build a house, cultivate a garden, and after five years obtain title to the land. Or, if they had money in their pocket, they could own the land in just six months by paying the government $1.25/acre. Their livestock still roamed on open range, but they began to file notices of stock watering rights on springs, creeks, and the Musselshell River, with the first recorded in 1869 on Elk Creek in the Upper Musselshell. As their families grew, ranches were expanded with additional homestead filings, or they bought up neighboring parcels from homesteaders who failed to meet the challenges of trying to farm under inhospitable conditions. Ranchers needed feed for their "home" livestock, and began filing for irrigation water rights. In the Upper Musselshell, there was a flurry of filings between 1880 and 1890. Development of the lower reaches of the basin proceeded at a more leisurely pace, with the first filing on the river appearing in 1885 near Roundup. Only a handful had been filed by 1890.

As more and more animals were turned loose on the range in the basin, grass began to disappear, and a combination of drought, overgrazing, and a bitterly cold snowy winter of 1887-88 wreaked havoc on ranch operations. Many ranches lost 90 percent of their cows. Sheep fared slightly better, as they usually had herders accompanying them. The woolies could subsist on cottonwood branches while they sheltered in the coulees. After that disastrous year, ranchers began to modify their practices, building fences to keep their animals close to home, where it was easier to feed them hay during the winter months.

More settlers poured into the area when the Northern Pacific Railway began selling the checkerboard sections it had obtained from the government in 1864. The deal was that the company would market the enormous grant of 39,000,000 acres across the nation's mid-section to individual settlers to help finance the construction of a rail line from Lake Superior to Puget Sound. The railroad hired experts from the Montana State Experiment Station in Bozeman to conduct tests on the success of dryland farming on land where precipitation averaged 14 inches a year. They may have neglected to test the soil in the Musselshell basin for its ability to hold moisture and provide enough nutrients to grow crops. Brochures were printed touting the wonderful productivity of the benchland along the Musselshell, and people came to try their luck at farming. Most failed, after laboriously plowing up their acres of rocky cactus-strewn land, planting seed, and watching it all blow into the next county in a cloud of dust.

Bair ranch sheep shed on Upper Musselshell
Photo by Wendy J. Ross Beye

They moved on to greener pastures, or started businesses and built homes in the small communities that sprang up along the Milwaukee Road rail line when it was punched through in 1907 from Forsyth west to join with the old Montana Railroad line (aka the Jawbone Railroad) from Harlowton to Butte. To help keep the rail line profitable, settlers were enticed with glowing descriptions of life on the Musselshell. When they climbed aboard, they brought little with them, so the railroad shipped in farming equipment, seed, building materials and food to supply the settlers in their new lives. The cycle of hardship and disappointment began again, and most of the settlers either abandoned their property to the counties, or sold to ranchers who wanted to expand their holdings.

Some of the communities managed to hang on through hard times, and the discovery of coal at Roundup gave the local economy a big boost. The Bull Mountains and the town of Roundup itself were soon honeycombed with tunnels built to remove coal from the ground. Some of the mine shafts were plagued with accumulating water, so pumps were installed and water from more than one mine was used for irrigation. Some ranchers in the area still use water from abandoned mines, as does the town of Roundup to meet residents' needs.

Settlers who were fortunate enough to obtain property along the river or its tributaries filed for water rights, and built diversion dams and ditches to channel water to their fields. A few entered into informal cooperative agreements with neighbors to share the expenses of building the necessary infrastructure and pay maintenance costs. Through the early years of the century, rain fell relatively abundantly and agricultural enterprises boomed, but when the drought years of 1928-1939 arrived, demand for water outstripped supply and the Musselshell riverbed baked dry in the sun every summer. The Dustbowl years had begun.

Many large-scale irrigation projects were planned over the years, but until Franklin Roosevelt's Public Works Administration provided funding, none were built in the Musselshell River basin. Now, with the Upper Musselshell and Deadman's Basin storage projects in place, there is enough irrigation water available to produce at least one cutting of good quality hay on the ranches along the river. Agricultural operations are the economic mainstay in the basin, supplemented by the coal mine in the Bull Mountains near Roundup. No one tries to survive on 160 acres any more – a viable ranch is at least several thousand acres in size, but livestock production is still not an easy way to make a living.

One-of-a-kind home-built irrigation pump built of 55 gallon drums, boat propellers, and a 1939 Buick car engine
Photo by Wendy J. Ross Beye

V. Historic Floods and Droughts

The gravel of the brand new Milwaukee Road railroad bed had hardly settled when it was subjected to its first flood. The June 5, 1908 issue of the *Roundup Record* headlined its story, "Musselshell on Rampage," and reported that heavy rains in Roundup and to the west caused the river to rise over ten feet in less than a week, and it was still rising as of the publication date. A railroad bridge was washed out near the town of Musselshell, and several more west of town were damaged by the flood. Stranded passengers and their baggage were taken off and transported by wagon to Roundup to await resumption of rail travel. J.W. Newton's irrigation diversion dam west of town was in danger of washing out, and his ice house located near the railroad depot had already been damaged. His entire summer ice supply was in jeopardy. The railroad, along with all residents along the river, was suffering the consequences of the new railroad bed that shortened the river's path, increased the speed with which spring run-off flowed, and constricted the floodplain. Long after the railway abandoned its route, the railbed continues to restrict the river and increase flood hazards.

After 1908, a number of relatively trouble-free years passed in the Musselshell basin, with abundant dryland crops and no major floods. Then in 1928, average annual rainfall amounts plummeted from over 15 inches per year to as low as 8.5 inches. Only one year during the period had above-average precipitation, and that by barely more than an inch. Dryland farmers, even those who scrupulously followed the 1908 advice of Prof. F.B. Linfield of the Montana State Bozeman Experiment Station, failed to produce enough to sustain their families. Linfield recommended plowing and then continuously cultivating fields all through the spring rainy season to drive moisture deep into the ground for the next year's planting,. Unfortunately, the method could not save rain that never fell, and the high plains winds blew away topsoil that drifted across roads and blocked travel. Families packed up and looked for more hospitable land, or for work other than farming.

The drought finally broke, after a localized flash flood occurred in June, 1937. A cloudburst hit the Bull Mountains just south of Roundup, and water raged down Half Breed Creek and into the Musselshell River. More than 20 county bridges washed out, and the rail line near Gage, east of Roundup, was once again under water. Some forty homes in the vicinity of Klein were damaged or destroyed by the creek waters, many washed completely off their foundations.

The next major Musselshell River flood occurred in 1948. One resident remembers accompanying her father to the cliffs west of town to watch the floodwaters rush by. As a 7-year-old, she was impressed by the rattlesnakes, pigs, and even cows that were swimming to escape the river. The flood crest reached 11 feet at Roundup, just barely qualifying as a major flood.

A flood in 1967 that eclipsed all previously-recorded floods was a precursor to another long period of drought. The scenario was very similar to the one that resulted in the even more impressive flood in 2011. Snowpack in the Snowies, the Little Belts, the Castles, and the Crazies was deep and late to melt, with most of it still in place in mid-May. Rain moved in to the area from the southeast with a low pressure system, and pelted the middle Musselshell near Lavina. Up to 5 inches fell over a two-day period. The river crested on June 8, with 8,180 cubic feet per second passing by Roundup. The water receded slightly, and then another storm hit, dumping rain on saturated ground in the upper reaches of the watershed June 10-14. A second crest at Roundup occurred on June 18, at 8,100 cfs and a height of 12.45 feet, classified as a 50-year flood. Several million dollars of damage hit area ag producers hard. They lost equipment, livestock, road access, and fields to water and the silt it left behind. They were unable to harvest crops along the river during the following summer.

To add insult to injury, just when producers were beginning to recover from the flood, the five-year period of 1969-1974 brought another drought. In the midst of the drought, the winter of 1971 must have been exceptionally cold, and an ice jam caused a major flood at Roundup in February. The drought broke with a bang in the spring of 1975, with yet another flood of major proportions. The river at Roundup crested at 12.89 feet on June 22. Once again, producers were struggling with damage that left them without crops to harvest in the fall.

Two more ice jam floods at Roundup and Mosby – 1979 and 1985 – a severe drought in 1988, another major spring flood in 1997, and a drought in 2001 that saw grass growing where water used to flow brought the Musselshell River to the epic flood of 2011. Winter had dumped an above-normal snowpack in the mountains surrounding the basin. By mid-May, as much as three feet of slushy water content was poised to begin melting after an exceptionally cool early spring. Water managers were thinking that producers would have plenty of water for irrigation if only the snow would melt slowly. Unfortunately, Mother Nature had other ideas. It began to rain. A monsoonal flow brought warm moisture-rich air all the way from Gulf of Mexico, and a low pressure system flung it against the south and east-facing slopes of the Snowies and the Little Belt Mountains. Some locations received up to 9 inches of rain in a week, or 400% of the average precipitation total for the season.

Water collected in the canyons of the high country and began to gather momentum in the Musselshell tributaries. Timber Creek, Careless Creek, Swimming Woman, Flatwillow, and other usually ephemeral streams became raging torrents that gobbled up soil and sent it tumbling into the river. Streamflow gages in the river broadcast record flow information to satellites, but then went silent as the river destroyed them. One water manager who was monitoring the in- formation made phone calls to all her water con- tract holders downstream, as well as local sheriff's offices, warning of high water heading their way. Those who were able to move portable pumps away from the river did so, and residents along the river were dashing out of their homes in their pajamas at midnight. At the height of the first wave of floodwater, almost 15,000 cfs passed under and over the highway bridge at Roundup – nearly double the discharge experienced during the next largest volume flood that occurred in 1967. The crest hit 14.69 feet – more than two feet higher than the 1967 flood. Roads and highways disappeared under water, fences were swept away, livestock drowned, the old abandoned Milwaukee Railroad grade that had served as a dike in past floods was breached in many places, and more than 50 homes were destroyed.

Remains of a bridge after 2011 flood
Photo by Wendy J. Ross Beye

The aftermath of the 2011 flood, which was classified by hydrologists as a 157-year event, lasted for what seemed an eternity. A second flood crest hit the community of Roundup just as clean-up efforts were beginning to make headway against the mess. Floodwaters remained standing on fields and in borrow ditches for 45 days, killing the vegetation it covered. Ranchers who had pragmatically weathered previous floods were stunned. They didn't know where to begin mak-

Old railroad bridge twisted like spaghetti by 2011 flood
Photo by Wendy J. Ross Beye

ing repairs and putting their operations back in order.

The river environment was dramatically altered by the 2011 flood. More than 35 miles of the river's length was lost due to cut-offs (avulsions) across oxbows, and only 9 miles of new meander were added, mostly due to breaching of the old Milwaukee Road rail bed. Every time a river is shortened, the gradient steepens, and water flows more rapidly down the streambed. The result is increased bank erosion and greater silt load. As future floods of lesser magnitude occur, however, new sandbars will build, and the river will eventually create new meanders.

Many old cottonwoods were felled by the floodwaters, but millions of cottonwood seeds found purchase on gravel bars and in silt deposits and had established deep roots by the autumn of 2011. Unfortunately, weed seeds also found a suitable environment for proliferation, and the battle is on to control them. Destruction of irrigation infra- structure has allowed ranchers to consider new and improved methods of watering Many switched to portable pumps after their permanent pump sites were destroyed, and some have installed pipelines to carry water more efficiently than did their old leaky ditches. How more efficient delivery of water, including installation of pivot sprinkler systems, will affect the river environment and downstream water users remains to be seen.

By the time producers had begun to deliver water to their fields in 2012, another year of drought hit the Musselshell River basin. Total rainfall in Montana Division 4 from May through September, 2012, was only 4.62”, the lowest for that period since 1895, by nearly an inch. Water managers scrambled to adjust delivery promises, and streamflows dropped precipitously. Dryland fields produced next to nothing, and many were not harvested. The area bounced back in 2013, with a wet July leaving the whole basin green until late August. The cycles of flood and drought march on, and the people who live in this sometimes inhospitable basin learn to cope with unpredictable conditions that result in either too much or too little water.

VI. Irrigation, Reservoir, and Water Quality Projects

The Desert Land Act of 1894, sponsored by Senator Joseph Carey of Wyoming, was a congressional response to lack of agricultural production on dry western homesteads. More widely known as the Carey Act, the Federal Land Office was authorized to transfer up to a million acres of arid public lands to each participating state that established programs to water the land within ten years. States were to sell the land to cover their expenses and increase their tax revenue. There were several serious problems with the act. Tracts were limited to 160 acres each – not enough land to run an economically viable operation. Private irrigation developers were supposed to build the infrastructure while being paid with an "IOU" because the federal government retained ownership until settlers bought the land and "proved" it to perfect their title.

In Montana, the state legislature refused to appropriate any money for reclamation until 1897, after the Carey Act was amended to allow title to transfer to the states when irrigation works were completed, and before sale to settlers. The state then issued bonds in the amount of $500,000, repayable in 30 years. A number of projects were engineered in Montana, but few were completed. The only one proposed in the Musselshell River basin was at Flatwillow Creek, and it only made it to the preliminary engineering stage. Eastern Montanans were bitter because the state's governor packed the Arid Land Grant Commission, tasked with implementing the Carey Act, with representatives from the western part of the state. The Commission was dumped by the legislature in 1903, and the Carey Land Act Board was established under the office of State Engineer. That board oversaw the completion of the Billings Bench project and another in Big Timber before 1919.

In 1919, the Board of Railroad Commissioners took on the role of serving as the Montana Irrigation Commission. The board was active until 1932, and oversaw creation of irrigation districts, the sale of water, water rights, and the contracting of water for irrigation. During its first year of operation, the legislature only appropriated $2,500 to the board. The first annual report published in 1919 recommends that water storage projects that could capture spring run-off and distribute it by gravity were more desirable than systems that required electrical pumps to deliver water. A number of irrigation districts were organized in the Musselshell River basin under the guidance of the board. These included the Harlowton-DuRand Irrigation District, the Franklin Irrigation District, the Fish Creek Irrigation District, and the Musselshell Valley Irrigation District, none of which ever sold bonds to finance their projects. The board's emphasis on water storage projects, however, led to the next era of irrigation development in the Musselshell River basin.

One action Montana's legislature did take that turned out to be very effective was to create the State Water Conservation Board in 1934. The country was in the depths of the Great Depression and the Dust Bowl drought period, which had hit central Montana in 1928. Privately-funded irrigation projects in Montana had reached a limit on development due to lack of capital. Under the leadership of Governor Frank Cooney, the State Water Conservation Board approached Franklin Roosevelt for assistance through his Public Works Administration (later called Works Progress Administration). The delegation was able to secure a promise of $5 million to help build projects that would increase the acreage of irrigated land in the state.

A number of large irrigation projects in the Musselshell River basin had been simmering since the turn of the century, unable to proceed because of lack of financing. In January, 1910, an article in the Harlowton Times reported a project planned by the Judith Basin Land Co. of Two Dot that would involve construction of four large stone

dams on the Musselshell River to capture floodwaters for irrigation northwest of Harlowton. Construction was to begin in 1911. The Harlowton-Durand Irrigation District was a later version of the proposal. Another project called for reclamation of a large tract of land near Ryegate with river floodwaters diverted into a natural basin called Dead Man's. A second natural basin would hold spring run-off from Careless Creek. A later incarnation of this plan was presented by the Franklin Irrigation District. In August of 1910, Harlowton Times reported on yet another proposal to irrigate land obtained under the Carey Act with a reservoir built on land sold by C.E. Durand; bids to be let immediately. Potential water supply for all these projects had been carefully measured for years, and there were ranchers waiting to water their fields. There just wasn't enough money to build the projects.

By 1938, Montana had snagged $6 million from the federal government for state water projects and was set to irrigate an additional 400,000 acres of land with the water supplied by scores of new reservoirs. The largest project funded in the Musselshell River basin was the Deadman's Basin project. The first shovelful of dirt was thrown by water resource advocate Governor Cooney on July 10, 1934, who said, according to the Harlowton Times, "Water is our most valuable asset, when our mines are forgotten and other great industries lag, the water will be rolling on." Another luminary who spoke at the ground-breaking ceremony was Judge J.G. Jeffries from Roundup. The newspaper quotes him: "Water is the crying need in Montana, it always has, and always will be."

The Deadman's Basin irrigation project proved to be a difficult one to finish. Stories about it occupied the front pages of both the Harlowton Times and the Roundup Tribune for the next seven years, until it was finally completed in the fall of 1941. Ranchers had to sign up guaranteeing to purchase up to 57,000 acre/feet of water from the project to pay back money advanced by the state to help pay for construction. There was concern that the project would interfere with decreed water rights or reduce the amount of water available to fill those rights. Assurances were published in the Harlowton Times on November 22, 1934, that no new irrigable land would be developed as a result of the Deadman's Basin project, but the reservoir would be able to supply the needs of irrigation systems already in existence. Benefits of the project would include flood control, reduction in stream pollution, recreation, wildlife reserves, provide water to part-time farmers who worked in the coal mines, and "point the way to others" who might want to

Deadman's Basin Reservoir diversion dam and inlet canal before 2011 flood
Photo © 2011 Chris Boyer, Kestrel Aerial Services

pursue similar efforts. When the project at last began to store water in 1941 for distribution the following spring, a disagreement over water right dates between the Deadman's Basin project and the Upper Musselshell project ensued. Though the Deadman's Basin project began almost four years before the Upper Musselshell project, the latter won the race for putting the water to beneficial use. According to water rights protocol, Deadman's Basin is still the senior priority, based on the filing date in 1934.

The Upper Musselshell project received the blessing of the Montana State Water Conservation Board in August of 1934, The board was impressed that the petition for construction was the most complete of any yet presented to the board, with a great deal of engineering and water availability work having already been accomplished. Contracts for purchase of 30,000 acre/feet of water supplied by the project to ranchers from Checkerboard to Shawmut were approved by the Board on June 1, 1938. The contracts guaranteed that bonds sold by the state to finance its portion of the construction costs would be repaid. Construction was begun even before that, in April of 1938 paid for by the Public Works Administration, and was completed by September 1939, while the Deadman's project languished. Drought limited the first year's filling of the Upper Musselshell reservoirs, and in May of 1940, a Times article mentioned that by May 16, all water stored in the DuRand Reservoir (later re-named Bair Reservoir) had already been released, and June would draw down the Martinsdale Reservoir by 25%. The reporter commented that even 40 years of water flow records are not enough to calculate flows into the future. A comment in the August 26, 1937 issue of the Roundup Tribune summed up how many downstream water users felt about the Upper Musselshell project: "To the farmers and ranchers living along the Lower Musselshell River valley, however, this project is just another way to keep water from dampening the bed of the Musselshell, which is now dry a great part of the time, and will allow so much less water to enter the Dead Man's basin, when and if it is completed."

The Delphia-Melstone Canal was built between 1949 and 1955 with the assistance of the Montana State Water Conservation Board, and paid by bonds issued by the state. A group of ranchers organized in 1949 to file on water rights from the Musselshell River for 2,028.5 acre/feet, and that filing is supplemented by contract water purchased from Deadman's Basin Water Users Association to deliver a total of 12,171 acre/feet to 52 irrigators. Maintenance costs are paid by the Delphia-Melstone Canal Water Users Association, which has owned the canal system since 1996. The original plan was to provide water to eventually irrigate 16,000 acres, but limited water supply has held that acreage to 6,085. The contracts for water supplied by the canal system require that it be used to irrigate specific tracts of land and are not transferable to different tracts even if they are in the same ownership.

In the summer of 1935, the Roundup Tribune reported that a Public Works Administration project on South Willow Creek in Musselshell County called for two reservoirs, a diversion dam, and the drilling of four artesian wells to supplement creek water that was to be diverted into Lake Mason. An earlier well drilled on the nearby Miller Ranch was producing 30,000 barrels of water a day, and had been consistently doing so for a year. The October 17, 1935 issue of the Roundup Tribune said the plan also called for the early spring runoff from Currant, Cameron, and Pole Creeks to be channeled into Lake Mason to ensure the "ultimate conservation of all water in that territory." PWA funds were pulled, and by November of 1937, one new artesian well had been drilled, and one dike built with costs paid by the Resettlement Administration (later called the Farm Security Administration and now known as Farm Service Agency)

When the Carey Act Flatwillow Creek project failed to materialize, a new proposal to channel water from Yellow Water Creek into a reservoir east of the Flatwillow location was presented to the Montana State Water Conservation Board in 1935. The estimated capacity of the reservoir would be 4,400 acre/feet. Construction began with labor supplied by the Civilian Conservation

Corps in 1937, and the reservoir was completed in June of 1938. It took the Yellow Water Irrigation District until 1948 to find financing to complete the necessary ditches to deliver 2,000 acre/feet of water to the ranches served by the reservoir.

While the larger projects were underway in the Musselshell River basin, many small dam and reservoir projects were built with federal funding. In 1934 the Montana Extension Service recommended small-scale reservoir/flood irrigation projects instead of the large-scale efforts that were soon under way after this recommendation was made. In April 1936, seven dams were under construction in Musselshell County, with fifteen more proposed. They were being built on land the federal government bought back after homesteaders abandoned it. By 1937, the Resettlement Administration had paid for construction of 64 dams in Musselshell County, and six more were nearly completed. Ranchers in other areas of the basin were paying for and building their own small reservoirs, and filing on water rights to fill them with spring run-off water. This no doubt had an effect on difficulties experienced in filling the big project reservoirs. One local rancher pointed out recently that a great deal of water is lost to evaporation from the surface of small, shallow reservoirs, and thus unavailable for use downstream. A commentary written by a Roundup area rancher and published by the Roundup Tribune June 6, 1935, pretty much summed up the opinion of lower Musselshell water rights holders: "impounding and diverting water has been encouraged to such an extent that we on the lower Musselshell River have had almost no water this spring." He went on to say that there is no practical way to protect historic water rights from new filers upstream.

Water quality was a background issue in the early days of water use in the Musselshell River basin. Homesteaders had a difficult time finding suitable water for simple sustenance, much less for irrigation. In June of 1998, the Montana Department of Natural Resources and Conservation (DNRC), US Bureau of Reclamation, Upper Musselshell Water Users Association, and Deadman's Basin Water Users Association conducted a major study of water management on the Musselshell. Chapter Five was devoted to water quality. Thirteen water sampling sites were selected from Martinsdale to Mosby, and on several major tributaries. Flow measurements were made concurrently with quality measurements. The main concern was the level of dissolved solids in water. It was known that irrigation return flows carry dissolved solids with them into the river, and the levels increase as the river flows toward Ft. Peck Reservoir. Also, not surprisingly, as streamflow decreases, the total dissolved solid measurement increases, sometimes to the point where the water is toxic to crops. The main culprits are sodium, chlorides, and sulfates. Small stock watering reservoirs can also become so loaded with these chemicals that the water can kill the cows that drink it.

Careless Creek deep cutbank after 2011 flood
Photo by Wendy J. Ross Beye

One Musselshell River tributary that has received special attention is Careless Creek, which arises in the Big Snowy Mountains and also serves to carry water from one of the outlet canals for Deadman's Basin Reservoir. Water sampling showed that total dissolved solids in the creek were higher above the confluence with the Deadman's Reservoir outlet canal than they were below it. The outlet canal, however, contributed to bank erosion when summer irrigating releases of up to 300 cfs were channeled into the creek, and the solids went on into the mainstem river. In 1992, a group of local landowners and representatives from Deadman's Basin Water Users Association partnered to

remedy the situation. Montana's Department of Environmental Quality helped the group set measurable standards for improvements. Landowners worked to establish protective bank vegetation on a 15.5 mile stretch of the creek, and irrigation water releases from Deadman's Basin were limited to 100 cfs. The project was a success, and the partners looked forward to further improvements. Unfortunately, the catastrophic flood of 2011 undid most of their hard work. Inspite of that, the decreased irrigation water releases have had a beneficial effect on suspended solids in the water that makes its way into the river, and the quality still meets the standards set by DEQ.

Good hay crop on irrigated land west of Shawmut
Water provided by Upper Musselshell Project
Photo by Wendy J. Ross Beye

One year after flood, picnic table rests in the silty Musselshell River
Photo by Wendy J. Ross Beye

VII. Water Rights

When Montana was a Territory, filing for water rights was a simple matter. A miner would write a note on a piece of paper stating the amount of water he would take from a source such as a spring or a creek, the beneficial use, the date, and his signature, then nail it to a tree at his point of diversion. If he felt like it, he might also record a notice in the closest territorial county seat. Or, a rancher could simply begin using water, and not post any kind of notice. For the Musselshell River basin, the earliest water rights, if filed, would have been carried to the county seat of Meagher County. There were only nine territorial counties, and now there are 56 in the state, so when county boundaries and seats of government were changed over the years, records of filings were misplaced, destroyed, or otherwise lost. Streamside land was quickly settled, and multiple filings or use rights added up to more water than the source could ever provide. Political interests, especially mining interests, squashed every attempt to set up a central water rights filing system. Landowners were generally happy with the status quo, as over-appropriation tended to discourage new water right filings, and thus, limit new settlers. The situation didn't change when the territory became a state in 1889.

Basin Creek in the Little Belt Mountains - a tributary of the North Fork of the Musselshell
Photo by Wendy J. Ross Beye

People who wanted to see the state water rights system reformed lobbied for the creation of a position of State Engineer when the state's first constitution was drafted, but most of the delegates to the convention wanted to continue down the road already comfortably traveled. The effort failed. Finally, in 1903, after the Arid Lands Board was dissolved, a State Engineer was seated on the replacement Carey Act Board. Unfortunately, the State Engineer had no authority to alter the water rights system, and the haphazard filings continued. When disputes over water occurred, they had to be settled by shotgun, on the ditch bank, or in court, and that's the only place water rights were adjudicated until the state adopted a new constitution in 1972 and made an attempt to unravel the mess in earnest.

The new constitution affirmed "all existing rights to the use of any waters," that originated prior to July 1, 1973, to allay the fears of anyone who had historic water rights. The right could be a use right, a decreed (by a court) right, or a filed right – they all had equal value. The document was very emphatic on the issue of who owns the water that flows within Montana's boundaries, above or below the ground – the state. Water rights holders only enjoy the use of the water. The constitution also called on the legislature to create a system of centralized record-keeping. The Montana Water Use Act, effective July 1, 1973, authorized the state to adjudicate all pre-1973 rights, establish a permit system for future rights, centralize record-keeping, set up a system for authorizing a change of use for a water right, and reserve water for future use and in-stream flows. The adjudication process began in the Powder River basin with DNRC collecting and examining claims with on-the-ground investigation. After six years of work, the basin still had not been adjudicated, and it became obvious that a more efficient program was necessary. The Montana Water Court was created, and the Court began holding concurrent hearings all around the state. Water rights holders were required to appear before the Water Court upon notice of a hearing, and could present information to verify their claims. Though the process was quicker than the original examination method

by DNRC, it did not necessarily result in accurate records.

Under the Water Court program, accuracy of water rights records relating to how much water was applied to which acreage relied upon neighboring water users' objections. In many cases, Joe might not want to object to Sam's water right claims because his own claims might be just a bit shaky, and Sam could just as easily file an objection. As a result, a true picture of historic use does not exist, and it may take many years of wrangling in the district courts to sort it all out. Even then, the results of adjudication will not help water managers determine how much water is available in the Musselshell River basin, nor will it tell them how much water is being put to beneficial use. State water resource planners are encouraging water users to develop a collaborative approach to water sharing in drought years rather than relying on the Water Court to serve as an arbitrator.

The total number of irrigated acres in the Musselshell River basin has increased dramatically since a 1949 inventory was conducted by the state, all without benefit of any new water use dates. That expansion has diminished the supply of water available to water users downstream. If ranchers so affected want to do anything about changing the way the basin is adjudicated, they have to collect the signatures of 15% of the water rights holders in their basin, or one affected water rights holder has to convince the court to order a re-examination – an expensive process. A further difficulty is that the Musselshell River basin is divided into two sub-basins, so to change the decree in the upper sub-basin, the water rights holders there would need to file their own 15% petition – a move that would probably result in a loss of water for them. That is not a likely scenario.

Until the adjudication process reaches its conclusion – an elusive target somewhere down the road – the state court system has been the only way available to settle disputes among water rights holders, and there have been disputes aplenty over the years. This places a heavy burden on the shoulders of the district court judges who hear water rights cases. Water rights issues are nearly always extremely complex, and district court judges don't have the time to become experts on water while they are also handling the many other cases on their dockets. Transcripts of Montana Supreme Court decisions demonstrate this difficulty.

A representative case involved a ranch near Ryegate and an order by a district judge. According to the Montana Supreme Court decision of January 29, 2002, the District Court, on its own motion, found that the "remaining stored water level in Deadman's Basin Reservoir has reached a critical level" and that the reservoir water was needed to maintain the Musselshell River flow "to supply domestic, municipal, stock and wildlife water usage." The rancher had paid for his contract water, and he hadn't used it all by August, so he continued to irrigate. The rancher filed a motion for the district court to reconsider its order, restrain the water commissioners from preventing him from irrigating, and allow him to use his full order of contract water. His motion was denied, and his appeal turned down. In the meantime, he was found to be in contempt of the district court order and ordered to pay a fine. The Supreme Court found that the district court judge had erred in cutting off water rights without considering the rule of prior appropriation. Reservoir water right dates were earlier than other rights, particularly streamflow rights held by Montana Fish, Wildlife, and Parks. The case led to more careful apportioning of contract water by water managers, based on early spring estimates of water availability through the irrigating season on the Musselshell.

Because the Musselshell River earned the label of "chronically de-watered," its basin was one of the first to be adjudicated and issued a Temporary Preliminary Decree. This allowed water rights to be enforced, and 15% of the water rights holders in the Upper and Lower Musselshell River basin signed a petition asking the court to create an enforcement program in 2001. The name of the program was soon changed to the Musselshell River Distribution Project. Creation of the project allowed the court to

appoint water commissioners to monitor water use by water rights holders, including the water users associations (Upper Musselshell, Deadman's Basin, and Delphia-Melstone Canal) from the North and South Forks of the Musselshell, all the way along the mainstem Musselshell River to the Mosby Bridge. Water rights holders downstream of the bridge petitioned to join the project in 2006. Water users pay for the costs of the Distribution Project based on the number of acre/feet of decreed water they use each irrigation season.

Water commissioners serve as the court's enforcement arm. Water commissioners are authorized by Montana statute to monitor water use up to the water rights holder's point of diversion, and the court required all water users to install measuring devices at or near their headgates or on their pumps so that use records could be accurately maintained. The project got off to an inauspicious start, with some ranchers objecting to having to allow water commissioners onto their land, and to having to install measuring devices. The river was still occasionally de-watered, especially in the lower reaches, by the end of the irrigation season. The river was even dry during the winter four years after the project started, because of drought the previous summer and over-use of water. The water commissioners found that it was essential to stay in constant contact with each other, with contract water managers, with irrigators, and to monitor streamflow gaging station data sometimes several times a day. As communication and cooperation improved, and ranchers became accustomed to working with the water commissioners, water delivery improved, everyone was generally pleased with the results, and the riverbed has been wet (sometimes by only a few inches) through the summers.

Only two tributaries of the Musselshell River (Careless Creek and Swimming Woman Creek) have court-appointed water commissioners to monitor water use. Once the basin receives its Final Decree, the tributaries may all need some sort of monitoring because use dates in the entire basin will be tied together for priority determinations. This will magnify the complexity of water commissioners' duties, and the state has yet to decide how to deal with the problems that will arise.

Cold water fishery, Basin Creek, Little Belt Mountains
Photo by Wendy J. Ross Beye

VIII. Water Management

When the Deadman's Basin water storage project began in 1934, the Montana State Water Conservation Board filed for a water right on unused winter and spring flows to fill the reservoir, so its priority date is June 5, 1934. The filing date for diversion of water into the Martinsdale Reservoir, which stores water for the Upper Musselshell Project is May 10, 1938. The Upper Musselshell Project was completed and ready to store water by the winter of 1939, while Deadman's Basin wasn't ready for water until September of 1941. When managers of the two projects began to look for water at the same time to fill their reservoirs, a dispute arose over who should get water first. Deadman's had the earlier priority date, but if it was allowed to be filled to the brim before the Upper Musselshell could divert water, there was little left in the river, and the upstream contract water holders were left high and dry for the summer.

After many years of conflict, the two water user association boards decided to sit down together to hammer out a compromise. In 1995 an agreement was formalized that allowed Deadman's to use its water right flow to divert into its inlet canal at maximum capacity from October 1 through March 1. On the first of March, if the Upper Musselshell reservoirs (Martinsdale and Bair) were at a lower percentage of full capacity than Deadman's, the senior water right would yield to the junior right until the three reservoirs were at equal percentages of capacity. At that point, the naturally-flowing water remaining in the river would be equally shared by the two associations. The agreement's success is dependent upon cordial and cooperative communication between the water managers for the two projects, and it is working well. In 2009 when a Deadman's Basin dam rehabilitation project required lowering water levels during the winter, the Upper Musselshell Water Users Association stored extra water and released it to help fill Deadman's reservoir when the construction project was completed. Such cooperation was certainly not the norm before 1995.

Releases of contract water from all the storage reservoirs requires a complex dance involving the water managers, the water commissioners, and the irrigators. The managers must allow for a percentage of any given release that is lost to evaporation, ditch leakage, and seepage through the riverbed so that the proper amount ends up at the irrigator's point of diversion. After the water passes that point, it's up to the irrigator to conserve it for his beneficial use. Until Deadman's Basin Water Users Association required the installation of water measuring devices (meters or calibrated flumes) in 1984, no one really knew how much water was being diverted into the irrigators' ditch systems or sucked up by their pumps. Once all the devices were in place, deliveries could be monitored by the Association's own water commissioners. Irrigators were required to check their devices daily, and log their water consumption. The whole process is further complicated by the mix of decreed and contract water used by most irrigators.

Water delivery took another step toward efficiency when the Musselshell River Distribution Project was established by petition of water right holders on the mainstem of the river. The court ordered all decreed water users to install measuring devices. The Deadman's Basin irrigators were ahead of the curve, having already used devices for more than 15 years. The river was eventually divided into six zones to allow water commissioners time to cover their territory. Water commissioners served not only to monitor water use and be the “cops” enforcing priority of water rights on the river, but also to educate irrigators in the benefits of cooperation with other water users. A water commissioner who was courteous and took time to have a cup of coffee with a rancher had much better success than one who appeared officious and aloof, or worse, left gates open. With a good corps of water commissioners in place, water deliveries were going smoothly until the flood of 2011 hit the basin.

Few producers were able to irrigate their fields during the summer of 2011, as most of the irrigation infrastructure was destroyed from Shawmut to Ft. Peck. In addition, many fields were wastelands of mud and debris, with alfalfa dead and buried beneath it. When it was time to start delivering water in 2012, water managers found that the river had changed so much that their calculations for allowing time for delivered water to arrive at a particular point of diversion were no longer useable. Water commissioners who could in years past accurately estimate streamflow just by looking at a stretch of river found they had to rely heavily on streamflow gages rather than their experience. Communication became a problem because conditions changed more rapidly than anyone was expecting. To top off the misery, the basin experienced record low precipitation from May through September in 2012, by nearly an inch. Many ranchers had planted water-thirsty crops in the spring to prepare their fields for alfalfa plantings in 2013. They counted on plenty of water for irrigation. It didn't materialize. Others were so distracted by re-building efforts that they would forget to tell the water managers that they had closed their headgates, and precious water ended up passing on downstream and into Ft. Peck Reservoir.

The water managers, water commissioners and irrigators all learned their lessons well in 2012. When reservoirs didn't fill to capacity over the winter and spring of 2013, everyone was ready to deal with the shortage. The water user associations notified contract holders that they could expect to receive only receive a percentage of their water. Water commissioners spent all day roaming up and down the river in their zones, monitoring streamflow gages and calling each other several times a day. Priority dates on decreed water sometimes changed every few hours. Irrigators paid more attention to their water measurement, and were quick to notify water managers when they had stopped pulling their water from the river. Everyone had a less stressful summer.

Streamflow gages maintained by the US Geological Survey have come to play an extremely important role in efficient use of water in the Musselshell River basin, as well as providing critical information to Disaster and Emergency Services. During the flood of 2011, gages from Martinsdale to Harlowton to Shawmut to Lavina showed the march of the torrents downstream toward houses built on low-lying land at Roundup. The Deadman's Basin water manager was monitoring the gages with real-time data transmitted via satellite to the internet, and made calls to all the ranchers who had water contracts, as well as to the Sheriff's departments of downstream counties. The notification, short as it was, no doubt saved lives. The following year, as water was once again delivered for irrigation, the gages were essential to tracking water releases down the river, as there was no predicting how fast the water would move through all the new channels cut by the flood. Future funding for maintenance of the gages is in jeopardy, and the Musselshell Watershed Coalition is working to find the resources to continue their operation.

As disastrous as the flood of 2011 was, it also brought opportunities for improvements in water storage and delivery. All three of the water user associations applied for and received state grants for repairs and improvements in their water delivery infrastructure, and many producers were also able to upgrade their water delivery methods by cost sharing with the Natural Resources Conservation Service (NRCS). NRCS and FSA also helped pay for debris clean-up and land leveling in fields, and signed up ranchers for a cottonwood regeneration protection program that pays for fencing riparian areas and providing water tanks for livestock fenced away from the river.

The largest post-flood projects were replacement of an above-river siphon on one of the canals operated by the Delphia-Melstone Canal Water Users Association (DMCWUA) and the yet-to-be-accomplished new diversion dam for Deadman's Basin Water Users Association (DMWUA) that will replace a forty-year old structure damaged by the flood. The DMCWUA siphon was replaced with one that runs under the river instead of over it, removing the concrete support columns that interfered with the flow of the river during

high water. The new design also pleased fisheries managers. The DMWUA proposal is for a more fish-friendly structure made of rocks instead of concrete. The associations have all been slowly replacing old leaky headgates and lining canals to help conserve water.

Deadman's Basin Reservoir diversion dam
During 2011 flood
Photo © 2011 Chris Boyer, Kestrel Aerial Services

In the early days of irrigation in the basin, diversion dams emulated the beavers' style of building. They were made of cottonwood branches, rocks and mud. When floods damaged or destroyed them, ranchers just cut more branches, moved the rocks back upstream and they were in business again – low cost, but labor-intensive. After the 2011 flood, at least one diversion dam was completely abandoned, as it was buried in gravel and no longer reached the main river channel. Instead, the private cooperative ditch group installed a large pump and mainline to fill their ditch system. Some of the ranchers in the group opted for installation of pivot sprinklers rather than continuing to flood irrigate.

Many permanent pumping sites were destroyed by the flood, while ranchers who used portable pumps were generally able to move them to higher ground before the rising waters reached them. More ranchers are now considering that option as a hedge against future floods. The expense of replacing pump pads, pumps that were filled with silt, and power lines running to the river outweighed buying diesel-operated pumps that can be moved.

The Musselshell Watershed Coalition obtained several grants that allowed a team of technical specialists (called the River Assessment Triage Team, or RATT) to visit ranchers who had suffered severe flood damage and who wanted assistance. The team walked the river bottom land, cataloged the damage, and made suggestions about what options for repair might be available at over 40 sites. The team recommended, for instance, that in areas where the old Milwaukee railroad grade was breached by floodwaters, the breaches should not be repaired. Those connections with a wider floodplain will help reduce damage in future floods by storing some flood water and also allowing inundated fields on the land side of the railroad grade to drain as flood waters recede. The RAT Team also recommended future monitoring of restoration projects to determine relative usefulness in future floods, and monitoring of areas where no restoration was accomplished to see how well the river heals itself over the years.

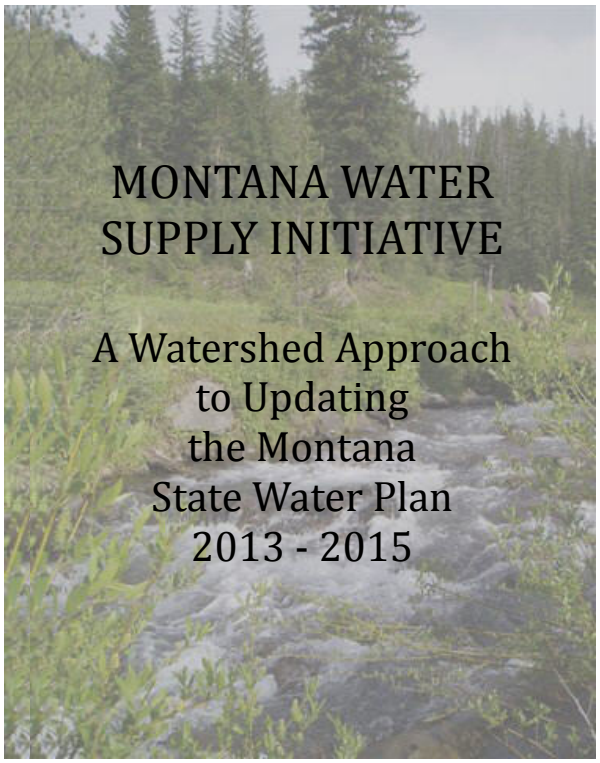
Partners in the Musselshell Watershed Coalition are now considering a response to the need for basinwide long-range planning of water management. They know that there are additional challenges ahead of them and they want to be prepared to meet them successfully. Continued management by crisis is not an option, and saddled with an aging infrastructure that is bound to fail soon, water managers need to prioritize future repair or replacement projects. The groundwork for good planning is in place: partners who understand the need for planning; carefully-nurtured relationships with state water resource planners; water user association boards that are willing to make financial commitments for necessary projects; and a new web-based Geographical Information System in place that can help track infrastructure condition and water use demands.

IX. Water Use Planning

The state has made attempts at long-range planning for water use since at least 1905, so far without much success. In 1949, as a part of a Montana State Engineer's project, detailed water resource surveys were published for Golden Valley, Musselshell, and Wheatland counties. A survey was published for Meagher County in 1950. Researchers combed through county courthouse records, examined aerial photographs, and visited with agricultural producers to compile data for the surveys. They provide a very accurate historical record of the state of water use at the time they were written, and have been helpful in the adjudication process when examination of claims is necessary. They also detail the history of settlement and agriculture in each of the counties, and catalog the various irrigation projects completed or proposed.

In 1967, the Montana legislature passed the Montana Water Resources Act, which required the Montana Water Resources Board (previously known as the Montana Water Conservation Board) to inventory the state's water resources and draft a comprehensive statewide water use plan. By 1972, not much had been accomplished toward meeting the assignment, although additional water resource surveys by county were produced, and an avalanche of data was stored on newly-acquired computers. The Water Resources Division of the Department of Natural Resources and Conservation (DNRC) took on the responsibility for drafting plans for each sub-basin in the state. Those drafts would be presented to the public for comment, and the plans were scheduled to be completed by 1978. A plan called Framework Report: A Comprehensive Water and Related Land Resources Plan for the State of Montana was completed in 1976.

In 1987, DNRC had another go at developing a statewide water use plan. A handbook was published outlining the procedure that would be used. Public input was to be sought, but issues were to be defined by DNRC in consultation with the Board of Natural Resources and Conservation and the State Water Plan Advisory Council. Steering committees would be appointed in each basin to conduct scoping sessions for public input and to later present the draft plan to the public. A series of documents outlining DNRC's recommendations for action and policy adoption by the department and the state legislature included "Agricultural Water Use Efficiency," "Instream Flow Protection," "Federal Hydropower Licensing and State Water Rights," "Water Information System," "Drought Management," "Integrated Water Quality and Quantity Management," "Montana Groundwater Plan," and two sub-basin plans for the Clark Fork River basin. These guides were published between 1989 and 1999, and some recommendations were implemented. Communication of the plan objectives did not trickle down well to the local level, however, and few end-users of water are aware of the documents or their content.



A new round of planning, called the Montana Water Supply Initiative is in process in 2013. Each major basin in the state (Clark Fork, Yellowstone, Upper Missouri, Lower Missouri) is appointing a Basin Advisory Council. The BACs will conduct scoping meetings in their basins to listen to the public's concerns on water issues. In 2014, the BACs, in cooperation with DNRC, will go on to develop recommendations to be presented to the 2015 Montana State Legislature for action and funding. A real effort to involve the public in the entire process may result in more wide-spread knowledge of the outcomes. The Musselshell River basin is included in the Lower Missouri River basin, and several scoping sessions will be held in the area.

Conservation Districts (formerly known as Soil Conservation Districts) were established in Montana in 1939 in response to severe drought conditions that caused topsoil to blow away, and are political subdivisions of the state with the power to levy a tax of up to 1.5 mills to pay their costs in the county where they operate. Some districts are multi-county where it isn't feasible to support a district in each county because of low population and limited tax base. Conservation districts play an important role in public education, and most have an association with their local school districts. They are also tasked with administering the 310 permit process that applies to any construction project conducted in a perennial streambed. There are four conservation districts that have jurisdiction in the Musselshell River basin: Wheatland County, Lower Musselshell, Garfield County, and Petroleum County.

In recent years, all of the basin's conservation districts have served in the capacity of grant sponsors for projects in the basin. A recent compilation of projects accomplished by partners in the Musselshell Watershed Coalition from 2009 to 2013 highlighted the nearly $4.75 million channeled into the Musselshell River basin, along with almost $2.5 million in local matching or in-kind contributions. The conservation districts served as sponsors for dozens of grants, carefully administering them for the benefit of residents. In an area that is on precarious footing on the economic ladder, this financial assistance from federal and state agencies is helping to save the basin's rural heritage as well as wisely manage water resources. Much of the grant funding was used for repairs and recovery from the catastrophic 2011 flood, keeping in mind the goals of improving the efficiency of water delivery to end-users and allowing the river to heal itself. Before the flood, other projects included water quality monitoring, weed control, and resource assessment studies. In the year following the flood, the Lower Musselshell Conservation District helped administer funding for planting grass seed in the Bull Mountains where wildland fires consumed more than 70,000 acres of timberland.

Young cottonwood seedlings on gravel bar
West of Roundup, summer 2011
Photo by Wendy J. Ross Beye

The partnerships established in the Musselshell River basin are a relatively new phenomenon. Water sharing has been a contentious issue since the first day two neighbors fought over water diverted from a trickling prairie stream, probably not long after the first notice of water right was nailed to a cottonwood tree somewhere in the basin. The water wars continued on the range and in the courts until the state began sorting through claims in 1973. Even that process did not end the battles. The first major effort at mediation between two large water users – Deadman's Basin Water Users Association and Upper Musselshell Water Users Association – occurred in 1994 when the two boards came together to hammer out an agreement for fair division of river water to fill their reservoirs during the winter and early spring months.

It is likely that the atmosphere that allowed the boards to agree to mediation began to develop when the association ditch riders visited each rancher that received contract water to check their measuring devices and water use logs. A friendly chat about how water delivery was going with the people up and down the river changed the concerns about water from personal supply to community needs. Upstream users gradually began to think about how their actions affected their friends and neighbors downstream.

In 1995, the first local cooperative group concerned with water quality started an outreach program to seek ideas for improvements for Careless Creek, one of the Musselshell's major tributaries that was dumping tons of silt and salt into the river every year. Collaborators include the Lower Musselshell Conservation District; Musselshell and Golden Valley County Commissions; U.S. Department of Agriculture's Natural Resources Conservation Service; Deadman's Basin Water Users Association; Upper Musselshell Water Users Association; U.S. Bureau of Reclamation; Montana Watercourse; Deadman's Basin Cabin Owners Association; Montana's Fish, Wildlife and Parks Department, Department of Natural Resources and Conservation, and Department of Agriculture; local schools; landowners; and the Montana Conservation Corps. The restoration project was so successful that it won a Watershed Stewardship Award from the Montana Watershed Coordination Council and a CF Industries National Watershed Award. Measurable results of the project included over 52,000 feet of streambank restoration, 18,000 acres of rangeland improvements, riparian plantings on the lower reaches of the creek, a cooperative agreement with Deadman's Basin Water Users Association to limit the flow of irrigation water releases from the reservoir down the creek to help protect against bank erosion, exclusion of livestock from the riparian area along the creek, a 25% reduction in sediment loads, and educational outreach to local schools. Perhaps the most important benefit, however, was the spirit of cooperation and collaboration that developed among the project's partners.

That developing spirit carried forward to the establishment of the Musselshell Watershed Coalition in 2009. Many of the same partners now participate in regular meetings to discuss issues of concern to water users in the basin. Though the group is not formally organized, it has been able to apply for and receive grants for its work by calling on conservation districts, the City of Roundup, and the Central Montana Resource Conservation and Development board to act as fiduciary agents for the grants. The Coalition was immediately able to call for state and federal assistance for area ranchers and the water user associations after the 2011 flood because the agencies were already familiar with the group's ability to successfully complete projects. Producers were more comfortable working with people they knew as neighbors than they would have been if only government employees had shown up to offer help. The Coalition will assist Montana's DNRC in conducting public listening sessions to discuss common concerns about water supply in the Lower Missouri River basin. It has also been developing education and outreach programs available on the internet to help keep people informed about water resource issues.

More than twenty interviews of Musselshell River basin residents have been conducted as a part of this water history project. Their comments and suggestions are extremely important to the work of the Coalition and to the state's efforts at long-term water resource planning. Nearly all of the interviewees had heard of the Coalition and believe that the partners have been successful in building cooperation among water users in the basin. Other common threads that were uncovered during the interviews are summarized below.

1. For many years before the Musselshell River Distribution Project was established, the river dried up during most irrigation seasons. After surviving a few bumpy early years where violence was threatened against enforcers, the Project hit its stride and gave more thought to selecting water commissioners who could work compatibly with ranchers and closely monitor streamflow in the river. Since then, water has flowed throughout the

summer all the way to Ft. Peck Reservoir. During drought years, the flow may not be much, but water at least covers the riverbed, maintains subterranean storage pools, and supports fisheries. Most interviewees give the bulk of the credit for improved water delivery to the installation of water measuring devices that were required by all of the water user associations for contract water, and by the Distribution Project for decreed water. Careful monitoring of water measurement logs by water commissioners has taken the burden off ranchers who suspect their neighbors are using more than their fair share of water. The system keeps everyone honest.

2. There have been sometimes dramatic, sometimes subtle, changes in the land along the Musselshell River over the past 70 years. Some old-timers recall that there were many more mature cottonwood trees along the river when they were young. Winters experienced much heavier snowfalls than we see now, and spring rains aren't as generous as they used to be. One rancher couldn't recall a really harsh winter since the 1970s. There were more beaver dams in the area than there are now, and fishermen were still catching trout in the river all the way downstream to the town of Musselshell in the 1930s.

3. When the water rights adjudication process started in the 1970s, the Musselshell River basin was moved to the front of the line due to its classification as "chronically de-watered." The DNRC water resources staff began the process of examining all claims, and had nearly completed the task when the Montana Legislature changed the rules in order to speed up the adjudication process statewide. As a result, claimants' statements about historical use of their water rights and how much acreage was irrigated at the time of the original filings were not examined as thoroughly as they might have been under the original adjudication process. The result is dissatisfaction with the decrees for the basin, especially among the producers in the lower reaches of the river, because much more water is being used by upstream water rights holders than during the early years of irrigation. Ranchers are reluctant to file objections against their friends and neighbors to adjust the temporary preliminary decrees before they become final. They are just making do with the water they get each year. One rancher's suggestion for a solution was to compare tax classifications of land (irrigated vs. dryland) with water right claims.

4. Everyone along the river agrees that the 2011 flood brought a bumper crop of weeds to the riparian area. Floodwaters picked up an assortment of weed seeds and carried them far downstream. Lingering pools of water allowed millions of those seeds to germinate, and because the ground stayed moist all summer, weed seedlings grew rapidly. Salt cedar (tamarix) is the most pressing worry now. In places, salt cedar plants are as thick as grass, and some are so robust they produced new seeds by the fall of 2011. When they grow into small tree size, they use a great deal of water to grow, shed salt as the fine leaves transpire, crowd out willows and cottonwoods, and send their colonizing seeds in all directions. Ranchers are desperate for help in combating the invaders. They have to be treated with chemicals that are safe to use near the river.

5. Most ranchers see value in protecting areas of post-flood cottonwood regeneration, and many signed up for the NRCS program that pays for fencing to keep cattle out of protected areas for a few years and new water systems so cattle don't need to go to the river to drink. The cottonwoods that sprouted after the 2011 flood are now 4-5 feet tall, and will soon be able to hold their own against browsing deer and livestock. As they continue to grow they will help stabilize banks along the river.

6. Many ranching families are struggling with the decision of what to do with their operations in the future. Young people are generally moving out of the area rather than staying on the ranches. Some families have placed conservation easements on all or portions of their agricultural land to protect it from future residential development. They all take pride in what they have accomplished and love their way of life in spite of all the hardships they face.

X. Future Challenges

When the Musselshell River basin was settled in the late 1800s and early 1900s, the area was generally experiencing higher than average annual precipitation. A few drought years were sprinkled in, notably in 1887, the summer before the frigid winter that killed some 90% of the livestock on the open range. Hundreds of homesteaders poured into the valley by wagon and later by rail to settle on their 160-acre parcels of dryland. They were encouraged by the crop yields in those wet years, and continued to break up the sagebrush prairie to plant grain. By 1928, a long period of drought had settled in, turning croplands to dust and weeds, and many of the settlers moved out, abandoning their property. It had become impossible to make an agricultural living on such limited acreage, and they had no financial reserves to carry them through the dry years.

During the 1930s, when drought combined with the financial crisis called the Great Depression, the federal government came to the rescue in the West. Uncle Sam bought back millions of acres of abandoned land from the counties who were left holding the bag when settlers packed up. Water storage projects sprouted up in many of Montana's river basins, and water finally began to flow onto fields again by the 1940s. The stored water made it possible for ranchers to hang on during the years when precipitation was scarce, and there was never a year that left the majority of them completely dry through the irrigation season.

Since records were first maintained in the Musselshell River basin in 1895, the precipitation trend has been heading down, especially during the period May – September (See Graph 1 in Chapter III.). Water user association managers and water commissioners have sometimes been left scrambling to meet the needs of both decreed and contract water users. Every drop of water that flows down the river during the irrigation season has to be carefully tracked to be sure it ends up in the right field. There is no room for haphazard water management. Water managers have also learned to use the technological tools available to them – streamflow gages, water trackers in canals and ditches, Snotel precipitation and snowpack records, internet communication, smartphones, and computer spreadsheets. What has been lacking, however, is a plan to manage drought conditions in the future if it becomes impossible to fill the storage reservoirs over the winter and early spring. The water user associations are too busy dealing with the present to spend much time looking toward the horizon.

Basin-wide, an increasing demand for water is exacerbating the consequences of the climate trend toward more drought years ahead. Contract water purchasers are installing sprinkler systems on land that has never before been irrigated, and using their water continuously through the summer. They have increased their consumptive use, with crops utilizing all the water that rains down on them, sending no returns back to the river for downstream users. Other contract water purchasers have leased their water, so that even if they temporarily halt production on some of their land, the water continues to be used. Other users are selling their water to oil exploration and production companies, whose “fracking” processes can consume up to two million gallons of water for a single well. Downstream water compact requirements may at some point add further stresses on water supplies. Wells drilled to provide water for residential and agricultural use may have an effect on streamflows in the basin. All of these demands will impact the ability of water managers to meet the needs of the basin's residents in the future.

Center pivot sprinkler system
Photo USGS file

Some limited research has been conducted on the effects of changing methods of irrigation on water supply, but none in the Musselshell River basin. Evidence from other plains states with similar soil type and water quality suggests that switching from flood irrigation to sprinkler irrigation can reduce streamflows because nearly all the water delivered is either used by the crop or lost through evaporation. None boosts river levels as surface return flow, nor does it percolate deep enough to reach aquifers. In the Two Dot area of the Upper Musselshell, some ranchers noted the loss of springs and water in small streams below fields that were converted from flood irrigation to sprinklers. Sprinklers can also contribute to soil salinity problems by delivering salty irrigation water to the fields. Because there is usually no excess water to flush the salt from sprinkler-irrigated fields, it builds up in the soil, eventually sealing the surface and reducing productivity. This is of particular concern where soils have high silt and/or clay content. Pivot sprinkled fields are seldom leveled, so water, especially that delivered at the outer edges of the circular fields where delivery volume must be high to compensate for speedier pivot movement, can puddle up to create more salinity problems.

Flood irrigation has problems of it own. Unless it is very carefully managed, it can be much less efficient than sprinkler irrigation. It is labor-intensive, and it's difficult to water a field evenly, even if a rancher has worked hard to level and dike his fields. Water can pool and allow salt build-up in the soil. Sometimes there is not enough early season water available to flush the previous year's load of salt back into the river. Flood irrigation is usually accomplished only a few times, or even once, a season, using up all of a rancher's decreed and contract water in just a few shots. If there is untimely rainfall on top of soggy flood-irrigated ground, sometimes it's difficult to harvest a crop. But flood irrigation can benefit downstream users, and even the original user, by allowing flood irrigation return flows to be recycled onto additional fields. It may also help to recharge groundwater supplies along the river.

Irrigation isn't the only agricultural activity that affects our water supply and quality. Range management practices can reduce or augment both supply and quality. Rangeland that is over-grazed allows rapid run-off of heavy spring and summer rains, moving salt, silt, and weed seeds downstream. The precipitation has no opportunity to soak deep enough into the soil to allow plants to access it during dry days that surely follow the rain. If native grasses are allowed to thrive, they help slow the rate of run-off, and subsurface soil moisture is present to greater depths. Ground that is covered with grass stands a better chance against invasive weeds, and can reduce the costs of weed control. Ranchers in the Musselshell River basin generally do a good job of managing their rangeland, making sure that their herd size is reduced when conditions are tending toward drought.

Sagebrush and native grasses northeast of Roundup, August, 2013
Photo by Wendy J. Ross Beye

Another agricultural practice that can affect water supply and quality is livestock watering reservoir construction. During the 1930s the government encouraged ranchers to build small stock watering and irrigation reservoirs, even paying for construction costs in an effort to help subsistence settlers survive in the arid west. As one rancher recently pointed out, if a series of reservoirs is built on one flowing stream, the first few fare pretty well, with water flowing in at the upper end and out at the bottom end. At each subsequent reservoir,

however, more water is lost to surface evaporation, and eventually, there is no water flowing out of the lowest reservoir in the string. Downstream water rights holders can no longer access the water they are entitled to use. There are thousands of stock reservoirs on tributaries in the Musselshell River basin, and there is no way to calculate how much they affect the flow in the river mainstem. The water in the reservoirs also becomes saltier as it evaporates. Some reservoirs become unusable for livestock, and ranchers have to breach the dams, leaving a white crusty expanse in the creek bottom, ready to wash downstream with the next heavy rain.

Weeds are the bane of all ranchers. They are non-native plants that can invade an area and spread like wildfire. Livestock will seldom eat them, some are poisonous, and they always seem to be prickly and able to survive on very little water. Many are resistant to chemical applications that are supposed to kill them. The Musselshell River flood of 2011 brought residents a bumper crop of many different kinds of weeds that threaten to take over riparian areas. Salt cedar, knapweed, Scotch thistle, Russian thistle, cocklebur, whitetop, bindweed, leafy spurge, and others are all thriving along the river and its tributaries. Weed control programs, to be effective, need to encompass the Musselshell River basin from the headwaters to the confluence with the Missouri. The Musselshell Watershed Coalition is addressing the weed problem, working to build cooperation among all the county weed boards in the basin. If Lower Musselshell ranchers spend time and money on eradicating weeds, people upstream need to do the same, because weed seeds love to travel downstream. Fewer weeds mean better productivity, and more water for crops.

The energy industry has been a presence in the Musselshell River basin since the first discoveries of oil were made at Cat Creek in the Lower Musselshell area, and Devil's Basin north of Roundup in the early 1920s. There are active oil wells still dotting the landscape at Gage, Big Wall, the Devil's Basin formation, and Cat Creek. In the past few years, new exploratory wells have been drilled in Petroleum County west of the Musselshell River, and in Musselshell County. The next step for the companies is to begin drilling horizontally and using the fracking process to see if enough oil can be produced to make the wells a commercial success. Fracking uses enormous quantities of water, and the use is consumptive; that is, it cannot be re-used for any purpose, including more fracking, because of the chemicals that are added to it. One oil well can consume two million gallons of water for fracking. This new use of water resources will certainly have an impact on existing supplies.

It would be easy for people who live and work in the Musselshell River basin to throw up their hands and give up on trying to meet the challenges facing them. They come from hardy stock, though, and have come to love this land and its capricious climate. It's worth the effort it takes to make a living here. Through communication and cooperation, ranchers are learning that sharing the limited resources available can mean a better chance of success for everyone. State and federal agencies are beginning to recognize that allowing local residents to work out for themselves the best way to manage resources is a wise approach. The Musselshell River basin can continue to serve as an example of a successful grassroots approach to solving difficult problems.

Volunteers pulling salt cedar on river sand bar, July, 2012
Photo by Wendy J. Ross Beye

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