S. HRG. 105–410

FLOOD CONTROL AT DEVILS LAKE, NORTH DAKOTA

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED FIFTH CONGRESS

FIRST SESSION

ON A PROPOSED FLOOD CONTROL PROJECT AT DEVILS LAKE, NORTH DAKOTA

OCTOBER 23, 1997

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C O N T E N T S

FLOOD CONTROL AT DEVILS LAKE, NORTH DAKOTA

THURSDAY, OCTOBER 23, 1997

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The committee met, pursuant to notice, at 9 a.m. in room 406, Senate Dirksen Building, Hon. John H. Chafee (chairman of the committee) presiding.

Present: Senators Chafee, Reid, and Wyden.

OPENING STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator CHAFEE. I want to bid a welcome to everyone here this morning.

This is a meeting to receive testimony on proposed solutions to the flooding at Devils Lake in North Dakota. The overall Devils Lake Basin, which encompasses some 3,800 square miles in the northeastern part of the State, is a closed sub-basin of the Red River-Hudson Bay drainage system.

As a result of the 5-year wet cycle in the region, Devils Lake has risen some 16 feet since 1993 to its present level of 1,438 feet above mean sea level. During this period, Devils Lake has doubled in size and tripled in volume. By tripled in volume, I mean by that the content of water within the lake.

The situation in Devils Lake is most unusual. The lake is found in one of only two closed basins in North America, Utah's Great Salt Lake Basin being the other. Carved into the prairie by glaciers during the Ice Age, the low-lying land has no natural outlet for the water that floods into it from the north.

Indeed, according to the 1995 report of the Devils Lake Basin Interagency Task Force, no water has left the Devils Lake Basin in recorded history since the 1830's. Indeed, the Basin's surface runoff flows southward through many small streams and lakes and is collected by Devils Lake and the smaller nearby Stump Lake. There it remains until it evaporates or enters the groundwater table.

Geological evidence shows that the water level in Devils Lake has fluctuated dramatically from completely dry, about 1,400 feet, to overflowing into the Sheyenne River at about 1,457 feet. All of this over the last 10,000 years.

Records from the first European settlement of the area indicate that the lake level in the 1830's was about 1,440 feet. That level

dropped over time to reach a level of 1,402 feet in 1940, rose again to 1,429 feet in 1987, dropped back to 1,423 feet in 1991. As I stated a moment ago, the lake level now stands at 1,438 feet.

As we will learn today, the people who settled this area have long struggled with the problems presented by the unpredictable changes in the level of Devils Lake. In the current cycle, rising lake waters have caused some $100 million in damage to development and crop lands that had existed on dry lands during decades of low water.

To help stem the further flood damage and prevent the lake from overtopping, the U.S. Corps of Engineers has embarked upon a plan with State and local agencies that includes the construction of a lake outlet. The proposed outlet would periodically drain excess water from Devils Lake into the Sheyenne and Red Rivers. The Devils Lake outlet and associated Federal water projects will be our focus today.

In March of this year, the President requested an authorization in funding for the Devils Lake outlet as part of the fiscal year 1997 emergency supplemental appropriations bill. The estimated total cost for the outlet is $50 million, 65 percent of which, or $32.5 million, would be financed by the Federal Government. This request was denied by Congress. However, $5 million was included for Army Corps planning and design work.

The same request for authorization and funding, construction authorization funding, was advanced by the Administration and the North Dakota Congressional delegation as part of the fiscal year 1998 Army Corps appropriations bill. Once again, the specific request was denied by Congress in the recently approved Energy and Water Development Appropriations Act.

However, under an agreement reached between myself, other members of the committee, the North Dakota delegation and the Appropriations Committee, Public Law 105–62 does include $5 million to initiate outlet construction if a handful of criteria are met. Briefly, the recently enacted provision requires the Secretary of the Army to make a determination that an emergency exists, as defined by the Stafford Act. And I understand that Dr. Zirschky has recently made such a determination.

In addition, the Secretary must report to Congress the project is technically sound, economically justified and environmentally acceptable and in full compliance with the National Environmental Policy Act of 1969, so-called NEPA. The agreed-upon language also specifies the project will be carried out in a manner consistent with the terms of the Boundary Water Treaties of 1909. Finally, the Army Corps of Engineers feasibility study shall not examine lake stabilization or inlet controls.

The reason for our including these requirements is simple and fair. Such determinations are required for all other water resource projects recommended by the Corps.

While the serious situation at Devils Lake unquestionably requires swift action, it has not yet been demonstrated by the Corps that the proposed outlet is technically sound, economically justified and environmentally acceptable. The standard Army Corps feasibility study and report by the Chief of Engineers has not been completed in this case. To definitely respond to the water quality and

water quantity concerns expressed by the Canadian government, certain local citizens, neighboring States, plans for the Devils Lake outlet must undergo appropriate scrutiny.

Now, having said all that, I want to welcome our witnesses. We're joined by our colleagues from North Dakota, Senators Conrad and Dorgan, and Representative Earl Pomeroy. Later we'll hear from the Army Corps and FEMA representatives, as well as two representatives of residents of North Dakota.

I want to note that we invited Governor Ed Schafer to appear today. He worked hard to shift pre-existing commitments, but was unable to be here. Testifying in his absence is the State Engineer from North Dakota, Mr. Sprynczynatyk.

I met with Governor Schafer a few weeks ago and know how committed he is to the efforts of Devils Lake.

Senator REID.

OPENING STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM THE STATE OF NEVADA

Senator REID. Mr. Chairman, thank you very much for calling this meeting.

I have a statement I would ask be submitted into the record so we can have the witnesses testify. But I will say that in all the time I've been in Congress, I've never seen such advocacy as the representatives from North Dakota on an issue. This is something that, as a member of the Appropriations Committee, they have been working day and night for months.

They've worked so hard, I should say with me, not only me, that I feel that I know a lot about Devils Lake. It's a serious problem. You've been very good advocates for a difficult problem. And I think those of us from around the country must reach out and do what we can to help other States that have these emergencies that develop.

So I appreciate your advocacy. And it speaks well of each of you and the work you've done for North Dakota.

Senator CHAFEE. All right, Senators, we welcome you both. Senator Conrad, if you want to proceed.

STATEMENT OF HON. KENT CONRAD, A UNITED STATES SENATOR FROM THE STATE OF NORTH DAKOTA

Senator CONRAD. Thank you, Mr. Chairman, and thank you, Senator Reid.

We appreciate very much, Mr. Chairman, your holding this hearing. We appreciate very much your sincere interest in helping us face the crisis that we confront in the Devils Lake Basin.

Mr. Chairman and Senator Reid, we believe that the flooding in the Devils Lake Basin constitutes an emergency. The President has so declared it, we have witnessed it. We have people here today who have lived it.

And with the Chairman's permission and the committee's indulgence, I would like Vern Thompson, who is a State Senator from North Dakota, and co-chairman of the Lake Emergency Committee, to show us a brief video. It's 3 minutes in length, Mr. Chairman. I think it will help put in perspective what we face.

Senator CHAFEE. Go to it.

Mr. THOMPSON. Thank you, Mr. Chairman.

[Video shown.]

Mr. THOMPSON. What you see here is 19 miles from the shores of the lake. There are thousands and thousands of acres of agricultural deeded property. This is an example of many homes that have been moved, up to 300 homes.

In 1993, Devils Lake covered 40,000 acres, and today it covers about 105,000 acres. Another example of some homes that have been overtaken by the water.

Damages now exceed $200 million and rising. This is a vital link, Highway 57, between Devils Lake, where there's a hospital and Fort Totten, the Spirit Lake Nation. It's estimated the lake will rise another two to three feet, coming this spring. A two foot increase in the water will result in another $30 million in damages.

Senator CHAFEE. What is that we just saw?

Mr. THOMPSON. Nearly 300 families have already lost their homes. Another 50 will likely lose theirs this coming spring.

This is on the protective dike around Devils Lake that Mayor Bott has worked out. Dikes protecting the city have already been raised five feet at a cost of $7 million. Work has now started to raise dike levels another five feet at an extra cost of $45 million. That's not included with the $200 million in damages.

The economic activity is down 15 to 20 percent across the Devils Lake region. To date, business expansion is non-existent because of the rising waters.

[Video continues.]

Mr. THOMPSON. Senators, he lost his home. He's moved and relocated.

Sixty-two million dollars has been spent to keep the roads above the rising water. Millions more may be needed for emergency services to get from Point A to Point B next spring.

My wife is in law enforcement. Domestic violence reports are up, while the population is decreasing.

We respectfully ask for your help.

Senator CHAFEE. Thank you. That was very powerful.

Senator why don't you proceed.

Senator CONRAD. If it would be all right, I'd like to stand, if I could, Mr. Chairman.

Mr. Chairman, I think that video demonstrates in very short order what we face. This is a remarkable situation without parallel anywhere else in the United States. Mr. Chairman, I direct your attention and the attention of the staff and Senator Reid to this depiction, which shows how big the lake was back in 1993. The succeeding overlay will show where it is today. This is 1993, this is——

Senator REID. It's more than one body of water?

Senator CONRAD. Yes. This lake, there are related lakes to the north, Senator Reid. This is Devils Lake proper. Off to the east it's Stump Lake.

As you can see, this is a massive body of water. To put this in perspective, the size of this body of water today is three times the size of the District of Columbia. This is not some placid, small lake. This is a massive body of water. And it is growing, and it is growing inexorably.

In fact, it has grown 20 feet in the last 4 years, doubling in size, tripling in volume as the chairman indicated.

This shows what happens if the lake goes to 1,457 feet, at which time it will have an uncontrolled release into the Sheyenne River Valley. Mr. Chairman, for your perspective, this size would be about the size of the entire State of Rhode Island.

Senator CHAFEE. Which one is that now, Senator?

Senator CONRAD. This is what happens if the lake goes to 1,457 feet, where we know it has gone several times before in history. If it goes to this level, it will then have uncontrolled releases, uncontrolled as to both quality and quantity. I think that's a critically important point.

If it goes to this level, we will see releases that will be uncontrolled.

Senator REID. What do you mean, releases?

Senator CONRAD. There will be an escape of the water from the Devils Lake lakebed. And this water will then go over into the Sheyenne River Valley uncontrolled. Uncontrolled both as to quality and quantity. That would simply move the flood downstream.

And in terms of water quality, that would mean people downstream get sick. They get sick because the dissolved solids are not something their systems can tolerate. And the water treatment facilities of the major cities downstream are not prepared to deal with the level of dissolved solids that they would experience.

Senator CHAFEE. When you say downstream, down what stream?

Senator CONRAD. Very, very important point. Mr. Chairman, the first people downstream are the people of North Dakota. People in the city of Valley City, people in the city of Fargo, which is the largest city in our State. People in the city of Grand Forks.

Because remember what happens here. If the lake goes to 1,457 feet, which we know has happened before in history, at that level it goes over into the Sheyenne River. Sheyenne River goes over into the Red River, and remember, the Red River goes north. Red River goes north.

When we're talking downstream, initially, it's down in terms of, most people would think of down as south. It goes south into the Sheyenne. That goes down into Valley City. That goes over, loops over into the Red River. Then the Red River goes north, goes over into Fargo and Grand Forks.

So when people say there are water quality concerns for our neighbors to the north in Canada, we need to remind them, the first people who will experience water quality problems are our people. And it is the majority of the people in our State who are resident in this part of North Dakota.

If we could go to the next chart. Mr. Chairman and Senator Reid, this chart shows the historic water levels of Devils Lake. The chairman recounted in his opening statement what we have seen. You can see it, the lake has now, Mr. Chairman, gone up another five feet.

In your opening statement, you indicated 1,438 feet. That was exactly right a year ago. It's gone up another five feet this year, again, unpredicted by all of the forecasting services. This lake has gone up another five feet to 1,443 feet. You can see that's the highest it has been in over 130 years.

Mr. Chairman, this is an emergency. And it has required an emergency response from the Federal Government. This is the money that we have spent so far from the Federal Government, over $210 million, from the Federal Treasury already. The Office of Management and Budget and the Corps of Engineers tell us if this lake continues to rise, and if in fact it goes to the level of 1,457 feet, that the damages then will reach $450 million.

So the question of cost effectiveness is an important one. Again, if this rise continues and goes to 1,457 feet, the estimates are the total cost to the Federal Government will then reach $450 million. We've already spent $210 million. The latest estimate of the cost of this outlet is $45 million.

Mr. Chairman, there has been a great deal of confusion about how an outlet from Devils Lake may relate to the transfer of water from the Missouri River Basin over into the Red River Valley. I have prepared this chart to show this committee that in fact, an outlet has nothing whatever to do with the transfer of water from the Missouri River Basin. It has nothing to do with it.

Mr. Chairman, this shows the Devils Lake Basin inside the larger basin of the Red River watershed. Devils Lake watershed, inside the Red River watershed. Here is the Missouri River. The Missouri River has nothing to do with an outlet from Devils Lake.

Some are saying, and some will present to you today that this is all a scheme to further Garrison, the Diversion project. That is false. Let us be clear. That is simply false.

There is no inlet that is provided for in this legislation. And in the Garrison Diversion amendments that we will be offering later this year, there will be no provision for an inlet, period.

Senator CHAFEE. Let me just ask you, Senator, could you put that chart back up, please? In other words, what you're saying is there are two totally separate subjects?

Senator CONRAD. Two totally separate subjects.

Senator CHAFEE. And I mean, since Senator Burdick left here, I've really lost track of the Garrison project, which he was deeply interested in. I thought, as best I recall, we had gotten that settled pretty well. But in any event, that's not involved here.

The other thing I think is important for us to remember in the discussions today is there are two separate things we're talking about. One, we're talking about an outlet and on a separate direction, we're talking possibly an inlet. But that's a separate subject. You're talking outlet here.

Senator CONRAD. Mr. Chairman, I want to be crystal clear on this point. We are talking solely about an outlet. No. 1, any inlet consideration is precluded by the legislation. No. 2, in the Garrison amendments that we will be offering later this year or early next, there will be no provision for an inlet to Devils Lake. None.

So those who seek to confuse this issue, those who seek to tie the two, are attempting to mislead this committee and attempting to mislead the Congress of the United States. There is no connection between an outlet from Devils Lake, which is contained completely in the Devils Lake watershed and the Red River watershed, with the question of the Missouri River.

Senator REID. How far is it from Devils Lake to the Missouri River in miles?

Senator CONRAD. It's about 150 miles.

I would just close, Mr. Chairman, by showing, this is a road leading into the lake. This is what we have going on all throughout the Devils Lake Basin.

And I would close, Mr. Chairman, with this picture, which I think is especially compelling. This is a house that didn't catch on fire, this is a house that is being burned down. It is being burned down because, Mr. Chairman and members of the committee, it is being inundated by the flood waters and it could not be moved fast enough.

This is a scene that is being repeated all across the Devils Lake Basin, as homes are being burned because they cannot be moved quickly enough. Mr. Chairman, this particular home happens to belong to a paraplegic. This man has had to burn his own home down because of health considerations for the rest of the community.

It is time to act. This is an emergency situation. I don't know what could be more clear.

I thank the chairman.

Senator CHAFEE. Thank you very much, Senator.

Senator DORGAN.

STATEMENT OF HON. BYRON L. DORGAN, A UNITED STATES SENATOR FROM THE STATE OF NORTH DAKOTA

Senator DORGAN. Mr. Chairman, thank you very much.

Senator Conrad has very ably described for you the circumstances of our being here this morning.

And Mr. Chairman, when you indicated you haven't heard much about Garrison Diversion lately, that is because it is true, in the mid-1980's, we passed a reformulation act for Garrison Diversion. There will need to be a further adjustment in that, and I expect we will be involved, and your staff, in fact, has been involved in some initial discussions about that.

But this does not have anything to do with Garrison Diversion. It has to do with the question of flooding that exists in a closed basin, one of only two closed basins in American for which there is no inlet and no outlet, and seemingly, no solution. So faced with that, the question for us and for the folks in the Devils Lake Basin is, what do we do?

And the answer was, you do a lot of everything in order to try to resolve this issue. You do upper basin storage, you build dikes, you do a range of things, including you try to find a way to provide for a reasonably sized outlet to try to relieve some of the pressure from this lake.

In addition to the charts that Senator Conrad has shown you, I'd like to show this chart. This is a woman standing at the bottom of a telephone pole, at the base of a telephone pole looking up. That was taken in 1965. And she was standing at the base of that telephone pole, looking up. And she was looking at where the waters of that lake had been previously.

Now, if you go all the way to the top of that telephone pole, which was July 2, 1997, that's where the water is today. She's not going to stand at the base of that telephone pole today, because the water has risen to that level, and 1,444 is the highest projected level on that chart, and that's where it is now predicted to go.

Mr. Chairman, I have heard some say, gee, this is not an emergency. I'd like to just pose this question. This is a proposition of time and dimension. Let me pose this question. What if, after the time that we retired for the evening last evening, all of us had a fitful sleep, and we awakened this morning to hear on the news that we had a huge body of water that had just flooded. It had done over $200 million worth of damage last night, 300 families were gone, and we had an Indian community that was now isolated. The Spirit Lake Tribe is isolated from medical help and so on.

Would we not see that in banner headlines across the country? Of course we would. This is a slow motion disaster. It is clearly, by any standard of definition, an emergency.

I want to describe it in other terms. But first I want to describe it in personal terms, if I might. The fellow that you saw in the video with the western hat, Mr. Chairman, his name is Dwayne Howard. My dad was a horseman. All the time I grew up, we went to rodeos and horse shows. Not just in North Dakota, we went to other parts of the country.

When I was a kid, I watched Dwayne Howard ride bulls all across this country.

Senator REID. That's why he limps?

Senator DORGAN. That's exactly the case. You saw him with a rather slow gait.

He was one of the great bull riders in America, as a rodeo cowboy. You could have seen him ride in Boston Gardens, in the Cow Palace in San Francisco, the National Western in Denver. I can't tell you how many times I saw Dwayne Howard come out of a chute on a bull. And he was one of North Dakota's national champions as a bull rider.

He retired to Minnewauken, North Dakota, to a farm and ranch. He's lost his land, he's lost his home, he's lost everything. He's lost the small inheritance he had. He's cashed in his insurance, cashed in his retirement and now has nothing left.

I tell you that simply to say, this is a human problem of desperate proportions, to some wonderful people who are confronting this emergency, and they're asking for help. Now, what is the help? The help is a whole series of things to try to respond to what's happening to us in this basin.

One of those is an outlet. And the outlet itself is not a magic solution. It is part of a series of things that must be done in coordination to do what we can do to take the pressure off this lake. And that's why we're here this morning.

Mr. Chairman, you especially have been enormously helpful to us. We know that you have the capability of stopping the $5 million of construction funds that were included in the last appropriations bill. I understand that could have been stopped, and it was not because you and others felt that the community and the State had made its case.

This hearing is further evidence of your interest and concern about this region of the country. We are a community of interest in this country and the folks who live in this basin, the Devils Lake Basin, have an abiding interest in asking you and this committee and the Congress to help address this problem. They are addressing it every day in every way. And they're asking for your help.

Let me make just a couple of comments about the criticisms that you may have heard. The outlet will somehow cause angst to Canada or to downstream interests. Senator Conrad pointed out that the water will go into a river whose downstream interests first and foremost are North Dakotans. I would not be at this table asking to transfer water in a manner that would injure other North Dakotans. It's not in North Dakota's interest, it's not in the Congressional delegation's interest.

This is not an outlet that will remove water from Devils Lake that in any way comes from another basin. So to the extent that Canada writes letters, as they have, and they've written to me and to you, suggesting that this is of great concern with the potential of removing water from the Missouri River Basin, it is not going to happen. That's not what this proposal is about.

They're welcome to win a debate we're not having. But this is not about moving Missouri River water. This outlet will actually help with quality and quantity problems, because it will give us some control over both the quality and the quantity of water that's released. We will not have that control if we do nothing, and this lake moves naturally across its boundaries and dumps into the Sheyenne River, and then up the Red River.

This outlet makes good economic sense and is strongly supported by the Administration, which included, as you know, in its own fiscal year 1997 disaster supplemental bill a proposal for the entire funding for the outlet. And the outlet has enormous economic value to the community and to the region, because it will preserve a regional trade center, it will reduce flooding and avoid expenditure of other Federal funds. This will be of great economic value to that region.

Finally, this outlet is needed to protect the homes and livelihoods of all the folks in the Basin who are threatened, including and especially a tribal government and the Native Americans who live in the Spirit Lake Nation, who are among the most affected by high water and who are least able to cope with it. They have a very high unemployment rate, a very high rate of poverty. And we hold a trust responsibility for them as well, and they will benefit enormously by this approach.

Finally, let me say that this outlet will be cost shared. It's a critical part of a comprehensive strategy. We are not moving around saying, this is the solution. We have worked very hard with the Governor, with State legislators, with Federal, State and local officials, to develop a comprehensive policy that has many different parts to it, all of which are now being implemented to address this flooding problem.

One of those parts, just one, but a critical one, is the building of an outlet. And let me finally just show a map, because I think it's always good in terms of frame of reference, we mentioned Rhode Island. This will give you a notion of the size of the lake area, it's overlaid with the outline of Rhode Island.

Our State, incidentally, Mr. Chairman, is ten times the size of the State of Massachusetts. The actual Devils Lake Basin, the Basin itself inside our State, is about the size of the State of Massachusetts. And you can see that if you overlay the State of Rhode

Island, for example, on the specific lake area, about what kind of dimension we're talking about.

So Mr. Chairman, thank you very much for your patience and your help, and especially your courtesy in hearing in great detail the story of an emergency that causes us to ask once again for your help.

Senator CHAFEE. Thank you very much, Senator Dorgan.

I don't know what your situation is, you and Senator Conrad. Can you stay for a few minutes while Representative Pomeroy makes his statement? Then I have some questions. Or I could ask you questions now if you're anxious to go. Can you stay a few minutes?

Senator REID. Mr. Chairman, I am going to have to leave. I got a note to leave.

I would ask consent from the Chair that I be able to submit some questions in writing for Secretary John Zirschky when he appears.

Senator CHAFEE. Certainly.

Senator REID. Thank you.

Senator CHAFEE. Now, the Honorable Earl Pomeroy, who is the U.S. Representative from the State of North Dakota, and I believe the only representative, right?

Mr. POMEROY. That's right. Senators come by the pair, but we only have one Congressman.

[Laughter.]

Senator CHAFEE. Well, we won't pursue that any further.

Now, why don't you proceed.

STATEMENT OF HON. EARL POMEROY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NORTH DAKOTA

Mr. POMEROY. Thank you, Mr. Chairman.

I want to briefly discuss three important points. First, there's virtual unanimous agreement among all those with actual responsibility for dealing with this problem that an outlet has to be part of the solution. Second, while this hearing focuses on the outlet, extensive efforts have been made at the other alternatives, the other things that must be done as part of the solution. And third, while this is an emergency and a quick response is required, full NEPA review of this outlet prior to its construction will take place.

Think of the most significant water problem in your State, Mr. Chairman. Imagine the different perspectives that inevitably exist across the varying stakeholders to this problem, the many public officials with a hand in trying to find some solution. I would doubt that there would be virtual unanimity among all of those entities in terms of how to deal with it.

But that is the case with the Devils Lake outlet. At the State level, the Governor, each member of the delegation, the State legislature, and the State water commission have all reached what I believe is the inevitable and inescapable conclusion that the outlet has to be part of the mix in terms of dealing with this problem.

Now, I say that as someone who was born and raised literally on the banks of the Sheyenne River, downstream from Devils Lake. I used to represent Valley City, my hometown, the first city downstream from Devils Lake, in the State legislature. Now, more than half of the voters I represent live downstream of Devils Lake.

Obviously, I reached the conclusion that the outlet is an important part of this answer only upon reaching a very thorough personal conclusion that this outlet can be done in a way that's compatible with downstream interests and that there is simply no other way to meaningfully deal with the ongoing, very, very severe flooding in the Devils Lake area.

Now, I'm not saying downstream there aren't opposing views on the outlet. There are a few that think this is a bad idea. But any public policy problem presents different conclusions. Yet you don't see in the record, nor will you see to date one city council resolution, one county commission resolution opposing the outlet. Those that have some responsibility in terms of actually trying to deal with this terribly vexing public problem have all come to the conclusion an outlet is necessary.

We don't have the luxury of viewing this in an academic light. Or perhaps from the dispassionate geological perspective covering thousands of years. People are being hurt today, farms and businesses are being destroyed. A town is threatened. A Native American reservation with a population of up to 4,000 is having their access to essential medical services threatened today. These are the needs here and now, and we have had to respond to them.

I would also emphasize that across the Federal agencies that have spent so much time and invested such substantial resources, there is also virtual accord that an outlet has to be part of the answer.

Now, when I emphasize part of the answer, Mr. Chairman, this isn't one of those pull the bathtub stopper and the water goes away. But it were that simple. There's not a silver bullet answer to Devils Lake, and we're not proposing that the outlet is. Two other lines of attack have been intensely pursued: upper basin storage as well as infrastructure investment, as my colleagues have noted.

This upper basin storage is not a terribly easy thing to achieve, dramatically increasing the water impoundment upstream. Most of the land that might be available for that has been under cultivation in productive family farms for over a generation. You take acreage out of production, you literally take away the economic base of those individual family farm units.

The only way we can expand upper basin storage dramatically is basically a strategy of maximizing impoundment on public lands and trying to put in place a series of financial incentives to enlist private landowners to impound water.

The delegation at every conceivable opportunity has attempted through one program after another to enhance the incentives for upper basin water storage. And we've had some considerable successes. The most significant in terms of actual acreage would be the CRP program.

We fought for and obtained a special designation for much of the acreage in North Dakota, including virtually all of the upstream acreage. That made it much more likely to be enrolled in the CRP program. Presently in the 6 area counties of the region, 436,000 acres signed up in CRP. There is, as you know, the second enrollment taking place right now for this 10-year lease program. And

this area has been so inundated with the response, they've had to bring on extra help.

So we have really done what we feel is the best job we possibly can at expanding the upper basin storage. And some thoughts of random county-wide condemnation or some other things to try and take away the productive acreage of family farmers and get that water on there is simply not viable in a realistic way.

In addition, the infrastructure struggle, one that I have been particularly involved in, is getting homes moved before we have to burn them, as that terrible picture showed. We have learned in North Dakota that this house moving is a real art. If you would just hold up that, we've moved more than 200 homes, all shapes and sizes. The Federal Flood Insurance program has been an integral part of that program. It's cost us to date $17 million as insured homes are moved from harm's way just prior to inundation and total loss.

In addition, as had been mentioned, we've worked at levies and we've worked at levies some more. Every time you further raise them, the costs seem to compound on you. We are now in the process of a $43 million dike-levee raise up to the 1,450 mark.

The final thing I want to mention is that this outlet will have NEPA review. It is in an expedited form. The outlet under consideration, that enjoys the strong consensus I indicated earlier, will have NEPA review. Some suggest that even, that any expediting, any trying to get this NEPA review done more quickly than the usual, normal, staid, leisurely, up to 6 year process, is some kind of abrogation of the environmental safeguards. Not so. It's done, it's just done as quickly as possible, because we've got a full-fledged emergency on our hands.

And people that really don't think this is an emergency I believe are being terribly cavalier with the plight of the individuals that we represent and that we have seen choked up as they try to tell us about their losing businesses and inundated homes.

In conclusion, then, Mr. Chairman, I think North Dakota, aside from the moving Fargo adding a lot of fame to that city of the State, North Dakota has become known for almost a tale of two cities, Grand Forks and Devils Lake. There's a contrast between the two. Grand Forks is like having a friend hit by a truck. Everything's fine, and then everything's terrible.

Devils Lake is like watching a friend waste away to cancer. That is, a cancer that is a plague on our State. It is a most serious problem, it is a cancer not in remission, it is a rapidly deteriorating situation. We desperately need your help.

Thank you.

Senator CHAFEE. Thank you very much, Representative.

I want to welcome Senator Wyden here. I understand you have no statement, Senator.

As you know, the way we do these matters, where the Army Corps of Engineers is involved, there's what we call a feasibility study, which is really something quite swift that normally is done on these matters. We don't yet have the feasibility study. I'll be asking the Chief of Engineers about that. I just wanted to let the Senators and Representative know. And I don't know why.

And from that, we also need a report from the Corps that the project is technically sound, economically justified, environmentally acceptable. We don't have any of that yet. I don't know why. Because although this is an emergency, it hasn't happened overnight. I think, Senators, you spoke to me about this some time ago, and it's been going on long before that.

Let me ask you about a letter that was sent by your Governor, by the Governor on August 1 to Senator Lott. This letter was from the Governor and the majority leaders of the State legislature. And I quote: "Abandoning for all time the possibility for an inlet," and I think all through this we want to keep people's focus on the difference between the inlet and the outlet, they are two separate matters, but they both affect this Devils Lake, or potentially could, the Senators and the Representative are here now discussing an outlet, and indicating that's what you seek.

But the Governor and the legislative leaders wrote this: "Abandoning for all time the possibility for an inlet runs contrary to the statewide water development plan, which envisions stabilization of Devils Lake. It represents a significant statewide policy shift, made suddenly at the Congressional level, with minimal input from North Dakota."

What do you say about that, gentlemen?

Senator CONRAD. Mr. Chairman, I think it's very important that we make this very, very clear. That matter has been resolved. It has been resolved——

Senator CHAFEE. That matter being the inlet?

Senator CONRAD. That is correct. Mr. Chairman, as you know, in this legislation, an inlet is specifically excluded. No. 2, the State of North Dakota negotiating team that includes the three gentlemen that are signatories to that letter, have agreed on a submission of amendments to the Garrison project with respect to this issue. And the State of North Dakota——

Senator CHAFEE. This issue being?

Senator CONRAD. The issue of an inlet. And the State negotiating team that includes the three gentlemen that are signatories to that letter have agreed that there will be no provision for an inlet in the Garrison amendments. That has been decided. That is resolved. It's no longer an issue.

Senator CHAFEE. In other words, even though this was dated August 1, which is a couple of months ago, you're saying that's now been resolved, and that what comes under the Garrison project is a separate subject, a future matter to be taken up, the Garrison project could well involve an inlet to Devils Lake, but that's a separate subject to be considered later?

Senator CONRAD. Mr. Chairman, could I make it even more clear than that. We have agreed, in fact, I have a letter from the Governor and the other two gentlemen who are signatories to the August 1 letter. And this letter relates to Garrison amendments that we are working on. In the document that addresses the question of an inlet or an outlet for Devils Lake with respect to the Garrison amendments, in that document, the working document, it says, do not include outlet or inlet in amendments to 1986 Act, referring to the Garrison project.

Outlet is being considered on a separate emergency basis. And the document from the three gentlemen who are signatories to the letter dated August 1 say that their position is agreement, agreement with the principle that we will not include, will not include, in any Garrison amendments, any reference to an inlet or an outlet. That the outlet is being considered on a separate, emergency basis.

So the August 1 letter has been overtaken by events. The Governor and the top legislative leaders have signalled their agreement that in any Garrison amendments, an inlet will not be included.

Senator CHAFEE. Could you, Senator, submit that letter and whatever attached documents for the record, please?

Senator CONRAD. We'd be happy to submit the relevant parts for the consideration of the committee.

Senator DORGAN. Mr. Chairman?

Senator CHAFEE. Senator Dorgan.

Senator DORGAN. If I might just further respond to that. As you know, I'm a member of the Appropriations Committee. And this issue was addressed in the appropriations deliberation before, in fact, the last item of business before the Energy and Water Appropriations Bill left the U.S. Senate.

The $5 million was provided for this outlet, as the last item of business. But the $5 million was combined with language required and requested by Senator Bond. That language dealt with the issue of the inlet. And we accepted that in exchange for getting funding for an outlet.

The fact is, there was fairly substantial criticism in North Dakota for our accepting that. But nonetheless, that is done. That went to conference. There was an attempt, and I think the letter addresses that attempt, to soften that language. The conferees refused to do so. And we now have in law a provision that says there will not be an inlet, in attendance with this discussion of an outlet.

So I was a part of the process, in the appropriations process, that accomplished the money for achieving the outlet. But I understand what happened was, language was included that is now law dealing with the question of prohibiting an inlet.

Mr. POMEROY. Mr. Chairman, I'd only add that this happens all the time. The State leaders wanting maximum flexibility, Congress not disinclined often to have some assurances that things go as they direct. In this case, the direction was imposed in the legislation, now enacted, in Federal law, relative to the inlet. So that has been disposed of, and irrespective of the wishes of State officials as expressed in the August 1 letter.

Senator CHAFEE. Let me ask one final question, and then I want to go to Senator Wyden. We've got on the next panel the State engineer and so forth.

But just briefly, from your point of view, is there a concern about the quality of the water, if you have this outlet? In other words, if you look at this thing here, without getting into tremendous detail, what you are proposing is reasonable, you build an outlet, it goes down to the Sheyenne River, flows over to the Red River, then it goes up and everything's fine.

But I presume there are some hitches to it. One is the quality of the water. It's a saltish water, is there a concern about that? And I know I'm not looking to you as experts, because we've got other experts on the next panel, probably. But what do you say to that?

Senator CONRAD. Yes, sir, we are concerned. That's why we believe it is critically important to have an ability to release water on a controlled basis. Controlled as to both quality and quantity.

The reason that is especially important, Mr. Chairman and Senator Wyden, is because the quality of the water in this lake is many times worse out at the east end, where an uncontrolled release would occur, than out at the west end, which is where the controlled release would occur. In other words, we are much better able to manage the quality of the water if we have it released out of the west end than on an uncontrolled basis out of the east end.

If you look across that lake, the natural outlet is out of the east end. And the water quality is many times worse, many times worse out of the——

Senator CHAFEE. Dissolved solids?

Senator CONRAD. Yes, dissolved solids, salts, much worse out at the east end. If this lake goes over into Stump Lake, it will raise Stump Lake 40 feet. And the water quality, much worse.

One of the reasons that those who have been working to devise a solution have chosen a controlled outlet out at the west end is because then you can have water quality in the Sheyenne that is roughly equivalent to what is in the Sheyenne now. And you can meter out the water in a way that does not present a water quality concern downstream.

Again, I'd remind the chairman and the other members of the committee and the staff, that we're the first ones downstream. It is the majority of the population of the State of North Dakota who are in the first trench, if you will.

And that is why we have got a special concern about water quality. We have no interest in moving this flood downstream. Because downstream is North Dakota. And we have no interest in imposing bad water quality downstream, because downstream is North Dakota in the first instance.

Senator DORGAN. Let me also mention the Corps of Engineers report says, the operation of the outlet as proposed would meet applicable water quality standards. The operating plan proposed in a previous report was based on meeting the Sheyenne River's class 1A standards at the release point.

And what Senator Conrad says is critically important. If you do nothing and this moves by its own motion, and goes over, what happens is the worst possible quality water goes into the Sheyenne. If measured releases from an outlet in a thoughtful way are able to reduce the pressure from that lake, you are able to provide releases from the better quality water in the lake. So there's no question that what we're doing represents the best interests with respect to water quality that would go down the Sheyenne.

Senator CHAFEE. You're suggesting that if nothing happens, there's liable to be an overflow on the eastern end, where the worst water is, and it could flow right down there. So you'd have a situation that would put the worst water into the Red River.

Senator DORGAN. And it's not just the worst, it's many times worse in terms of quality than other water in the lake. You're exactly correct.

Senator CHAFEE. OK, thank you.

Senator Wyden, I understand you have no questions.

Thank you all, gentlemen, very much. We appreciate your coming here, and this is a very serious matter, and we'll do our very best. Thanks for your attention.

Now we'll have the next panel. John Zirschky, Acting Secretary for Civil Works, Corps of Engineers; the Honorable Michael Armstrong, Associate Director for Mitigation, of FEMA; Dave Sprynczynatyk, North Dakota State Engineer, from Bismarck; Dr. Gary Pearson, Dakota Prairie Chapter, National Audubon Society; and Mr. Joe Belford, Lake Emergency Management Committee.

If you'd all take your seats, and I want to say one thing. Gentlemen, if we'd move right along now, folks, there's going to be a vote at 11 o'clock. So that gives us a little bit over an hour, and we ought to able to have everybody have a fair chance here. But I would ask that you keep your statements to 5 minutes. You'll see the lights here, if somebody goes a little bit over, they're not going to be guillotined, but we want to keep that so we'll have a chance to ask questions and give thorough consideration to everything that's said.

Mr. Zirschky, why don't you proceed.

STATEMENT OF HON. JOHN H. ZIRSCHKY, ACTING ASSISTANT SECRETARY FOR CIVIL WORKS, DEPARTMENT OF THE ARMY

Mr. ZIRSCHKY. Thank you, Mr. Chairman, members of the committee.

I would ask that my written statement be placed into the record.

Senator CHAFEE. Without objection.

Mr. ZIRSCHKY. Mr. Chairman, I've been in my present position for about 4 years, which is something of a record for the job that I'm in. I can say in all honesty that Devils Lake is one of the toughest challenges that I've faced, and that finding the right solutions to this problem are going to be very, very difficult.

Furthermore, the Corps of Engineers has been the Nation's problem solver since 1775. In fact, we're one of the few Federal agencies the founding fathers would recognize.

Even with this long history, the situation at Devils Lake is unique. This is going to be a tough problem for us to solve.

To highlight the problem, Mr. Chairman, I'd like to ask everyone in the room to sort of imagine a line on the wall about 12 feet from the floor. And that's how much higher the water is in Devils Lake than the adjacent town of Devils Lake. I think it's about where the joint is on the two wood panels.

And I doubt that would be acceptable to most Members of Congress.

Senator CHAFEE. Now, what are you saying, 12 feet is what?

Mr. ZIRSCHKY. The water level in Devils Lake is about 12 feet higher than the adjacent town of Devils Lake. Our levee systems are basically acting as dams. We're essentially building an earthen dam between Devils Lake and the town of Devils Lake. And the water level right now is 12 feet higher than the town.

Senator CHAFEE. They're dikes, rather than dams, aren't they?

Mr. ZIRSCHKY. Pardon?

Senator CHAFEE. It's a dike, isn't it?

Mr. ZIRSCHKY. Well, what we're essentially building it as a dam, sir.

Senator CHAFEE. OK.

Mr. ZIRSCHKY. A very large, earthen dam.

I doubt it would be acceptable to many Members of Congress to have their constituents for years living next to basically 12 feet of water.

The first point I would like to make is that there is a flood at Devils Lake. It's not a hypothetical situation. There's a flood there right now.

And one of my former professors used to tell me that you should put problems in three categories: real problems, potential problems and imaginary problems. Devils Lake is a real problem and one that the exact solution to is going to be very, very hard to find.

We have to look at a lot of different options, upstream storage, an outlet. We're going to be doing that. We've been doing it for several years. I don't know what history is going to show will be the right way to address the flood, because I don't know how long the flood is going to last or how much worse it's going to get.

I do know that it's going to get worse before it gets better, because the flood waters are still rising. That imaginary line on the wall is getting higher and higher off the floor each year.

To help me make the right decision, I asked the Corps to enter into a contract with a leading research institution to develop a rational decision model for the situation. None of the normal assumptions on flood forecasting will work in a situation such as at Devils Lake.

Normally, when you do probability modeling, you assume that what happens in 1 year is not related to what happens the next year. But because this is a closed lake, the water level that we have today has a very big bearing on what the water level is going to be next year. So we've got to do a different kind of probability analysis.

There's been a lot of discussions of the conditions that were added to the appropriations act, and frankly, I don't think those conditions served us very well at all. At least in Washington, everyone seems focused on the conditions and not focused on the actual flooding.

At least four times a week, I hear people come and talk to me about how I'm going to address the conditions, and they don't come and talk to me about how I'm going to address the flooding. I guess I'd like to keep everybody focused on how do we address the flooding, not how do we answer certain conditions. Because the real problem that we have to solve is the actual flood.

The third point I'd like to make is that Devils Lake is going to overflow into Stump Lake, and that Stump Lake is going to overflow into the Sheyenne River, 100 percent certain that that is going to happen. What isn't certain is when. We know it's happened in the past. It could happen in the next few years, it could happen in 1,000 years. But we know it's going to happen. What we don't know is when.

When that eventually happens, there's going to be an outlet from Devils Lake, and it's going to be an uncontrolled outlet, and we're going to lost the opportunity to minimize the environmental damage. There's not going to be an opportunity to mitigate downstream flooding. There's not going to be an opportunity to mitigate health effects on the people who are going to have to drink that water.

When we have that ultimate situation, we're not going to be talking about an outlet any more, we're going to be talking about a spill lake. And I don't believe that anybody here wants that situation. I'm pretty sure the Canadians don't, and the Minnesotans don't, and the North Dakotans don't.

I guess the standard I would like to use in addressing the flooding is the same one I've used for every other member of the committee and Congress, and that is, I'm going to try to do all that I reasonably can to protect the people of North Dakota, Minnesota and Canada. I have asked and I'm going to continue to ask the Corps to undertake all reasonable efforts to protect those people.

In closing, Mr. Chairman, I'd like the Congress to remember three things over the next few months. First, there's a flood at Devils Lake right now. The second is the conditions that have been added I think increased our risks of getting the answer wrong, because we've got too many people focused on the conditions and not the flood.

And third, that there is going to be an outlet from Devils Lake. There's been one in the past, and there's going to be one again.

Mr. Chairman, you asked about the feasibility study. I'd be happy to answer any questions about that. I also have charts that I can explain the situation in more detail if you so desire.

Thank you.

Senator CHAFEE. Thank you very much, Mr. Secretary.

Mr. Michael Armstrong, Associate Director for Mitigation for FEMA.

STATEMENT OF HON. MICHAEL J. ARMSTRONG, ASSOCIATE DIRECTOR FOR MITIGATION, FEDERAL EMERGENCY MANAGEMENT AGENCY

Mr. ARMSTRONG. Good morning, Mr. Chairman and Senator Wyden.

This is my first appearance before you since this committee was kind enough to recommend my confirmation to the Senate earlier this year, and I'd like to just thank you again for this opportunity to serve in this capacity.

Before I was confirmed by the Senate, I served as the regional director at FEMA in Region VIII, which includes North Dakota. In that capacity, I was asked to chair the interagency task force for the Devils Lake Basin. And my written testimony, which you have before you, talks about the work of this task force.

I'd like to highlight several things, because I think it's important to know the context in which we are talking today, which is a different scenario than I encountered when I was first asked to chair a task force 2 years ago. At that time, the community had been studied repeatedly, but there was a sense that there was no coordination occurring between the various stakeholders, both at the gov-

ernmental levels, at Federal, State and local, as well as people in the private sector and ordinary citizens in the Basin.

Therefore, the mission of the task force was, and is, because we are continuing to meet and I am continuing to chair it, is to find and propose intermediate solutions to reduce the impacts of the high lake levels in the Basin, intermediate solutions to find as remedial actions that could be achieved within approximately 5 years after or along with disaster response efforts, but before the benefits from any long term engineered solution could be realized.

From the very beginning, it was recognized that to achieve this mission, the task force effort would require the coordinated activity and commitment of numerous Federal, State and local government entities along with elected officials, private citizens, environmental groups, and representation from the Spirit Lake Sioux Tribe. For this reason, the task force is operated with one key point in mind: that any solutions to be recommended could not involve a single agency response, but instead would require an approach that is multidisciplinary, multi-objective, multi-agency, bottom up and achieved through consensus building partnerships.

Two years have passed since I was first appointed to serve as the chair of the task force. And since 1995, the members of the task force have pulled together to mitigate the flooding impacts in the Basin by leveraging Federal, State and local stakeholder resources.

Some of the examples: all essential roads in the Basin have either been raised or are being raised above the rising lake level. Flood plain maps for the entire Basin were developed and all communities are now participating in the national flood insurance program.

To date, 504 claims have been reported, helping those who were affected by the flooding to rebuild their lives. This has been an infusion of over $17 million to impacted residents.

Waivers of the standard flood insurance policy have been issued by FEMA in order to allow homeowners and business owners who are threatened by imminent flooding to receive payments in advance of experiencing flood damage. These waivers have allowed 122 home and business owners to access the resources they needed to move out of harm's way and 344 additional claims are pending at this time.

Twenty-one homes on the Spirit Lake Reservation have been relocated outside of the flood hazard area. The levees around the city of Devils Lake are being raised. Internal drainage systems are being put in place.

Approximately 30,000 acre feet of upper basin storage has been created through various programs. A series of agricultural programs have been funded and put in place to assist farmers. Twenty lift stations in Ramsey County have been elevated. A sewage lagoon for the town of Minnewauken has been relocated. Lake water quality monitoring is ongoing. A long term lake stabilization study is funded and underway. And now we are considering the possibility of building an outlet.

While the Federal Government has spent over $200 million to address issues, and I have listed some of the achievements that this task force has helped coordinate, nevertheless, it remains that we still have a crisis in Devils Lake. James Lee Witt, the director

of our agency, has said that he has never seen anything like this situation. And as you know, Mr. Chairman, he has seen an extraordinary variety of disaster scenarios during his time as director of FEMA.

The studies that have occurred number over 400 in this area. Our purpose is not to do another study, but to instead create a process whereby all stakeholders would come together to examine the problem from many angles, brainstorm alternatives and confront differences of opinion and reach consensus. Through this process, we have seen an incredible development of partnerships. The task force has succeeded in creating an understanding that no one solution or one level of government provides all the answers.

But we believe by pursuing a combination of options, including removal and flood proofing of structures, alternative land usage and water storage, rehabilitation of infrastructure, local planning, the people of Devils Lake have sought permanent approaches to mitigation. And that's what makes today different from 2 years ago. We believe that there is a concerted effort to involve all levels of government, and that the levels of government have made a good faith effort to demonstrate that no one solution is being pursued.

Given that, in this package of options, we believe that a construction of an outlet in a manner that is sensitive to environmental concerns and downstream impacts could complement the other efforts underway.

Thank you.

Senator CHAFEE. Thank you very much, Mr. Armstrong.

Mr. Sprynczynatyk?

STATEMENT OF DAVE SPRYNCZYNATYK, NORTH DAKOTA STATE ENGINEER, BISMARCK, NORTH DAKOTA

Mr. SPRYNCZYNATYK. Good morning, Mr. Chairman and Senator Wyden.

Thank you for the opportunity to testify here today. My name is Dave Sprynczynatyk. I'm the North Dakota State Engineer and the Secretary to the State Water Commission.

The testimony I'm giving today is on behalf of Governor Ed Schafer. Governor Schafer asked me to extend his apologies to the committee for not being able to attend in person.

Since 1993, Devils Lake has risen more than 20 feet, from an elevation of 1,422.6 to elevation 1,442.9. Today, it is the most serious, the most pressing flood problem facing North Dakota. Since 1993, the Federal, State, tribal and local governments, as well as the people of that area, have incurred more than $200 million in damages and flood fighting expenses.

As the lake continues to rise, the U.S. Army Corps of Engineers forecasts that cumulative damages will grow to $370 million by the time the lake reaches elevation 1,450, less than 8 feet above its current level. This year alone, the lake rose five feet over last year's level.

Most often, rivers will rise, flood adjacent areas and then recede. This is not the case with Devils Lake, which continues to rise relentlessly, engulfing land, homes, roads and everything else within

its constantly growing borders. This is a progressive disaster that requires emergency action to gain control.

The lake's natural outlet occurs when water rises another 15 feet and reaches elevation 1,457.5. It then overflows into the nearby Sheyenne River, which drains into the Red River, and ultimately into Lake Winnipeg and the Hudson Bay. Geologists have concluded that this natural spillage has occurred several times during the past 10,000 years.

No one can predict what will happen with the lake next year. We have watched the lake rise well above the best scientific predictions for 5 years in a row. Just a few weeks ago, Mother Nature dumped another three to five inches of rain over the entire Devils Lake Basin. Every naturally occurring event, such as this, compounds our problems and reminds us of how little control we have over the situation.

North Dakota's approach to managing the problem has been a comprehensive, three-part effort, including upper basin storage and management, protecting infrastructure and removing water from the lake. First, the Federal and State government have made significant efforts to hold water back within the upper areas of the basin. Upper basin water management, as we call it, has been ongoing for several years. But it alone is not the answer.

Some people point the finger of blame to agriculture and suggest that closing wetland drains is the solution. Again, this is a grossly simplistic approach. Scientific evidence shows that the lake's level has ebbed and flowed for thousands of years, and overflowed naturally into the Sheyenne River long before man had any influence on the watershed.

We firmly believe there is a limit to what we can accomplish through upper basin water management. Nevertheless, we continue to spend millions of dollars on upper basin management to restore holding areas and to create new ones.

Second, we're protecting infrastructure around the lake. The greatest expenses have occurred as a result of relocating more than 200 homes, raising miles of roads, replacing several bridges and building levees and protecting utilities. This year alone, we had 17 highway elevation raising projects in the area, for a total cost of $30 million. More dirt and road work took place in the Devils Lake region this year than occurred in our State even during construction of the interstate highway system.

Resources to continue these infrastructure efforts are limited. Yet we must continue pursuing these projects, not knowing if our efforts will ultimately be overtaken again by a lake that is rising uncontrolled.

Our third effort is to remove water from the lake. This is where an outlet is necessary, because evaporation is the only current method of reducing the lake level. Even with a prolonged drought, it would take more than 10 years of normal evaporation for the lake to return to the pre-flood level of 1993.

A managed outlet is technically feasible, and others have been completed successfully elsewhere in the country. Lake Pulaski in neighboring Minnesota is a good example, a managed lake outlet built in 1986 by the Corps of Engineers.

Environmentally, the outlet can be constructed and operated to meet downstream State and Federal water quality standards, as well as international water quality objectives. The runoff to Devils Lake is the same as runoff from other agricultural areas in the State into the Sheyenne and Red River.

Operating the outlet only during non-flood periods will eliminate additional downstream flooding in peak flood times. The entire basin would be managed like a reservoir, with water being stored when needed for downstream flood control, and released during non-flood periods.

The benefit of the outlet has been questioned since it is limited in capacity. At the current lake level, any future rise will cost approximately $30 million per foot, much more than what was projected by studies completed by the Corps of Engineers several years ago, when the lake was nearly 25 feet lower, and the damages at that time per foot were much less than what we are experiencing now.

A rise in 1998 similar to what we experienced this year could cause up to $150 million in additional damages. To the people who have lost nearly 60,000 acres of land, their homes and their livelihood to the lake since 1993, I can assure you that the situation is an emergency and that the outlet is very justified.

Regarding the non-Federal cost share for the project, the 1997 State legislature unanimously passed a resolution of support for an outlet to Devils Lake, and provided sufficient funding for the cost share to the State Water Commission. During the hearings and the dozens of public meetings that have occurred across the State regarding Devils Lake, there has been considerable public debate. The State stands ready to provide funds as necessary.

Finally, there seems to be some confusion regarding the relationship of Devils Lake to the Missouri River Basin. Devils Lake physically is not a part of the Missouri River Basin. It is part of the Hudson Bay-Red River drainage. An outlet from Devils Lake to its natural basin, the Red River, will in no way affect the Missouri River nor the Mississippi River.

Thank you for your time today, and thank you for your careful consideration of this outlet project that we believe will provide the relief necessary from this terrible unfolding disaster and emergency that plagues the Devils Lake region, the Spirit Lake Nation and the State of North Dakota.

With my testimony I have also submitted a Devils Lake fact sheet that gives more detailed information. I have also provided to you a brochure entitled the Devils Lake Flood: Managing the Problem, which presents a comprehensive strategy that has been put forward and the document is signed by the co-chairs of the Lake Emergency Management Committee, Vern Thompson and Joe Belford, our Congressional delegation, Senator Dorgan, Senator Conrad, and Congressman Pomeroy and also by Governor Ed Schafer.

Mr. Chairman, thank you again, and if you have any questions, I'll be glad to try to answer them.

Senator CHAFEE. Thank you very much, Mr. Sprynczynatyk.

Dr. Gary Pearson, Vice President, Dakota Prairie Chapter, National Audubon Society.

We welcome you, Doctor. Why don't you proceed?

STATEMENT OF GARY L. PEARSON, VICE PRESIDENT, DAKOTA PRAIRIE CHAPTER, NATIONAL AUDUBON SOCIETY, JAMESTOWN, NORTH DAKOTA

Mr. PEARSON. Thank you very much, Chairman Chafee, Senator Wyden.

It's going to be a little difficult to respond to an hour and a quarter of emotional statements on this project, but I will do what I can in the time allotted.

The rising level of Devils Lake in recent years has caused millions of dollars of damage to roads and other developments and has created tremendous hardships for many people living near the lake. The problems are serious and they require solutions that are effective, are based on sound hydrologic and engineering analyses, and are economically justified and environmentally responsible. Unfortunately, the proposed emergency outlet from Devils Lake to the Sheyenne River fails, and it fails dismally, to meet any of these criteria.

In considering the problems created by the high water levels at Devils Lake, it is necessary to recognize that we are dealing with a natural phenomenon, which has been transformed into a man-made emergency. As you have heard, Devils Lake has never been a stable lake. And over the last 4,000 years, it has been completely dry five times, it has overflowed to the Sheyenne River twice, and it has fluctuated between these extremes another eight times.

As the level of the lake continued to decline in the first half of this century, roads, railroads and other developments encroached more and more on the dry lake bed. Simultaneously, agricultural development resulted in extensive wetland drainage throughout the watershed.

It is now estimated that a minimum of 189,000 acres of wetlands with the capacity to store nearly a million acre-feet of water have been drained in the Devils Lake Basin. With evaporation and seepage, much of this storage was renewable. Instead, however, most of that water now finds its way directly into Devils Lake.

We've been told that this project is economically feasible. We have seen no data to substantiate that. However, in 1994, the Corps of Engineers calculated an outlet would produce only 39 cents in benefits for each dollar of cost. Since then, nearly $200 million have been spent to move 300 homes. I point out those homes have been moved, there have only been about 20 structures that have actually been destroyed. People haven't actually lost their homes, they've moved them. And there have been $14 million in Federal national flood insurance payments made, and in comparison, there's been only $900,000 in premiums paid by those people receiving those benefits.

The money has been spent to raise roads and dikes and implement other measures to minimize the damage that has resulted from the high water levels, thus reducing even further any benefits of an outlet. It is obvious, therefore, this proposed outlet is devoid of economic justification.

I am also disappointed that no one of the previous witnesses told you that the outlet, had it been in operation when the lake began

to rise in 1993, would have lowered the lake by only 13 inches by October 1995. The lake still would have risen more than five feet, and it would have risen another five feet since 1995. The fact is, the lake has been rising at five times the rate that an outlet would lower it.

In other words, the proposed outlet simply wouldn't work to prevent flooding around the lake. Nor would it prevent the lake ultimately from overflowing into the Sheyenne River. And should that occur at 1,457 feet, it doesn't matter to those people downstream whether it be the water from the outlet or from the natural overflow. This project simply doesn't work to solve the problem.

The Corps' preliminary emergency outlet plan notes specifically that environmental impacts of the proposed outlet have not been addressed. But they include destabilization, erosion and remodeling of the stream bed of the Sheyenne River, worsening of low water level situations at Devils Lake, increased mercury in downstream aquatic systems, persistent high sulfate levels in Lake Ashtabula during drought conditions, higher water treatment costs for cities using river water, an increased frequency, duration and magnitude of violations of State and international total dissolved solid standards.

However, just last week, under pressure from our North Dakota Congressional delegation, President Clinton declared the Devils Lake outlet to be an emergency requirement. Senator Conrad now asserts that this somehow compels construction of the outlet without consideration of an effective and feasible alternative, and without addressing the environmental impacts until after they have occurred. In other words, without full compliance with the National Environmental Policy Act.

We strongly disagree with this interpretation, because it is neither wise policy nor is it a legal requirement.

Although the Corps' report was intended to be ''a common reference for discussions,'' despite widespread opposition, little factual information has been provided to the public and no forum has been established to permit meaningful public participation in decisions regarding the outlet.

While the North Dakota Congressional delegation is telling Congress to abandon all thoughts of seeking authorization for an inlet, now it's interested only in an outlet from Devils Lake, politicians and proponents of the outlet are telling a very different story in North Dakota. And I would like to quote from attachment number 24 to my written submission. ''Dorgan and Conrad said Congress could change the legislation in question in later years.'' This was legislation regarding the outlet-inlet.

Attachment number 27 to my statement, North Dakota Senators push for emergency inlet. ''An emergency inlet option is the only one opponents may buy, Conrad said.'' We were told this issue was resolved in an August letter from the Governor. Here is a story from the Fargo Forum September 26th, 1997. Senator Byron Dorgan and Senator Kent Conrad, both Democrats, said that the inlet had to be bargained away to win funding for the outlet.

The inlet has been strongly opposed by Senator Christopher Bond, a Missouri Republican. ''Senator Bond refused to budget on the inlet, Conrad said, adding that securing money for the outlet

was the most difficult fight in my Senate career.'' Dorgan said he will bring back the inlet debate in future sessions. But for now, he said, the outlet is what is needed. This is dated September 26th, 1997.

By their own admissions, they are steadfastly pursuing a piecemeal strategy to construction of an inlet to Devils Lake. It is important to recognize that effective solutions are available and already are being implemented to deal with problems at Devils Lake.

However, Governor Schafer said in July, ''State Water Commission Chairman voiced his misgivings that all the work and money being put into protecting infrastructure at Devils Lake and upper basin storage was taking pressure off the Corps to produce an outlet. I am concerned by putting all the Federal and State efforts into infrastructure, we are building ourselves into the position that efforts will be less intensive to secure an outlet.

We are very intent on getting an outlet, and we don't want to reduce the pressure on getting an outlet by making an investment in the infrastructure.'' In other words, we don't want to look at other solutions to this problem. We just want our outlet.

It is evident, really, that the real motivation behind North Dakota's pursuit of an ineffective and economically infeasible Devils Lake outlet has little to do with any emergency, but is simply another element of the State strategy for piecemealing together its plan for a $1.5 billion Garrison Diversion project.

In fact, just this week, the U.S. Geological Survey released a reporting indicating that the odds are, Devils Lake will stabilize and then start to slowly fall over the next several years. I would like to submit a copy of that news story for the record.

Senator CHAFEE. All right, fine.

Mr. PEARSON. Obviously, the most pressing emergency facing proponents of the Devils Lake outlet is getting it built before the lake starts to drop.

In view of the many people downstream in North Dakota and other States and Canada who would be affected by the outlet, but who have been deprived of meaningful participation in decisions regarding the proposal, we strongly recommend that this committee reiterate to the President and the executive branch the requirements that Congress has specified in the fiscal year 1998 Energy and Water Development Appropriations Act must be met before construction may be initiated on the Devils Lake outlet.

And these include that it be technically sound, economically justified and environmentally acceptable, and in compliance with the National Environmental Policy Act.

Thank you.

Senator CHAFEE. Thank you very much, Doctor.

Mr. Joe Belford, Lake Emergency Management Committee.

STATEMENT OF JOE BELFORD, RAMSEY COUNTY COMMISSIONER, NORTH DAKOTA

Mr. BELFORD. Senator Chafee, Senator Wyden, my name is Joe Belford. I am a Ramsey County Commissioner representing Ramsey and the Devils Lake Basin.

Senator CHAFEE. That is, you are an elected official?

Mr. BELFORD. That's correct, sir. I am also a co-chair of the Devils Lake Emergency Management Committee, which is made up of elected officials of the Devils Lake Basin. I also serve in another capacity, as vice chairman and the North Dakota representative of the Red River Basin Board, which includes members from North Dakota, South Dakota, Minnesota and the province of Manitoba. And we organize for the purpose of managing water within the Red River Basin.

I have with me Senator Vern Thompson and a co-chair of the Lake Emergency Management Committee, and the Mayor of Minnewauken, North Dakota; and Mayor Fred Bott, the Mayor of the city of Devils Lake.

Before I start my presentation, which I have submitted to you, I would especially like to take issue with the comment that this is a man-made emergency. I would like that to be told to Mayor Thompson, whose community was eight miles from the lake in 1993. And now, he had to move his lagoon, because it was being inundated with water, and they're talking about building a levee for the city of Minnewauken. Or to our mayor, Fred Bott, who is overseeing a six mile levee being built at an additional cost of $43 million. I think you would have a hard time telling them that this is a man-made emergency.

Also, Mr. Sprynczynatyk mentioned that for every foot, $30 million additionally would be spent in saving property and infrastructure around the lake. For the record, the lake is freezing up only two-tenths of an inch from its high this year. We had three inches of rain in our area again last weekend, which is bringing it up within two-tenths of an inch.

So there's no question but it's going to continue to rise.

I want to thank you for the opportunity to testify, and as has been indicated, we do have a very serious problem in Devils Lake. Being an elected official and being involved with this process every day, it is indeed a real devastating thing on the citizens of our communities throughout the Devils Lake Basin.

And as indicated, it did start in 1993. Devils Lake has been a record lake for fishery and sports and other things going on within the Basin. So it's very beneficial to our community, but it's also very damaging.

At the same time, our problems started at the same time that the Missouri and the Mississippi kicked off in 1993, and Senator Bond and I talked about that the last time we met, all the damages in his State, which were taken care of, as we had in the Red River Valley this year. And we continue to have heavy rain and snowfall throughout our area, as we had last winter. A Presidential disaster declaration has been signed for every year since 1993.

The lake started out covering 40,000 acres, as was mentioned. And today, it's over 100,000 acres and continuing to rise. It took on more water this year than there was in the lake in 1993. Even though projects are going on in the upper basin for water retention, water management, there's a big CRP sign-up that has happened, there's a new one underway right now, wetlands restoration and other projects going on to continue to keep the water from coming into the lake.

In fact, the Devils Lake Basin has their own water management plan and it's printed, and the committee is working to implement a lot of the plans and ideas to keep water from flowing into the lake. Nevertheless, it continues to rise. And I want to call your attention to that.

It's a flood unlike a river flood. And the flooding at Devils Lake will continue to grow like a cancer, with no end. As indicated, over $200 million has been spent. The question we must ask is, do we want to manage water or let the water manage us?

If we continue to let the water manage us, we are looking at another $260 million. And as a Republican, I don't want to come back here and ask you gentlemen for another $260 million again to help save our infrastructure and the problems that are facing our communities up there. So let's act and move along with our outlet.

To illustrate how the lake has grown, Mr. Chairman, if I may just ask Senator Thompson for a couple of comments, and Mayor Bott, I would like to do that in the middle of my testimony.

Senator CHAFEE. Well, that's all right, briefly. Because we've had a pretty thorough presentation of the situation. And I want to save some time. As I said, there's going to be a vote in half an hour. And if you want——

Mr. BELFORD. We'll be very brief, and we'll have you out of here in time, sir.

Senator CHAFEE. It's not a question of us getting out of here at 11. It's a question of having an opportunity to thoroughly examine the witnesses.

All right, if those gentlemen want to briefly say something.

Mr. THOMPSON. Thank you again, Senator.

Senator CHAFEE. First, Mayor, was the Doctor accurate? I think he indicated there have been 20 houses burned? Is that correct?

Mr. THOMPSON. That's a fair statement. And there are a number that are being looked at, they have to file for permits to go ahead and have those burned.

But if you look at your briefing book, on the cover there's a picture, if Mr. Sprynczynatyk would hold it up, there's an example of where the lake shore was. It moved eight miles. On the top of that picture is the community of Minnewauken. And the lake has moved eight miles.

We didn't make that lake come. The lake encroached on us, and we've had to move and relocate our lagoon system for the town of 400 at a cost of over $800,000. We're basically broke, as political subdivisions. Our homes, our livelihoods, our futures are at risk. And this problem is not going away.

There's other documents in there, and you can go ahead and look through them at your leisure, have your staff do it. But I think it's important that, as a State Senator, we had a public debate about this issue, with the portion of the emergency outlet in the legislature. We passed unanimously a resolution for the outlet. And we passed overwhelmingly the funding for the State portion to match the Federal commitment.

Thank you.

Mr. BELFORD. Now I'd like to call on Mayor Bott, who is the Mayor of Devils Lake, North Dakota.

Mr. BOTT. Thank you, Mr. Chairman.

Just a couple other statements to talk about downstream from Devils Lake. I'm Mayor of Devils Lake. But I went to college and I have an aunt and uncle living in Valley City, the first city that would be impacted downstream from Devils Lake when the water flows. And I'm from Lisbon, North Dakota. My mother still lives there, that's the second city that would be impacted downstream when the water overflows Devils Lake, hopefully controlled, but uncontrolled, my relatives are living downstream.

There is a picture in your briefing booklet, and there was a poster showing the lake level in 1965, and the lady standing there. If someone stood on the sign that showed the lake level last year compared to the lake level this year, if they were not at least five feet seven inches tall, they'd drown. The lake has gone up that much from last year.

Two letters from my students. This is from a senior in one of my American Studies classes. It has to do with the inlet. If an inlet is not built, people will lose homes they've lived in for years. Devils Lake will no longer be a town that you can live in. There won't be any place for kids to go to school. They'll have to relocate all around the State. There won't be any high school games. You won't see the same faces in church that you've seen your whole life. And this is from a junior in my same class.

Senator CHAFEE. That young lady that wrote that, I think she meant an outlet, didn't she?

Mr. BOTT. She meant an outlet, yes.

And this one also.

Senator CHAFEE. I'm not trying to——she said inlet——

Mr. BOTT. She said outlet, I said inlet. Excuse me.

[Laughter.]

Mr. BOTT. I always tell them not to make that same mistake. Obviously, I should take some of my own advice.

This one also having to do with the outlet. Everyone watched as floods ravaged Grand Forks last summer. The Nation was shocked. Now Devils Lake is facing the same problem. If we don't act now, Devils Lake will be flooded over and we might not be so lucky. Lives could be lost.

Beginning cost for an outlet is $5 million. Is that the value of lives of 8,000 people? You have families. What's the value of your mom's life? Your dad's? Your aunts, your uncles? Your daughters, your sons? Can you put a price on it? If we don't get the money, you just have.

Thank you, Senator.

Christina Wentz

everyone watched as the floods ravaged Grand Forks last summer the nation was shocked. Amazingly everything came through all right now devils lake is facing the same problem. if we dont act now, devils lake could be flooded over and we might not be so lucky. lives could be lost. An outlet costs $5 million. Is that about the value of the lifes of 8,000 people. You have families. What is the value of your moms life? Your dads? Your aunt, uncles, daughters, sons? Can you put a price on it. If we dont get the money, then you just have.

Amber O.

If a levee or outlet is not built, People will lose homes that they've lived In for years. Devils Lake will no longer be a town that you can live in. There wont be any Place for kids to go to School they'll have to relocate all around the State. There won't be any highschool games, and you won't see the same faces in church that you've seen your whole life.

Senator CHAFEE. Thank you very much, Mayor.

Now, Mr. Belford, if you want to wind up.

Mr. BELFORD. I'll continue on very briefly.

Mr. Chairman, as a county commissioner, this is causing catastrophic impacts to our community and our local government.

And just Tuesday night before I came down, and I don't know if any of you gentlemen have ever been local elected officials or not, but we had 105 abatements to deal with of flooded land within the Devils Lake Basin. We had a room full of people asking for tax relief because of flooded properties and flooded lands.

It's quite a process to go through and grant those abatements, which we had to, which affects schools and townships and our county government. And that's going on and on within our area.

We've had hundreds of roads, as was indicated, and other concerns. Our Ramsey County rural sewage system has taken a real beating. We owe $950,000 worth of bonds on that. We're trying to figure out how to keep that process alive so that we can continue to get the revenue in.

The Spirit Lake Indian Nation, which is our neighbor to the south, the road has been closed, creating an impact. Six thousand cars a day travel that road, have not been able to come to our community to do business, nor have they been able to come in for health and public safety and so forth.

We are trying to come up with a comprehensive solution to our problem, as I have indicated. We have included a partnership of Federal, State and local governments working together for a holistic approach. The three-legged stool approach we talk about includes management of water in the upper basin, protection and moving of infrastructure, and an emergency outlet. And no one leg can stand on its own. That's the process that we are moving forward on.

And I indicated, of the things that are going on in the upper basin, to hold water and manage water and try to keep the problem from becoming a real catastrophe.

To protect infrastructure, we've moved dikes and homes and so forth, as was indicated. Over 5 million cubic yards of dirt have been moved to date to buildup our State road system.

The emergency outlet is a management tool that will allow us to release the controlled quality and quantity of the water without harming our downstream neighbors. We believe it is an environmentally and economically smart project. A controlled emergency outlet can prevent a possible environmental and economic disaster down the road.

The proposed west end outlet uses the best quality of water in Devils Lake. This water is very similar to what is in the Sheyenne presently. It would be released into the Sheyenne River during non-flooding or flood potential times. We are confident that the properly managed outlet will meet water quality standards of North Dakota, Minnesota and Manitoba.

Senator CHAFEE. Mr. Belford, are you close to winding up here?

Mr. BELFORD. I'll wind up here very quickly, sir.

In closing, we as local elected officials need your help. We need to move as quickly as possible in this process. Our community is stressed out. We are financially impacted, and our community is gradually dying, unless we can resolve this issue. In fact, once again, I want you to look at that home. Our house is on fire, and we need your help.

And I want to thank you for your time listening to me. And Senators, please, I beg you to move forward with this process as quickly as possible. We need help.

Senator CHAFEE. Thank you very much, Mr. Belford. We appreciate your testimony here.

Dr. Zirschky, I don't quite understand why you're not farther along with some just very standard matters. I noticed you objected

to the conditions in the appropriations bill. But you've been in that department for a long time, and you know that the feasibility study isn't the most difficult thing in the world. It's pretty standard. We've set that up here.

It is my understanding that hasn't even been completed so far. Is that correct?

Mr. ZIRSCHKY. That's correct, Senator. And it's my fault for that. I don't say that necessarily as a bad thing.

In 1995, we were faced with rising flood waters. And we were not going to have our feasibility study done in time. They should be very fast documents. In 1993, they were taking us over 5 years to get done. We've got that down now to less than 4 years to get done.

But in 1995, we didn't have four more years to get this done. So General Genegan and I decided we would undergo a parallel process. We would continue trying to do the studies for the feasibility study, but make our priority the contingency plan efforts for how we deal with the rising flood waters.

We're still using the same sort of philosophy in the feasibility study. We're going to make smart decisions. Every dollar that I've spent so far in North Dakota I've gotten a higher benefit than the cost I've incurred.

The conditions, per se, those are things we would normally look at. I don't have a problem answering those questions. My only concern about those conditions, and everybody keeps talking about the conditions, and not the whole range of options that we're going to have to look at to solve this problem. I'd be delighted to have more wetlands and more upstream storage. That would be a big help.

There is some range within which the outlet will be most effective. To make sure we make smart decisions in that regard, I've asked the Corps, we worked with the Department of Agriculture, to hire a research laboratory to help us develop a decision model that will then translate into sort of a simulation model. We can show you graphically, we build the outlet and we have this range of climate conditions, what's going to happen to the lake level. And I would be delighted to come back and brief the committee on those results.

I'm not proposing anything rash.

Senator CHAFEE. Well, as you know, this committee has to be guided by something. We can't just authorize funds without some kind of justification. So traditionally we've required that when an engineering project of this size is submitted or requested, that it be technically sound, economically justified, cost benefit ratio, you're familiar with all those, and environmentally acceptable. And none of those, it's my understanding, in none of them so far has the Corps demonstrated that these requirements are met.

Mr. ZIRSCHKY. That one I don't know. Because the design is not done. I can demonstrate that every action we've taken so far meets those criteria.

I guess what I consider unprecedented is to have that specifically spilled out for an emergency. I can't think of any case, unless I've been directed by Congress and it's been signed by the President, where I haven't followed those conditions in 4 years. It's not that those are bad conditions. It's that everybody is now talking about

those conditions, and we're ignoring the upstream storage possibilities and other, dike, levee increases.

I want us to get back to the flood, rather than the conditions. And I will make sure whatever we do is responsible. I promise you that.

Senator CHAFEE. Now, Dr. Pearson says that, I can't remember the exact figures, but I think he said that if you constructed this outlet, and I don't know how big, what would be the diameter of one of the pipes for an outlet? Would it be a piped outlet, or would it be a canal of some type?

Mr. ZIRSCHKY. I believe it would be a mixture. We would use some natural flow patterns and also some lift stations and pumping. And it would move about 200 million gallons per day, is the maximum of what we're designing. That's about two-thirds of what the city of Washington, DC uses.

The constraint, however——

Senator CHAFEE. But I think Dr. Pearson said that it would, I think, what did you say, Doctor, lower it 12 inches?

Mr. PEARSON. I said if the outlet had been in operation when the lake began its accelerated rise in 1993, by October 1995, it would have lowered the lake by 13 inches.

Senator CHAFEE. In other words, it would have met the increase, and indeed——

Mr. PEARSON. No. No. It would have been only 13 inches lower than it would have been without the outlet.

Senator CHAFEE. Oh, I see. What do you say to that, Mr. Zirschky?

Mr. ZIRSCHKY. We might disagree with the amount of feet that it would be lower. We think there would be a much greater decrease. But the water level still would have risen. That's part of the rational decision model we're trying to put together, with an entity called the Energy and Environment Research Center, which is to do that simulation.

I can pump millions of gallons of water out of Devils Lake, but I've got to find a place that can take that water. If I pump 200 million gallons of water into the Sheyenne River, I'm going to have a water quality problem, and I can probably, if the water conditions are correct, cause flooding downstream in the Sheyenne River.

So I have to make sure that if we're going to build an outlet that the amount of water we send out, one, is going to make a difference. And there is some range of climate conditions that will make a big difference. But we also won't be transferring the problem from Devils Lake to some other town.

Senator CHAFEE. Dr. Pearson says in his solutions that construction costs for the outlet are estimated at $34 million, with an annual cost of $1,500,000. The Corps estimates that an additional 63,000 acres would be flooded if the lake, and I'm going to ask you gentlemen this, Mr. Sprynczynatyk and Mr. Belford. Mr. Sprynczynatyk, I've butchered the pronunciation of your name, but I suspect I'm not the first.

[Laughter.]

Mr. SPRYNCZYNATYK. Unfortunately, you're not the first, and Mr. Chairman, if you want to call me Spry, that's what everyone else does.

Senator CHAFEE. Well, I think I will call you Spry.

[Laughter.]

Mr. SPRYNCZYNATYK. Thank you.

Senator CHAFEE. What happens, I'm curious, when I saw that, what happens when you're talking on a telephone and somebody says, would you please spell that for me?

Mr. SPRYNCZYNATYK. Interestingly, most often they say, can you spell it, and I say certainly.

[Laughter.]

Senator CHAFEE. Well, I'm going to ask you gentlemen, then, including Mr. Armstrong, to reply to what Dr. Pearson says, and then my time is up, and I want to give time for questions to Senator Wyden.

I'll just repeat that briefly. An additional 63,000 acres would be flooded if the lake were to rise to 1,455 feet, which is I guess the maximum, or if there is a maximum. In any event, and then he goes into the value of the crop land. And whether his figure is accurate or not, I don't know, therefore if the full crop land price of $557 an acre were paid, you could buy up all that land for $35 million and have a wetlands overflow, and you wouldn't have all these problems.

What do you say to that, gentlemen?

Mr. SPRYNCZYNATYK. Well, Mr. Chairman, I'll start and address at least part of the comment and the question.

Presently, Devils Lake is at about 100,000 acres. If the lake rises another 15 feet, to about elevation 1,457, it will grow in size to roughly 250,000 acres. And I haven't had the opportunity to sit down and calculate what the cost might be, but the concern is, if $35 million or whatever the estimate is were spent to buy out all that land, that would literally destroy that whole area from an economic, regional and cultural standpoint.

I would add, too, that in response to your question a minute ago, to Dr. Zirschky, what is being proposed today is a pumped outlet with a pipeline. That pipeline is estimated to be about 84 inches in diameter at its maximum. So that will give you an idea of the size, pumping up to 300 cubic feet per second.

Senator CHAFEE. What did you say, 84?

Mr. SPRYNCZYNATYK. Yes, 84 inches. And that is the current proposal and the project that's supported by the State. Had that pipeline been in place, what Dr. Pearson said is true, that up to 2 years ago, it would have only lowered the lake about 13 inches. Since 2 years ago, had it been in place, it would have lowered the lake at least another 24 inches.

So the lake today could be more than three feet below where it is. At the current rate of damage, we're experiencing somewhere in the neighborhood of $25 million to $30 million a foot. So in that 3 year period, the project would have paid for itself. We could have saved somewhere in the neighborhood of $80 million to $90 million.

Unfortunately, the study that was completed in 1994 said that the rate of return was only 39 cents on the dollar. That was based on pre-1993 data, pre-flood data. And that was based on data that was developed when the lake was lower and the damages in that first few feet were much lower. The people weren't living right on the edge of the lake in 1993. They were some distance back.

And as the Corps applied their forecast of what might happen to the lake, the damage per foot based on this scenario were much less. And they showed that would have not been a wise Federal investment. Today their situation is much different, and the return per dollar is much greater than what was estimated several years ago.

Senator CHAFEE. Any of you want to make a quick comment, because I want to move to Senator Wyden?

Mr. BELFORD. I would make the comment, as the local county commissioner, that this is not socially or economically feasible. I think Mayor Bott's letter from his student described it very well. That would affect the entire city of Devils Lake if it goes to the elevation of 1,457.

Also, the flooding has caused indirectly almost $1 billion in scab disease because of the high humidity coming off that lake, of the agricultural surroundings, for miles around. I personally take issue of the values that Dr. Pearson has brought forward. Socially, I think if all of you were in my place, you would not want that to happen. You would not want to move.

Thank you.

Senator CHAFEE. Dr. Pearson, quickly, and then we're going to move on.

Mr. PEARSON. The point is that this outlet will not prevent the lake from rising. It will not prevent those damages. It simply delays them a few years. We are not saving any money by building the outlet. We're simply deferring the damage.

Senator CHAFEE. Well, I think that's up to the Corps to tell us, if you have a seven foot diameter pipe, what's it going to do to the lake, what's it going to do to the river, the Sheyenne and the Red River. That's for the Corps to tell us.

Senator WYDEN.

Senator WYDEN. Thank you, Mr. Chairman.

And Mr. Chairman, let me say that by agreement with your staff this morning, and Senator Baucus' staff, I am going to ask some questions of Dr. Zirschky on a matter of great importance to my constituents, and I'll just take a few minutes. The folks from North Dakota can be at ease for a couple of minutes. You're going to get a short respite.

Mr. ZIRSCHKY. Somehow I don't get a feeling I'm going to be at ease.

[Laughter.]

Senator WYDEN. No, you will not be.

Dr. Zirschky, you are the official at the Corps that handles the dredging program, is that correct?

Mr. ZIRSCHKY. Yes, sir.

Senator WYDEN. All right. As you know, the Army audit agency found evidence in 1995 of substantial bid rigging efforts to raise prices on dredging contracts with the Army Corps. They found evidence of collusive bidding, they found evidence of winning bidders subcontracting out the work they bid on to losing bidders, a variety of questionable practices.

That audit was done in 1995. My first question to you is, has there been followup by the Army audit agency on the problems found in 1995?

Mr. ZIRSCHKY. Yes, sir.

Senator WYDEN. Has the investigation found evidence, the new investigation since 1995, indicating that the problems that were found earlier continue at this time?

Mr. ZIRSCHKY. There have been indications that the problem still continues, yes, sir.

Senator WYDEN. In 1995, the Army audit agency made a variety of recommendations on how to correct the problems with bid rigging, collusive practices, price fixing. What has been done since then to correct those problems?

Mr. ZIRSCHKY. Well, we don't have a final report from the Army audit agency. But the initial indications are that not enough has been done. I'm confident that the current Chief of Engineers, General Ballard, will take this problem very, very seriously, and that we will fix those problems.

But unfortunately, not enough's been done currently.

Senator WYDEN. We found evidence of price fixing, bid rigging from 1990 to 1995. Recommendations were made to correct them in 1995. You've told us that not much has been done from 1995 to 1997. What in fact has been done that's going to make a difference here?

Mr. ZIRSCHKY. Well, I would say not enough has been done, obviously, because the problem still exists. The things we're looking at now are to implement the suggestions that I hoped we would have been farther along the road on. They were suggestions that came up in 1995. I can't give you a good reason why they weren't implemented in 1996.

But I do know the current Chief of Engineers is committed to working with me to fix the problem. Looking at some of the examples of fixes, are looking at regional contracting so that not each office is doing contracting. That way we would have data more centralized and could detect, I won't use the term evidence, I'll use the term indications, I'll let the Justice Department decide what's evidence, indications of collusive bidding, bid rigging, non-competitive practices.

We're also looking at trying to put our dredging contracts into bigger packages to encourages more bidding. We found that in 1995, just having two people bid on the job cut our costs 10 percent. That kind of similar information was found, and we don't have a final Army audit.

But if we could get three bidders, for example, we could get bids from the dredging industry at 90 percent of the Federal Government estimate. The more competition, the lower our costs.

Senator WYDEN. Well, I will just say, this is North Dakota's day, and I'm not going to continue this, Mr. Chairman. But what has gone on is simply a rip-off of the taxpayers. I mean, we have seen a pattern of price fixing, bid rigging on this important dredging work. It went on for 5 years, there was an audit done.

Dr. Zirschky has now told us that essentially nothing significant has been done since then. And I just appreciate your willingness to respond to some of my questions, Dr. Zirschky. Now is not the time, as you know, to eliminate the Federal dredge fleet, given what you have pointed out. It's the only competition, frankly, that's

out there. Given the evidence of price fixing, this is the only thing that keeps the system honest.

Mr. Chairman, I will be having further discussions with you at an appropriate time. Because this is obviously in our jurisdiction and Dr. Zirschky has told us the problems are ongoing.

And I thank you for it, and to the folks from North Dakota, I appreciate a few minutes. Tip O'Neill used to say, all politics is local. You have come for your concerns and the chairman has been good enough to let me ask a few questions.

Senator CHAFEE. All right, fine.

Now, Dr. Zirschky, could you deal with, I know that you haven't gotten into this all the way. But what about this outlet? How does it strike you? And I know you haven't completed your work on it yet. But as your folks have looked at this, is it going to really lower the lake? What's the water quality going to be like? What's it going to do to the Red River?

Dr. Pearson suggested that you're liable to transfer flooding into those rivers. Now, I know we've had witnesses here who said their parents, families, so forth, live on the river. So the last thing they want to do is, I'm talking about the Sheyenne and the Red, the last thing they want to do is inflict harm on their families. Yet they support this and believe that no harm will come.

What do you say to all that?

Mr. ZIRSCHKY. I've not made a decision to tell the Corps to build an outlet. I have asked that studies be done to help me better define what's the range and which will be most effective. That study should be underway, I believe we transferred the money yesterday to the entity to do that study. And it will be done before the end of the construction season.

So there is nothing I could build today. But I want those answers before the next construction season starts. I believe the best thing to offer is to come back and tell you about what that study found.

But I believe the outlet is something we have to strongly and seriously consider. We've got a lot of people living next to 12 feet of water, and all that's between them and that lake is an earthen dam.

It is not the only answer to this problem, though. I do believe the State's efforts on upstream storage should be commended. The more wetlands we could have there, that's great.

We have to come up with a solution that keeps the people of that area safe, but doesn't transfer the problem to somebody else. And that's what I'm going to be looking for. I don't have a better answer to your question, I don't think.

Senator CHAFEE. Well, we certainly want those answers from you. And the North Dakota Congressional delegation, understandably, is deeply concerned about this. And we really want to move along.

So I just want you to give us that report as soon as you can. And I'll be talking more with you as we proceed here. Answer those questions that I mentioned in my statement, is the project technically sound, economically justified and environmentally acceptable, and in compliance with the NEPA.

The representative from North Dakota said he's not objecting to the NEPA study and expects a NEPA report on this.

So I think we've completed here. I don't have any further questions.

We might have some questions for the record, and if so, we'll write to each of you and give you the time when to reply. There might be other Senators that have something.

Mr. Armstrong, I might have rushed you along a little bit. Are you satisfied?

Mr. ARMSTRONG. Senator, just three final points, I guess. First of all, that every foot that the lake rises has an impact. I think that's important to note. We're now dealing with the impact of the infrastructure regarding the sewage treatment systems and the fresh water delivery to the citizens of the area.

So even if the lake lowers a foot, that has a significant impact on the infrastructure.

Second, as was stated——

Senator CHAFEE. What do you mean, infrastructure? Do you mean the roads, sewage plants?

Mr. ARMSTRONG. Everything. Everything. Because every foot——

Senator CHAFEE. Power company?

Mr. ARMSTRONG. Yes. Because it continually undermines the roads that have been continually rebuilt upon. It undermines the earthen levees and virtual dams that the Corps has been constructing.

Also, because we're in a cycle, I disagree with Dr. Pearson's statement that we're delaying the problem. In fact, we are, if an outlet can be part of a package that addresses this situation, we can ultimately get ourselves out of the wet cycle in a few years without as much damage as might occur otherwise.

And third, other options are being pursued. That was the point of my testimony today, that I think it would have been a bad faith presentation to come to this committee if the outlet was being presented as a silver bullet solution.

But instead, what this task force and other efforts have done in the last several years is work together to make sure we're applying a multi-objective planning approach to the greater basin, that we are pursuing upper basin storage, that we are relocating homes, that we are promoting planning, that we are looking at alternative land usage, and that we have State and local dollars invested in this process, not just Federal dollars.

Senator CHAFEE. Well, we're certainly going to require that, we always have in our matching, not necessarily matching 100 percent. But there is a requirement for local contributions. The Federal Government's not going to do this alone.

Well, I think that's a thoughtful presentation, Mr. Armstrong.

Senator Conrad. Mr. Chairman, if I might. Mr. Pearson brought us a series of quotes out of newspapers about a debate that was a lively debate in North Dakota, on the question of an inlet and an outlet. I want to be very clear.

North Dakota would have preferred not to have restrictions on an inlet. The chairman knows that very well. We've said to the chairman, we would prefer not to have restrictions on an inlet.

The fact is, the only way we could get an outlet was to accept restrictions on an inlet. Senator Bond and others forcefully argued for such restrictions.

It is also important, I think, for the committee to understand that since we've had that debate and we are about to discuss amendments on the Garrison project that the State leadership has concluded that we will not offer language for an inlet in the Garrison amendments.

So I think it's very important those two not get confused. This, the language of this energy and water appropriations bill says there will not be an inlet. We will not offer language for an inlet in the Garrison amendments.

But it is also true that no Congress can bind a future Congress. Some future Congress, if an emergency exists of a different nature, who knows, 20 years from now or 30 years from now or 40 years from now what they might decide. And it would be inappropriate.

That's why we have the conditions that we have, that no Congress can bind a future Congress. None of us here can predict what might happen 40 years from now or 50 years from now.

But what we can say to you, directly and clearly, there's no provision for an inlet in this legislation. In fact, it's prohibited, and we make a commitment to you that in the Garrison amendments, there will be no provision for an amendment.

Senator CHAFEE. All right, thank you very much. That's totally understandable.

I want to stress to Mr. Zirschky and others that I am concerned about the effects on the water quality. We have a letter here from the Canadian ambassador indicating his concerns. So that's an important thing, and I think the testimony that to the west, the waters are far superior than the waters to the east, was interesting testimony.

So I want to thank you all very, very much for the testimony. To my fellow Senators, I would point out, it looks like the vote has started now. Thank you all.

I want to thank all the witnesses. You've come a long distance, Dr. Pearson and Mr. Spry and Mr. Belford. Thank you all for coming, and all the others. Thank you.

[Whereupon, at 11:07 a.m., the committee was adjourned, to reconvene at the call of the Chair.]

[Additional statements submitted for the record follow:]

STATEMENT OF HON. KENT CONRAD, U.S. SENATOR FROM THE STATE OF NORTH DAKOTA

Mr. Chairman, I appreciate the opportunity to come before the Senate Committee on Environment and Public Works to stress the emergency nature of the flooding at Devils Lake, North Dakota and the importance of an emergency outlet to combat this flood.

We have faced a continuing disaster at Devils Lake since North Dakota entered a wet weather cycle in the spring of 1993. Since that time, above-average precipitation has caused the lake to more than double in size and triple in volume. The lake has risen 20 feet since 1993, rising 5 feet this year alone and has expanded from 40,000 acres only 4 years ago to nearly 105,000 acres today. To put this in some perspective, Devils Lake has grown to nearly 200 square miles, almost three times the size of the District of Columbia. Even more alarming, experts tell us the lake will grow nearly two and a half times larger before it finds its natural outlet.

Mr. Chairman, this is a massive lake that is inundating homes, roads and other infrastructure, productive farmland and is threatening the city of Devils Lake. Already over 200 homes have been moved from the encroaching lakeshore. More dramatic, emergency management officials have had to burn some homes to keep debris out of the lake because the water is rising faster than homes can be moved.

The main road connecting the Spirit Lake Nation reservation to the city of Devils Lake is underwater. This forces residents of the reservation to travel an additional 50 miles for medical and emergency services in the city of Devils Lake, which is the regional economic and health care hub. Also, the rising waters are threatening the nearly 9,000 residents of Devils Lake. The top of the levee protecting the city of Devils Lake is currently only two feet above the water level and the U.S. Army Corps of Engineers is frantically trying to raise this dike five feet to prepare for continued flooding next spring.

Mr. Chairman, the Federal Emergency Management Agency established the Devils Lake Basin Interagency Task Force in 1995 to identify ways to combat this flood. Federal, State and local government officials are now aggressively implementing the comprehensive flood-fighting strategy developed by the Task Force. This comprehensive approach includes a three-pronged strategy: 1) upper-basin water storage; 2) infrastructure protection and relocation of structures (such as the levees currently under construction); and 3) an emergency outlet from Devils Lake to the Sheyenne River. Implemented independently, none of these elements can solve this flood disaster. But each is a critical element of the overall strategy to combat this flood.

Water storage is important to slow run-off into the lake and increase the rate of evaporation. Senator Dorgan, Congressman Pomeroy and I secured changes to the Conservation Reserve Program (CRP) to make it better suited to the needs of landowners in the Devils Lake basin. The Secretary of Agriculture named the entire Prairie Pothole Region, including the Devils Lake basin, as a National Conservation Priority Area and modified the enrollment of shallow water areas in CRP to address water retention around Devils Lake.

Efforts are continuing to protect infrastructure in the basin. The Federal Highway Administration has committed $68 million to the Devils Lake region to keep the road system operational. FHWA is coordinating with the North Dakota Department of Transportation to construct a bridge connecting the Spirit Lake Nation to the city of Devils Lake. Also, as I mentioned, over 200 homes have been moved or destroyed and the Corps is raising the dike protecting the residents of Devils Lake.

An emergency outlet from Devils Lake to the Sheyenne River is an essential element of this comprehensive strategy. Devils Lake is currently at a level of 1,442.6 feet. As the water continues to rise, it will eventually flow to the east into Stump Lake at 1,446.6 feet, immediately raising that lake 40 feet. When the water rises to 1,457 feet, it will spill uncontrolled into the Sheyenne River from the part of the lake with the worst water quality. An emergency outlet is necessary to provide a controlled release of water from Devils Lake that will not harm water quality downstream.

Officials from the Corps inform us that under the normal study process, an outlet will take six to 10 years to complete. Unfortunately, we cannot wait six to 10 years. This is an emergency situation that requires an emergency response.

The operation of the outlet will not injure downstream interests, including communities along the Sheyenne and Red Rivers in North Dakota and Minnesota and the Province of Manitoba. In fact, the Corps held numerous public meetings in downstream communities to discuss the emergency outlet plan. Devils Lake and the outlet route are contained wholly within the Red River watershed, so there is no transbasin transfer of water or interaction with the Missouri River watershed. The outlet will be operated so as not to exacerbate downstream flooding or worsen water quality for downstream communities.

The emergency outlet is a cost-effective flood control project. To date, the Federal Government has spent over $210 million to combat this flood. Officials from the Corps of Engineers estimate that as the lake rises to 1,457 feet, total cumulative damages will reach nearly $450 million. Estimated total cost for the outlet is less than $45 million, cost-shared at a rate of 65 percent Federal, 35 percent non-Federal. Both the Corps and the Office of Management and Budget have endorsed Federal expenditures for an outlet now to avoid additional Federal expenditures later.

Further, the emergency outlet from Devils Lake will be constructed and operated in an environmentally sensitive manner. The Fiscal Year 1998 Energy and Water Development Appropriations bill includes $5 million for construction of an outlet and stipulates that the construction must be environmentally acceptable and in compliance with the National Environmental Policy Act of 1969.

Mr. Chairman, I recognize that an outlet is not the sole solution to the flooding disaster at Devils Lake, North Dakota. Unfortunately, there is not one solution to this flood. But an outlet is a necessary part of the comprehensive approach to battle this flooding. We face an emergency situation at Devils Lake, North Dakota. I urge this committee to join the North Dakota Congressional delegation and State and local leaders in making every effort to avert a larger disaster.

Mr. Chairman, thank you again for conducting this important hearing. In addition to the Congressional delegation, we have a number of witnesses from North Dakota that are present. We would be happy to answer any questions that you or members of the committee may have regarding the need for an emergency outlet at Devils Lake.

STATEMENT OF HON. BYRON L. DORGAN, U.S. SENATOR FROM THE STATE OF NORTH DAKOTA

Mr. Chairman, thank you for giving us the opportunity to discuss with the Committee the impact of flooding at Devils Lake in North Dakota and the need for an emergency outlet for its flood waters. Devils Lake, one of only two major lakes in North American with no usual outlet, rises or falls with the weather. Since 1993, the beginning of our current wet cycle, the lake has doubled in surface area and tripled in volume, increasing from 40,000 acres to 105,000 acres today and continued rising is expected. The lake has grown to nearly 200 square miles or an area approximately three times the size of the District of Columbia.

A DEVASTATING PROBLEM WARRANTS ATTENTION

High waters have cutoff roads, destroyed houses, flooded farms and devastated the local economy. For example, the area near the lake has sustained over $200 million in damage with another $30 million expected by next spring. Over 300 families have lost their homes with another 50 at risk in the next 6 months. Residents of the Spirit Lake Nation must travel an additional 40 miles for medical services and the tribe's major source of business income and jobs, a multimillion dollar casino, has been virtually cutoff and its patrons are dwindling.

The local, State and Federal Governments have each spent millions on raising roads and diking flood waters yet their combined efforts will not be enough to stop additional damage. The Federal Government alone has spent $ 68 million to preserve transportation infrastructure.

North Dakota is suffering from a real emergency—one that requires emergency measures. We can't afford to do nothing and wait for the waters to recede. It's simply too costly, economically, environmentally and in harm to human lives. To cite just one example, you just saw on the tape how flooding has affected rancher Duane Howard. Because of losses from high water he has been forced to cash in his retirement, insurance and a small inheritance, yet his family will still have troubling making ends meet.

Mr. Chairman, we can't wait the six to 10 years a regular Corps flood control project process would require. Each year we wait costs Federal taxpayers additional millions in compensation on top of the $210 million already paid out under a variety of Federal programs ranging from highway renovations to increased diking.

Doing nothing also risks harm to the environment since, unmanaged, the floodwater will spill out of the lake from an area of poor water quality. Once the lake reaches an elevation of 1,457 feet it will overflow sending poor quality water down the Sheyenne River and into the Red River Valley. This highly saline water will not only wreak havoc on downstream drinking water systems, it will also ruin thousands of acres of valuable farmland.

A COMPREHENSIVE SOLUTION IS RECOMMENDED

But this catastrophe can be avoided by a combination of raising levees, relocating property, raising roads, increasing water storage in the upper basin and building an emergency outlet Since no one flood-control strategy can do the whole job, our delegation supports using all of these methods together in a comprehensive water management effort. This is a strategy recommended by a joint Federal-State task force which Mike Armstrong headed and about which he will speak.

Mr. Chairman, North Dakota and the Federal Government are devoting a considerable amount of money and effort to programs promoting upper basin water storage one part of a comprehensive program. In the six counties within the Devils,Lake Basin over 430,000 acres are enrolled in the conservation reserve program (CRP). Much of these CRP acres are either under water or saturated thereby effectively serving as water storage areas. The Devils Lake region is also the location of over $ 1.5 million worth of Federal and State water bank contracts for upper basin storage with another $500,000 applied for under the emergency watershed program. Another $3.2 million has been spent on public lands water storage. May I underscore that the North Dakota delegation sought and obtained funding for upper basin storage before we even requested outlet funding. However, these efforts are not enough

to prevent future floods. A multi-faceted problem demands a multi-faceted solution—a solution which includes the construction of an emergency outlet.

AN EMERGENCY OUTLET IS NEEDED

I'd like to take a few minutes to address the questions raised about the effects of building an emergency outlet. First, an outlet is not an inlet. It doesn't transfer water and organisms from the Missouri Basin to the Red River Basin and the Hudson Bay watershed. It can't since it is not even connected to the Missouri. The Devils Lake Basin is part of the Red River Basin. The outlet is just a controlled manmade drain preventing uncontrolled overflow that would occur once the lake reaches an elevation of 1,457 feet.

An outlet also gives us some control over both the quality and the quantity of water flowing downstream and a chance to avoid the worst effects of unmanaged flows into the Sheyenne and Red Rivers. It releases the best quality water from the western end of the lake and times the releases to take into account downstream interests.

An outlet makes good economic sense and is strongly supported by the Administration whose own Fiscal Year 1997 Disaster Supplemental Appropriations bill included $32.5 million for its construction. Because of the unique nature of flooding in a closed basin, traditional cost/ benefit rules don't really apply to the Devils Lake Outlet. Unlike river floods our high waters.

STATEMENT OF THE HONORABLE ROD GRAMS, U.S. SENATOR FROM THE STATE OF MINNESOTA

Thank you Chairman Chafee for holding today's hearing on the proposed outlet for Devil's Lake, North Dakota. I appreciate having the opportunity to submit my remarks on this matter.

As you know, my State, along with North and South Dakota, experienced unbelievable destruction and hardship this past summer along the Red River in Northwestern Minnesota. The citizens of communities up and down the river were uprooted from their homes, schools and places of employment. Many of those communities will never be the same as a result of the damage caused by flooding.

The people of my State expect, and have been promised, that the Federal Government will work with them to ensure that whatever can be done to prevent a similar situation in the future will be done. It is precisely because of this promise that I must express my reservations with the Devil's Lake proposal.

First, any proposed outlet from Devil's Lake presents the possibility for an increased water flow into the Red River Basin in years in which flooding occurs. Quite clearly, this region cannot afford to take a chance on that possibility. My constituents cannot live under the potential threat that not only might they have to endure the wrath of mother nature, but the consequences of public policy not very well thought out.

In a recent letter to the Honorable Joseph M. McDade, the Canadian government touched on many of the same concerns, pointing out the importance of bilateral cooperation on crossborder issues. Appropriating money for this project prior to hearings and action by an authorizing committee, violates any expectation shared by the United States and Canada to work cooperatively on joint concerns.

In addition, there exists the potential that this project would provide Devil's Lake a potential inlet in years of drought, a more common occurrence for Devil's Lake. This inlet would draw water from the Missouri River Basin, thereby diminishing the flow of water in the lower Mississippi Basin. For this reason, the Upper Mississippi River Basin Association passed a resolution on September 24, 1997, opposing any construction of Devil's Lake outlet or inlet projects prior to completion of an Environmental Impact Statement.

I remain concerned that the potential negative impacts of this proposal have not been properly considered. No one can say with any degree of certainty just what will happen to either the Red River Basin or the Missouri River Basin as a result of this project. This project has received significant appropriations without any authorization or cost-benefit analysis. Therefore, the question must be asked, is this the most cost-effective measure to reduce the stress in and around Devil's Lake? I doubt anyone can answer that question definitively considering the lack of study and analysis.

I hope the committee will take a very close look at the means by which this project has moved through Congress and consider the concerns of the regions Governors and Congressmen, as well as the concerns of the Canadian Government and environmental organizations such as the National Wildlife Federation. Most impor-

tantly, however, I hope you will keep in mind the struggles and triumphs of the people of my State over the past year and work to ensure that whatever is done in Congress, protects them from further harm rather than threatens them with greater hardship.

Again, Mr. Chairman, thank you for your time and effort on this important issue.

STATEMENT OF HON. EARL POMEROY, U.S. REPRESENTATIVE FROM THE STATE OF NORTH DAKOTA

Mr. Chairman, thank you for holding this important hearing. In my remarks I will discuss three points.

First there is virtually unanimous agreement among those with actual responsibility for dealing with this problem that a controlled measured outlet is an important component of attempting to manage this significant flooding problem.

Second, while this hearing focuses on the outlet, extensive efforts have been made on the other two major lines of response, upper basin storage and infrastructure investment to deal with the flooding levels already experienced.

Third, while this is an emergency and quick response is required, the process underway will involve full NEPA review of the outlet prior to its construction.

Think of the most significant water problem being experienced in your State. Given the complexity of water issues and the sharply differing perspectives that inevitably exist across stakeholders, I would be surprised if virtually all agencies and elected officials—local, State, and Federal—agree how to deal with it.

That is, however, the case in North Dakota with the Devils Lake outlet. At the State level, the Governor, each member of the Congressional Delegation, the State legislature and State Water Commission, all agree that a controlled outlet is part of the answer. Consensus at the State level is particularly striking in light of the fact that most of the people of North Dakota live downstream.

I was born and raised downstream of Devils Lake, literally on the banks of the Sheyenne River. I used to represent my hometown Valley City in the legislature. Numerically speaking, I represent a lot more downstream North Dakotans than upstream.

Yet, I am for this outlet—like all other public officials—because it can be done in a way compatible with downstream interests and there is no other way to meaningfully respond to the significant threat of much more severe flooding from the rising waters of Devils Lake.

I am not saying there aren't opposing views on the outlet. Any tough public problem produces those who hold differing conclusions. Yet among those with actual responsibility for dealing with this problem there is complete agreement. We don't have the luxury of viewing this in an academic light or with the geological perspective covering thousands of years. People are being hurt, farm and businesses are being destroyed and a town is threatened. Those are the needs here, and how we have had to respond to them.

I would add that across the Federal agencies involved a strong consensus exists that an outlet is part of the solution.

We do not seek the outlet as a silver bullet answer to this vexing problem—pull the bathtub stopper and the water goes away. If only it was that simple!

Two other lines of attack have been pushed as intensely as possible. These are increasing water storage upstream of the lake and addressing infrastructure and housing needs as the lake continues to rise.

Upper basin storage is very important yet not easily achieved. Most of the potential storage exists on land which has been under active cultivation for many many years. These productive acres are critical to the family farmers making their living off of these lands.

Accordingly, we have pursued a strategy of making maximum use of public lands and building a variety of financial incentive programs to achieve water storage on private land.

As a delegation, at every opportunity we have sought to increase Federal support for additional water storage. The most significant result in terms of acreage numbers involves the Conservation Reserve Program.

Local efforts to maintain infrastructure have been significant. More than $17 million has been used to relocate 200 homes and businesses under a National Flood Insurance Program waiver from FEMA. The Federal Highway Administration has spent more than $68 million in the lake region to repair and maintain major roadways. Work to raise the levee protecting the city of Devils Lake is underway. The Corps of Engineers will spend $43 million to protect the city from a lake level of

1,450. These are just some of the efforts undertaken to preserve and relocate infrastructure.

Finally, the language in the fiscal year 1998 Energy and Water Appropriations bill passed by Congress requires that the emergency outlet be environmentally acceptable in compliance with the National Environmental Policy Act of 1969 (NEPA). In accordance with the legislation, the NEPA process will be completed. However, the emergency nature of Devils Lake, as declared by the President for the past 4 years, requires the NEPA process to be expedited. The average NEPA process take two to 4 years. We cannot wait years to complete the process, but yet we want the impacts to be studied. Under this emergency, the necessary studies will occur concurrently with construction, and in full compliance with NEPA.

We have spent more than $210 million in Federal aid to Devils Lake. Upper basin storage and infrastructure relocation continue to be successful efforts. The remaining piece of the puzzle is construction of the emergency outlet. The Corps estimates the total cost of the project to be $45 million which would have a 65 percent Federal- and 35 percent State-cost share under the 1996 Water Resources Development Act (WRDA). Considering the sizable investment in what has so far been a band-aid approach to the Devils Lake flooding, construction of the outlet is cost-effective, responsible and necessary in order to frilly implement the three-legged response to the disaster.

Thank you, Mr. Chairman, for holding this important hearing. I appreciate the opportunity to discuss the emergency outlet with you and the committee.

DEVILS LAKE EMERGENCY OUTLET: NEED FOR THE EMERGENCY OUTLET

October 23, 1997

Devils Lake is one of only two major lakes in North America contained within a closed basin. Due primarily to abnormally high precipitation levels, Devils Lake has risen 20 feet since 1993 to its current level of 1,442.6 feet and will rise to over 1,443 feet before winter freeze-up. Preliminary indications are that the lake will continue to rise by at least two feet next year.

Devils Lake has more than doubled in size and tripled in volume since 1993, expanding from 40,000 acres to nearly 105,000 acres, inundating farmland that is the sole source of income for hundreds of families. The lake has grown to nearly 200 square miles, about 3 times the size of the District of Columbia.

Highway 57, the main link between the Spirit Lake Nation Indian Reservation and the City of Devils Lake, was inundated this summer by the rising lake. Due to this road closure, residents of the reservation must travel an additional 56 miles or more for medical and emergency services.

At 1,446.6 feet, Devils Lake flows naturally to the east into Stump Lake, raising that lake 40 feet and inundating roads, houses and hundreds of acres of farmland.

At 1,457 feet, Devils Lake will cover over 250,000 acres and flow through its natural outlet channel into the Sheyenne River, which eventually flows into the Red River of the North to the Hudson Bay drainage in Canada. Devils Lake water will flow uncontrolled into the Sheyenne River, from the part of the lake with the worst water quality.

COMPREHENSIVE FLOOD-FIGHTING STRATEGY

To coordinate efforts in combating continuous flooding in the basin, the Federal Emergency Management Agency (FEMA) formed the Devils Lake Basin Interagency Task Force in 1995.

Federal, State and local levels of government are now aggressively implementing the Talk Force's comprehensive flood-fighting strategy, including relocation of structures, upper-basin water storage, raising the levee protecting the City of Devils Lake, raising essential roads and increasing flood insurance coverage. The Task Force also determined that an emergency outlet from Devils Lake to the Sheyenne River is a critical part of the this comprehensive plan to battle this disastrous flood.

RECENT LEGISLATIVE HISTORY

The fiscal year 1997 Supplemental Disaster Appropriations Bill included $5 million for the preconstruction, engineering and design of the outlet.

The fiscal year 1998 Energy and Water Development Appropriations bill recently signed by the President included $5 million in emergency spending to initiate construction of an emergency outlet after certain conditions are met.

ANSWER TO QUESTIONS RAISED ABOUT EMERGENCY OUTLET

Question. A previous Corps benefit/cost analysis indicates the outlet project rates .39 to 1.0. Will this project be economically justified?

The .39 to 1.0 ratio was taken from a 1992 Corps Reconnaissance study that the Corps now indicates does not accurately reflect the benefits to be derived from this project.

In a document titled Responses to Concerns with Devils Lake Outlet, the Corps indicates that, "[t]he preliminary traditional economic models that were developed by the Corps of Engineers for evaluating the benefits of an outlet from Devils Lake are not designed to be applied to a closed basin lake and do not fully represent the potential merits of an outlet."

Corps officials indicate that prudent measures taken to combat this flood, including road raises and structure relocations, help explain why the Corps of Engineers preliminary analysis of a benefit to cost ratio are not as favorable as might be expected. Even more importantly, the Corps preliminary analyses vastly underestimate the benefits to agriculture resulting from stemming the flood. Finally, the early Corps analyses admittedly do not account for the benefits of preserving the City of Devils Lake as a significant State regional commerce center.

Further, per the language adopted by the Congress, the Corps must determine the emergency outlet to be economically justified before proceeding to construction.

Question. How will the concerns of the Government of Canada be addressed?

The emergency outlet will not injure Canadian interests. Canadian Ambassador Raymond Chretien wrote the Senate Appropriations Committee expressing concern that the emergency outlet is a component of the Garrison Diversion project. This is not the case. This flood-fighting effort is being pursued altogether separately from our consensus efforts to reformulate the Garrison project. Further, Devils Lake is contained solely in the Red River watershed.

Also, the provision in the Senate bill requires the Secretary of State to review the outlet project and offer an assurance, in consultation with the International Joint Commission, that the project will not violate the U.S.-Canada Boundary Waters Treaty of 1909.

Question. How will the concerns of the environmental community be addressed?

The Senate bill requires that an outlet be environmentally acceptable and in compliance with the National Environmental Policy Act of 1969.

Question. What will be the Federal/non-Federal cost-share for the outlet?

Construction costs for the outlet will be cost-shared 65 percent Federal, 35 percent non-Federal, accordance with the cost-share for flood-control projects established by the 1996 WRDA bill.

Question. Does this outlet provision seek to divert Missouri River water?

The fiscal year 1998 Energy and Water Development Appropriations bill provided $5 million to initiate construction only for an emergency outlet from Devils Lake to the Sheyenne River, wholly contained within the Red River watershed. This outlet would allow controlled releases to monitor both water quality and water quantity.

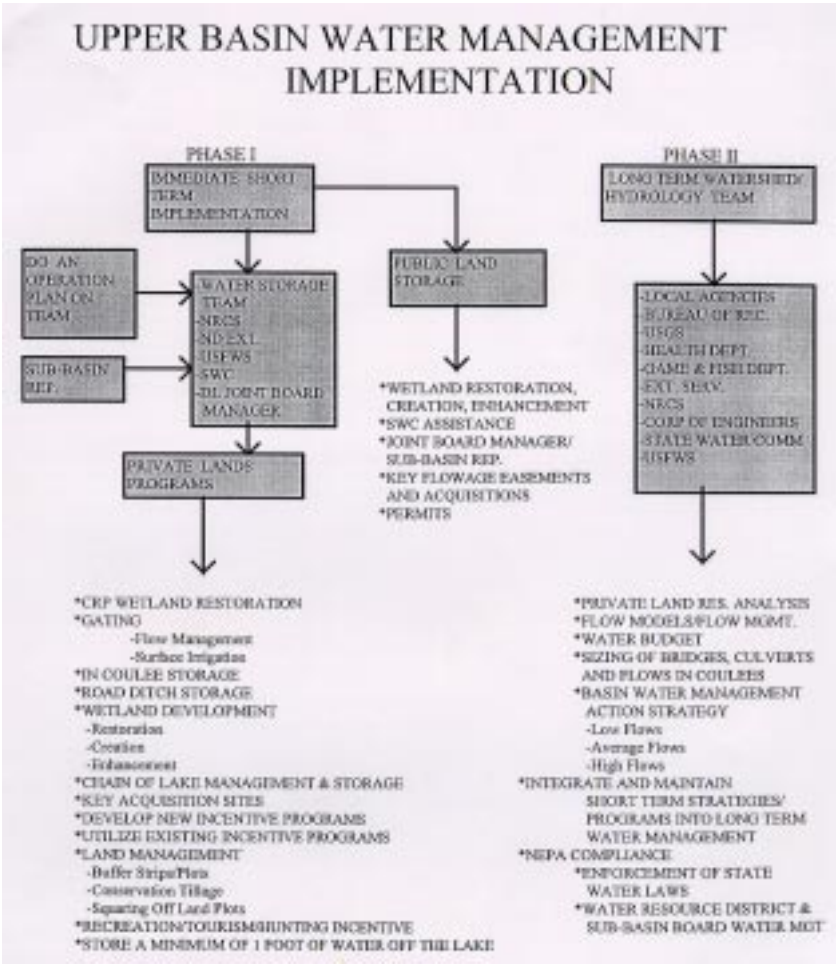
Further, the legislation precludes the construction of an inlet or the transfer of water from the Missouri River basin into Devils Lake.

Question. What is the Federal funding required in Fiscal Year 1998?

The U.S. Army Corp of Engineers indicated they could utilize $5 million in fiscal year 1998 for construction of an outlet. This funding level was included in the fiscal year 1998 Energy and Water Development Appropriations bill.

Question. What is the total project cost?

The Corps' original estimate for total project costs was $50 million, of which $32.5 million would be the Federal contribution and $17.5 would come from the non-Federal sponsor. The Corps has since revised this estimate downward to a total project cost of less than $45 million.

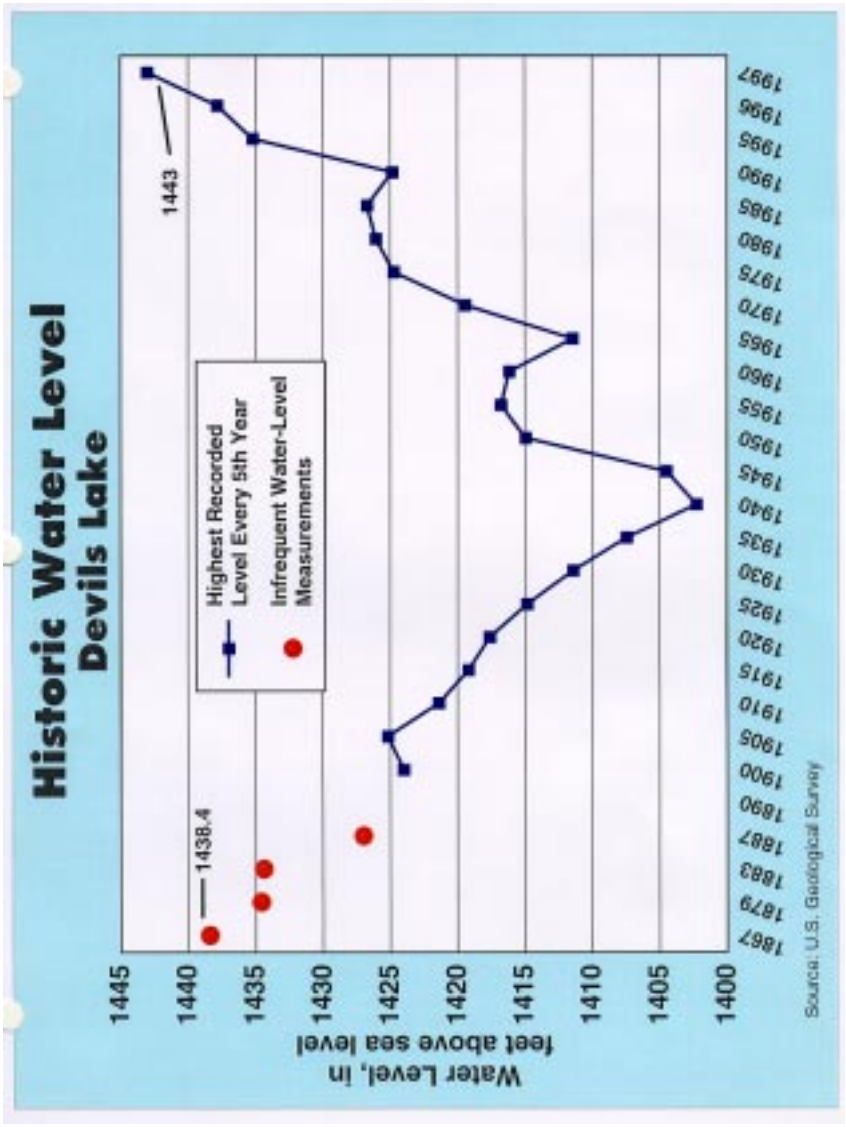


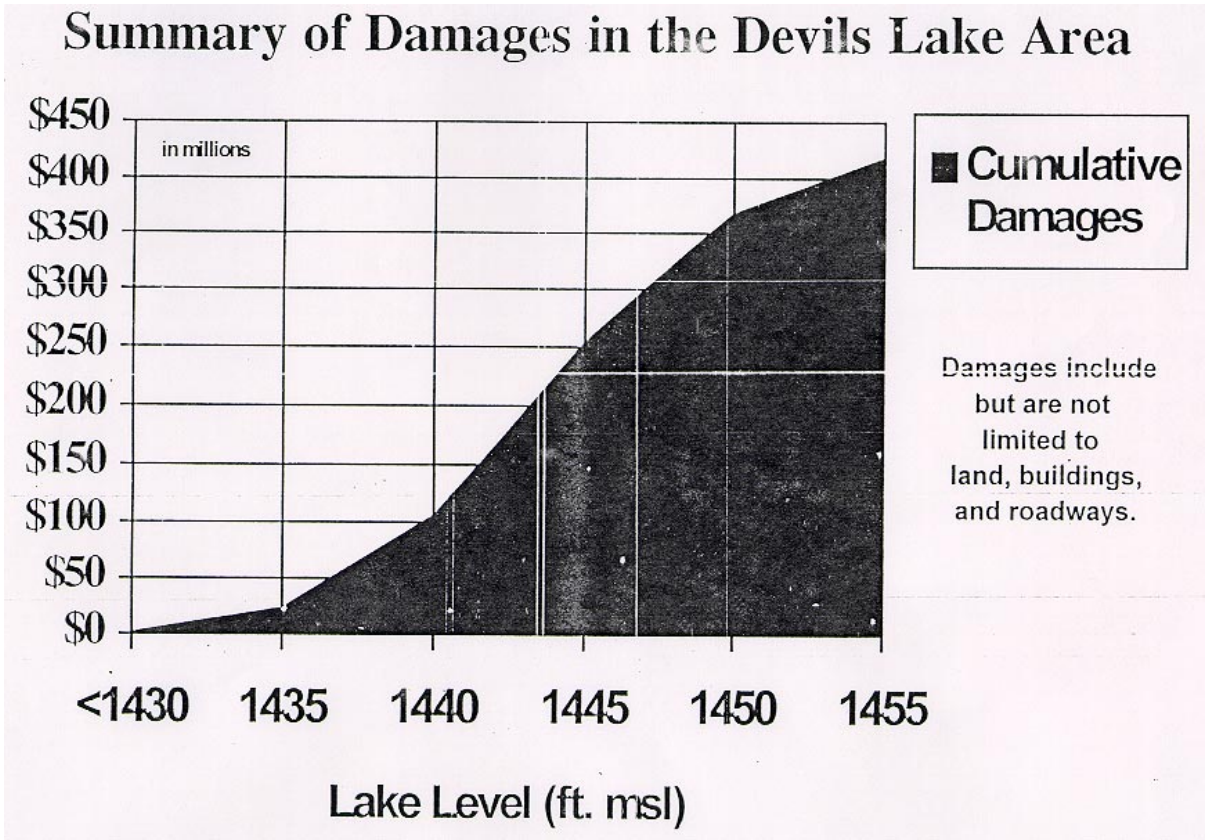
DEVILS LAKE, NORTH DAKOTA—DRAMATIC LAKE RISE THREATENS CITY

If you were standing here on highway 57 today, you would be 30 feet under water. This photo was taken in 1965 when the lake elevation was 1,412 feet. The lake has risen more than 30 feet since then. The lake has risen 20 feet in just the past 5 years. On July 22, 1997, water was at an elevation of nearly 1,443.

The Devils Lake region has already suffered hundreds of millions of dollars in economic and property losses. The Federal Government has obligated some $150 million for disaster relief.

Unless further steps, such as raising the city's levee and building an emergency outlet, are initiated immediately, 9,000 people could become victims of catastrophic flooding.


Historic Water Level
Devils Lake
Water Level, in feet above sea level
1445
1440
1435
1430
1425
1420
1415
1410
1405
1400
1867
1879
1883
1887
1890
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
1996
1997
1443
1438.4
Highest Recorded Level Every 5th Year
Infrequent Water-Level Measurements
Source: U.S. Geological Survey


Summary of Damages in the Devils Lake Area
$450
$400
$350
$300
$250
$200
$150
$100
$50
$0
in millions
Cumulative Damages
Damages include but are not limited to land, buildings, and roadways.
<1430
1435
1440
1445
1450
1455
Lake Level (ft. msl)

FEDERAL RESPONSE TO DEVILS LAKE FLOODING
1995-97

FEDERAL HIGHWAY ADMINISTRATION	$68 M
ARMY CORPS OF ENGINEERS	$44 M
FEDERAL EMERGENCY MANAGEMENT AGENCY (NFIP)	$17.0 M
HOUSING AND URBAN DEVELOPMENT	$8 M
NATURAL RESOURCES CONSERVATION SERVICE/USDA	$2.125 M
FISH AND WILDLIFE SERVICE	$3.4 M
ECONOMIC DEVELOPMENT ADMINISTRATION	$4.8 M
GEOLOGICAL SURVEY	$66,400
ENVIRONMENTAL PROTECTION AGENCY	$323,300
RURAL DEVELOPMENT/USDA	$748,000 (loan)
FEDERAL CROP INSURANCE CORPORATION/USDA	$61.9 M
TOTAL, DEVILS LAKE BASIN	**$210.2M**

DEPARTMENT OF THE ARMY,
ARMY CORPS OF ENGINEERS CENTRE,
St. Paul, MN, April 15, 1997.

RESPONSES TO CONCERNS WITH DEVILS LAKE OUTLET

Cost Effectiveness of Outlet: The preliminary traditional economic models that were developed by the Corps of Engineers for evaluating the benefits of an outlet from Devils Lake are not designed to be applied to a closed basin lake and do not fully represent the potential merits of an outlet. Expenditures and damages that have been incurred relates to the flooding problems at Devils Lake are estimated in excess of $100 million. Potential damage estimates from lake level rises of another five feet (from elevation 1,440 to 1,445) are estimated to exceed an additional $140 million The probability of the lake reaching these higher levels is much greater now with the lake at its present high level than the probability previously estimated.

Effectiveness of Outlet in Controlling Lake Level: Closed basin lake hydrology is considerably different than riverine or lakes with outlets. The electiveness of an outlet for alleviating the upward rise of the lake level must be measured on the cumulative effects over several years. The outlet could lower the lake approximately one foot per year. This reduction would come after the rise in the lake level due to spring runoff. Over a several year period, the outlet could take several feet of water off of the lake. The unprecedented rise in lake level of 16 feet in the last 5 years could not be completely prevented, but peak level that the lake would have reached could have been reduced by several feet The cumulative effect over the longer term can represent significant reductions in flood damages.

Comprehensiveness of Solution/Alternatives to Outlet; The outlet is not being proposed as the only action to solve the problems of flooding around Devils Lake. Relocations of low-lying structures around the lake is taking place through the Flood Insurance Program. Levees are being raised through Corps of Engineer emergency authorities to protect the City of Devils Lake. Water storage in the upper basin is being provided to reduce the volume of flows reaching Devils Lake. Rural utilities are being raised and protected around the lake. There is a comprehensive multiple agency effort to address the flood problems associated with the rising level of Devils Lake. The outlet is only one component, however it is a key component that is necessary to take water out of the lake system at a controlled rate that will minimize any potential downstream impacts.

What if the Devils Lake Emergency Outlet is not included in the Supplemental Funding Bill? The Corps is presently conducting a Feasibility Study for the Devils Lake basin which is scheduled for completion in the year 2000. Subsequent Congressional action and authorization would be required on the recommendations from the feasibility study. Under a normal study and construction process, the earliest completion for an alternative recommended through the feasibility study process would be six to 10 years. Under the accelerated Emergency Process of the Supplemental Funding Bill, about 2 ½ years will be required to complete the project, including a revised Environmental Impact Statement process to comply with National Environmental Policy Act. With the lake at unprecedented high levels and having the potential to came extremely high additional damages, an accelerated emergency process is necessary to reduce the risks of potential fixture flood damages.

Relationship of Outlet to Garrison Diversion Unit (GNU): Stabilization of Devils Lake by bringing water from the Missouri River via an inlet component of the GDU has long been a goal of the State of North Dakota and residents of the Devils Lake basin. The Corps of Engineers feasibility study is addressing the lake stabilization issues, including both an outlet and an inlet. The feasibility study will provide ample opportunities to address and discuss the issues associated with an inlet from the GDU and will provide many forums for opponents to express their concerns. The seriousness of the current flooding situation around Devils Lake requires immediate attention to the outlet, as it is a key component of a comprehensive plan to address the flooding problems. The emergency implementation of an outlet does not imply any approval of the importing of water to Devils Lake via the GDU. The GDU and inlet implications are a totally separate issue requiring separate studies, authorization, funding and congressional action.

Biota Transfer: The Devils Lake basin is hydrologically part of the Hudson Bay (Red River of the North) watershed and has overflowed to the Sheyenne River in the past, providing historical mixing of species. There have been concerns that non-native fingerlings raised in Missouri River hatcheries and stocked in Devils Lake would be introduced to the Hudson Bay drainage by an outlet. However, similar fingerlings have already been stocked in Lake Astabula and other tributaries of the Red River of the North. The non-native striped bass, was introduced to Devils Lake in 1977; however, in 1996 the North Dakota Game and Fish Department reported that studies showed the survival oft he original stock is unlikely and that reproduction and hybridization have not occurred. Preliminary conclusions from a U.S.-Canada joint working group evaluation are that the risk of adverse impacts at the International Border from outlet-related biota transfer is minimal.

Water Quality: The operation of the outlet as proposed would meet applicable water quality standards. The operating plan proposed in the Emergency Outlet Plan Report of 12 August 1996 was based on meeting the Sheyenne River's Class 1A standards at the release point. Downstream concentrations would be further diluted by tributary and local inflows. Total dissolved solids and chloride standards in the Red River north of Grand Forks are occasionally exceeded under natural conditions during low flow conditions. Operation of the outlet would have minimal effect on the water quality of the Red River north of Grand Forks and would not significantly affect the frequency or magnitude of the current water quality conditions.

Downstream Flooding: The outlet would not be operated when there is a potential threat of downstream flooding. One of the key constraints on outlet operation would be the Sheyenne River's channel capacity at the release point of the outlet into the Sheyenne. Channel capacity of the Sheyenne River increases as its goes downstream and the risk of any potential adverse effect on downstream flooding is minimal.

DEPARTMENT OF THE ARMY,
April 15, 1997.

BACKGROUND INFORMATION: PROPOSED EMERGENCY OUTLET FROM DEVILS LAKE

The proposed emergency outlet from Devils Low estimated at a cost of $50 million is based on a preliminary plan that would consist of a combination of pumps, pipeline, open channel, dams and impoundments that would allow water to be taken from the west end of Devils Lake to the Sheyenne River. The proposed plan has been sized so that enough water could be taken from Devils Lake to cause a lowering of the lake level of approximately one foot per year, recognizing channel capacity, water quality and other constraints of adding the water to the Sheyenne River.

An Emergency Outlet Plan for Devils Lake was developed by the St. Paul District, Corps of Engineers, and is described in a report dated 12 August 1996. That report describes an outlet plan from the west end of Devils Lake that was selected primarily because it is one of the most cost-effective options based on initial construction costs. That plan went along an alignment that crosses the Spirit Lake Nation Reservation for its entire length, had one of the shortest distances and one of the smallest elevation differences required to get the water to the Sheyenne River. During development of that plan, the Spirit Lake Nation was supporting the route selection. The Spirit Lake Nation still supports an outlet, however, they prefer variations from the plan designed in the Emergency Outlet Plan report. We are currently evaluating additional alignments and plan features that would result in minimal impacts to the Spirit Lake Nation lands, that would take water from the west end of Devils Lake, and would have comparable effectiveness concerning the lowering of the level of Devils Lake and comparable effects along the Sheyenne River and other downstream interests.

Three outlet routes have been identifies from the west end of Devils Lake that have the potential for developing implementable plans. Preliminary evaluations of outlet plans for these routes resulted in the identification of several potential plans which could be implemented for $50 million or less. The features of each plan differ somewhat, but all plans include pumping to lift the water over the drainage divide, and most plans include buried pipeline for some portion of the route to minimize environmental, social and cultural impacts. Open channel construction, rock or concrete water control structures and earthen embankments are also included in most of the plans.

A summary description of the potential plans for which preliminary evaluations were made is listed in the following table:

	Alternate A	Alternate B
Outlet Route	Highway 281	Peterson Coulee
Total length of Outlet	10.6 miles	13.4 miles
length of open channel	0.4 miles	4.7 miles
length of pipeline	10.2 miles	8.7 miles
Number of Pumping Stations	1	2
Pumping head (elevation difference from lake level to drainage divide).		
	140 feet	140 feet
Total Estimate Project Costs (preliminary)	$46 million	$48 million
Estimated Federal Share (65 percent)	$29.9 million	$31.2 million
Estimated non-Federal share (35 percent).	$16.1 million	$16.8 million
Estimated Annual Operating Costs	$1.9 million	$1.6 million

Each of the plans preliminarily identified, including the two listed above, are based on a preliminary assessment using available information. The total estimated Casts include contingencies to suggest that the plans identified as potentially

implementable would approach $50 million. If an Emergency Outlet plan is authorized, the first task to be accomplished would be the identification and selection of the specific alignments and components of the plan to be implemented. This selection process would include agency and public meetings and presentations of the costs and the environmental and social impacts of the plans to the extent the information can be developed in a very short time frame (2 to 3 months). Coordination with the Spirit Lake Nation would also be accomplished during this selection period. Environmental studies would beam immediately and would be extended throughout the construction period and beyond. Environmental considerations would be incorporated into the design and construction process to assure that adverse impacts are minimized, and where unavoidable, mitigated.

The design and construction of the outlet on an emergency basis is expected to take a minimum of 33, months. This requires that a waiver from the normal Environmental Impact Statement preparation and processing be approved by the Council on Environmental Quality.

An overview of key activities in the anticipated emergency implementation of the outlet plan is:

Activity—Time Frame

Plan identification, selection and EIS scoping process—Months 1 to 3
Engineering and Design—Months 4 thru 20
EIS (environmental studies and evaluations)—Months 1 thru 33 (and beyond)
Start of first Construction Contract—Month 13
Completion of Construction/Available for Operation—Month 33

DEPARTMENT OF THE ARMY,
OFFICE OF THE ASSISTANT SECRETARY, CIVIL WORKS,
Washington, DC 20310, 22 April 1997.

HON. HARRY REID, *Ranking Member,*
Subcommittee on Energy and Water Development,
Committee on Appropriations,
United States Senate,
Washington, DC 20510.

DEAR MR. CHAIRMAN: As you know, on March 19, 1997, President Clinton transmitted to Congress his request for Emergency Supplemental Appropriations. Part of that request dealt with the authorizations and funding needed by the Army Corps of Engineers to address flooding in Northern California, the Northwest, and the Midwest.

To reduce the flood damages being suffered by the residents of the Devils Lake Basin in North Dakota from rising waters of the lake, the March 19 request includes a proposal to authorize the Secretary of the Army to construct an emergency outlet from Devils Lake to the Sheyenne River. The total first cost of an outlet is about $50 million, which would be cost shared 65 percent Federal and 35 percent non-Federal. Non-Federal interests would assume ownership of the project after construction and would be responsible for its operation, maintenance, repair, replacement, and rehabilitation. The proposal would provide $2 million in fiscal year 1997 for the necessary design and environmental studies, and $30.5 million in fiscal year 1998 for the Federal share of construction.

The Army supports the President's request for the authorization and funding of an emergency outlet for Devils Lake, and requests the inclusion of this project in the fiscal year 1997 Emergency Supplemental Appropriations Bill. We are very concerned that the extremely heavy snowpack in the Devils Lake Basin will lead to continued lake level rises and result in increased flooding of private, public, and Indian lands, and may even lead to uncontrolled releases from Devils Lake. Such uncontrolled releases would likely result in further damages and loss of lands and could have significant adverse environmental consequences. Continued increases in lake levels would also result in additional direct flood damages to farmlands, along with long-term impacts due to deposits of salts in the soil.

To date the Federal Government has spent over $114 million to address the flooding around Devils Lake. If the level of the lake were to rise another five feet, we estimate that potential damages could increase by about another $140 million. Construction of an emergency outlet, as the first step in a comprehensive structural and

non-structural program and in conjunction with other efforts, would reduce this risk of flood damages.

Sincerely,

H. MARTIN LANCASTER,
Assistant Secretary of the Army (Civil Works).

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, DC 20503, April 22, 1997.

HON. BYRON DORGAN,
United States Senate,
Washington, DC 20510.

DEAR SENATOR DORGAN: Thank you for your letter to the President concerning proposed supplemental emergency funding for Devils Lake, North Dakota. He has asked me to respond on his behalf.

As you know, the Administration supports funding for design and construction of an outlet for Devils Lake and included a request for these funds in the fiscal year 1997 Emergency Supplemental Request submitted to Congress on March 19, 1997. Since there is no natural outlet to this lake, it is predictable that the extreme snowpack in the Devils Lake Basin, will lead to continued lake level rises, and result in increased flooding of private, public, and Indian lands and may even lead to uncontrolled releases from Devils Lake—in effect, the creation of a natural outlet. Such a natural outlet would likely result in further damages, loss of lands, and have environmental consequences. In addition, damages could accrue to farmland as the lake increases in size and deposits salt in the soil. Once the flooding subsides, this land could be unusable for years. Constructing an emergency outlet would reduce the risks of further flooding and of an uncontrolled natural outlet occurring. An emergency outlet will not, by itself, eliminate the threat of flood, at Devils Lake. It is, however, an essential element of a broader program, and will provide a measure of reduction flood risk.

The Federal Government has already spent over $114 million to address the flooding around Devils Lake, and constructing an outlet could help minimize future expenditures. According to the Army Corps of Engineers, there has been approximately $100 million total in expenditures and damages. If the level of the lake were to rise another five feet (1,440 feet to 1,445 feet), potential damages could increase by another $140 million. Construction on of an outlet, in conjunction with other efforts to address the situation could greatly reduce this damage estimate.

Also as you make clear in your letter, the Administration's's proposal would not waive or amend any of our environmental laws. Our proposal requires fulfillment of all requirements of the National Environmental Policy Act and the 1909 Boundary Waters Treaty Act with Canada. In addition. in the Administration's view, there is no link between support of an emergency outlet and potential future authorization of a reformulated Garrison Diversion project.

Thank you for letting me know of your strong interest in this project.

Sincerely,

FRANKLIN D. RAINES, *Director.*

EDWARD T. SCHAFER, GOVERNOR,
State of North Dakota, April 23, 1997

HON. DAVID OBEY,
U.S. House of Representatives,
Washington, DC 20515.

DEAR REPRESENTATIVE OBEY: I am writing to ask; for your support to include finding for an emergency outlet at Devils Lake, North Dakota. No doubt you have heard of the immense flooding taking place in North Dakota these past several weeks. We need your help in North Dakota.

This project is part of the Administration's 1997 Supplemental Emergency Appropriation for the U.S. Army Corps of Engineers which included $32.5 million for construction of the Devils Lake emergency outlet.

Unfortunately, the funding did not make it into Chairman McDade's mark-up, coming out of subcommittee, because of concerns over "authorizing" a project in a supplemental appropriations bill. However, I am advised that authorizing a project like an emergency outlet for Devils lake in an emergency appropriations bill is not unique. But, our circumstances are unique.

The State and Federal Governments have spent over $100 million responding to damages from Devils Lake since 1993. We have raised roads, and dikes to 1,445, the highest limit reasonably possible.

We were bracing for levels of 1,440 this year. However, as of April 23, 1997 recent projections by the National Weather Service indicate the lake is likely to rise to 1,444, 8 feet above the high level reached in 1867. Clearly. 1997 is the last year we have to take critical steps to avoid jeopardizing the entire community of Devils Lake and incurring millions of dollars in additional damages.

The situation at Devils Lake is both a disaster and an ongoing emergency. The lake has risen 16 feet since 1993, and will rise another four to six feet this year. I have enclosed several recent photos that show some of the problems from last year. The impacts were terrible then and will be even more extreme this year. I have also enclosed a map of the area showing how Devils Lake has grown from about 45,000 acres in 1993 tO about 85,000 acres this year. As the lake continues to rise, it could soon reach nearly to Cando. Unfortunately, there is nothing to prevent this from happening, and history shows it can happen again. Since the lake will reach new levels this year, we have no time for the usual six-seven year study for a project to be authorized under normal circumstances.

The Devils Lake emergency outlet is one part of a comprehensive three-part solution devised in 1995 by the Devils Lake Basin Interagency Task Force lead by FEMA and comprised of numerous Federal, State and local agencies. This report and the Emergency Outlet Plan published by the U.S. Army Corps of Engineers on July 26, 1996, both conclude that an emergency outlet is necessary to gain control of the flood disaster that now plagues the Devils Lake region.

The emergency outlet project will be a 200 cfs outlet facility operated under stringent rules to protect downstream interests. If this project had been in place in 1993, it would have lowered Devils Lake 2 feet and saved $30 million for infrastructure protection, and prevented the relocation of at least an additional 70 to 90 homes, as we are now preparing to do.

All planning to date has included provisions to comply with the National Environmental Protection Act (NEPA) and the 1909 Boundary Waters Treaty (BWT). Future efforts will also comply with NEPA and the BWT to ensure recognition and protection of downstream interests. In planning thus far, all downstream water quality standards have been met. Biota transfer issues and downstream flood and erosion potential have been addressed. In North Dakota. we are concerned about water quality at Kindred, Valley City, Lisbon, Fargo, and other downstream communities in Minnesota and Manitoba. At the same time, we must recognize that Devils Lake is clearly a part of the Red River Basin and has naturally overflowed on several occasions into the Sheyenne River.

I assure you that all measures that can effectively reduce the flood losses at Devils Lake are being aggressively pursued. Despite these efforts, Devils Lake continues to rise. Evaporation the past 4 years has been non-existent, and without our three-part solution, there is no end in sight to increasing damages at Devils Lake. Will an outlet alone solve the problem? No, we must implement all parts of the solution. Even that may not be enough. But to do less is irresponsible. Our hope is that God Almighty will contribute the fourth and final part of the solution.

I have enclosed a chart showing the recorded levels of Devils Lake. I have also enclosed a fact sheet that further explains the recent problem, the need for an outlet, and the comprehensive solution we are pursuing.

Finally, let me add that the North Dakota Legislature, on behalf of the people of North Dakota carefully reviewed and endorsed the three part solution that we are pursuing, passed a resolution approving the outlet, and passed a bond program to pay for the State's share of an emergency outlet. Congressman Pomeroy will provide you with a copy of the resolution and other briefing materials on behalf of North Dakota.

I request that you help us gain control of a disastrous situation. As the Governor of a State, I recognize the demands placed upon you for even program and request imaginable. Likewise, the people of our great country have asked that we exercise some fiscal restraint in the management of their affairs. I would not ask you for this help, in the face of growing demands and critical needs resulting from disasters across the country, unless we desperately needed it. We desperately need it.

Sincerely,

EDWARD T. SCHAFER, *Governor.*

OFFICE OF THE GOVERNOR,
State of North Dakota, October 1997.

TO ALL INTERESTED PARTIES: In 1995, a wide range of local, State, and Federal agencies and organizations; the Spirit Lake Nation; elected public officials; and numerous concerned individuals, met to form a Task Force assigned to address, in a comprehensive, multi-objective manner, ways to mitigate the Devils Lake flood.

This Task Force, chaired by the Federal Emergency Management Agency, produced a variety of mid- to long-term response measures to complement the short-term efforts of the local emergency management agencies. Many of these measures have been implemented while others are works in progress. The Interagency Task Force continues to meet on a regular basis to monitor and evaluate these efforts.

Local, State, and Federal leaders have identified three key components in the effort to combat this flood: improved upper basin water management, infrastructure protection, and pursuing a west end outlet from Devils Lake to the Sheyenne River. As each component is somewhat reliant upon implementation of the others, this approach has been termed the "three legged stool."

To further the specific discussions, a separate group of local, State, Federal, and environmental representatives began to meet in 1996. After numerous meetings, it was agreed that a "flowchart" depicting the various efforts associated with the three legged stool and the agencies involved, would be a helpful complement to the work of the Task Force and to others interested in understanding the wide range of efforts which are being pursued to deal with this ongoing flood. This flowchart is attached, with a separate page outlining efforts associated with each leg of the stool.

In addition, a website has been developed to keep interested parties informed of the progress being made on these many parts of the three legged stool. This website is updated regularly and is accessible at: http://water.swc.state.nd.us.

As local, State, and Federal elected leaders working together toward implementing the three legged stool, we hope that this information is helpful to you and we thank you for your support in the implementation of this plan.

Sincerely,

VERN THOMPSON, *LEMC Co-Chair.*
JOE BELFORD, *LEMC Co-Chair.*
EDWARD T. SCHAFER, *Governor of North Dakota.*
KENT CONRAD, *U.S. Senate.*
BYRON DORGAN, *U.S. Senate.*
EARL POMEROY, *Member of Congress.*

THE DEVILS LAKE FLOOD: AN OVERVIEW

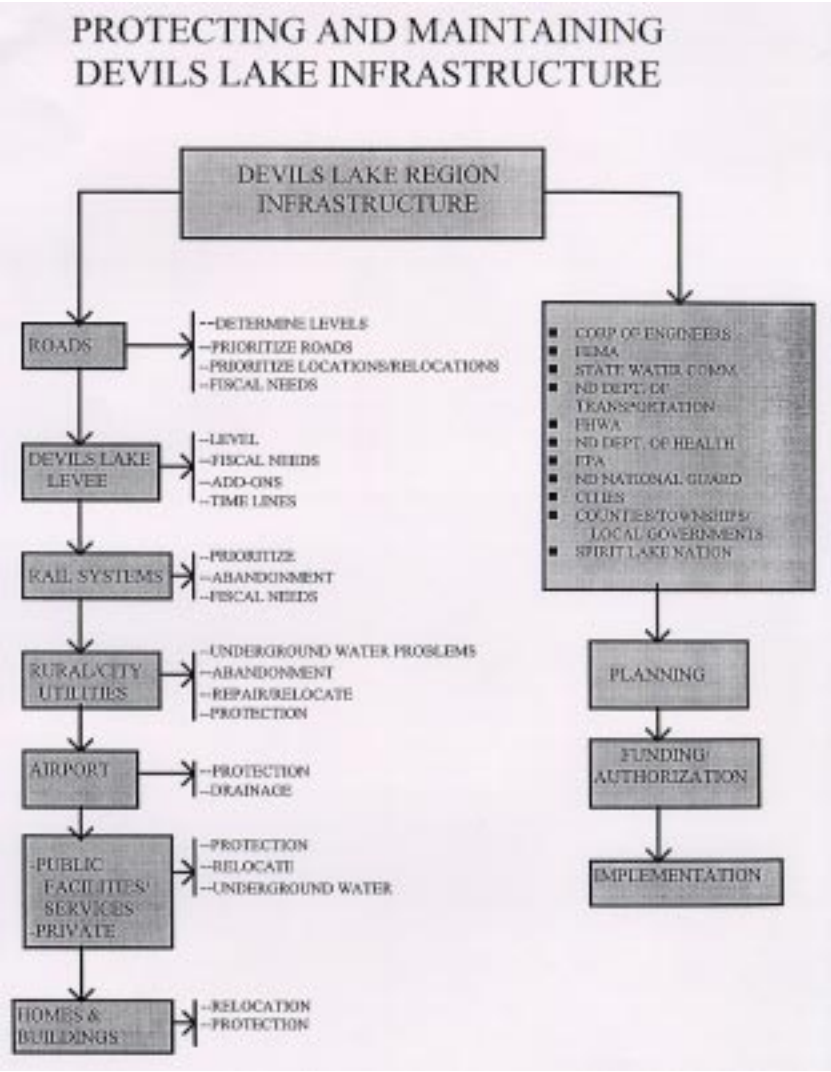
Flooding in the Devils Lake basin continues. High water started working its way into Devils Lake, a terminal lake, in the summer of 1993. High flows have continued at an alarming rate through 1997, causing Devils Lake to rise approximately 20.5 feet, triple in volume, and spread from 45,000 surface acres to 100,000 surface acres. The result of this continued flooding has been extraordinary damages to the region's homes, infrastructure, rangeland, cropland, and economy. Over $200 million in aid has flowed to the region to raise roads, move homes, provide levee protection and for other mitigation efforts.

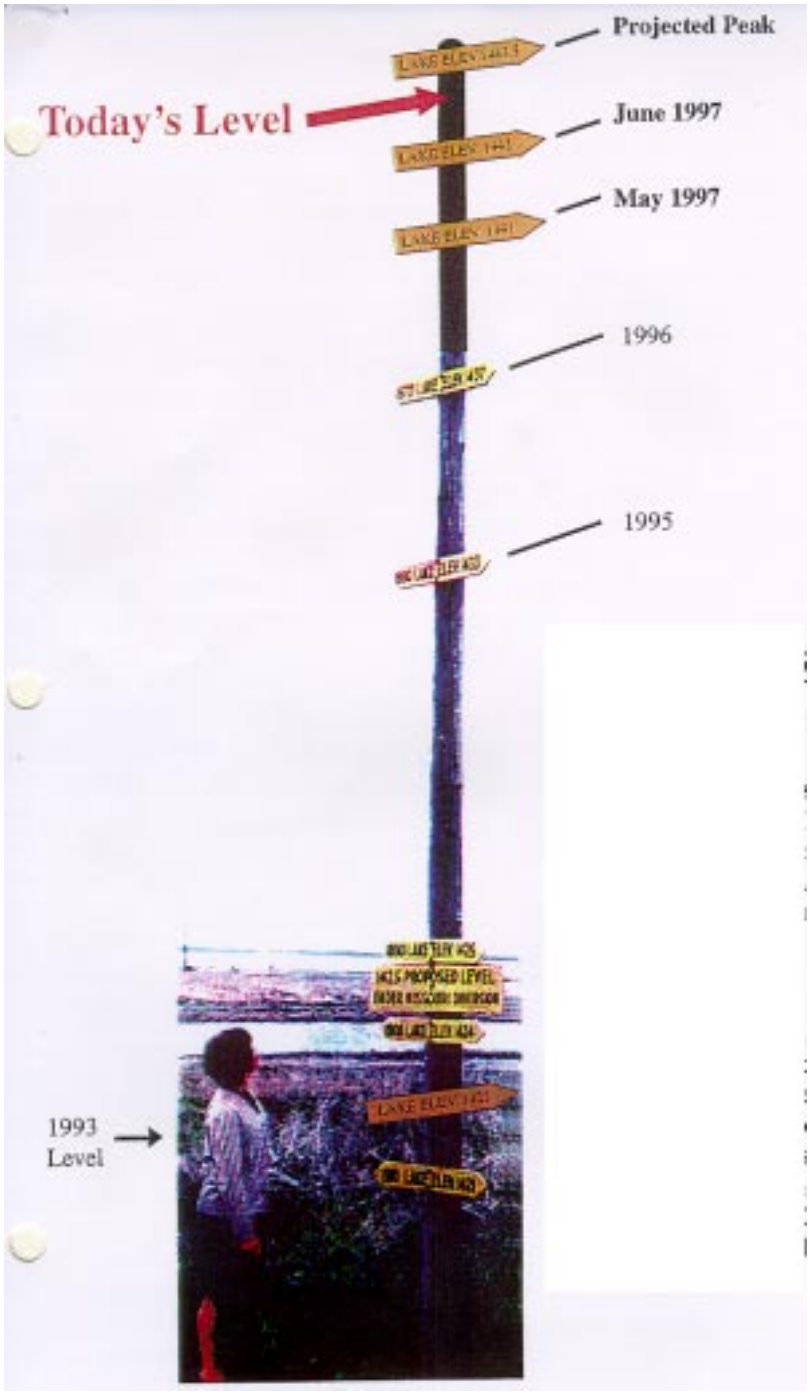
Communities most acutely impacted include the city of Devils Lake, which is North Dakota's eleventh largest city, a regional trade center, and an integral part of the State's recreation and tourism industry. On the western edge of the lake is the community of Minnewaukan, which was approximately eight miles away from the lake in 1992. The Spirit Lake Sioux Nation borders Devils Lake to the south and has experienced significant impacts from this continued flooding. Numerous other communities throughout the basin have also suffered during this wet cycle.

In 1997, the lake reached an elevation of 1,442.9 feet. The complexity and magnitude of this problem increases as the lake reaches natural overflow levels. At approximately 1446 feet it will begin to flow into nearby Stump Lake, and at approximately 1457 feet Stump Lake will overflow into the Sheyenne River. The Sheyenne flows south through the communities of Valley City and Lisbon before it winds northward and where it enters the Red River, which flows into Canada.

Implementing solutions to the flooding is also very complex. As outlined in the attached flowcharts, improved upper basin water management, infrastructure protection, and an outlet from Devils Lake are three main components to reducing flood impacts. In order to move forward with these initiatives, however, we must also address such concerns as upper basin agricultural productivity and water quantity and quality concerns from downstream communities in North Dakota as well as Minnesota and Canada.


MOVING WATER OUT OF THE DEVILS LAKE BASIN
DEVILS LAKE OUTLET
LOCATION, DESIGN, OPERATION
DOWNSTREAM ISSUE MANAGEMENT
NEPA COMPLIANCE
*ROUTING
*EASEMENTS
*SIZING
*OPERATION PLANNING
*RESPONSIBLE PARTIES
*FUNDING
*MEET WITH AND INVOLVE:
-Landowners
-Water Boards
-Cities
-Counties
-Rural Areas
-Devils Lake Management Advisory Committee
-Agencies
-Tribe
-Special Interest Groups (Environmental & Conservation)
-Minnesota
-Canada
-Red River Boards/Authorities
*CEQ
*AGENCY RESPONSIBILITIES
*REVIEW
-Agency
-Interested Groups
-Public


PROTECTING AND MAINTAINING
DEVILS LAKE INFRASTRUCTURE
DEVILS LAKE REGION INFRASTRUCTURE
ROADS
--DETERMINE LEVELS
--PRIORITIZE ROADS
--PRIORITIZE LOCATIONS/RELOCATIONS
--FISCAL NEEDS
DEVILS LAKE LEVEE
--LEVEL
--FISCAL NEEDS
--ADD-ONS
--TIME LINES
RAIL SYSTEMS
--PRIORITIZE
--ABANDONMENT
--FISCAL NEEDS
RURAL/CITY UTILITIES
--UNDERGROUND WATER PROBLEMS
--ABANDONMENT
--REPAIR/RELOCATE
--PROTECTION
AIRPORT
--PROTECTION
--DRAINAGE
-PUBLIC FACILITIES/ SERVICES
-PRIVATE
--PROTECTION
--RELOCATI
--UNDERGROUND WATER
HOMES & BUILDINGS
--RELOCATION
--PROTECTION
COE OF ENGINEERS
FEMA
STATE WATER COMM.
ND DEPT. OF TRANSPORTATION
FHWA
ND DEPT. OF HEALTH
FTA
ND NATIONAL GUARD
CITIES
COUNTIES/TOWNSHIPS/ LOCAL GOVERNMENTS
SPIRIT LAKE NATION
PLANNING
FUNDING/ AUTHORIZATION
IMPLEMENTATION


Projected Peak
Today's Level
June 1997
May 1997
1996
1995
1993
Level

STATEMENT OF JOHN H. ZIRSCHKY, ACTING ASSISTANT SECRETARY OF THE ARMY FOR CIVIL WORKS

Mr. Chairman, Members of the Committee, I am John H. Zirschky, Acting Assistant Secretary of the Army for Civil Works. Thank you for inviting me to provide testimony on the U.S. Army Corps of Engineers (Corps) response to the flooding problems caused by the rising levels of Devils Lake, North Dakota. My statement will consist of a brief history of the Corps involvement in Devils Lake including the projects and assistance that the Corps has provided thus far and our plans for the future. Mr. Mike Armstrong, FEMA, addresses other Federal, State, and local efforts in his testimony.

HISTORY OF CORPS ACTIVITIES IN DEVILS LAKE

The Corps of Engineers investigated primarily agricultural flooding problems in the Devils Lake area in the 1960's and early 1970's and again in 1980. Also in the early 1980's the Corps began to develop a flood protection plan for the city of Devils Lake. This study culminated in the construction of the levee system in 1986 to protect the City.

A study in the late 1980's focused on broader flooding problems in the Devils Lake region and looked at different solutions, including an outlet to the Sheyenne River. This study highlighted the difficulty of predicting whether the lake will rise or fall. These are the same concerns facing us today.

In 1993 the Corps and the North Dakota State Water Commission began a cost shared feasibility study to develop plans to stabilize Devils Lake. While the feasibility study is continuing in parallel with our emergency activities, many of the feasibility activities related to an outlet to the Sheyenne River are under way now as part of our design efforts that I will speak to in a moment.

However, during this same time period, the region began to experience dramatic rises in the lake levels. Federal, State and local efforts quickly focused on a response to the flooding situation. The Corps provided assistance under the Corps emergency authority. These activities included technical assistance, protection of sewage lagoons and lift stations and emergency equipment and supplies. Preparations were also started to raise the levee protecting the city of Devils Lake. Unfortunately, Federal, State and local response efforts are handicapped by the difficulty in forecasting future lake levels.

We are continuing to provide emergency assistance and are working with the city of Devils Lake and other local interests to raise the levee system in anticipation of additional lake rises. We have been adapting our designs and construction methods to allow for future raises. Even now, we have undertaken an additional two foot raise to help ensure the protection of the City next spring. Our designs are taking in to account the special nature of the Devils Lake area and the likelihood that water will be high for several years. We have adopted an incremental raise approach to be sure that we can continue to provide protection for the City but also to husband the State, local and Federal Governments' resources. We want to make sure that we do what we need to do to protect the City.

In the summer of 1995, with the lake levels having risen over 13 feet in a 4-year period, at the request of the North Dakota delegation, the Corps developed a Contingency Plan which identified a wide range of possible actions, their likely cost and performance and the responsible agency for implementing them. The measures discussed in the report included: outlets to the Sheyenne River and Stump Lake; upper basin storage; raising the levee protecting the city of Devils Lake; flood insurance; evacuation of the floodplain and relocations; other levees; road raises; and infrastructure protection. This report was released in February 1996 and complemented the efforts of the Interagency Task Force chaired by the Federal Emergency Management Agency. It focused attention not only on the complexity of the problem but most importantly that many different measures would be needed to provide flood relief. Many of these measures, such as providing upper basin storage, relocation of structures, and road raising have already been implemented by other Federal, State and local agencies. The Corps on-going feasibility study, currently scheduled for completion in September 2000, considers these and other measures to develop comprehensive plans that are flexible enough to address the great uncertainty in future conditions.

In 1996 when the lake was forecast to continue to rise, the Corps used information from earlier studies, the on-going feasibility study and judgment, to develop a conceptual emergency outlet plan. This plan provided information on the impacts and performance of an outlet from Devils Lake to the Sheyenne River. Following the release of that report in August 1996, the Corps and the North Dakota State Water Commission held over a dozen public meetings in the Devils Lake basin, with

the Spirit Lake Nation, Minnesota officials and others throughout the region to discuss the outlet and its' performance and impacts. The Corps is now undertaking the detailed design of an outlet, as directed in the Emergency Supplemental Appropriations Act of 1997 (Public Law 105–18), and we have issued a Notice of Intent to prepare an Environmental Impact Statement. The Energy and Water Development Appropriations Act, 1998, authorizes and provides $5 Million of funding to initiate construction of an emergency outlet at Devils Lake. These specific funds are available after the Secretary of the Army reports to the Congress that an emergency exists and that the construction is technically sound, economically justified, and environmentally acceptable; and provided that the Secretary of State, after consultation with the International Joint Commission, reports that the project will not violate the requirement& or intent of the 1909 U.S.-Canada Boundary Waters Treaty.

Although an outlet route was tentatively identified during the preparation of the 1996 Outlet Plan, additional route selection efforts were undertaken to address concerns raised by the Spirit Lake Nation. These efforts resulted in a route change that has been agreed upon by the Spirit Lake Nation and the State of North Dakota. As a result of the route change and ongoing design efforts for the pumping station, we would expect some increase in the total discharge from the Devils Lake basin into the Sheyenne River over that identified in 1996 conceptual plan. The changed route and its related design are expected to lessen environmental impacts of the outlet.

As detailed in Mr. Armstrong's statement, the Corps and numerous other Federal agencies have been heavily involved in providing assistance to the State and the local communities during the most recent flooding. I believe these actions reflect the recognition of the serious problem faced by the people of the Devils Lake basin as well as the wide range of measures that are required to deal with this complex problem. The uncertainty that we face in dealing with a closed lake basin requires us to adopt a stance that allows the local, State and Federal Governments to make wise use of their resources while continuing to provide assistance.

CORPS PLANS FOR THE FUTURE

My previous remarks illustrate the Corps efforts to adapt to the changing conditions and to continue to provide support and assistance to the region. Now, as we are in the fifth year of record rises, we must turn our attention to the future and the decisions that will be facing us. We don't know Nature's time line that might cause the lakes to spill over into the Sheyenne River and thus it is exceedingly difficult to time the implementation of any flood mitigation measures.

Forecasting the long term lake levels in a closed basin (Figure l) is much more difficult than forecasting the probability of floods in our free flowing rivers and lakes. Flood events on rivers are generally independent events resulting from storms or yearly snowmelt. Devils Lake flooding is dependent upon the previous year's lake level and is related to long term climatological cycles, which makes it much more difficult to forecast. We worked closely with the United States Geological Survey and other agencies in 1994 to improve our ability to forecast lake levels and to attempt to quantify the uncertainty and assess the risk of future lake level increases. To further enhance these efforts, we have finalized an agreement with the University of North Dakota's Energy and Environmental Research Center to work with the Corps to examine the potential of new findings about climate variability in order to improve forecasts for future lake levels. The Corps St. Paul District and Institute for Water Resources will use this information to develop a state-of-the-art decision model. This model will assist decisionmakers on the critical and exceedingly difficult choices on future actions for dealing with the flooding from Devils Lake. The model will allow us to consider different assumptions about likely future inflows into the lake, test possible solutions to see if they can provide relief, and determine which alternatives work best in such an uncertain situation. This work, conducted in close collaboration with affected groups, will produce decision support tools, forecasts, data and forums that can continue to be used by the Corps, the States of North Dakota and Minnesota, the International Joint Commission, and the people of the Devils Lake region.

We are faced with making further decisions to expend additional amounts of Federal and local funds if the lake continues to rise. More importantly, we are faced with significant impacts to peoples' lives if we don't take the proper actions or if we take the wrong ones. In order to understand the implications of taking various actions, I would like to explain in broad terms the climatic and hydrologic uncertainties that face us.

We do not know what elevations to expect on Devils Lake for next year nor the next several years. We know that it has exhibited great variability over both geo-

logic time (Figure 2) and recorded history (Figure 3). From 1950 to the present, almost a third of the total inflow to Devils Lake has occurred in the last 5 years. Such a series of large inflows translates to dramatic rises in lake levels. Yearly inflows and corresponding maximum lake elevation and surface area are shown in the table below starting with the 1993 low point of 1,422.7 feet, mean sea level (msl).

Year	Estimated Annual Inflow (acre-feet)	Maximum Lake Elevation (msl)	Change in Lake Elevation (ft)	Lake Surface Area (acres)	Change in Lake Surface Area (acres)
1950–93	65,000 average	—	—	—	—
1993	296,000	1,427.8 (min 1422.7)	—	56,600 (47,000)	—
1994	189,000	1,430.9	3.1	62,500	5,900
1995	405,000	1,435.7	4.8	74,000	11,500
1996	280,000	1,437.8	2.1	80,000	6,000
1997	420,000 (thru Sept)	1,443	5.2	97,500	17,500
1998	??	??	??	??	??

The lake is currently at 1,442.5 feet, msl and is forecast to reach about 1,443 feet, msl by winter freeze-up. The volume of Devils Lake at 1,443 feet, msl is approximately 1,958,000 acre-feet and covers nearly 100,000 acres.Figure 4 shows a cross-section through the basin and the key elevationslinking Devils Lake to the Stump Lakes and then to the Sheyenne River. At the average annual rate of inflow we have seen into the lake over the last 5 years, it could take about a year to rise to the elevation of the divide between Devils Lake and the Stump Lakes. At this same average inflow, it would take about 2 years to fill the Stump Lakes to the same elevation as Devils Lake. It would then take about six more years to fill the combined Devils lake and Stump Lakes to elevation 1,457 feet, msl, which is where the lake would naturally begin to flow into the Sheyenne River. But we don't know what next year's inflow will be.

There has been concern over the possible environmental impacts of an overflow of the natural divide between the Devils Lake basin and the Sheyenne River. There is a risk of an overflow of the divide which would be several years away even under the continued high inflow conditions I described above. The impacts of such a non-catastrophic overflow would include: erosion and subsequent deposition of sediments in the Sheyenne River; long term inundation of wetlands along the Sheyenne River which could reduce their productivity depending on the duration of their inundation; and higher levels of dissolved solids in the Sheyenne River, that would likely have some effect on the ecosystem but the scope of which is unknown at this time. There is also a danger of contaminating water supplies along the river. Higher treatment costs would occur and alternate sources of water might be necessary for those with special health considerations.

The amount of inflow into Devils Lake is highly variable as shown in Figure 5. We have plans in place to continue to protect the City but the remaining areas adjacent to the lake would continue to be vulnerable. There is some time to consider options before there is a danger of an overflow to the Sheyenne River although damages will continue to occur. The additional information from the work by the University of North Dakota and the Corps offices will be very important in making our future decisions.

Much has been made about an outlet from Devils Lake to the Sheyenne River. A major concern expressed is the salinity (measured as total dissolved solids) of the water in Devils Lake and the Stump Lakes. Current salinity levels vary from about 900 mg/l in the west to nearly 15,000 mg/l in east, as illustrated in Figure 4. By comparison, sea water is usually 35,000 mg/l. These salinities are very dependent upon the level of the lakes and are much higher as the lake levels drop. In 1961, the salinity in East Stump Lake was over 240,000 mg/l or nearly seven times as salty as seawater. Setting aside the environmental, social, and international concerns, let us consider the hydraulic aspects of an outlet. Right now the Corps is working on the design of a pumping system that could move 300 cubic feet per second (cfs). This would amount to almost 200 MGD, which is two thirds more than the average daily use in Washington, DC. However, based upon the Corps 1996 Outlet Plan simulations, the amount that could be pumped would be much less because of conditions on the Sheyenne and Red Rivers. These limits are both in terms of channel capacity, so that flooding is not induced on those rivers, and the need to meet State water quality standards. An outlet is not a simple solution, nor one

guaranteed to work. If very high inflows to the lake continue, a spillway may be a necessary action given the volume of water that may flow naturally to the Sheyenne River.

Along with the North Dakota State Water Commission, we are continuing our feasibility study to develop and evaluate an array of measures to reduce the flood damages in the region in the event the lake continues to rise. From all our earlier studies, it is clear that one component of any comprehensive plan will be an outlet. We are continuing our design efforts for an outlet as directed by the Congress.

In summary, the rising level of Devils Lake has had a serious impact on the region. A great many resources from the Federal, State, and local governments have been committed to address these flooding problems. Future lake levels are unknown but we have studies underway to try to reduce the uncertainty of our forecasts and improve our decisionmaking. We have construction, design, and study efforts underway to address expected problems and insure that we are poised to respond quickly to changes. We are ready to provide needed assistance while being mindful of our responsibilities to the environment and of the impacts to the Federal taxpayers.

Thank you and I will be happy to answer any questions.

Figure 1

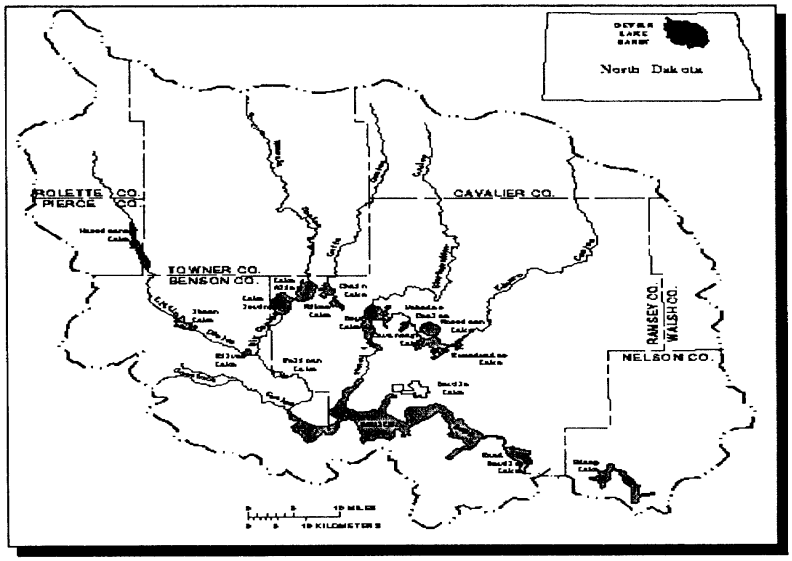


Figure 2

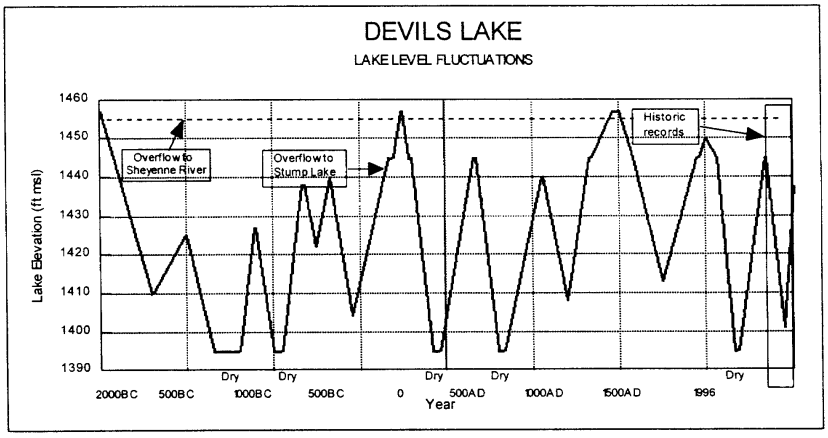


Figure 3

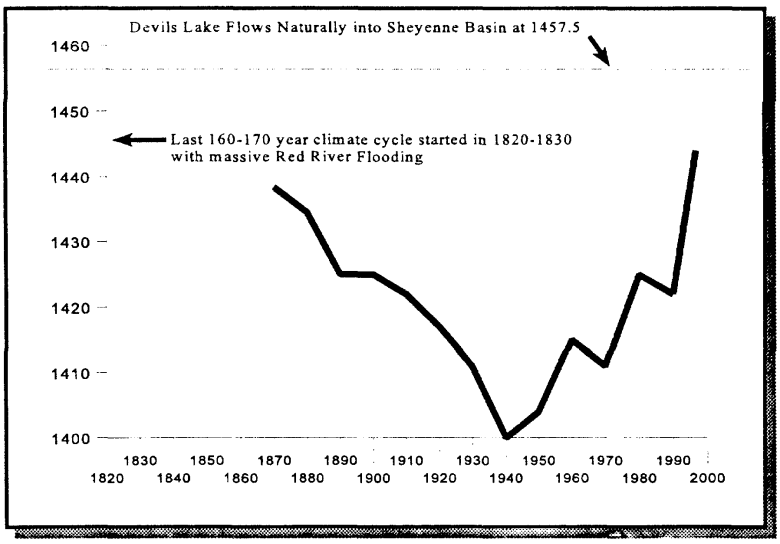


Figure 4

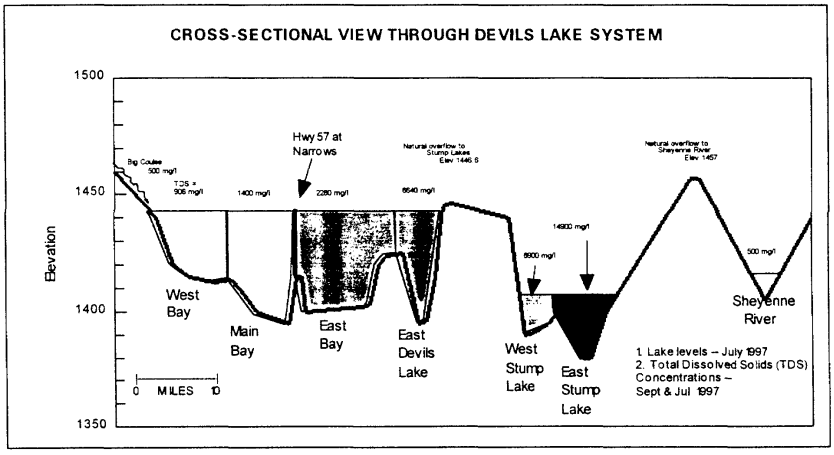
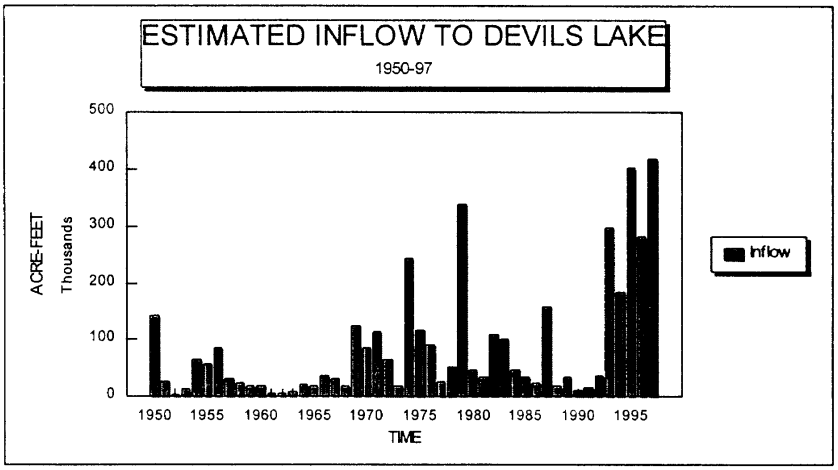


Figure 5



RESPONSES BY JOHN ZIRSCHKY TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1. As part of the project study requirements that we have followed for many years now, we require a thorough vetting of the cost and benefit analysis; the technical feasibility; and the environmental impacts. As I stated in my opening remarks, this data is collected and reviewed by appropriate agencies at the Federal and State levels as part of the cost-shared feasibility report. The data is later "certified" by the Report of the Chief of Engineers. Where are we in this process for the Devils Lake outlet and all other related projects or project features?

Response. To comply with the requirements of the 1998 Energy and Water Development Appropriations Act (P. L. 105–62), necessary studies are underway that will address an outlet's economic justification, technical feasibility and environmental acceptability and would include coordination and consultation with the Department of State and the International Joint Commission and compliance with the National Environmental Policy Act.

As part of the report, the Corps will present the results of an economic analysis. At the current time, there are two consultants conducting studies on flood damages related to the rising levels of Devils Lake. The U.S. Geological Survey (USGS) has been and is continuing to conduct lake level probability studies. The results from the flood damage studies conducted by the Corps will be combined with the USGS lake level-probability analyses to develop an assessment of the outlet's economic justification. Additional information will be developed on the outlet's impact on other ongoing and potential Federal, State, and local flood fight investments.

We have also contracted with the Energy and Environmental Research Center (EERC) and the Regional Weather Information Center (RWIC), both associated with the University of North Dakota, to assist in providing the best available science on which to base any recommendations on an outlet, or on other means to address the flooding. The RWIC is investigating climatic variations that could refine estimates of the probability of future flooding. The EERC will use those results as part of a "Virtual Flood" simulation in Grand Forks, ND in February 1998. This "Virtual Flood" will allow stakeholders and decision makers to simulate flooding conditions on Devils Lake and then fight the flood with simulated alternatives such as an outlet, levees, and relocations. We hope that this simulation, and the process of developing it, will help develop a consensus on the likely effectiveness and impacts of various alternatives including an outlet.

Based on the analyses to date, construction of an outlet poses no technical problems. The pre-construction engineering and design process is ongoing; detailed designs of various outlet project features will be developed over the next several months; and, plans and specifications for selected components of the outlet will follow. The environmental impacts will be addressed in an EIS. The Notice of Intent (NOI) to prepare an EIS was issued in the Federal Register of October 21, 1997.

Agencies and interested parties at the Federal, State, international and local levels are being and will continue to be coordinated with throughout the design and EIS process.

Regarding other related projects in the area, the cost-shared feasibility study was started in 1995 to address a wide variety of water resources issues in the Devils Lake basin. This feasibility study is still ongoing and is scheduled for completion in the year 2000. The levee to protect the city of Devils Lake has been recently raised to a Top of Levee (TOL) elevation of 1,450 feet. Further incremental raises, as needed, are proposed to maintain a TOL of about five feet above predicted lake levels. In April 1995, the levee at the city of Minnewauken's sewer lagoon was raised and strengthened as part of an advanced measures project. This raise afforded the City the time to relocate the lagoon to a more suitable site. As the lake level continued to rise, the abandoned lagoon was eventually inundated.

Question 2a. Page two of your written testimony states that many of the feasibility study activities related to the outlet are being conducted in the project design work. Speaking broadly, is the feasibility study a waste of time? Should we just do away with the feasibility study step?

Response. The feasibility study should be continued; however, the original scope of the feasibility study is being modified to recognize the work being undertaken on the outlet under the authorities provided by Public Law 105–18 and Public Law 105–62. The feasibility study is the necessary vehicle for addressing the details of alternatives other than the emergency outlet. For example, upper basin storage, the impact of high ground water levels at the City of Devils Lake and other problems related to the high lake levels that are not directly related to the outlet are being evaluated under the feasibility study. Also as required by Public Law 105–62, study efforts on an inlet to Devils Lake have been eliminated from the feasibility study.

Question 2b. Just yesterday, the committee received a copy of your 3-sentence letter, dated October 15, 1997, to the President of the Senate informing him of your determination that an emergency exists at Devils Lake. This, of course, was a requirement of the recently enacted Energy and Water Appropriations act. What factors led to your determination?

Response. As noted in my testimony, there is an ongoing flood problem in the Devils Lake basin where we are at historic levels. We can also predict, with almost 100 percent certainty, that the lake will rise higher. We just do not know when or by how much. There is a good chance it will rise higher next year. Therefore, we need to proceed as quickly as possible to evaluate options and make decisions on actions to be taken to mitigate for the expected and potential rise in lake level.

Question 2c. I recognize that the Congress did not specify the need for a report to accompany such determinations, but are there any supporting documents, criteria or materials that shed light on the merits of such determinations?

Response. As I noted, there is an ongoing and record flood in the Devils Lake basin and the lake will rise higher. State and local interests have and are committing their resources to address an ongoing emergency which is beyond their capability. These criteria have been the traditional basis for providing Corps of Engineers emergency flood assistance. These factors provide the basis for my making the emergency declaration.

Question 3. Some have indicated that the standard benefit-to-cost methodology applied by the Army Corps for other flood control projects may or may not be well-suited for the unique hydrologic circumstances at Devils Lake (because it is a closed basin and not a free-flowing river).

Would you explain this to me? If this is so—that the methodology cannot be easily applied—what are we going to do to try to understand the appropriateness (at least in economic terms) of moving forward with the outlet?

Response. It is true that a closed basin presents unique hydrologic circumstances. Essentially the problem is that for a closed basin what happens in any given year, say to a lake level, depends in part on what happened the year before, and the year before that, and so on. This "dependence" is much less likely for open river flood stages, so much less likely that it is reasonable to treat the open river flood stage in any given year as unaffected by the stage in any previous year. In addition, for Devils Lake, the analyses are further complicated by long-term and short-term (El Nino) climate variability.

These real world differences translate into hydrologic modeling and statistical analysis complexities which, due to the rareness of the closed basis situation, have not been made routine within the Corps. To address this analytically difficult situation, the Corps, in conjunction with other agencies, is developing computer models to estimate the outlet's effect on the lake level-probability relationships. Although

these probability relationships are the best technically supportable methodologies available at present, they are extremely sensitive to many factors. The Corps intends to integrate those probability changes and the lake level-damage relationships to estimate the potential benefits of an outlet operation. The Corps will estimate benefits relating to the prevention of future flood damages (national economic development benefits), as well as; regional and local benefits associated with the prevention of future business losses, the cost of foregone or deferred investments, and costs incurred in avoiding or fighting the flood. We will also measure the cost that other Federal, State and local agencies might incur if lake levels continue to rise, and the damages resulting from failure to protect recent Federal investments.

Question 4. Given the rather impressive amount of funding (some $ 114 million) the Corps and other Federal agencies have spent on mitigating flood damages in the Devils Lake basin, including relocating many structures, roadways, and infrastructure facilities, and given the limited amount of water that can be pumped out of the Lake, even under the best of circumstances, is it not possible that there may be very limited benefits from this project?

Response. The work already done by the Corps and other Federal and State agencies have limited the benefits of an outlet. But, if further hydrologic analysis leads us to raise our estimates of the probability of even higher lake levels, the expected damages would rise accordingly. As stated above, an outlet may result in savings in other flood-related measures as well as in the reduction of direct flood damages. An elimination of or even a delay in the uncontrolled overflow into the Sheyenne River could have substantial economic and environmental benefits over a wide area. In addition, whether lake levels rise or not, the lowering of Devils Lake could help return currently flooded lands to productive uses sooner, resulting in economic benefits.

Question 5. How does the Corps currently plan to conduct the environmental impact statement on the Devils Lake outlet? Will the Corps conduct the EIS according to the normal process, meaning you intend to complete a Final EIS, including analysis of alternatives, and analysis of potential impacts on the environment of: construction, operation, and maintenance of the project prior to the start of project construction?

Response. Army will consult with CEQ on how best to comply with NEPA given the emergency nature of the situation.

Question 6a. Questions have been raised as to how much water could be pumped from the Devils Lake outlet and how long the pumping season would be. What is the Corps current thinking on this?

Response. The Devils Lake Emergency Outlet Plan, issued in August 1996, assumed that operation of an outlet would be limited to 7 months per year, May through November, with operation being constrained by downstream channel capacity and water quality limitations. While the pumping season has not changed, the downstream channel capacities have been found to be greater than originally estimated, and the water quality in Devils Lake has improved as a result of the very high volume of flood runoff into Devils Lake in 1997. Based on current information, and at the current lake level, the Corps estimates that about 60,000 acre feet could be pumped out in a year without having adverse flooding or water quality impacts.

An outlet, however, could remove far greater amounts of water. If lake levels rise such that a discharge from Stump Lake to the Sheyenne River would occur, opportunities to mitigate downstream flooding and water quality problems will be few. If this situation develops, there would be an uncontrolled discharge of high saline water into the Sheyenne River and into the Red River of the North We believe that it would be better to release the large volumes of water from Devils Lake via an outlet located at the west end of the lake. A controlled flood would occur. We believe a controlled flood of higher quality water is better than an uncontrolled flood of salt water.

Question 6b. How and when will the issue of operation criteria for the outlet be addressed?

Response. The operation plan will be developed that will comply with downstream water quality standards and to keep flows in the downstream receiving waters within normal non-damaging channel capacities, except under the extreme conditions noted above.

The North Dakota State Legislature established a 9-member Devils Lake Outlet Management Advisory Committee consisting of the State Engineer and representatives from the Devils Lake Basin, the Spirit Lake Nation, the North Dakota Game and Fish Department, and downstream communities. This committee met for the first time on October 20, 1997. The Corps will be coordinating with this committee

and other stakeholders in the development of an acceptable operating plan for an outlet.

RESPONSES BY JOHN ZIRSCHKY TO ADDITIONAL QUESTIONS FROM SENATOR REID

Question 1. Based on testimony I have read, I understand that the emergency outlet is not being pursued as a single solution to the flooding in the Devils lake basin. A memo from the Department of the Army on April 15, 1997 indicated, in fact, that an emergency outlet ". . . is necessary to take water out of the lake system at a controlled rate that will minimize any potential downstream impacts." This same position was outlined in a joint Federal-State-local task force on Devils lake which included an emergency outlet in its recommendations. Do you support the recommendation of the Joint Task Force on Devils Lake that an emergency outlet should be a key part of a comprehensive flood control strategy?

Response. The memorandum that you refer to is background information prepared by the St. Paul District of the Corps. Members of the district staff represented the Department of the Army on the 1995 Devils Lake Interagency Task Force, chaired by the Federal Emergency Management Agency, and supported the recommendation to consider an emergency outlet as a part of a comprehensive flood control strategy for the Devils Lake situation. We still believe an outlet could be part of a comprehensive flood control plan for Devils Lake.

Question 2. In your remarks, you emphasized that flooding in the Devils Lake basin is creating an emergency for the communities in the region. I also understand that the President recently affirmed that the Devils lake flooding constituted an emergency. Are you concerned that the Federal response may fall short of treating this situation as an emergency and that necessary measures such as an emergency outlet may not be accomplished in time to prevent serious damages?

Response. Yes, absolutely. It is my main concern. Serious damages have already been inflicted on the residents surrounding Devils Lake, and the potential for much greater damages exists. Federal responses to the flood threat at Devils Lake so far have been very effective in most cases; however, in some cases the response was not effective in preventing the damages. Significant Federal resources have been invested to minimize or to mitigate the flood damages around the lake. The requirement for future Federal resources to address the threat of potentially higher lake levels and the associated flood damages could be very great. The construction of an outlet has the potential to improve the ability of the Federal response to address the needs of residents in the region around Devils Lake. In spite of these efforts, we have had a significant increase in lake levels in the past few years. Again, I am concerned about the timely implementation of measures to help reduce future rises in lake level, and a return of the lake to less damaging levels. This is why I have initiated a contract with the Energy and Environmental Research Center and the Regional Weather Information Center to develop a decision model for Devils Lake.

Question 3. In the same April 15, 1997 memo to the Congress on responses to concerns with the Devils Lake outlet, the Department of the Army explained that "With the Lake at unprecedented high levels and having to cause extremely high additional damages that an accelerated emergency response process is necessary to reduce the risks of potential future flood damages." Is this also part of your concern about the need to proceed with an emergency outlet as part of a comprehensive solution to Devils lake flooding?

Response. Yes. Since the lake is at such a high level, the potential for higher additional damages is very real. While no one can reliably predict whether the lake will in fact continue to rise, the risks associated with further lake level increases are great. As the levees and roads around Devils Lake have been raised to respond to the threats to the regional community of Devils Lake, the efforts and resources required for each additional foot of lake level increase are incrementally larger than those required for the previous foot of lake level increase. For example, the costs to raise the level of levee protection by five feet at the City of Devils Lake from elevation 1,440 to 1,445 were approximately $7 million, the costs to raise the level of protection of these levees by five more feet from elevation 1,445 to 1,450 and to include additional areas that now need protection are currently estimated to be an additional $43 million. A coordinated effort in several areas to address these problems is required, and an outlet from Devils Lake could be one of the components to the overall plan.

STATEMENT OF MICHAEL J. ARMSTRONG, ASSOCIATE DIRECTOR FOR MITIGATION
FEDERAL EMERGENCY MANAGEMENT AGENCY

Thank you Mr. Chairman, and other Members of the Committee, for the opportunity to testify before you today about Devils Lake. I would also like to thank Senators Conrad and Dorgan for their continued support in addressing this issue.

I sit here before you not only as the Associate Director for Mitigation at the Federal Emergency Management Agency (FEMA), but also as the Chair of the Devils Lake Basin Interagency Task Force. I've served in this capacity since its establishment in 1995, when I was the FEMA Region VIII Director. At that time, I was asked by FEMA Director James Lee Witt to lead the Task Force in order to identify appropriate methods of responding to the rising lake levels in the Devils Lake Basin in North Dakota.

The mission of the Task Force was to find and propose intermediate solutions to reduce the impacts of high lake levels in the Devils Lake Basin. Intermediate solutions were defined as remedial actions that could be achieved within approximately 5 years—after or along with disaster response efforts, but before the benefits from any long-term engineered solution could be realized. From the very beginning, it was recognized that to achieve this mission, the Task Force effort would require the coordinated activity and commitment of numerous Federal, State, and local government entities along with elected officials, private citizens, environmental groups, and representation from the Spirit Lake Sioux Tribe. For this reason, the Task Force has operated with one key point in mind—that any solutions to be recommended could not involve a single-agency response, but instead would require an approach that is multi-disciplinary, multi-objective, multi-agency, bottom-up, and achieved through consensus-building partnerships.

Two years have passed since I was first appointed to serve as Chair of the Task Force, and I am pleased to be able to report this approach is working. And over that time, the water levels in the Lake have increased another 7.5 feet to its present 1,443 feet msl. But while lake levels have climbed, we have made great strides to coordinate and implement an appropriate response to the problems in and around Devils Lake. Since 1995, the members of the Task Force have pulled together to mitigate the flooding impacts in the Devils Lake Basin by leveraging Federal, State, and local stakeholder resources. And the results have been profound. For example:

- All essential roads in the basin have either been raised or are being raised above the rising lake level;
- Floodplain maps for the entire basin were developed, and all communities are now participating in the National Flood Insurance Program. In fact, to date 504 claims have been reported, helping those who were affected by the flooding to rebuild their lives. To date, this has meant an infusion of over $17 million to impacted residents;
- Waivers of the standard flood insurance policy have been issued by FEMA in order to allow homeowners and business-owners who are threatened by imminent flooding to receive payments in advance of experiencing flood damage. These waivers have allowed 122 home- and business-owners to access the resources they needed to move out of harm's way, and 344 additional claims are pending at this time;
- Twenty-one homes on the Spirit Lake Reservation have been relocated outside of the flood hazard area;
- The levees around the city of Devils Lake are being raised, and internal drainage systems are being put in place;
- Approximately 30,000 acre feet of upper basin storage has been created through various programs;
- A series of agricultural programs have been funded and put in place to assist farmers address their losses due to flooding and for upper basin storage;
- Twenty lift stations in Ramsey County have been elevated;
- The sewage lagoon for the Town of Minnewaukan has been relocated;
- Lake water quality monitoring is ongoing, and a long-term lake stabilization study is funded and underway; and—As you all know, consideration is being given to the possibility of building an outlet from Devils Lake to the Sheyenne River.

All in all, the Federal Government has spent over $200 million to address issues in the Devils Lake Basin, not to mention the funds and resources brought to bear at the State and local levels. And with these resources and the commitment of all stakeholders to the process, the Task Force has had a significant and positive impact on the lives and economy of the communities surrounding Devils Lake.

One of the reasons for our success to date has been a direct result of the approach we used to identify alternatives. Unlike past attempts to address the fluctuating water levels in the Devils Lake Basin, this effort was not designed to be another study. Over 400 such studies have been pursued in the past, with little known im-

pact on the problems at hand. Instead, our intent was to work through a process whereby all stakeholders came together to examine the problem from many angles, brainstorm alternatives, confront the differences of opinion, and reach consensus on those actions that appeared most feasible, achievable, and most likely to be effective. We did this on a large scale, and ended up producing a report of which we can all be very proud.

Through this process, we have seen an incredible development of partnerships between Federal, State and local governments. The Task Force has succeeded in creating an understanding that no one solution, or one level of government, provides all the answers. By pursuing a combination of options, including removal and floodproofing of structures, alternative land usage and water storage, rehabilitation of infrastructure, and local planning, the people of Devils Lake have sought permanent approaches to mitigation which make the region more disaster resistant.

Construction of an outlet, in a manner sensitive to environmental concerns and the downstream impacts on other communities and Canada, could complement these other efforts.

Thank you for the opportunity to speak to you today to discuss this important issue. I would be pleased to answer any questions you may have.

RESPONSES BY MICHAEL ARMSTRONG TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

Question 1: How would you characterize the Federal Government's response to the flooding problems at Devils Lake? What has the Federal Government done? How much has the Federal Government spent so far in response to this flooding?

Response: The Government has used a multi-objective, multi-level response effort drawing together as many different entities as possible to deal with a common disaster. These entities range all the way from Federal agencies to local, community, and citizens groups. The Devils Lake Basin Interagency Task Force is now in its third year of meetings and/or regular conference calls with as many as 40 people participating in the monthly calls.

The Federal Government has spent over $210 million as of the attached list, which was compiled in October 1997, with two-thirds being spent by Federal Crop Insurance Corp., the Federal Highway Administration, and the Army Corps of Engineers. This money has been spent in many ways including crop insurance, Upper Basin water storage, road raising around the lake, building and improving protective dikes, relocating residences, sewage lagoons, rural utilities and infrastructure, developing floodplain maps, and many other efforts.

Question 2: Do you have a breakdown of how much each of the Federal agencies has spent on this? Did I get the numbers right? Some $114 million since 1995? What have we done with the money?

Response: A list entitled "Federal Response to Devils Lake Flooding 1995–97" (see copy attached) was compiled in October which indicates that over $210 million has been spent in the basin. The money has been used as described in paragraph 2 of the response to question 1 above.

Question 3: How much more would you expect will be spent on continued flood mitigation in the coming year by Federal agencies?

Response: It is very difficult to estimate either the total dollars that will be spent within the Devils Lake Basin or what portion would be spent during 1998. Among the larger known items are $34 million for an outlet to the Sheyenne River, of which $5 million is projected for 1998; $15 million for a bridge across Devils Lake connecting the town and the Ft. Totten reservation; and $30 million to raise the levees protecting the town of Devils Lake to 1,452, of which $20 million is projected for 1998. The unknown items are related to the weather and future flooding and include crop insurance payments, highway raises and maintenance, structure relocation and others.

Question 4: Is flooding from closed basin lakes extremely rare or unprecedented?

Response: While closed basin lakes have occasionally caused flooding, many of the circumstances involving Devils Lake make it unique, including the repetitive inundation of the area and the threat to reservation lands. There are other instances which have been studied. FEMA Region VIII experienced disaster declarations in 1983 and 1984 in Utah with flooding of the Great Salt Lake. A case study was presented at the Association of State Floodplain Managers Symposium in March 1986 entitled "Closed-Basin Lake Flooding: Case Studies and Mitigation Opportunities." This study cited Lake Pulaski, Minnesota; Great Salt Lake, Utah; Devils Lake, North Dakota; Lake Elsinore, California; the Salton Sea, California; and Malheur (Ilarney) Lake, Oregon, as examples of closed-basin lakes where flooding has oc-

curred. The subject was also addressed in "Floodplain Management in the United States: An Assessment Report—Volume 2: Full Report" which is a FEMA publication FIA-18/June 1992.

Question 5: Has the U.S.G.S. made predictions for what might be expected in terms of water levels at Devils Lake in the coming year?

Response: No. The U.S.G.S. has not made any predictions of lake levels that include any consideration of expected weather conditions and/or snow and rainfall. Probabilities have been computed based on a statistical water mass-balance model for Devils Lake. They differ significantly depending on whether the initial conditions entered are the spring of 1994 (starting lake level of 1,430.6 feet) or the spring of 1995 (starting lake level of 1,435.0 feet). Significant differences are also incurred depending on whether the statistics are entered beginning with the early 1900's, the 1950's, or a more recent date. The lake levels projected are presented as probabilities: 1 in 2, 1 in 10, 1 in 100, etc., rather than predictions.

PROBABILITY OF FUTURE LAKE LEVELS FOR DEVILS LAKE, NORTH DAKOTA—ATTACHMENT TO QUESTION NO. 5

Prepared by the U.S. Geological Survey in cooperation with the North Dakota State Water Commission

Historic Lake-Level Information

Devils Lake Basin is a 3,810-square-mile closed basin (fig. 1) in the Red River of the North Basin. About 3,320 square miles of the total 3,810 square miles is tributary to Devils Lake; the remainder is tributary to Stump Lake.

Since glaciation, the lake level of Devils Lake has fluctuated from about 1,457.0 feet above sea level, the natural spill elevation of the lake, to about 1,400.0 feet above sea level (Aronow, 1957). No documented records of lake levels are available before 1867, but, on the basis of tree-ring chronology, Upham (1895, p. 595) indicated that the lake level of Devils Lake was 1,441.0 feet above sea level in 1830. Lake levels were recorded sporadically from 1867 to 1901, when the USGS established a gaging station on Devils Lake. For the period 1867 to the present (1995), the lake level reached a maximum of 1,438.4 feet above sea level in 1867 and a minimum of 1,400.9 feet above sea level in 1940 (fig. 2). On May 25, 1995, the lake level was 1,435.1 feet above sea level. This lake level is about 12.5 feet higher than the level recorded in February 1993 and the highest level in about 120 years.

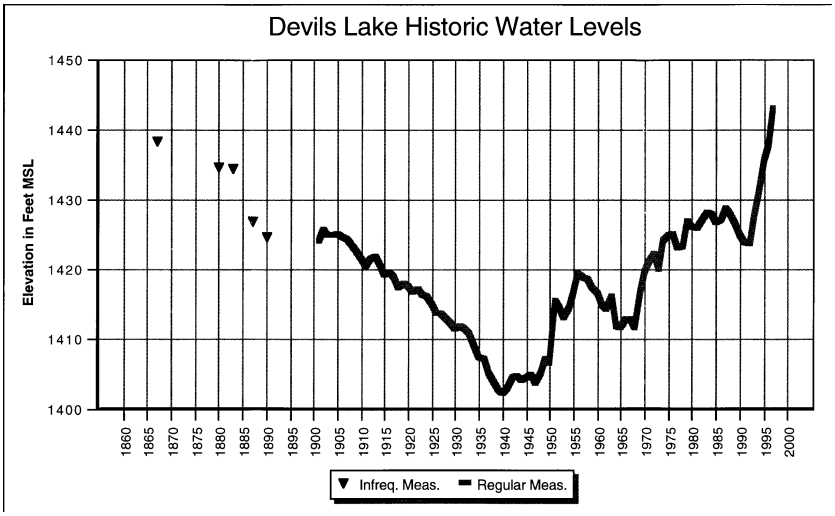


Figure 2. Historic water level for Devils Lakes 1867–1995.

RECENT FLOODING IN THE DEVILS LAKE BASIN

Since 1993, the lake level of Devils Lake (fig. 2) has risen rapidly in response to generally above-normal precipitation from the summer of 1993 to the present (1995). The recent lake-level rise has inundated thousands of acres of cropland around the lake and tens of thousands of acres in the Devils Lake Basin. State highways near

Devils Lake have been closed, and construction is underway to raise roadbeds. Sections of many rural roads have been submerged or washed out near stream and wetland crossings.

The estimated mean annual inflow to Devils Lake for 1950–93 is 65,500 acre-feet. The estimated annual inflow for 1993 is 296,000 acre,feet, the estimated annual inflow for 1994 is 216,000 acre-feet, and the estimated inflow for January 1 through May 31, 1995, is 292,000 acre-feet. Total inflow to Devils Lake for 1993–95 accounts for about 24 percent of all inflow to Devils Lake for 1950 through May 31, 1995.

Future Lake-Level Probability

In response to rising lake levels from 1969 through the 1980's, the U.S. Army Corps of Engineers (COE) is conducting a reconnaissance study for a flood-control project to stabilize the level of Devils Lake. The COE study required analyses of future lake-level probabilities and associated economic damage estimates to evaluate the benefits and costs of proposed flood-control or lake-stabilization projects. To assist the COE and to assist water-resource managers in making decisions regarding lake-level fluctuations, the USGS, in cooperation with the North Dakota State Water Commission, conducted a study of the lake-level fluctuations. The principal objective of the study was to estimate the probability of possible future lake levels for Devils Lake using a statistical water mass-balance (WMB) model. The WMB model is used to compute the total volume (mass) of water stored in Devils Lake due to precipitation on the lake surface, evaporation from the lake surface, and inflow to the lake from the drainage basin.

Seasonal precipitation, evaporation, and inflow data for Devils Lake were estimated and compiled for 1950–93 (Wiche and Vecchia, 1995). The data were used to generate 2,000 possible future sequences of precipitation, evaporation, and inflow. These values then were used to generate 2,000 possible future lake-level traces, each 50 years in length. The model closely reproduced the statistics of recorded seasonal precipitation, evaporation, and inflow and recorded lake-level data for 1950–93 for Devils Lake. The chance that a given lake level will be exceeded can be determined by evaluating the 2,000 possible maximum lake levels in each year (table 1). The chance of a given lake level occurring is dependent on the previous precipitation, evaporation, and inflow and on the starting lake level. The starting lake level for the spring of 1995, when the lake level was 1,435.0 feet above sea level, was used for the simulations shown in table 1. Chances are 1 in 10 that the lake level will exceed 1,438.1 feet above sea level in 1996 and 1 in 100 that the lake level will exceed 1,443.0 feet above sea level in 1996 (table 1).

Table 1. Possible future levels of Devils Lake given the initial conditions that existed in the spring of 1995 (starting lake level is 1,435.0 feet)

Year	1 in 100	1 in 50	1 in 20	1 in 10	1 in 2
1995	1,437.8	1,437.3	1,436.6	1,436.0	1,435.0
1996	1,443.0	1,441.9	1,439.6	1,438.1	1,435.3
1997	1,445.3	1,443.3	1,440.5	1,438.8	1,435.2
1998	1,446.2	1,444.3	1,441.1	1,439.1	1,434.8
1999	1,446.3	1,444.2	1,441.4	1,439.1	1,434.4
2000	1,446.6	1,444.4	1,441.4	1,439.1	1,434.1
2001	1,446.3	1,444.6	1,441.2	1,439.2	1,433.8
2002	1,446.5	1,444.7	1,441.4	1,439.1	1,433.5
2003	1,446.5	1,444.4	1,441.3	1,438.9	1,433.2
2004	1,446.0	1,444.2	1,441.2	1,439.0	1,432.9

The assumed initial lake level, of course, affects the estimated chances of future lake levels. Possible future lake levels were estimated in 1994 using the initial lake level for the spring of 1994, when the false level was 1,430.6 feet above sea level. The resulting lake-level chances are shown in table 2. On the basis of hydrologic conditions as of June 1, 1994, chances were 1 in 20 that the lake level would exceed 1,436.0 feet above sea level in 1996 and 1 in 100 that the lake level would exceed 1,440.7 feet above sea level in 1996. However, after initial conditions were changed to those existing in the spring of 1995, when the lake level was 1,435.0 feet above sea level, chances were 1 in 20 that the lake level would exceed 1,439.6 feet above sea level in 1996 and 1 in 100 that the lake level would exceed 1,443.0 feet above sea level in 1996. Periodically updating the model to reflect the most recent hydrologic conditions for Devils Lake allows water-resource managers to base decisions on the most up-to-date hydrologic information.

Table 2. Possible future levels of Devils Lake given the initial conditions that existed in the spring of 1994 (starting lake level is 1,430.6 feet)

Year	1 in 100	1 in 50	1 in 20	1 in 10	1 in 2
1994	1,432.9	1,432.4	1,431.8	1,431.3	1,430.6
1995	1,438.4	1,436.9	1,434.6	1,433.3	1,430.8
1996	1,440.7	1,438.5	1,436.0	1,434.2	1,430.7
1997	1,441.9	1,439.5	1,437.1	1,434.7	1,430.3
1998	1,442.6	1,440.2	1,437.5	1,435.0	1,430.0
1999	1,442.8	1,441.0	1,437.5	1,435.4	1,429.8
2000	1,443.1	1,441.4	1,437.7	1,435.7	1,429.7
2001	1,443.0	1,441.8	1,437.8	1,435.7	1,429.5
2002	1,443.0	1,441.5	1,438.1	1,435.7	1,429.3
2003	1,443.1	1,441.2	1,438.4	1,435.9	1,429.1
2004	1,443.4	1,441.7	1,438.8	1,435.7	1,429.0

REFERENCES

Aronow, Saul, 1957, On the postglacial history of the Devils Lake region, North Dakota: Journal of Geology, v. 65, no. 4, p. 410–427. Upham, Warren, 1895, The glacial Lake Agassiz: U.S. Geological Survey Monograph No. 25, 658 p.

Wiche, G.J., and Vecchia, A.V., 1995, Lake-level frequency analysis for Devils Lake, North Dakota: U.S. Geological Survey Open-File Report 95–123, 65 p.

RESPONSES BY MICHAEL ARMSTRONG TO ADDITIONAL QUESTIONS FROM SENATOR REID

Question 1: Based on testimony I have read, I understand that the Emergency Outlet is not being pursued as a single solution to the flooding in the Devils Lake Basin. A memo from the Department of the Army on April 15, 1997; indicated, in fact, that an emergency outlet "is necessary to take water out of the lake system at a controlled rate that will minimize any potential downstream impacts." This same position was outlined in a joint Federal-State-Local Task Force on Devils Lake, which included an Emergency Outlet in its recommendations. Do you support the recommendation of the Joint Task Force on Devils Lake that an Emergency Outlet should be a key part of a comprehensive flood control strategy?

Response: The Federal Government has spent over $200 million to date because of the flooding that has occurred since 1995. If the lake level continues to rise, potential problems that might have to be addressed include inundation of the entire Rural Utilities System of Ramsey County, destruction of both the sewer system and the electrical system in the City of Devils Lake, relocation of U.S. Highway 2, the railroad lines and the airport in Devils Lake, and many others. If the lake rises to a level where it flows out of the basin naturally (at lake level 1,457 msl) there would be much less opportunity to control salinity of the outflow, biota transfer, and other legal obligations included in the Boundary Waters Treaty of 1909. The Emergency Outlet is one part of an overall plan to prevent much more costly damages and control the outflow from the lake.

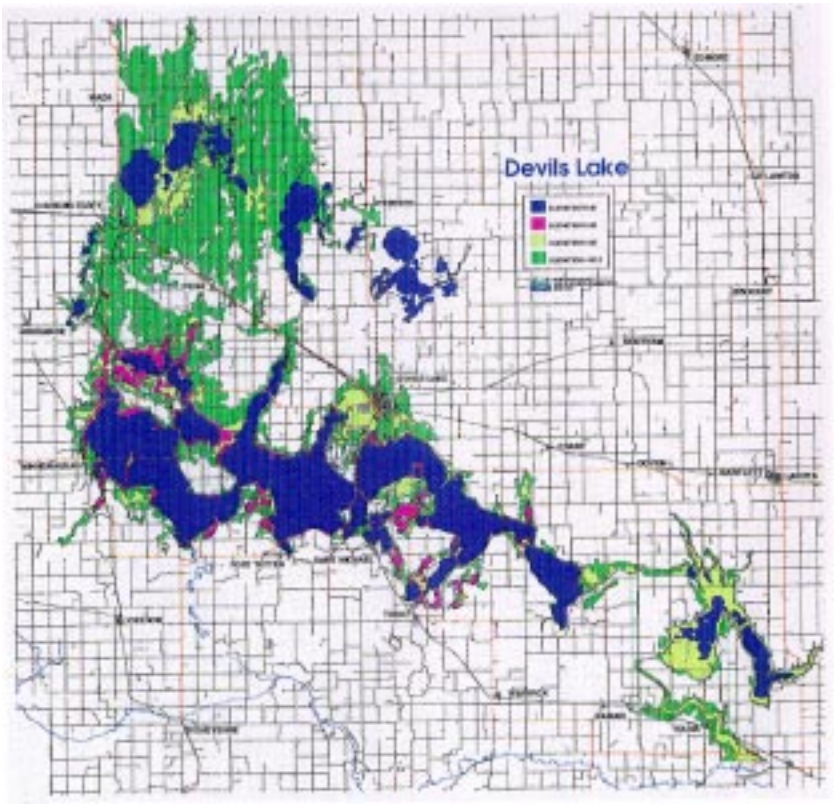
Question 2: In your remarks, you emphasized that flooding in the Devils Lake Basin is creating an emergency for the communities in the region. I also understand that the President recently affirmed that the Devils Lake flooding constituted an emergency. Are you concerned that the Federal response may fall short of treating this situation as an emergency and that necessary measures such as an Emergency Outlet may not be accomplished in time to prevent serious damages?

Response: The Federal response has been continuous since the formation of the Devils Lake Interagency Task Force in the summer of 1995. It has addressed as many problem areas as possible in that time and has achieved much success in many of these areas. The response was immediate and is ongoing. Therefore, the situation was definitely treated as an emergency. Some serious damages have already occurred and cannot be prevented. Certainly there is concern that with every lake rise, the absence of an Emergency Outlet option makes the critical nature of the situation more acute. The Emergency Outlet is one measure that, in combination with other efforts, can alleviate or diminish the severity of effects of flooding in the future and return some stability to the basin.

Question 3: In the same April 15, 1997, Memo to the Congress on responses to concerns with the Devils Lake Outlet, the Department of the Army explained that "with the lake at unprecedented high levels, and having to cause extremely high additional damages, that an accelerated emergency response process is necessary to

reduce risks of potential future flood damages." Is this also part of your concern about the need to proceed with an Emergency Outlet as part of a comprehensive solution to Devils Lake flooding?

Response: Yes. The Interagency Task Force in 1995, identified a number of hazards that would have to be addressed at each foot of increase in the level of Devils Lake. The lake peaked at just under 1,443 feet msl in July of 1997, and has receded about one-half of a foot since that time. The Emergency Outlet could compliment other efforts to control the level of the lake and the only man-made measure that can reduce or maintain a lake level. Completion of the outlet will allow the ability to remove water from the lake and reduce the consequences of drainage of the 3,800 square mile basin into the lake.



Federal Response to Devils Lake Flooding 1995–97

Details 1 & 2, Compiled October, 1997.

Federal Highway Administration	$68 M
Army Corps of Engineers	$44 M
Federal Emergency Management Agency (NFIP)	$17.0 M
Housing and Urban Development	$8 M
Natural Resource Conservation Service/USDA	$2.125 M
Fish and Wildlife Service	$3.34 M
Economic Development Administration	$4.8 M
Geologic Survey	$66,400
Environmental Protection Agency	$323,300
Rural Development/USDA	$748,000 (loan)
Federal Crop Insurance Corporation/USDA	$61.9 M

Total, Devils Lake Basin	$210.3 M

FLOODPLAIN MANAGEMENT IN THE UNITED STATES: AN ASSESSMENT REPORT

VOLUME 2: FULL REPORT

Prepared For The Federal Interagency Floodplain Management Task Force

LIQUEFACTION

Although less common than subsidence, liquefaction is another type of ground failure that contributes to flood problems. Liquefaction can result in serious flooding of structures built on fill or saturated soils, as in portions of San Francisco or Anchorage.

Liquefaction is triggered by earthquakes and occurs when seismic shock waves pass through unconsolidated and saturated soil, allowing the soil grains to move freely and pack more closely together. A soil structure with water in the pore spaces is transformed to groups of grains in a fluid matrix, and the load of the overlying soil and buildings is transferred from the soil grains to the pore water. If the pressure on the water causes it to drain away, the overlying soils and structures will sink or tilt. If the water cannot drain away, the water pressure rises. When the water pressure equals the downward pressure of the overlying strata and structures, the saturated soil layer will become liquid and flow. On steep slopes (greater than 3 percent) where the saturated layer is at or near the surface, soil, vegetation and debris can flow rapidly downslope with the liquified material. These flow failures can result in the movement of material for miles. On gentle slopes (0.3 to 3 percent) where the saturated layer is below the surface, failures termed lateral spread occur, with huge blocks of soil moving 10 to 100 feet or more (Federal Emergency Management Agency, 1987).

FLUCTUATING LAKE LEVELS

Water levels in U.S. lakes can fluctuate on a short-term (e.g., seasonal) or long-term (e.g., yearly) basis. Periods of heavy rainfall, for example, can cause high water levels for short periods of time and annual snowmelt can result in higher water levels in the spring. Long-term lake level fluctuations are a less-recognized phenomenon that can cause highwater and subsequent flooding problems lasting for years or even decades.

While all types of lakes may exhibit fluctuating water levels, water levels usually do not change dramatically in lakes where outlet streams provide a fairly regular balance of inflow and outflow. Some lakes, however, are completely landlocked or have outlets that are "inadequate" for maintaining a balance between inflow and outflow. These lakes, commonly referred to as "closed basin lakes," are particularly susceptible to dramatic fluctuations in water levels—five to 15 feet in some instances—over long periods of time. The Great Salt Lake in Utah and the Salton Sea in California are examples of landlocked lakes, and the Great Lakes are examples of lakes with inadequate outlets under extreme high water level conditions.

Long-term water level fluctuations are particularly pronounced on the Great Lakes and other lakes that were formed by glacial action. The significance of this problem is underscored by the fact that most of the lakes in the United States are glacial lakes. In the States of Alaska, Maine, Michigan, Minnesota, New York, North Dakota and Wisconsin alone, there are more than 100,000 inland lakes (Federal Emergency Management Agency, 1987).

The "playa" or drainage lakes in the West and Southwest have no outlets or only limited outlets and are also subject to long-term fluctuations in water levels. Sinkhole lakes in Florida and throughout the Southeast also exhibit the characteristics of closed basin lakes. Flooding can be a problem on the shorelines of oxbow lakes,[1] which are common in the floodplains of the Mississippi River, its tributaries and other southern rivers:

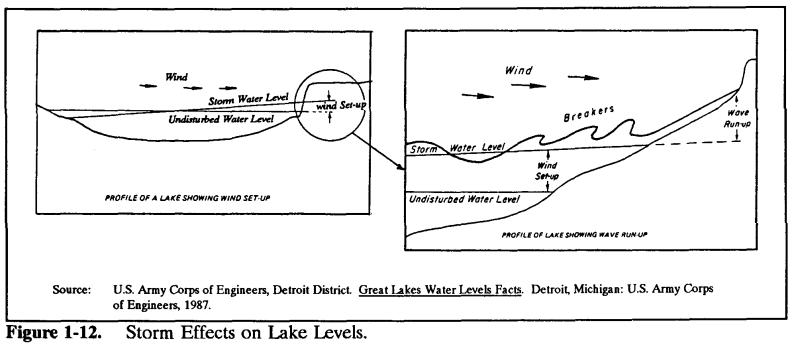
[1] Oxbow lakes are closed-off channel segments left behind when the main channel of a meandering river cuts through the land and creates a new channel.

Flooding caused by fluctuating lake levels presents a different set of problems than riverine flooding. Riverine flooding is typically of short duration, lasting for a period of hours or days. While relatively short-duration flooding can also occur on lakes, flooding associated with closed-basin lakes or lakes with inadequate outlet channels may persist for years.

TYPES AND CAUSES OF LAKE LEVEL FLUCTUATIONS

Lake level fluctuations can be caused by both natural and man-induced events. Natural factors influencing lake levels include precipitation, evaporation, upland runoff, ground water conditions, ice, aquatic growth, meteorological disturbances, and long term climatic trends. Man-induced factors influencing lake levels include dredging activities, diversions, consumptive water use, and regulation by structural works.

The most dramatic short-term changes in water levels are caused by strong winds and by sharp differences in barometric pressure. These fluctuations usually last less than a day and do not cause any changes in the total volume of lake water. The phenomena of surface tilt or wind set-up is illustrated on Figure 1–12.



Source: U.S. Army Corps of Engineers, Detroit District. Great Lakes Water Levels Facts. Detroit, Michigan: U.S. Army Corps of Engineers, 1987.

Figure 1-12. Storm Effects on Lake Levels.

Seasonal lake level fluctuations are associated with the hydrologic cycle. In the early spring, snowmelt, heavier rains and reduced evaporation over a drainage basin typically cause lake water levels to rise from winter lows. This trend continues until peak levels are reached in the summer. As the summer progresses, runoff and ground water flows reach their lowest values and steadier winds and drier air increase evaporation. As a result, water supplied to the lake becomes less than the outflow, and the water level begins a downward trend, reaching the lowest levels during winter.

Long-term fluctuations in lake levels result when water supply conditions in a drainage basin become persistently low or high. These conditions can be caused by such factors as long-term climatic changes. The intervals between periods of high and low water and the lengths of such periods vary widely and erratically, and extreme lake levels are likely to persist even after the factors that caused them have changed. Long-term fluctuations in lake levels are particularly significant in the Great Lakes Basin.

WATER LEVEL, FLUCTUATIONS IN THE GREAT LAKES SYSTEM

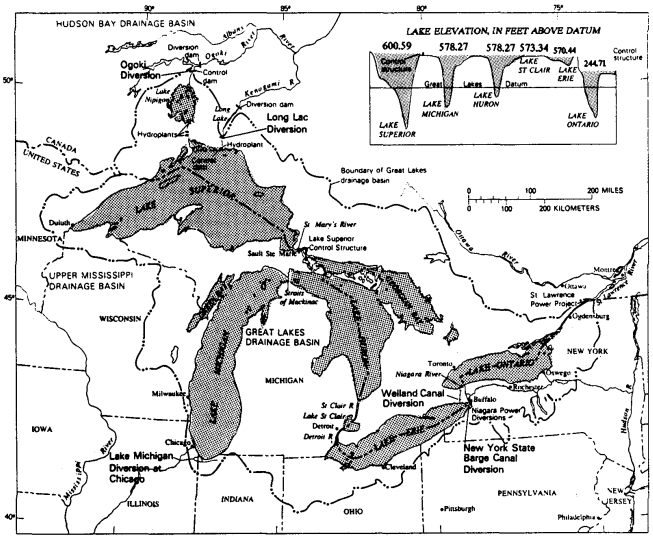
The five Great Lakes (Superior, Michigan, Huron, Erie and Ontario) and their connecting waterways (see Figure 1–13), make up the largest fresh water lake system in the world, with a total water surface area of 95,000 square miles (Great Lakes Commission, 1986). Despite the natural drainage through the lake system, the Great Lakes are considered a closed-basin system because of the lakes' limited outflow capacities relative to the size of the basin (Federal Emergency Management Agency, 1986).

Fluctuations in Great Lakes water levels have occurred continually since the modern Great Lakes were formed some five to six thousand years ago and after the last ice age ended some 10,000 years ago (Hough, 1968). Yearly fluctuations on the average account for changes of about 12 to 18 inches, with lows normally occurring in January or February and highs in June through September (Great Lakes Commission, 1986). Longer-term fluctuations in water levels have been measured at over six feet from record lows to record highs. Since modern lake level measurements began in 1860, the Great Lakes have experienced distinct periods of high and low water levels. High water periods have occurred in the late 1920's, mid-1940's, early

1950's, early 1970's and mid-1980's (Federal Emergency Management Agency, 1987). Table 1–5 shows surface elevation data for the Great Lakes in this century (U.S. Army Corps of Engineers, 1987).

The water level in each of the Great Lakes is dependent on the hydrologic water balance—the balance between the amount of water entering the lake (from precipitation, runoff, snowmelt, inflow from connecting channels, diversions of water into the lake basin and ground-water inflow) and the amount of water lost (through evaporation, ground-water outflow, consumptive uses, diversions out of the lakes and flow through surface outlets).

The large size of the Great Lakes and the limited discharge capacities of their outlets cause extremely high or low lake levels to persist for a long period of time. Much of the shoreline of the lakes is highly erodible, and shore erosion and flooding have caused significant damage, especially during high water periods. Shoreline property damages have increased with each high water period because of the increased development of unprotected shorelines, rising shorefront property values and record high water levels.



Note: Elevations are in feet and are referenced to International Great Lakes Datum 1955. Zero Great Lakes Datum ranges from about 0.7 foot to about 2 feet below sea level.

Source: United States Geological Survey, National Water Summary 1985 - Hydrologic Events and Surface Water Resources. Water Supply Paper 2300. Washington, D.C.: U.S. Geological Survey Printing Office, 1986.

Figure 1-13. The Great Lakes System Showing Lake Profiles and Average Monthly Water-Level Elevations, 1900-1984.

It is extremely difficult to forecast future water levels in the Great Lakes Basin. Any attempt to do so requires accurate information on the various natural and human-induced factors affecting water levels. Future long-term fluctuations will occur, likely generating both extreme high and low conditions. It is also likely that serious flooding and erosion problems will occur again along the shorelines of the Great Lakes in the future.

Recently, the National Oceanic and Atmospheric Administration (NOAA) has conducted research into the impacts of the greenhouse effect on Great Lakes levels. NOAA predicted that higher air temperatures from the greenhouse effect "would also lead to such events as a shortened snow season in the Great Lakes basin with reduced snow melt runoff; increased evaporation of lake waters..." and other impacts. The result is that water levels in the Great Lakes over the next 75 to 100 years may drop an average of 2 to 4.5 feet (Anonymous, 1988).

Table 1-5. Changes in Water Levels in the Great Lakes, 1900-1986.

LAKE	LAKE SURFACE ELEVATION IN FEET* MONTHLY MEAN 1900-1986			RANGE (winter low to summer high monthly means)		
	Average	Maximum	Minimum	Average	Maximum	Minimum
Superior	600.61	602.24	598.23	1.2	2.1	0.4
Michigan-Huron	578.33	581.62	575.35	1.2	2.1	.4
St. Clair	573.40	576.69	569.86	1.7	3.3	.4
Erie	570.50	573.70	567.49	1.6	2.8	.9
Ontario	244.73	248.06	241.45	2.0	3.6	.7

* Water levels are referenced to International Great Lakes Datum 1955.

Source: Adapted from U.S. Army Corps of Engineers, Detroit District. Great Lakes Water Levels Facts. Detroit, Michigan: U.S. Army Corps of Engineers, 1987 (Table 2, p. 14).

LAKE LEVEL FLUCTUATIONS IN OTHER AREAS

Other lakes that have exhibited dramatic fluctuations in water levels include the Great Salt Lake in Utah, Lake Pulaski in Minnesota, Lake Elsinore, and the Salton Sea in California, Lake Malhuer in Oregon, and Devils Lake in North Dakota. Flooding problems of the Great Salt Lake and Lake Pulaski are illustrative of flooding problems on these other lakes.

Great Salt Lake, Utah

The Great Salt Lake can be described as a "terminal lake" because it receives inflow but has no outlet. Historical accounts of lake levels have been well documented since the mid-1800's and fluctuations between elevation 4,191.35 and elevation 4,211.85 feet above mean sea level (msl) have been recorded. After 1963, when the lake fell to the record low, new development and infrastructure facilities were established on the exposed lake bed. By 1975, however, the lake level had risen to 4,202 feet above msl, and in the fall of 1982 it began to rise even further in response to a series of storms (Federal Emergency Management Agency, 1987).

Between September 1982 and June 1983, the lake rose 5.2 feet—the greatest seasonal rise ever recorded—increasing the lake's surface area by 171,000 acres (267 square miles). In April 1983 a Presidential disaster was declared following severe storms, landslides and lake flooding. Damage estimates for total losses at the end of 1983 were approaching $500 million (Federal Emergency Management Agency, 1986).

Fed by unprecedented precipitation, the lake continued to rise steadily, reaching an all-time recorded high of 4,211.85 feet above sea level in June, 1986. It had risen 11 feet in 4 years, and the State of Utah was faced with the imminent loss of Interstate 80, railroads, wastewater treatment plants, and possibly the Salt Lake International Airport if the lake level continued to rise a few more feet (Federal Emergency Management Agency, 1986).

As a result, a number of flood control options were thoroughly studied and evaluated, including: diversion of water from the Bear River into the Snake River Basin in Idaho; dredging, diking, and pumping water from the Bear River; and pumping water into the west desert. The West Desert Pumping Project evolved as the quickest action that could be taken to provide the greatest flood control benefit at the most reasonable cost.

The pumping project was completed and the three giant pumps (3,300 ces total capacity) began discharging water into the west desert in March 1987. Pumping, combined with two successive dry years, resulted in a lowering of the lake to an elevation of about 4,206.5 feet above mat by May of 1989. In July of 1989 the project was halted and the pumps "mothballed" (U.S. Water News, 1989).

Lake Pulaski, Minnesota

Lake Pulaski, located approximately 45 miles northwest of the Minneapolis-St. Paul metropolitan area, is landlocked with no outlet stream. Ground-water inflow feeds the lake but direct rainfall and runoff are the most significant contributors to elevated water levels and resulting flooding problems.

Following prolonged drought during the 1930's, the lake level remained low for an extended period of time and extensive lakeshore development took place, including year-round homes and seasonal cottages. Since the late 1960's, however, the water level has continued to rise steadily, inundating many exposed structures. Today much of the existing development surrounding the lake is at risk (Federal Emergency Management Agency, 1986).

SUMMARY AND CONCLUSIONS

Floodplains may be defined and identified in two basic ways—as natural geologic features or from a regulatory perspective. The one percent annual chance ("100-year") flood is the standard most commonly used for management and regulatory purposes in the United States. In part because of the different ways of defining and identifying floodplains, there is no definitive estimate of the total area of floodplains in the United States, or even of the area subject to a one percent annual chance flood. Existing estimates vary widely and cannot be readily compared because of differences in estimation techniques and definitions used.

Flooding concerns are not limited to the traditional riverine and coastal flooding situations. Also of concern are more unusual floods associated with alluvial fans, unstable channels, ice jams, mudflows and other types of ground failure, as well as fluctuating lake levels and areas "protected" by structural control works in both riverine and coastal areas. Flooding in areas outside delineated floodplains caused by inadequate surface drainage and high ground water levels is also of concern.

CLOSED-BASIN LAKE FLOODING: CASE STUDIES AND MITIGATION OPPORTUNITIES

(Presented at the Association of State Floodplain Managers, Western State High Risk Flood Areas Symposium, March 24–26, 1986)

PREFACE

Flood damages resulting from long-term fluctuations in lake levels had not been commonly encountered in Region VIII of the Federal Emergency Management Agency prior to the 1983 and 1984 disaster declarations in Utah. In addition to Utah, the Region VIII states include Colorado, Montana, North and South Dakota, and Wyoming. This report was initiated to better understand the problem in order to identify possible solutions for the Great Salt Lake. Mr. Randy Hamilton was the primary researcher, assisted by other Hazard Mitigation Section staff. During the report's preparation, it became clear that the problem is more costly, widespread, and complex than originally anticipated. Therefore, the report concludes with recommendations for continued research into the causes, effects and management of flooding on closed-basin lakes.

Much of the information obtained during the research was gathered through telephone conversations and written correspondence with representatives of Federal, State, regional, and local entities who have been involved with closed-basin lake problems. Other information was obtained from existing documents, although little research has been done on this hazard.

More detailed treatment of many of the issues addressed in this report is provided in the references included as a part of the report. Comments and questions can be addressed to FEMA at the address given on the cover page or by calling the Hazard Mitigation Program Section at (303) 235–4900.

EXECUTIVE SUMMARY

The 1983 and 1984 disaster declarations in Utah introduced FEMA Region VIII to closed-basin lake problems. The Great Salt Lake has no outlet. This characteristic makes it subject to long-term fluctuations in lake levels. Surface elevations have varied over 20 feet since 1873. In the flat terrain immediately west of the Wasatch Range, these fluctuations alternately expose or inundate hundreds or even thousands of acres of lake bed. During low stages since the 1940's, development encroached into the bed because it appeared that the lake was "drying up." Since 1963, however, the lake has risen as much as 18 feet, engulfing homes, businesses, highways and rail lines, parks, game refuges, and countless other development. Damages have exceeded $200 million.

This situation is characteristic of problems around closed-basin lakes across the Nation. The hazard that they represent and the mitigation programs needed are fundamentally different from those of typical inland flooding situations on streams and on lakes with adequate outlets.

In the summer of 1985, FEMA Region VIII began an investigation of the causes, effects, and mitigation approaches to closed-basin lake problems. The best known and documented cases were selected for analysis. Much was learned, but much remains unknown. Lake flooding is widespread—not a problem unique to the West. Without a concerted management effort, losses attributable to it will likely exceed $1 billion by the year 2000. Most importantly, successful mitigation programs have been developed and they appear to be transferable. Recommendations are made for follow-up through a joint effort of FEMA Region VIII with the Association of State Floodplain Managers. The recommendations involve (1) continuing research into the most effective ways to identify the lake-rise hazard and mitigate its effects, especially as the lake is rising, but before serious damages occur; (2) determining the relationship between long-term climatic variations and lake-rises; (3) selecting additional case studies for analysis; and (4) assisting local decisionmakers in addressing lake-rise issues. This report is receiving wide distribution to decisionmakers and technicians involved with closed-basin lake problems.

PART I: BACKGROUND

A. Introduction

In an issue paper prepared for the Federal Emergency Management Agency (FEMA) by the Association of State Floodplain Managers (ASFPM), it is stated that:

Lake level fluctuations are a source of concern both for shoreline property owners and for local, State and Federal Governments with regulatory or financial interests in water and related land use. Lakes are usually considered to be amenities—providing recreation, water supply and hydropower. Development of the shoreline has frequently occurred without recognition of the fact that water levels can and do vary over time. It is generally recognized that lake levels can fluctuate daily or seasonally with inflow, but what often is not recognized is that lake levels also exhibit more extended trends—of years or even decades—associated with long-term climatic changes (Bloomgren and Kusler, 1984).

It is these extended trends in lake level fluctuations, and the problems which they cause, that comprise the primary focus of this research. An additional focus is on the management, utilization, and development of hazard prone areas located along the perimeter of these lakes and within the limits of fluctuation.

FEMA Region VIII, located in Denver, became interested in researching this problem further after its involvement with the 1983 and 1984 disasters in Utah where flooding from the rising level of the Great Salt Lake has resulted in hundreds of millions of dollars in damages. The Region's goal in this research is to identify successful mitigation strategies through analysis of case studies for application in Utah and other States that are subject to this hazard. This report is receiving wide distribution in order to share its findings.

B. Problem Definition

Most lakes have outlet streams that provide for a fairly regular balance of inflow and outflow, thereby regulating the lake surface and preventing drastic fluctuations. They have seasonal variations in response to the annual hydrologic cycle, i.e., higher levels in the spring and summer, followed by lower levels in the fall and winter, as well as shorter-term variations, typically during summer in response to heavy rainfall. In general, however, the outlet can accommodate inflow in the form of direct precipitation on the surface, flow from surface streams, and subsurface groundwater sources, as well as overland flow or runoff. This provides a fair degree of regularity for surface levels.

The lakes that are the subject of this report either have no outlets (completely land-locked lakes such as the Great Salt Lake or the Salton Sea) or inadequate ones, such as the Great Lakes. Lakes having inadequate or no outlets have only evaporation to regulate their surface levels, while others have low capacity outlets or groundwater seepage to assist in regulation. Throughout this report, these lakes are referred to as closed-basin lakes.

The lack of an adequate outlet leaves these lakes susceptible to drastic fluctuations in lake levels which can occur over a matter of days, or more commonly, over a period of years. During dry periods, lake levels can retreat scores of feet, yards or even miles over periods of 10, 20 or more years, giving the appearance that the lake is "drying up." This trend invites those unfamiliar with the history of the lake to begin developing closer and closer to the retreating shoreline—actually within the lake bed itself. When the lake begins to reclaim its bed, flood damages occur and water quality is impaired by the inundation of sewage and septic systems.

C. Magnitude of the Problem

Because of aesthetic values and recreational amenities, shoreline areas have routinely been developed, especially around lakes near population centers and major transportation routes. In Minnesota, for example, between 1967 and 1982, lakeshore homes increased 75 percent, year round lakeshore use increased 100 percent, and seasonal lakeshore use increased 63 percent (ibid., p. 9–3). Unfortunately, in most States, this development has occurred largely without recognition of the flood hazard.

The exact number of lakes with shoreline development subject to damages resulting from fluctuations in water levels is unknown. Since there are over 150,000 sizable lakes in the country, even with only a small percentage of them subject to this hazard, the problem is very significant. Most of the inland lakes in the United States were formed by glacial action; in the States of Maine, New York, Michigan, Wisconsin, Minnesota, North Dakota, and Alaska, there are more than 100,000 inland lakes. Oxbow lakes, depressions left behind when the main channel of a meandering river moves to a new position, are common in the floodplains of the Mississippi River and many other rivers (ibid., p. 9–1). Many of these lakes have been the site of damaging floods caused by long-term fluctuations.

The magnitude of the property damages in the United States due to floods resulting from fluctuations in lake levels has exceeded a quarter billion dollars in the past 5 years alone. Lakeshore industries, rail lines, highways, residential, commercial and agricultural property, wildlife refuges, and recreation facilities have been damaged or destroyed as a result of rising lake levels encroaching upon developed land. Economic data suggest that lake-rise flooding is a significant hazard in the United States. Between 1983 and January 1985, damages resulting from flooding around Malheur Lake, Oregon, had reached $13.5 million. Around the Great Salt Lake, damages have exceeded $200 million since 1983.

D. Hazard Identification

The key to developing an effective hazard mitigation program for closed-basin lakes lies in the identification of the hazard area within which to initiate programs for regulation, acquisition, relocation, structural protection or other forms of mitigation. The process of defining this area is more difficult for closed-basin lakes than for other water bodies. This is because closed-basin lakes do not exhibit the random inflow/outflow regime common to most lakes and streams, which allows peak annual discharges to be analyzed with some reliability statistically, and then hydraulically (Harnack, 1986).

Analysis of the case studies found four hazard identification approaches being used on closed-basin lakes: (1) stage-frequency analysis; (2) topographical analysis; (3) high water mark determinations; and (4) water balance-statistical analysis. The strengths and weaknesses of these techniques are discussed in Part III of this report. Each of these techniques may be used to identify a lake level above which the risk of flood damages is considered to be acceptable for development. Below this level, development needs to be made subject to structural or nonstructural mitigation techniques or some combination of each.

Stage-frequency analyses have been used on a number of occasions (see the Lake Elsinore and Salton Sea case studies). The topographical approach involves analysis of the land adjacent to the shore to identify a natural feature that can be used to define the hazard area. Overflow points into adjoining drainages, steep benches or other such features are the focus of investigation (see the Great Salt Lake case study). Where no topographical features can be used to define an upper limit for the hazard area, determination of a high water mark is an alternative. Another alternative may be to perform a water balance-statistical analysis which involves modelling lake inputs and outputs to estimate a level for use in mitigation.

E. Hazard Mitigation

Once a hazard area has been identified on a closed-basin lake, there is a wide range of structural and nonstructural techniques available for application. Attachment B describes several regulatory techniques for new construction, acquisition, and relocation for existing structures, as well as structural techniques such as outlet modifications (see the Malheur Lake case study) and levees (see the Devils Lake case study).

Structural techniques tend to be expensive for lake problems because of their scale. Pumping is another technique that can be used, but its effectiveness is also constrained by lake size.

F. Policy and Program Elements for Mitigating Lake Flooding

Lake rise flooding presents decisionmakers with a fundamentally different set of issues than those of typical inland flooding situations. Therefore, standard mitigation policies and programs need to be tailored to address this unique hazard. In their soon to be published analysis of high-risk flood hazard areas, Bloomgren and Kusler identify the following policy and program elements for structuring a local mitigation program for lake rise situations. Where there is potential for lake flooding problems, a policy and program with the following elements may be appropriate:

1. A policy statement or resolution that long-term fluctuations in water levels may result in flood damages quite different from those caused by riverine flooding.
2. A ban on roads, water, and sewer extensions to areas subject to long-term inundation.
3. A set of regulations that prohibit building in semi-permanently flooded areas. If building is to take place, it should occur only on fill with adequate access, water supply, and waste treatment ensured during times of high water, and not within wetland areas.
4. A strategy for relocating or protecting structures in areas subject to long-term fluctuations.
5. A formal agreement that ensures intergovernmental coordination and cooperation if the lake extends across the boundaries of more than one unit of government. The exact form of the agreement will vary with different State laws. Examples of cooperative arrangements include joint powers agreements, lake management districts, and watershed districts. The management plan for Lake Pulaski, Minnesota, in Attachment C, contains a comprehensive policy statement.

G. Case Study Selection and Format

At the time the case studies were selected, the true extent of closed-basin lake problems on a nationwide basis was not fully realized. During the preparation of this report, and from comments received during the review of early drafts, it became apparent that numerous other case study sites are available for analysis and may offer additional insights into the causes, effects, and management of floods resulting from long-term fluctuations in lake levels (see Recommendation 2 in the Summary and Recommendation Section). The Great Lakes system, alone, warrants its own detailed analysis, as may be the case for the dozens of sinkhole lakes in Florida and throughout the southeast United States. Both the Great Lakes and the sinkhole lakes exhibit the characteristics of closed-basin lakes.

For each of the case studies presented in the following pages, three issues provided the basis for analysis: (1) what hazard identification techniques were used; (2) what hazard mitigation techniques were used; and (3) how successful and transferable were these techniques?

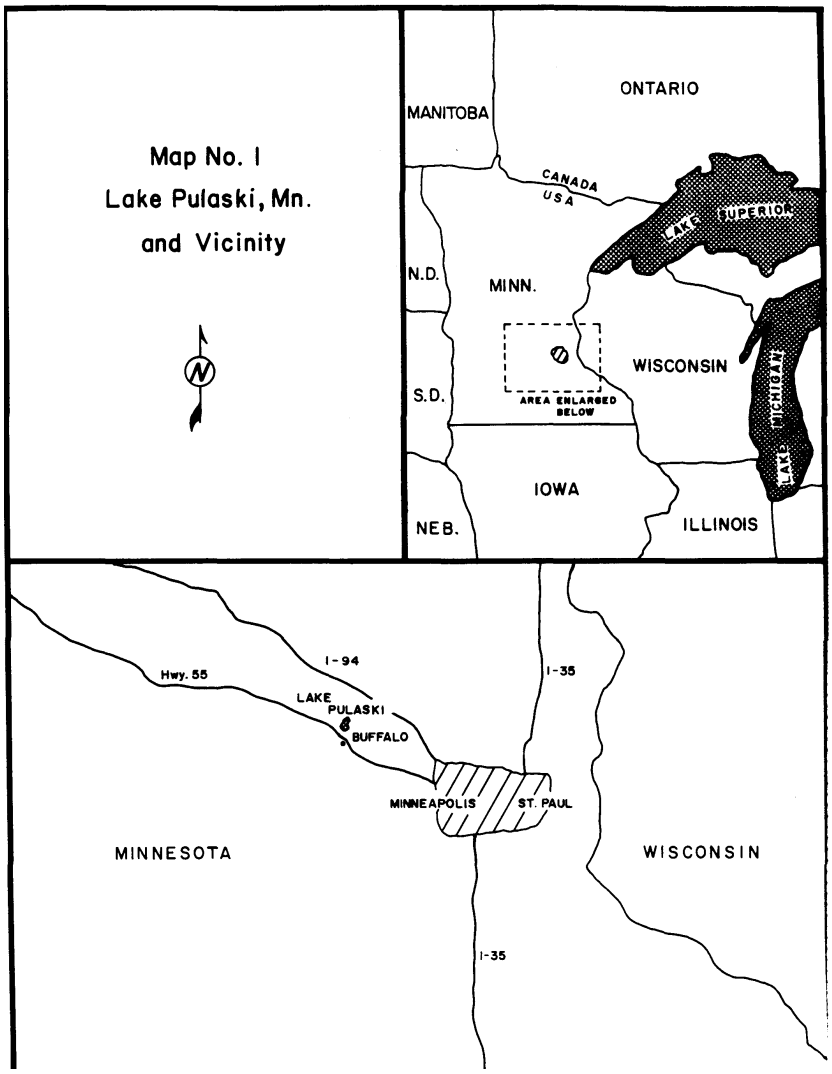
PART II: CASE STUDIES

A. Lake Pulaski, Minnesota

Lake Pulaski is located approximately 45 miles northwest of the Minneapolis-St. Paul metropolitan area. The lake is situated between the City of Buffalo on the south and Buffalo Township on the north. The lake is landlocked with no outlet stream. Although groundwater inflow feeds the lake, direct rainfall and runoff are the most important contributors to the lake flooding problem.

After the prolonged drought of the 1930's, the water level in the lake remained low for several years. During the 1940's, 1950's, and 1960s, much development took place while water levels remained relatively low, and now the shoreline is nearly fully developed with year-round homes and seasonal cottages. Since the late 1960's, the surface elevation has continued to rise steadily (ibid., pp. 2–3 and inclusion 2).

Some of the development has taken place in areas now defined as natural lake bed by the State of Minnesota's high water mark determination, termed the Natural Ordinary High Water Level (NOHWL) (ibid., p. 3). In Minnesota, the NOHWL is defined as the highest level that has persisted for a long enough period of time to leave physical evidence, e.g., vegetation (see Attachment A). In December of 1981, the NOHWL was established at 968.8 feet above mean sea level (amsl). All land adjacent to the lake below this level is now considered lake bed and is subject to direct regulation by the State Department of Natural Resources (DNR) (Bloomgren and Kusler, 1984). A March 1985 public hearing was held in order to discuss public concerns about the accuracy of the NOHWL. From that hearing came a recommendation by the Hearing Examiner that the NOHWL be lowered to 967.5 feet. This lower level is now considered to be the upper limit of the lake bed, below which all new development is prohibited. In addition, all new construction between 967.5 and 971 feet amsl must be elevated to or above 971 feet amsl.



The Lake Pulaski case is unique in that major decisions on all phases of flood damage reduction and water quality protection are being made jointly by Federal, State, and local agencies. This includes decisions on regulatory measures, property relocation, and structural solutions, as well as future studies. Joint policies and initiatives adopted to date include the following:

1. Existing structures on the lake bed may remain until water levels make their continued use or presence a threat to public health or safety.
2. Existing structures may be repaired and maintained, provided their dimensions are not changed and their longevity is not increased.
3. New structures cannot be placed in the lake bed.
4. New on-site sewage systems are prohibited in the lake bed, but temporary holding tanks may be allowed upon receipt of a permit from the county.
5. The city has agreed not to extend any city sewer lines to any structures located in the lake bed.
6. Placing fill in the lake bed will be strictly regulated. DNR permits for limited filling will be issued only to raise roads in the lake bed in order to provide for evacu-

ation and limited filling may be allowed in order to raise portions of lots that are partially out of the lake bed.

7. When water levels recede, those lots that had to be abandoned can only be used for open space.

8. Only temporary sandbags may be used by those who wish to fight the rising waters. Fill or retaining walls are prohibited.

9. Natural rock may be used to prevent erosion of the shoreline at the present water level under a general permit authority of the DNR. However, rock may not be used as fill and it must follow the natural shoreline alignment.

In mid-1984, approximately 100 structures had been built on land at elevations below the NOHWL, and approximately 170 additional structures were potentially exposed to damages as the lake continued to rise. The NOHWL determination presented an opportunity for Federal, State, and local governments to prepare for lake rise flooding before it became severe. In anticipation of continued rise, three main funding sources were investigated for the relocation of these structures. The first was the "preventative measures" clause in the standard flood insurance policy of the National Flood Insurance Program (NFIP). FEMA informed the State that relocation expenses cannot be provided under the standard flood insurance policy. (In a recent U.S. District Court Case, John E. Tankard, Sr., vs. FEMA, relocation expenses paid in anticipation of flooding were supported by the Court. The affect of this decision on FEMA policy is yet to be determined.) Second, local governments applied for a Small Cities Block Grant from the Department of Housing and Urban Development (HUD). The goal was to establish a revolving, low-interest loan program as a source of relocation funds. The application did not meet HUD's approval criteria. Third, the State investigated the use of Section 1362 funds from FEMA. This program provides funding for acquisition, but it is designed to apply after a property has incurred repetitive flood damages. Therefore, Section 1362 funds cannot be used in situations where damages are anticipated, but have yet to occur, even if damage appears inevitable.

Many of the 170 exposed structures were eventually inundated by rising lake waters. According to State officials, this loss was reasonably certain. Had any of the three potential funding sources for relocation proved to be more flexible, some or all of these structures could have been relocated before they were damaged. The cost of relocation has been estimated by the State to be 20–30 percent of the eventual outlays for flood insurance, tax refunds, and other costs.

In the fall of 1983, a Section 205 Small Projects Program application was made to the U.S. Army Corps of Engineers (USAGE) and a feasibility analysis was completed in 1985. The USACE has recommended a pumped pipeline outlet to stabilize the lake level. State staff have observed that the structural planning process is lengthy and numerous issues that extend beyond the area where lake flooding impacts are being experienced need to be resolved, including: (1) impacts on downstream property owners from increased flows, and (2) impacts on upland riparian landowners who would benefit when increasing lake levels give them access to the lake (Harnack, 1986).

State staff who have been involved in the Lake Pulaski program are currently performing an analysis of 20 other lakes in the State using a grant from FEMA. The purpose of the analysis is to:

1. Identify the source and potential magnitude of the water level fluctuations.

2. Define the physical setting and characteristics of each lake.

3. Inventory the potential environmental, social, and economic losses which would result from rising lake levels.

4. Identify alternatives available to local governments for mitigating potential losses.

The following points summarize the Lake Pulaski case study:

1. A high water mark determination was used as an interim means to identify the lake's flood hazard area. A FEMA flood insurance study was used to determine a final floodplain elevation.

2. Federal, State, and local agencies are working together to manage the flood problem.

3. A wide range of mitigation strategies is being applied covering all types of development, water quality protection, and flood damage reduction.

State staff observe that: (1) structural solutions to lake rise problems can take a long time to analyze and can have significant and wide-ranging impacts, and (2) programs are needed for acquisition and relocation that can be implemented before inevitable flood damages occur.

5. The USACE is proposing a lake stabilization outlet, which could be completed in the near future.

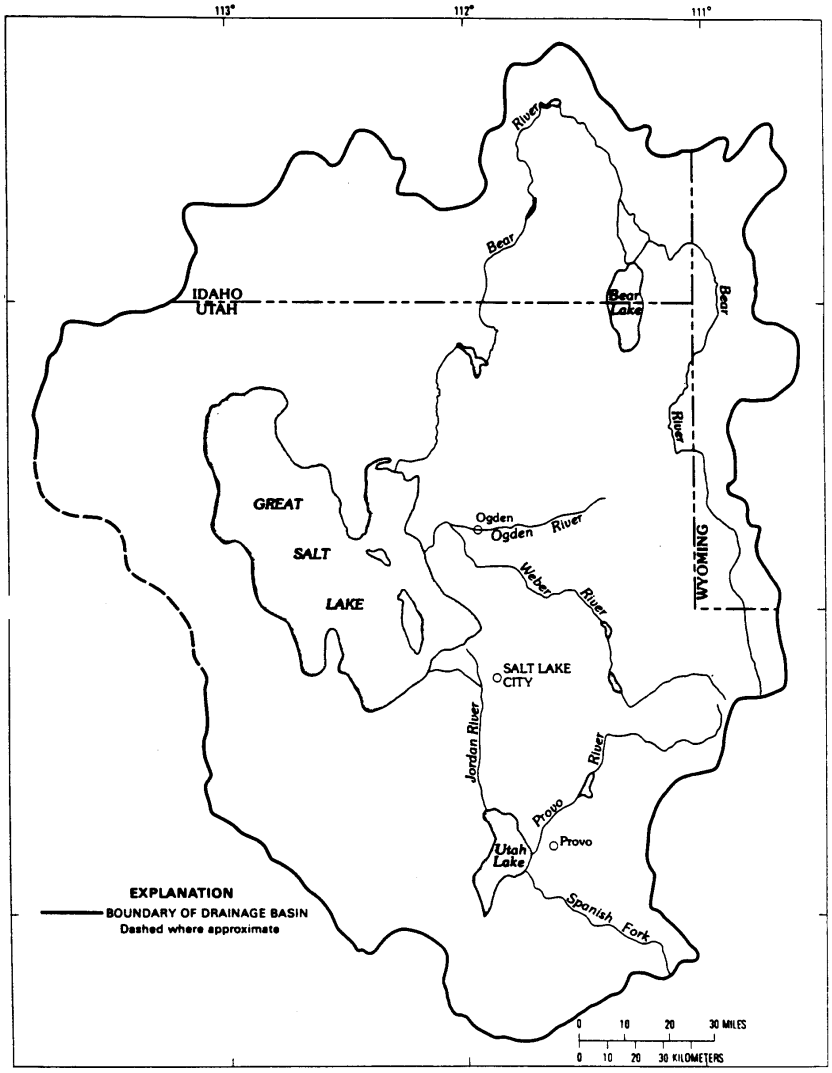
B. Great Salt Lake, Utah

In 1963, the Great Salt Lake fell to a historic low level of 4,191.35 feet amsl. Many people thought that the lake would eventually dry up and therefore, roads, railroads, wildlife management areas, recreation facilities, and industrial facilities were established on the exposed lake bed. By 1976 the lake level had risen to 4,202 feet amsl. Concern arose and studies were conducted to determine the feasibility of pumping water into the desert to the west of the lake. During 1977, the lake again began to decline and concern abated. In September 1982, the lake began to rise as a result of a series of storms. Record-setting rainfall was accompanied by cool weather and cloud cover which impeded evaporation. During the winter of 1982–83, snowfall was greatly above average. The weather remained unseasonably cool through the spring of 1983, but major snowbelt began with a heat wave on Memorial Day weekend. On April 30, 1983, the President declared a major disaster following a landslide at Thistle, Utah due to severe storms, landslides, and lake flooding. After the Memorial Day weekend heat wave, several additional areas of the State were included in the declaration.

Flows from the Jordan, Bear, and Weber rivers peaked on June 1, 2, and 3, 1983, and the lake level rose until June 30 when it peaked at 4,205. Between September 18, 1982 and June 30, 1983, the lake had risen 5.2 feet, the greatest seasonal rise ever recorded. The increase in the lake's surface area was 171,000 acres (267 square miles). The direct and indirect capital damages and the costs of work to protect lakeshore facilities as the lake rose to 4,204.75 were estimated by the Utah Division of State Lands and Forestry at $157 million (Arrow, 1984).

In the spring of 1984, precipitation and snowpack were above average again, and the potential for further flooding had not decreased substantially since the summer of 1983. The Great Salt Lake experienced its shortest evaporation period and subsequent recession in recorded history during 1983. On August 17, 1984, the President declared another major disaster due to severe storms, flooding, mudslides, and landslides.

Various solutions for lowering the lake level have been proposed. Pumping water from the Great Salt Lake into the desert west of the lake was considered in 1976, 1983, and again by the legislature in 1985. Construction of such a project would take 15–18 months and cost up to $75 million. Annual operating costs would be $4 million. The pumping project would maintain the lake elevation below 4,212 feet. During the first year of operation, it is estimated that the project would lower the lake by 16 inches. Because of questions raised about the economic feasibility of this project, other alternatives are being considered.



Map No. 2

—Drainage basin of Great Salt Lake (adapted from Hahl and Langford, 1964, fig. 2).

(Source: Arnow, 1984)

In 1983, a proposal was made to breach the Southern Pacific Railroad causeway in order to lower the elevation of the south arm of the lake which was three feet higher than the north arm. The proposal was rejected in 1983 but later approved when the elevation of the south arm reached four feet higher than the north. The causeway breach was completed in August of 1984 at a cost of $3.1 million. This action lowered the south arm by nine to ten inches. The legislature is also considering diking projects to protect critical facilities around the lake. Other proposed structural solutions have been determined not to be cost effective or are only considered as very long-term mitigation measures.

In 1983 and 1984, FEMA provided disaster assistance for damages caused by the rise of the Great Salt Lake. Emergency Federal assistance was also provided by the USACE and the Federal Highway Administration for diking, dredging, and elevation of highways. In 1985, the lake continued its rise and it became apparent that this was due to long-term climate variability. This continuous period of lake flooding losses has allowed sufficient time for the State to develop and implement mitigation strategies. As the authorities of these Federal agencies are limited to the delivery of emergency or disaster assistance only, it was determined that no further funding could be provided for this problem. As a result, FEMA and the other Federal agencies have encouraged the State and local governments to take appropriate mitigation measures as there can be no assurance that they will receive future disaster assistance for damages associated with lake fluctuations.

Federal agency compliance with Executive Order 11988, Floodplain Management, also contributed to the development of a Federal position on both future disaster assistance outlays and non-disaster assistance for acquisition and construction purposes in the flood hazard area of the Great Salt Lake. This Order, which applies in identified flood hazard areas, prohibits Federal financial support of development unless there is no practicable alternative. The Great Salt Lake flood hazard area was identified as the lake bed below elevation 4,217 feet by several independent groups. These included the Federal Interagency Hazard Mitigation Team which analyzed mitigation options following the 1984 Presidential disaster declaration; Utah's Comprehensive Emergency Management Division staff which issued the State's 1985 Hazard Mitigation Plan; a technical team headed by the Utah Department of Natural Resources, and an interdisciplinary group of experts that met in a conference in Salt Lake City in March of 1985.

Largely in response to the Federal position on future disaster assistance payments for lake rise losses, the State of Utah developed a nonstructural strategy for the development of land subject to lake rise flooding. This strategy addresses development between the shoreline and elevation 4,217 feet. It has been determined that elevation 4,217 should be used for planning purposes as the best available estimate of a maximum lake level. At this elevation (which includes wind, tides, and wave heights), the lake would naturally overflow into the west desert. The lake has reached this level at least twice in the last 500 years and there is the possibility that it may be reached again in the foreseeable future. The State refers to the land between the shoreline and 4,217 feet as the Beneficial Development Area (BOA). As the lake continues to rise, an Intergovernmental Great Salt Lake Beneficial Development Council (IBDC), composed of State and local governments, will be organized to develop planning objectives. The State has held an initial meeting with lake counties and proposes to hold future meetings with State agencies and County Commissioners to discuss representation on the IBDC, its authorities, and planning objectives for the BOA.

The following points summarize the Great Salt Lake case study:

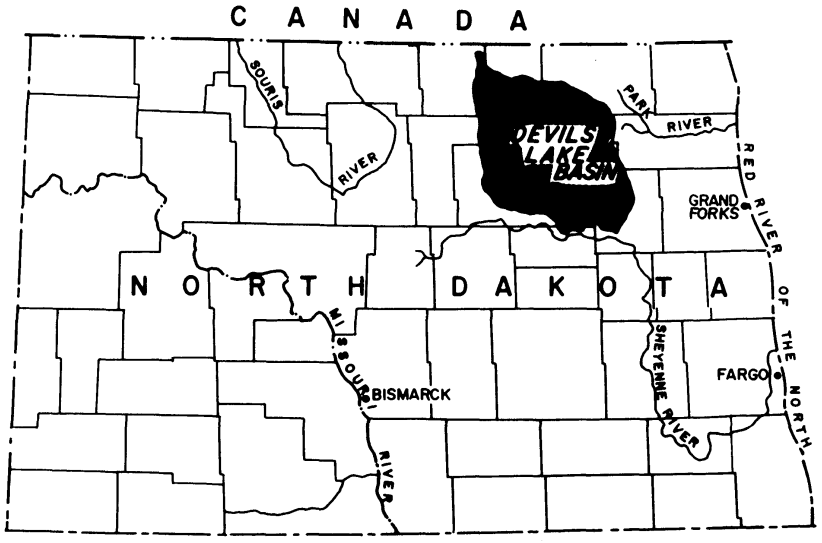
1. The hazard area was defined based on a topographical analysis that identified an overflow point.
2. A mix of structural and nonstructural techniques have been used, and are being further analyzed, but the greatest long-term potential for achieving mitigation appears to lie in a management approach based on the Beneficial Development Area.
3. Flood losses on the Great Salt Lake significantly exceed those from all of the other case studies.
4. Further Federal disaster assistance outlays for lake rise flooding and future non-disaster assistance for acquisition and construction purposes on the shores of the Great Salt Lake may not be available.

C. Devils Lake, North Dakota

Devils Lake is located in the northeastern quarter of North Dakota. Since the 1940's, when Devils Lake was almost dry, it has risen approximately 27 feet. It peaked in 1983 at 1428.3 feet amsl, the highest level in about 100 years. Geological investigations have shown that the lake has been dry several times since glaciation and may have been as high as its natural outlet elevation of 1457 feet on two or three occasions. Since 1983, the level has declined slightly, but Federal, State, and local interests initiated both short- and long-term solutions in the early 1980s as levels increased dramatically.

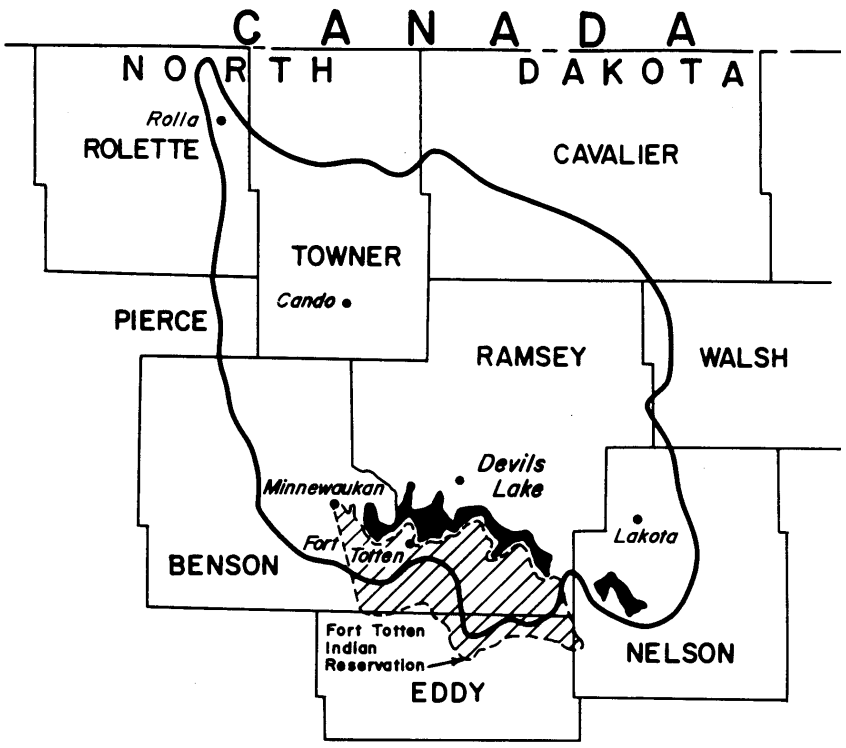
The major loss exposure in the area is concentrated at the City of Devils Lake. Additional development is scattered along the lakeshore areas of several townships in Ramsey County. Before the natural outlet is reached, extensive residential and commercial development would be inundated, as well as highways, rail lines, and

other infrastructure. If the lake level were to reach the natural outlet, potential damages are estimated to exceed $200 million.



DEVILS LAKE, NORTH DAKOTA
Map No. 3

(SOURCE: US ARMY CORPS OF ENGINEERS)



DEVILS LAKE BASIN

MAP No. 4

(SOURCE: US ARMY CORPS OF ENGINEERS)

Several short-term structural mitigation projects were considered in the early 1980s. A levee system for the City of Devils Lake was selected as the most favorable option. The USACE has recently completed the project, which provides protection to the city up to 1440 feet. This was considered to be the optimal level of protection for a short-term project. The USACE is now performing preliminary investigations of long-term options. Most of these are variations on constructing an outlet to the Sheyenne River. Other options include outlets to other water bodies, upstream storage, increases in levee height, and relocation. The final investigations should be concluded in 1987.

With the levee in place and lake levels declining, an additional element in the overall mitigation program, regulation through floodplain zoning, remains to be implemented. Several communities are encouraging the habitable portions of new buildings be raised above the 1440 level, but formal regulations do not appear to be in place at this time. Since most existing development is located behind the new levee system, approximately 80–9OX of the loss exposure up to the 1440 level will be protected when the lake again begins to rise.

The following points summarize the Devils Lake case study:

1. The hazard area was defined using the topographical approach combined with analysis of sediments, vegetation, and old beach lines.

2. Major flood damages have yet to occur and mitigation activities were initiated in anticipation of losses to existing development.

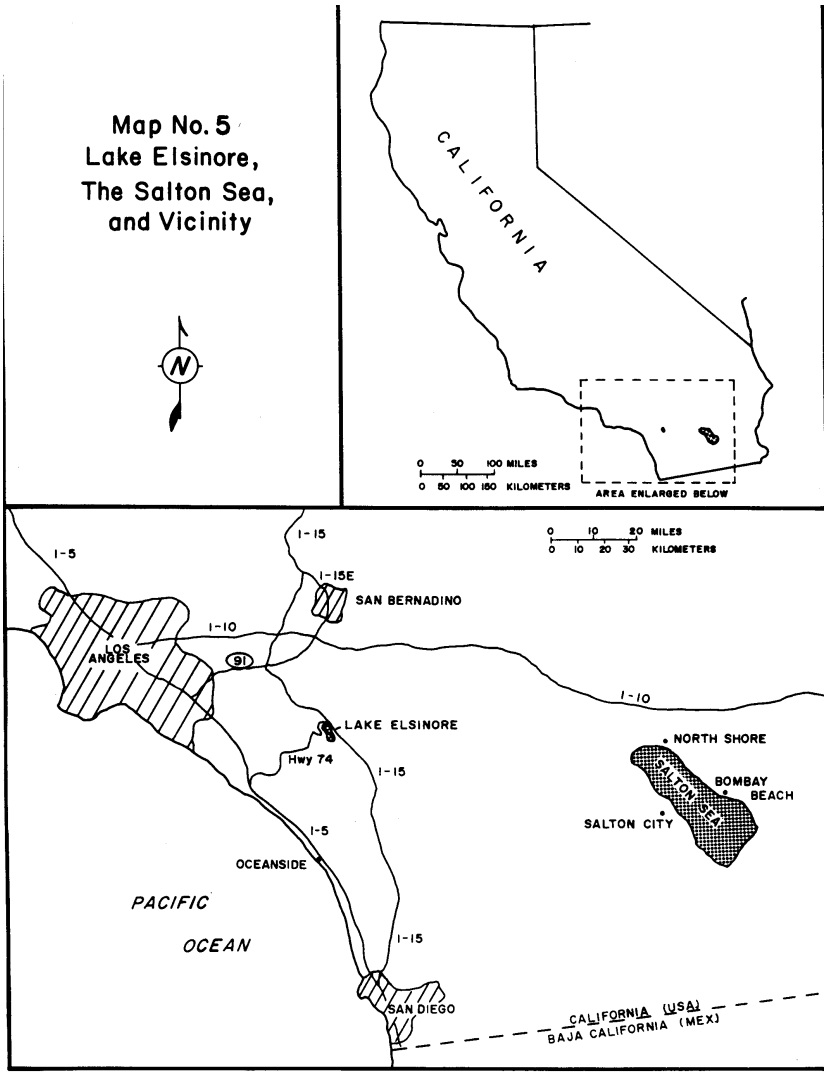
3. A short-term solution is in place—a levee system to protect the most highly exposed development.

4. Long-term solutions are currently being investigated with the focus on structural solutions involving construction of an outlet.

5. Despite significant expenditures on structural works, the regulatory provisions that were intended to supplement them have yet to be implemented.

D. Lake Elsinore, California

Lake Elsinore is located in southern California between Los Angeles and San Diego near Interstate 15. The City of Lake Elsinore lies along the north side of the lake. In January and February of 1980, heavy rains fell on the San Jacinto River Basin. Between February 13 and March 21, 1980, Lake Elsinore rose approximately 20 feet to 1265.72 feet amsl. Nearly 450 structures were damaged, and all crops in the area were a total loss.



"Approximately 450 structures were damaged by flooding, of which about 300 were damaged as a result of the rising lake. In addition, approximately 100 septic tanks, serving undamaged structures, were flooded, and became unusable. Thus, a total of 400 buildings were rendered uninhabitable due to the flooding of the lake" (Doty, 1980).

Records indicate that Lake Elsinore's surface elevation has reached 1265 feet seven times during the 200 years prior to 1980. Outflow begins when the surface level rises high enough to reach a natural spillway. Siltation in this natural spillway had raised the outflow level to 1268 feet amsl by February of 1980. During floodlighting operations, the USACE restored the outlet channel to an elevation of 1260 feet amsl (ibid., p. 2). Subsequently, an elevation of 1260 feet amsl, plus five feet of freeboard to raise it to 1265 feet amsl, was used to define the regulatory flood hazard area.

At the time of the flooding, both local government jurisdictions surrounding the lake, the City of Lake Elsinore and unincorporated Riverside County, were in the emergency phase of the National Flood Insurance Program (NFIP). Riverside County entered the regular phase on April 15, 1980 and Lake Elsinore entered on September 17, 1980. On May 21, 1980, the Lake Elsinore City Council adopted an ordinance that exceeds the requirements of the regular phase of the NFIP by prohibiting structural improvement of existing residential buildings if located on land below elevation 1265.

No residential construction is now permitted in the Lake Elsinore floodplain below 1265 feet amsl, commercial buildings must be elevated or floodproofed, and any buildings which incur structural damage may not be rebuilt or replaced. To date, enforcement of the new regulations has been excellent (Doty, 1985).

After the 1980 flooding, 39 structures were acquired with Section 1362 funds. These buildings, as well as approximately 50 others, were then demolished and the land was designated as open space by the City of Lake Elsinore.

Several structural mitigation alternatives have been investigated to provide a long-term solution to fluctuations on Lake Elsinore. The outcome is that the Bureau of Reclamation has approved a $26 million loan under Public Law 84–984 to the Elsinore Valley Municipal Water District to construct a lake stabilization project. The project will provide water for agricultural uses, flood control, and recreation. It will involve constructing a levee, relocating the inflow channel, excavating the outflow channel, constructing an outlet pump station and diversion structure for agricultural water, rehabilitating or constructing wells to replenish lake water, and constructing a pier, new bridges and crossings and parks. The project is designed to maintain the lake at a minimum elevation of 1235 feet amsl to ensure an adequate water supply for agricultural purposes (Doty, 1985). The outlet modification described above results in an anticipated maximum level of 1260 feet amsl.

Several insurance companies filed a lawsuit against various defendants including the City of Lake Elsinore, the Riverside County Park and Recreation District, the County Flood Control District, the Temescal Water Company, the Elsinore Valley Municipal Water District, and the State. FEMA has joined the lawsuit as a party plaintiff. It is alleged that the defendants negligently maintained and inspected Lake Elsinore, the inflow and outflow channels, and the adjacent property, therefore causing the flooding during 1980. The suit is based on a 1927 agreement that the city was to maintain the lake to prevent flooding.

The following points summarize the Lake Elsinore case study:

1. FEMA identified the flood hazard area based on a USACE study (stage/frequency analysis).
2. The typical NFIP regulations have been modified by the city to include a prohibition of any new residential construction within the hazard area and the reconstruction or replacement of any damaged structure.
3. FEMA Section 1362 funds were used to acquire damaged properties following a disaster declaration.

E. Salton Sea, California

The Salton Sea is located in southern California about 50 miles north of the Mexican border. It has experienced rising lake levels resulting from increased precipitation and agricultural runoff. The communities of North Shore, Bombay Beach, and Salton City were all affected, and as the water continues to rise, buildings have been abandoned and/or demolished. The Federal Insurance Administration (FIA) has established a base flood elevation, and local agencies have adopted regulations prohibiting rebuilding below that level (Doty, 1985).

Of special interest in this case is a lawsuit, Salton Bay Marina v. Imperial Irrigation District which was filed subsequent to the flooding of the early 1980s. Imperial County had permitted development to take place around the Salton Sea, but it re-

quired property owners to absolve the county and the Imperial Irrigation District (IID) from liability for the sea's rising. (The IID is responsible for controlling the level of the sea.) Salton Bay Marina argued that, by forcing landowners to take flood easements and then flooding their lands, the IID was actually exercising eminent domain over their property without just compensation. The IID argued that it had to be absolved from liability to succeed economically, and that the landowners freely and willingly entered into the easement agreements and understood that they were absolving the IID from liability related to flood damages. The Appeals Court disagreed with the IID's analysis and over $6 million in damages were awarded the plaintiffs.

The importance of this case is that municipalities and special districts may no longer be able to avoid liability from flood damages simply by entering into agreements with impacted landowners. Even where ordinances and written contracts existed, the courts found them to have no legal significance. The courts have again struck a blow to sovereign immunity; unless affirmative flood mitigation efforts clearly exist, municipalities may not be able to rely on fancy legal language to avoid liability for flood damages (The Flood Report, 1985).

The following points summarize the Salton Sea case study:

1. FEMA identified the flood hazard area using a stage/frequency analysis.

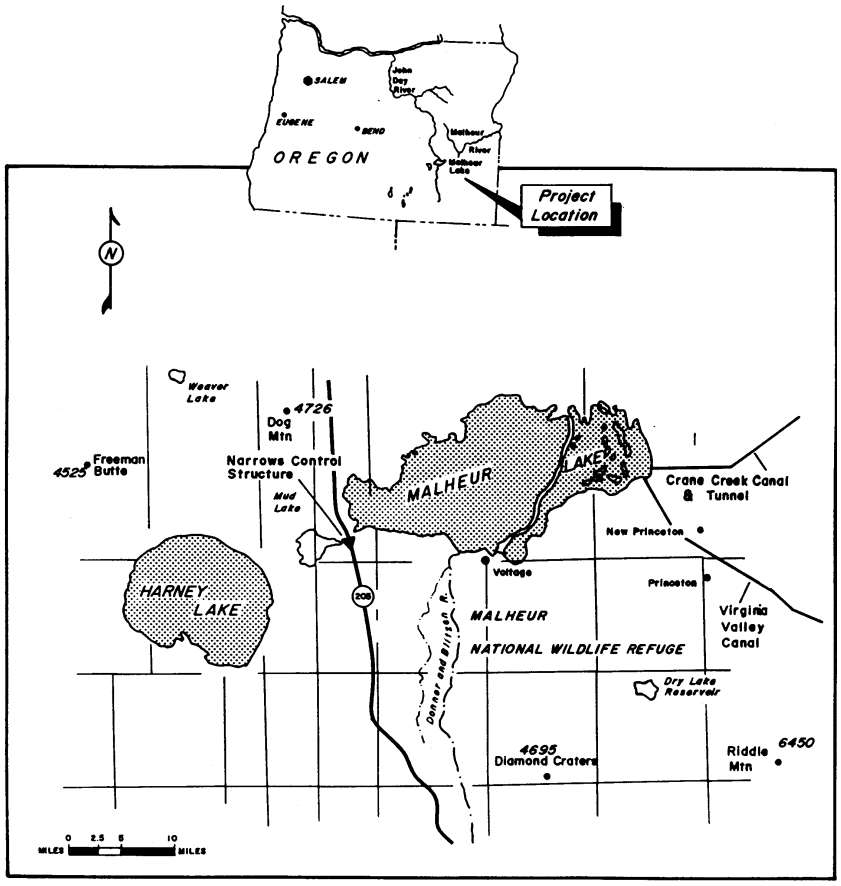
2. Mitigation involves application of the NFIP's regulatory requirements and removal of some abandoned properties.

F. Malheur (Harney) Lake, Oregon

Since the area around Malheur Lake in southeastern Oregon was settled in the late 1880's, water has never reached the natural outlet which lies at approximately 4,111 feet amsl. During this period, the lake has reached a maximum level of 4,095 feet amsl. In 1934, on the other extreme, the lake bed was completely dry. But over the past 4 years, unusually high runoff has raised the lake level to 4,102.5 feet amsl, resulting in extensive flood damages. At least thirty ranches and associated buildings, a section of the Southern Pacific Railroad, portions of two State highways, and many county roads have been flooded. What was once a system of lakes and marshes with a surface area of 80,000 acres is now one lake with a surface area of approximately 180,000 acres.

The area has received disaster declarations from the State, but requests for a Presidential declaration have been submitted, rejected, appealed, rejected, and dropped. According to Harney County Commissioner Judge Dale White, the most severe impact has been on the local economy because the railroad, the present link to the timber markets, is inundated with no alternate routes available.

In the USACE Reconnaissance Report of May 1985, several mitigation alternatives were listed. The recommended plan involved the construction of an 18-mile canal (the Virginia Valley Canal) which would carry water from Malheur Lake to a nearby river channel and lower the lake level to 4,093 feet amsl.



Map No. 6
Harney & Malheur Lake
and Vicinity

Other structural alternatives include construction of canals, tunnels and diversion systems to lower the lake, and upstream reservoirs to regulate inflow. A second approach involves relocation of the roads and railroads to land beyond the reach of the lake. A nonstructural alternative under consideration is a land exchange that would transfer Federal or State-owned land to ranchers. The low-lying ranch land would then be made part of a wildlife refuge. Other nonstructural options being reviewed are property acquisition and flowage easements. The regulatory approach is not applicable because its strength lies in protecting new construction, but there is little likelihood of future development.

The following points summarize the Malheur Lake case study:

1. A topographical analysis identified an overflow point on the lake, similar to that found in the Great Salt Lake case study.

2. New construction is not likely to be an issue, therefore the analysis of mitigation options is focused on protecting existing development, especially roads and railroads.

3. Structural options for lowering the lake are receiving the greatest attention.

PART III: ANALYSIS OF CASE STUDIES

A. Introduction

The focus of the case study analysis is on the techniques used to identify and mitigate impacts from flooding on closed-basin lakes. The purpose is to determine which techniques or combination of techniques work best and are most readily transferable.

B. Hazard Identification

As discussed in Part I, D, there are four approaches that are generally used for identifying the hazard-prone area of closed-basin lakes: (1) stage-frequency analysis; (2) topographical Analysis; (3) high water mark determinations; and (4) water balance-statistical analysis. Where decisionmakers are at the initial stages of addressing a closed-basin lake flooding problem, they should analyze the feasibility of using each of these four techniques before selecting the technique or techniques that are most likely to provide reliable results.

1. Stage/frequency analysis: This technique has been used on closed-basin lakes such as Lake Elsinore and the Salton Sea. The technique is modified somewhat from that used for lakes with adequate outlets and for streams. The analysis is performed using historic lake level records. If there is a long historic record, a stage analysis is run on the data, annual peaks are fit to a frequency distribution and the 1 percent recurrence interval level is selected, displayed on a map and may then be used for regulatory, flood insurance and other purposes. Where historic records are inadequate, synthetic or artificial data is used to simulate inflow, outflow, evaporation, precipitation, seepage into groundwater aquifers, and other inputs and outputs. Then the lake is modelled to develop the regulatory flood level. There are numerous problems with this approach, resulting in a high degree of uncertainty in its results. First, selection of a starting lake level from which to begin analysis, a "normal" water level, is speculative because of the nature of long-term lake fluctuations, i.e., no one can be sure of what's "normal." Second, elevations on lakes with no outlet or inadequate ones are neither random nor independent, a prerequisite for a reliable stage/frequency analysis. Third, historic records are generally not of adequate detail, continuity, frequency or duration. Fourth, where synthetic data and modelling are used, results are particularly uncertain because of the difficulty of estimating the effects of seepage and evaporation. Stage/frequency analysis is a complex, costly and uncertain method for identifying the hazard-prone area of closed-basin lakes.

2. Topographical Analysis: This technique involves analysis of the lake bed and surrounding land area to determine whether a natural feature exists that can be used to define a hazard area for mitigation purposes. The overflow point on the Great Salt Lake is a good example. Other features that could be used are benches or scarps. This technique can be effective without being costly or technically complex. However, not all lakes have such a convenient feature.

High Water Mark Determination: This technique appears to be applicable on all lakes. It is more costly and complex than the topographical approach, but less so than stage/frequency analysis, and it appears to be more reliable and affordable. Attachment A and the Lake Pulaski case study describe one form of this technique in detail.

Water Balance-Statistical: This technique has been used on the Great Salt Lake where good records exist for precipitation, surface inflow, and evaporation. It appears to be transferable to other lakes where adequate data on inputs and outputs exist. It was developed as an alternative to standard methods for estimating flood frequencies and damages which have the shortcomings listed above in number 1. As described by James et al. (1985), the water balance statistical approach involves developing a model to generate annual sequences of lake inputs and outputs. In James' case, 1000 event sequences were developed. The resulting data is used in a lake balance model to generate lake levels which can be used to define lake level probability distributions or can be applied to a damage simulation model (ibid., p. 1). The major shortcoming of this approach is its data requirements. Few lakes have as much data available as the Great Salt Lake. Where limited data exists, additional statistical simulations are needed, reducing the reliability of the results.

C. Hazard Mitigation

As discussed in Part I, E, there are several mitigation techniques being used on closed-basin lakes.

1 Regulations: The most common technique used to protect new buildings from lake-rise flood damages is the floodplain management regulatory approach based on the NFIP. Its key provisions are elevation and floodproofing. Previous investigations

into closed basin lake problems have contended that these elevation and floodproofing provisions are ineffective against this type of flooding. The rationale stated is that even if a property is elevated above the reach of flood waters, if it is surrounded by water for weeks, months or even years, occupancy is infeasible. Similarly, floodproofing the structure or its water and sewer lines is rendered ineffective by extended inundation. However, this is only true in cases where the regulatory elevation used when the structures were built was too low. If the level is accurately set, based on an overflow point or other topographical feature, or on a high water mark determination, such inundation will not be likely to occur. Therefore, the problem does not lie with the effectiveness of the mitigation technique, but rather with the accuracy of the hazard area identification.

2. Acquisition and Relocation: The regulatory approach of the NFIP is not useful for mitigating losses to existing structures. The most effective nonstructural technique for existing structures is acquisition followed by razing or relocation of the structure and conversion of the land to open space use.

3. Setbacks: One of the most effective mitigation techniques for new development is to restrict construction to some point well back from anticipated levels of lake rise. Setbacks are especially effective for achieving this result, and can be used not only for structures, but for all forms of development.

4. Flood Insurance: Flood insurance claims under the NFIP have been paid for flood damages on closed-basin lakes in every case where the surrounding community participates in the program. The slow rate of rise, repeated incidents of rise, and other factors have made claims adjustment very time consuming and complex, leading to a number of changes in insurance procedures and policies. The most recent FEMA policy on closed-basin lake claims is included as Attachment D. Its full implications have yet to be determined, but it simplifies the flood insurance claim process and appears to hold additional potential for long-term mitigation (see Recommendation l(c), in Part IV of this report).

5. Structural Works: Levees and flood walls have been used or are contemplated in a number of the case study communities. Outlet modifications are being performed on Malheur Lake. Pumping has been considered in others. Levees, flood walls, and pumping are expensive forms of protection on all but the smallest lakes because of the scale of the problem. There's too much storefront to levee or too much water to pump effectively on the larger lakes. Outlet modifications can only be considered on those few closed-basin lakes that have outlets.

D. Effectiveness and Transferability

Lake flooding situations require case-by-case analysis. Their commonalities are fewer than their differences, making it difficult to generalize about either effectiveness or transferability. Cases exist where the hazard was identified using stage-frequency analysis and where structural mitigation programs appear to be the only recourse. However, the case study communities, as well as others encountered during this research, would likely benefit most by using the topographical or high water mark approaches to identification, and giving greater consideration to primarily nonstructural mitigation programs. The Lake Pulaski case study seems to provide at least a framework for comparison if not a model for existing and evolving lake rise situations.

PART IV: SUMMARY AND RECOMMENDATIONS

A. Summary

Flooding on the shores of closed-basin lakes poses a significant and growing burden to the taxpayer. Without a timely and concentrated effort, this burden will continue to grow. To summarize the findings of this report:

1. Closed-basin lake flooding is not a minor, isolated problem.

2. It occurs in at least three-quarters of the States—from Florida to Washington and from California to Maine.

3. It affects hundreds of communities.

4. It impacts the shoreline—one of the most desirable areas for development and occupancy.

5. It has resulted in:

Almost $200 million in damages in Utah alone.

Over $1 million in damages in five other States

6. Total national losses have exceeded $250 million in the last 5 years.

7. Losses could exceed $1 billion by the year 2000 if left unchecked.

8. The key to effective mitigation is the identification of the area subject to flood damages from lake fluctuations, but this is a more difficult task than on most lakes and streams.

9. Relocation appears to be the most effective mitigation technique for existing structures, but programs need to be developed to fund relocation before structures are inundated.

10. A wide range of both structural and nonstructural mitigation techniques have been used successfully to protect new development.

B. Recommendations

One of the most comprehensive attempts to improve understanding and recognition of problems associated with closed-basin lakes was performed under the auspices of the ASFPM by Bloomgren and Kusler (1984). The ASFPM is uniquely positioned to continue pursuit of solutions to this problem. It has a nationwide constituency, an established interest in the issue, and it has the respect of professionals in hazard-related fields. Therefore, FEMA Region VIII has been discussing joint implementation of a continuing effort with the ASFPM. As a framework for this effort, FEMA Region VIII recommends that the ASFPM should:

1. Analyze this report in light of its own knowledge of the hazard and develop specific recommendations on the following issues:

(a) Mapping and Engineering. It is difficult to identify the flood-prone area of a closed-basin lake since flooding on these lakes is quite different from conventional flooding situations. What are the most appropriate techniques for identifying the lake rise flood-prone area? Who should be involved in determining which are most effective? Who should be involved in applying selected techniques in communities determined to be susceptible to this hazard?

(b) Mitigation Flood Damages and Water Quality. In addition to impacts on life and property, closed-basin lake flooding causes sewage facility failures as the water table rises. What mitigation techniques appear to be most effective in minimizing flood damages and water quality degradation? Which work best before flooding begins, which during, and which after? Who should be involved in applying selected techniques in communities that are susceptible to this hazard?

(c) Flood Insurance. In January of 1986, FIA issued a policy to simplify payment of flood insurance claims for flood damages on closed-basin lakes (see Attachment D). What opportunities does this policy provide for improving mitigation for structures that currently exist within the reach of rising lake levels? Can this policy lead to relocation of exposed structures? What additional policies or procedures would be necessary to maximize the potential of this policy to limit the Federal investment in flood hazard areas?

2. Initiate one or more case studies of emerging closed-basin lake problems. Site selection for the case studies should allow for investigation of all key issues and involvement of all key actors. Sites of emerging problems should take precedence over ongoing ones in order to be able to study the full duration of the hazard identification, mitigation, and evaluation stages. The purpose of these studies is to test the practicability of hazard identification and mitigation techniques from Recommendation 1, above, the transferability of successful techniques, and to ensure a continued effort to better understand and manage this costly hazard. The case studies should be performed by an interdisciplinary and intergovernmental team under joint FEMA/ASFPM leadership. The duration should be adequate to allow for the development, implementation, and evaluation of progress.

3. Encourage and assist local governments faced with closed-basin lake flooding problems in identifying, planning for, and managing the hazard. With ASFPM support, States should encourage and assist local decisionmakers in addressing closed-basin lake flooding issues in a comprehensive hazards management format that includes:

(a) Hazard identification using the techniques developed under Recommendation 1(a), above.

(b) Determination of the lives and property at risk within the identified flood-prone area.

(c) Identification of the mechanisms currently in place for reducing long-term vulnerability to the hazard.

(d) Mitigation using the techniques developed under Recommendation 1(b) above.

(e) Identification of the local, county, State, and Federal programs available to support implementation of steps (a) (d) above.

(f) Preparation and implementation of a plan of action for enacting the resulting program to address closed-basin lake flooding.

4. Determine the effects of long-term climatic trends on the accuracy of flood-prone area studies performed for closed-basin lakes. This subject, which was beyond the scope of the Region's study, was identified as a priority by Bloomgren and Kusler (1984). Their report noted that flood-prone area determinations "based upon a period of less than normal precipitation will only lead to a false sense of security

and result in flood damages when climatic conditions return to normal." Who should be involved in analyzing this issue? How should it be coordinated with the hazard identification tasks under Recommendation 1(a)?

REFERENCES

Anderson, Witt. 1985. U.S. Army Corps of Engineers, Walla Walla District. Personal communication.

Arnow, Ted. 1984. Water-Level and Water Quality Changes in Great Salt Lake Utah, 1847–1983. United States Geological Survey Circular 913. Alexandria, Virginia.

Bartz, Richard. 1985. State of Ohio Coastal Zone Management Office. Personal communication.

Bloomgren, Patricia, and Kusler, Jon A. 1984. Improving the Effectiveness of Floodplain Management in High Risk Areas. An issue paper prepared for the Federal Emergency Management Agency. The Association of State Floodplain Managers. Madison, Wisconsin.

——. 1984a. Improving the Effectiveness of Floodplain Management in High Risk Areas. From the proceedings of the Eighth Annual Conference of the Association of State Floodplain Managers, Portland, Maine, June 11–14, 1984. Natural Hazards Research and Applications Information Center Special Publication 11. Boulder, Colorado.

Bloomgren, Kusler and Vollbrecht, Mary Ellen. 1986. (Not yet published). Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials. By The Association of State Floodplain Managers for the Federal Emergency Management Agency.

Borek, Paul; Staats, David; and Wuestenfeld, Karen. 1981. "What You May Need to Know About Owning Shoreline Property." The Great Lakes Communicator, Volume 11, Number 5: pp. 3–5. Ann Arbor, Michigan.

Doty, Viki. 1980. Federal Hazard Mitigation Coordinator's Report on Lake Elsinore. Federal Emergency Management Agency, Region IX.

——. 1985. Federal Emergency Management Agency Region IX. Personal communication.

Federal Emergency Management Agency, Region VIII. 1984. Interagency Hazard Mitigation Report, FEMA-720-DR-Utah.

——. 1984a Post-Flood Recovery Progress Report, FEMA-720-DR-Utah.

——. 1985. Post-Flood Recovery Progress Report, FEMA-720-DR-Utah.

Federal Emergency Management Agency, Region IX, 1980. Environmental Assessment, 1362 Relocation Project, Lake Elsinore, California.

Finke, Peter. 1985. State of Ohio Department of Natural Resources, Division of Water. Personal communication.

The Flood Report. 1985. Litigation Alert: Court Throws Out Flood Easements Volume II, No. 8. Alexandria, Virginia.

Forsberg, Al. 1985. U.S. Army Corps of Engineers, St. Paul District, Minnesota. Personal communication.

Freitag, Robert. 1985. Federal Emergency Management Agency, Region X. Personal communication.

Hardy, Lynn. 1985. State of Oregon Office of Emergency Services. Personal communication.

Harnack, Ronald. 1986. Minnesota Department of Natural Resources. Personal communication.

James, L. Douglas, et al. 1985. Estimating Water Surface Elevation Probabilities for the Great Salt Lake.

Kay, P.A. and H.F. Diaz. 1985. Problems of and Prospects for Predicting Great Salt Lake Levels. Logan, Utah: University of Utah.

Kusler, Jon A. 1982. Innovation in Local Floodplain Management: A Summary of Community Experience. Natural Hazards Research and Applications Information Center Special Publication 4. Boulder, Colorado.

Larson, Larry A. 1985. State of Wisconsin Department of Natural Resources and the Association of State Floodplain Managers. Personal communication.

Lutgen, Tom. 1985. State of Minnesota Department of Natural Resources, Division of Waters. Personal communication.

Morton, David. 1985. Natural Hazards Research and Applications Information Center, Boulder, Colorado. Personal communication.

Powers, William. 1985. Federal Emergency Management Agency, Region V. Personal communication.

Smelcer, Dale. 1985. U.S. Army Corps of Engineers, Walla Walla District. Personal communication.

Snyder, Ed. 1985. Federal Emergency Management Agency, Region IX. Personal communication.

Spychalla, William. 1986. U.S. Army Corps of Engineers, St. Paul District. Personal Communication.

Sutphen, Sandra. 1983. Lake Elsinore Disaster: The Slings and Arrows of Outrageous Fortune, in Disasters, July 3, 1983, California State University, Fullerton.

Trakimas, William L. 1984. Federal Insurance Administration Initiatives To Resolve Inconsistencies in Floodplain Management Regulations. From the proceedings of the Eighth Annual Conference of the Association of State Floodplain Managers, Portland, Maine, June 11–14, 1984. Natural Hazards Research and Applications Information Center Special Publication 11. Boulder, Colorado.

U.S. Army Corps of Engineers, St. Paul District, Minnesota. 1983. Section 205 Detailed Project Report, Flood Control Project at Devil's Lake, North Dakota.

——. 1984. Section 205 Flood Control Initial Appraisal Report, Lake Pulaski, City of Buffalo and Wright County, Minnesota.

U.S. Army Corps of Engineers, Walla Walla District. 1985. Reconnaissance Report, Malheur Lake, Oregon; Upper Snake River and Tributaries.

U.S. Government Code of Federal Regulations: Title 44, Part 59. 1976. General Provisions, National Flood Insurance Program.

Utah Department of Natural Resources and Energy. 1983. Recommendations for a Great Salt Lake Contingency Plan for Influencing High and Low Levels of Great Salt Lake, Salt Lake City, Utah: Division of State Lands and Forestry.

Vaughan, R.D., 1984. Utah Coping with Flooding: A Perspective on an Arid State. Amherst, Massachusetts: University of Massachusetts Land and Water Policy Center.

White, Judge Dale. 1985. County Commissioner, Harney County, Oregon. Personal communication.

ATTACHMENT A

MAPPING THE FLOODPLAIN OF A LAKE: ONE APPROACH

Resource management and riparian rights pertaining to an inland lake are dependent upon identification and establishment of that lake's Natural Ordinary High Water (NOHW) elevation. The NOHW is coordinated with the upper limit of the lake basin and defines the elevation (contour) on the lakeshore which delineates the boundary of public waters. Identification of the NOHW comes from an examination of the bed and banks of a lake to ascertain the highest water level where the presence and action of water has been maintained for a sufficient length of time to leave recoverable evidence. The primary evidence used to identify the NOHW of a lake consists of biological (vegetation) and physical features found on the banks of the lake. Data depicting historic lake levels are often useful only as supporting data in NOHW studies. This is because the available data generally are not of sufficient detail, continuity, frequency and/or length of record to alone identify the NOHW.

Because trees are the most predominant and permanent expression of upland vegetation, they are used as NOHW indicators wherever suitable species and sites can be located. Particular attention must be given to the species of upland growth selected for consideration. In general, willow and most ash are very water tolerant; maples and elms tolerant; most birch intermediately tolerant and oak intolerant. The less tolerant trees make the best indicators, but factors in addition to species also have to be considered such as age, the slope of ground, the effect of water and ice action on the shoreline and the physical condition and growing characteristics of the trees. Water dependent vegetation, such as cattails, will follow lake levels as they rise and fall and therefore provide little evidence about the lake's NOHW, except in cases where more permanent vegetation does not exist. Trees, like people, will follow receding water levels and infringe upon the lake basin. When water levels rise to reclaim the basin, such trees are inundated and eventually die.

The tree analysis involves a relationship between the elevation of the ground at the base of the tree and the diameter of the tree. Depending upon the species of tree selected and the slope of the ground, it can be generally stated that a tree requires a depth of unsaturated soil about equal to its trunk diameter to grow. Most trees will not survive if water levels saturate their root systems for a sufficient period of time and if they do survive, stress signs may be evident in the growing characteristics of the tree. The diameter, height, shape of the stem, branch shape, branch spread and foliage density reflect the extent to which the tree roots have had an opportunity to penetrate into and spread through the soil to reach the elements that stimulate growth. A tree growing near the basin's fringe will often indi-

cate by its general appearance whether its root system has had breathing space and sufficient nourishment and support from the soil in which it grows. As an example, a seedling started in soil six inches above a zone subject to saturation will grow normally until it reaches a diameter of approximately six inches, after which it will show by its general appearance the adverse growing characteristics mentioned above.

Physical features searched for include soil characteristics, beach lines, beach ridges, scarp or escarpment (more prominent scarp can often be found in the form of the undercutting of banks and slopes), ice ridges, natural levees, berms, erosion, deposition, debris, washed exposed shoreline boulders, movement of deposits as a result of wave action, top and toe of bank elevations, as well as water levels. Caution is taken to be aware that many of the listed geomorphological features may take a long time to develop and also that several sets of these features may be found. That is, a lake likely will have more than one stage where the action of water has left recoverable evidence, however, only the stage coordinated with the upper limit of a basin is used to assist in identifying the NOHW level. As an extreme example, water level stages resulting from the drought years of the 1930's certainly were the result of natural conditions extending over a number of years, but the resulting recoverable evidence is not useful in performing NOHW determinations.

Credits: Excerpts from NATURAL ORDINARY HIGHWATER MARK DETERMINATION. Report for Pulaski Lake, Minnesota, Minnesota Department of Natural Resources, Division of Waters, March 1983.

ATTACHMENT B

MITIGATION APPROACHES FOR CLOSED-BASIN LAKES

Regulations

Floodplain zoning, shoreline zoning, subdivision control, building codes, and other special codes can be used to establish:

Protection elevation. In determining protection elevations, allow substantial freeboard where there is the potential for wave action or ice damage. The amount of freeboard should be based on the fetch (open water area), anticipated wave heights, and thickness of the ice (if this is a factor).

Buffers and setbacks. Wisconsin, Minnesota, Washington, and Maine require minimum setbacks of 75 feet for new structures on all lakes.

No Fill. Requirements that structures be located on existing grade, not on fill, at an elevation above the natural high water level.

Prohibit basements. Prohibiting basements, themselves, is more effective than prohibiting use of the basement as living areas.

Sanitary codes. Sanitary codes can be used to prohibit septic systems in expected flood and high ground water areas where such systems will not function.

Well construction codes. Well construction codes can cite conditions for abandonment of existing wells to protect groundwater and requirements for siting new wells.

Flood loss reduction standards are often appropriately included not only in flood hazard reduction ordinances, but also in shoreline zoning, wetland protection, and broader land use controls.

NON-REGULATORY ACTIONS

Acquisition and Relocation

Relocating structures may be the only practical solution when long-term flooding renders them useless or threatens to do so. Relocation is taking place on many closed-basin lakes.

Outlet Construction

Efforts have been made on both Lakes Elsinore and Pulaski to construct outlets in order to reduce water levels. The problem with this approach is that it may be difficult to find a place to put the excess water.

Levees

Levees have been constructed to reduce flooding at selected sites on the Great Salt Lake, e.g., at sewage treatment facilities, and on Devils Lake, North Dakota. However, levees are usually a temporary solution to flood problems, and are costly because of the scale of the required projects.

Credits: Modified version of text excerpted from a report soon to be published by Bloomgren and Kusler for the Association of State Floodplain Managers.

LAKE PULASKI MANAGEMENT PLAN

Credits: Excerpt from Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials by the Association of State Floodplain Managers (yet to be published).

ATTACHMENT C

Appendix 8-A: A Management Plan for the Developed Lake Bed Area of Lake Pulaski, Wright County, Minnesota.

Introduction

Lake Pulaski is located near the center of Buffalo Township (T120N, R25W) in Wright County Minnesota. Thc south half of the lake is located within the corporate limits of the City of Buffalo.

A December 1981 report by the Division of Waters of the Department of Natural Resources (DNR) estimated the Natural Ordinary High Water level (NOHW) of Lake Pulaski to be at an elevation 968.8 or roughly seven feet above present levels.

On June 11, 1982, in accordance with State law and after public hearings, the Commissioner of Natural Resources signed an order officially establishing the 968.8 elevation as the NOHW of Lake Pulaski. All land located adjacent to Lake Pulaski that is below this elevation is now considered lake bed. Upon signing this order, it is estimated that roughly 100 structures are considered located on the bed of Lake Pulaski and at least 170 structures will receive some water-related damage. At the 968.8 elevation, roughly 60 acres of land that is above the present lake level would be inundated by water.

This fact presents a very unusual but not unprecedented problem in Minnesota's history of shoreline management. Several lakes in eastern Minnesota have similar problems, such as Big Marine Lake in Washington County. However, this is the first time that the DNR has established the NOHW level to be above this many residences before the lake reclaimed itself. Experience from these eastern lakes has shown that the combination of lakeshore owners trying to save their homes, together with conflicting and uncertain authorities of State and local governments can lead to many problems. The Lake Pulaski problem is unprecedented in the respect that this is the first time State and local governments have had the chance to prepare for the problem in advance of its becoming severe.

The City of Buffalo and Buffalo Township contracted with Zack Johnson and Associates to study the Lake Pulaski problem and to work with a local task force in making recommendations to State and local governments as to how to deal with it. The study entitled "Lake Pulaski Area Development Study" was released in July of 1982 and it explored many possible solutions to the low development problems including artificial control of the lake level, filling and raising of all the structures, acquisition of the lake bed area, relocation of homes, and adoption of development controls.

The task force which worked with Zack Johnson and Associates came up with several recommendations on how to deal with the Lake Pulaski problem. Most of these recommendations involved non-structural means of addressing the problem. That is, they concluded that artificial manipulation of the lake level and massive relocation programs mere not financially feasible. Instead, they recommended use of development controls (zoning), public information, and further study as the most cost-effective way of addressing the problem. The Department of Natural Resources supports the task force's recommendations and hopes to see all of them carried Out.

The purpose of this plan is to address the environmental, social, and regulatory issues involved in future management of the lake bed area of Lake Pulaski and to lay out the framework and policies which State and local governments will follow in administering the area. The purpose is also to make this information available to local residents, developers, real estate agents and particularly lake bed owners so that they fully understand the legal limitations that govern the existing and future use of the lake bed area.

This plan is prepared under.authority granted the Department of Natural Re: sources in Minnesota Statutes, Section 104.03 (Flood Plain Management), 105.39 (Authority of Commissioner—DNR), 105.403 (Water and related land resources plans), 105.42 (Public water permits) and 105.48 (Shoreland management).

Geology and Hydrology

The geology and other physical characteristics of Lake Pulaski are addressed in both the "Lake Pulaski Area Development Study" and the Department's "Natural Ordinary High Water Determination for Pulaski Lake". The size of Lake Pulaski

has been measured at 837 acres in 1858, 770 acres in 1953, and 786 acres in 1979. The watershed, that is all land that slopes towards Lake Pulaski, has been estimated to be roughly 3500 acres in size. This results in a 3:1 watershed to lake area ratio, which is generally considered insufficient to maintain water levels in Pulaski. Therefore, it is assumed that the levels of Pulaski are in large part affected by ground water levels and ground water inflow (commonly referred to as being "spring fed".).

Since ground water inflow is extremely difficult to measure and since the extent of and recharge capabilities of the aquifers affecting Lake Pulaski are largely unknown, any calculations regarding projected levels and timing of those levels is impossible at this time. The only thing that is known for certain is that levels in Lake Pulaski reached and stayed at elevation 968.8 feet for extended periods at least once and possibly twice within the past 125 years. It should be noted that there was also evidence that the lake had exceeded 968.8 feet by 2 or 3 feet sometime in the past.

Reading of the two previously mentioned reports is recommended for those interested in more detailed information on the physical characteristics and history of Lake Pulaski.

Existing Regulatory Authorities

Presently, five governmental units have some interest or authorities relating to Lake Pulaski. They are the Federal Government State Government, Wright County, the City of Buffalo, and Buffalo Township. A summary of the general interests and authorities of each unit follows:

Federal Government: Direct authority over placement of fill in the lake or adjoining wetlands by the U.S. Army Corps of Engineers. No direct land use authority. Some Federal interest in Pulaski problems is through financial assistance type agencies such as HUD, VA, SBA, FHA, etc. Some technical assistance available through SCS. Primarily Federal interest is through the Federal Emergency Management Agency (FEMA) which administers the disaster assistance programs and the Flood Insurance Program.

State Government: DNR—Direct authority over all activities occurring below the ordinary high water level. Indirect authority over all property located within 1000 feet of the lake, through the Shoreland Management Program and indirect authority over all land located below any estimated 100-year flood level, through the State Floodplain Management Program. Permits are required of all individuals, companies, agencies. or government units doing any work that changes the cross-section of the bed of Lake Pulaski. Local governments are required to adopt and enforce ordinances relating to Shoreland and Floodplain areas that meet the minimum standards developed by the DNR.

Pollution Control Agency (PCA): Direct authority over water quality aspects of Lake Pulaski relating to community sewage discharge, feed lot location and construction of landfills. Indirect authority relating to individual sewage treatment systems and general ground and surface water quality.

Department of Health (DOH): Direct authority over well construction and location, and commercial food or recreation related establishments. Well drillers have to be licensed and must follow DOH well code which specifies various elevation requirements and setbacks.

Local Government: Wright County: Has extensive direct land use authority which is administered through the Wright County Planning and Zoning Ordinance. This ordinance contains provisions which meet or exceed all DNR required shoreland and floodplain provisions. This authority applies to the north one-half of the lake only. The County also has taxing authority over the area and property values of the area may affect county revenues.

City of Buffalo: Has extensive direct land use authority over the south one-half of the lake, which is administered through the City's zoning ordinance. This ordinance does not meet all of the DNR required shoreland and floodplain provisions, but the City recently enacted a moratorium on any development below the ordinary high water level. The City also has indirect control over land uses on Lake Pulaski through its municipal sewage collector system.

Buffalo Township: Has the authority to adopt extensive land use controls provided they meet or exceed the county standards. These controls would apply to the north half of the lake only. However, the township presently addresses its land use concerns through the County planning process.

The primary tool by which governmental units control uses of land is through a permit or approval system. What follows is a listing of common development activities that do or could occur in and around Lake Pulaski, and a summary of the various types of permits and/or approvals that are required for each activity.

1. Erecting, moving or wrecking any building or structure. A building permit is required by either the City of Buffalo or Wright County any time this activity occurs within their corporate boundaries. In the County, the permit may actually be issued by a Township Building Inspector, but a permit is not required for a building of less than 150 square feet of area. On the lake bed area, a permit would also be required by the DNR and possibly by the U.S. Army Corps of Engineers Generally, DNR regulations would prohibit building or moving new structures onto the lake bed; the city or county would normally issue building permits provided the building code and all other ordinance provisions are met. On the lake bed both the City and County prohibit the construction or location of new structures.

2. Remodeling, enlargement, repair or modification of existing structures. A building permit is required for any of these activities either in the City or County controlled areas. On the lake bed area, DNR permits would also be required, except for minor repairs such as reshingling and painting under the county ordinance, lake bed structures are classified as a nonconforming-use which cannot be extended or expanded. However, the county ordinance does allow normal maintenance of structures. The City does not differentiate between lake bed or non-lake bed areas.

3. Filling, excavation. landscaping, terracing, grading, and construction of retaining walls. On the lake bed areas these activities all require a permit from the DNR. Whether or not such permits are issued depends on the environmental effects and the purpose of the activity. Permits from the U.S. Army Corps of Engineers are generally needed when material is placed in the lake bed, but not for excavation. In the county controlled lake bed area, placement of fill requires a conditional use permit, which can be issued if the applicant can show that the fill has some beneficial purpose and the amount is as small as possible. Outside of the lake bed area, but within the county controlled shoreland area, a land alteration permit is required any time more than 50 cubic yards of earth is to be moved. Within city controlled lake bed and shoreland areas, a specific permit is not required for any of these activities but they may be controlled by the City when done in conjunction with another controlled activity.

4. Subdivision of land. In the County controlled area any division of property or moving of lot lines requires approval of the County. Simple lot line adjustments arc handled through the Board of Adjustment. Division of tracts of land for development requires that platting procedures be followed and requires County Board of Commissioner's approval. Within the City, any time property is divided into parcels smaller than 2 and one-half acres in size or 150 feet in width, platting provisions must be followed and City Council approval is required.

5. Installation, repair, replacement, removal or use of individual on-site sewage treatment systems. Within the County-controlled area, a permit is required prior to installation, alteration or repair of any individual on-site sewage disposal system. On the lake bed area, a DNR permit may also be required as such installation or repair would involve a temporary or permanent change of the cross-section of the bed of the lake. Within the City, on-site systems are prohibited and hook up to public sewer is required.

Recommended Policies and Regulatory Changes

From reading the preceding section, one can see that the authority of the Federal, State, and local government units often overlap as regards control of the lake bed area. In examining the various policies relating to each of the involved permit requirements, it becomes obvious that none of the affected regulations or ordinances were really designed to deal with this unique situation. Therefore. it is felt that some general policies must first be agreed upon by the State and local governments, before the regulatory conflicts can be sorted out. These recommended policies and the action needed to implement the policies follow:

1. Policy—Existing structures located on the lake bed may remain in their present location and continue their present local of use until water levels make their habitation unsafe.

Action. The State, Counts and City shall implement a monitoring program in order to notify owners when continued habitation of their homes could be hazardous.

2. Policy—Existing structures on the bed may be repaired or maintained provided the degree of permanence of the structure and the outside dimensions of the structure arc not increased. Permits far such repair or modification shall be required by the County and City in conformance with existing ordinances or codes.

Action. The DNR shall issue general permits to both the County and City so that lake bed owners only have to deal with one agency. These general permits would only apply if the above policy was met.

3. Policy—Existing structures on the lake bed shall comply with on-site sewage treatment standards. Those whose systems are polluting shall be encouraged to install temporary holding tanks or to find a disposal site out of the lake bed.

Action. The City should require city sewer hook-up for any homes not presently served by such. The County should consider the issuance of variances to allow temporary holding tanks to be utilized. The DNR will not require permits for either of these activities provided adequate conditions are placed on the local permits to prevent future pollution and to assure removal of the tank or disconnection from the system when appropriate.

4. Policy—Fill for lots that are totally surrounded by lake bed shall be prohibited. Fill for lots that connect to land above the bed may be issued provided that certain conditions arc met. Fill to raise public roads leading to lake bed lots shall be prohibited unless the lots arc connected to land above the bed.

Action. DNR shall institute the above policy in compliance with the Public Waters Permits Standards. The County and City should adopt a policy to not take any actions that encourage filling that would not be allowed under this policy.

5. Policy—New or additional structures shall be completely prohibited from being located on the lake bed. The reuse or reoccupation of lake bed lands shall be in conformance with all State and local standards.

Action. None necessary

6. Policy—Temporary flood fighting measures such as sandbagging, pumping. or dike construction should be discouraged. However, pumping and sandbagging should not be strictly prohibited unless it is obvious that they mill become permanent features of the lake bed.

Action. Agreement by the State, County and City regarding enforcement policy should be made.

7. Policy—The "Management Plan" for Lake Pulaski shall be utilized to effectuate a long-term solution far high water problems.

Action. The State shall develop specific rules for dealing with future development and reuse of late bed lands. The County and the City should consider similar specific rules or guidelines for lake bed lands. In addition, the State, County and City should cooperate in joint administrative actions to implement the "actions" recommended in the Management Plan.

Recommended Long-Term Approaches

As the lake level rises, there is no doubt that considerable new interest will again develop in things such as lake level control structures, dikes, relocation funding. Before any of these activities are again explored, it is recommended that all efforts be directed towards obtaining funding to study the lake and ground water hydrology in much detail. Dikes and lake level control could not even be considered without this information. Also such information would be extremely useful in timing any relocation efforts and in making sure that any relocated homes are placed at a high enough level.

At this point in time, it appears that the best and most cost-effective long-term solution would be relocation. Several home owners already have or are in the process of doing so on their own. Also, relocation may also be at least partly accomplished through the Federal Flood Insurance Program, as many of these landowners already have flood insurance coverage.

MEMORANDUM

FEDERAL EMERGENCY MANAGEMENT AGENCY,
Washington, DC 20472, January 6, 1986.

TO: Deputy Administrator; Assistant Administrators; Special Assistants

FROM : Donald L. Collins, Assistant Administrator, IPATS

SUBJECT: Administrator's Policy Interpretation No. I-86 Continuous Flooding Claims—Rising Lake Waters

PURPOSE STATEMENT

At issue is payment of building policy limits when it is reasonably certain that continuous flood damage from rising lake waters will eventually reach the building policy limits.

BACKGROUND

The National Flood Insurance Program frequently encounters situations where lake waters rise over a long period of time, gradually causing increased damage to an insured building.

The Standard Flood Insurance Policy (SFIP) provides in Article VIII.N of the Dwelling Form that "all loss arising out of a single, continuous flood of long duration shall be adjusted as one 1066.

Similarly, the General Property Form of the SFIP provides in paragraph L of the *General Conditions and Provisions* section that fall loss arising out of a continuous or protracted occurrence shall be deemed to constitute loss arising out of a Single loss.

POLICY STATEMENT

Where it appears reasonably certain that flood damage from rising lake waters reimbursable as one loss under the provisions of the Dwelling Form and the General Property Form has occurred to an insured building (other than any appurtenant structure on the premises) and will eventually reach the building policy limits, payment of the building policy limits without waiting for the further damage to occur will benefit both the insured ant the insurer by simplifying the adjustment of the claim and is authorized by these provisions.

Since contents can be moved out of harm's way, there is no need for any payment of anticipated contents damage.

Inasmuch as the building policy limits would be paid under this procedure and any further flood damage In this situation would be part of the same loss so that the further flood damage would not be reimbursable, it is appropriate to require the insured, as a condition for payment of the building policy limits under these circumstances, to sign a release agreeing to three conditions, In addition to-all of the terms and conditions of the policy:

1. To make no further claim under the policy;
2. Not to seek renewal of the policy, and
3. Not to apply for any flood insurance under the National Flood Insurance Act of 1968, as amended, for property at the property location of the insured building.

Attached is the Administrator's Policy Interpretation.

NEW MATTER

The payment of full policy limits due to the reasonable certainty of damage from rising lake waters eventually reaching policy limits, prior to such an outcome, constitutes a new loss adjustment method made possible by the Administrator's policy interpretation.

FEDERAL EMERGENCY MANAGEMENT AGENCY,
Washington, DC 20472.

Federal Insurance Administration; National Flood Insurance Program; Standard Flood Insurance Policy Interpretation; Continuous Flooding Claims

The National Flood Insurance Program continues to encounter situations where lake waters rise over a long period of time, gradually causing increased damage to an insured building. The Standard Flood Insurance Policy (SFIP) provides In Article VIII.N of the Dwelling Form that "all loss arising out of a single, continuous flood of long duration shall be adjusted as one loss. Similarly, the General Property Form of the SFIP provides in paragraph L of the GENERAL CONDITIONS AND PROVISIONS section that "all loss arising out of a continuous or protracted occurrence shall be deemed to constitute loss arising out of a single loss.

Thus, where it appears reasonably certain that flood damage from riling lake waters reimbursable as one loss under these provisions has occurred to an insured building (other than any appurtenant structure on the premises) and will eventually reach the building policy limits, payment of the building policy limits without waiting for the further damage to occur will benefit both the insured and the insurer by simplifying the adjustment of the claim and is authorised by these provisions. Since contents can be moved out of harm's way, there is no need for any payment of anticipated contents damage. Inasmuch as the building policy limits would be paid under this procedure and any further flood damage in this situation would be part of the same lose so that the further flood damage would not be reimbursable, it is appropriate to require the insured as a condition for payment of the building policy limit under these circumstances to sign a release agreeing to three conditions, In addition to all of the terms and conditions of the policy: (l) to make no further

claim under the policy, (2) not to seek renewal of the policy, and (3) not to apply for any flood insurance under the National Flood Insurance Act of 1968, as amended, for property at the property location of the insured building.

JEFFREY S. BRAGG,
Federal Insurance Administrator.

STATEMENT DAVID A. SPRYNCZYNATYK, STATE ENGINEER, ON BEHALF OF NORTH DAKOTA GOVERNOR, ED SCHAFER

Chairman Chafee and members of the Senate Environment and Public Works Committee. Thank you for the opportunity to testify today.

My name is David Sprynczynatyk. I am the State Engineer and Secretary to the North Dakota State Water Commission. The testimony I am giving today is on behalf of Governor Ed Schafer. Governor Schafer asked me to extend his apologies to the committee for not being able to attend in person.

Since 1993, Devils Lake has risen more than 20 feet from elevation 1422.6 msl to 1442.9 msl. Today it is the most serious and most pressing flood problem facing North Dakota. Since 1993, the Federal, State, tribal and local governments, as well as the people of that area, have incurred more than $200 million in damages and flood-fighting expenses. As the lake continues to rise, the U.S. Army Corps of Engineers' forecasts that cumulative damages will grow to $370 million by the time the lake reaches 1450 msl, less than eight feet above its current level. This year alone the lake rose five feet over last year's level.

Most often, rivers will rise, flood adjacent areas, and then recede. This is not the case with Devils Lake, which continues to rise relentlessly, engulfing land, homes, roads and everything else within its constantly growing borders. This is a progressive disaster that requires emergency action to gain control.

The lake's natural outlet occurs when water rises another 15 feet and reaches elevation 1457.5 msl. It then overflows into the nearby Sheyenne River, which drains into the Red River and ultimately into Lake Winnipeg. Geologists have concluded that this natural spillage has occurred several times during the past 10,000 years. No one can predict what will happen with the lake next year. As Governor, I have watched the lake rise well beyond the best scientific predictions for 5 years in a row. Just a few weeks ago, Mother Nature dumped another three to five inches of rain over the entire Devils Lake Basin. Every naturally occurring event such as this compounds our problems, and reminds us how little control we have over the situation.

North Dakota's approach to managing the problem has been a comprehensive, three-part effort including upper basin storage and management, protecting infrastructure, and removing water from the lake.

First, State and Federal Governments have made significant efforts to hold water back within the upper areas of the basin. Upper basin water management, as we call it, has been ongoing for several years, but it alone is not the answer. Some people point the finger of blame to agriculture, and suggest that closing wetland drains is the solution. Again, this is a grossly simplistic approach. Scientific evidence shows that the lake's level has ebbed and flowed for thousands of years, and overflowed naturally into the Sheyenne River long before man had any influence in the watershed. We firmly believe there is a limit to what we can accomplish through upper basin water management. Nevertheless, we continue to spend millions of dollars on upper basin management to restore holding areas and create new ones.

Secondly, we are protecting infrastructure around the lake. The greatest expenses have occurred as a result of relocating more than 100 homes, raising miles of roads, replacing several bridges, and building levees and protecting utilities. This year alone we had 17 highway elevation raising projects in the area for a total cost of nearly $30 million. More dirt and roadwork took place in the Devils Lake region this year than occurred in our State even during construction of the Interstate Highway System. Resources to continue these infrastructure efforts are limited. Yet we must continue pursuing these projects, not knowing if our efforts will ultimately be overtaken again by a lake that is rising uncontrolled.

Our third effort is to remove water from the lake. This is where an outlet is necessary because evaporation is the only current method of reducing the lake level. Even with a prolonged drought, it would take more than 10 years of normal evaporation for the lake to return to the pre-flood level of 1993.

A managed outlet is technically feasible and several have been completed successfully elsewhere in the country. Lake Pulaski in neighboring Minnesota is a good example, a managed lake outlet built in 1986. Environmentally, the outlet can be constructed and operated to meet downstream State and Federal water quality standards. Operating the outlet only during non-flood periods will eliminate additional

downstream flooding in peak flood times. The entire basin would be managed like a reservoir with water being stored when needed for downstream flood control, and released during non-flood periods.

The benefit of the outlet has been questioned since it is limited in its capacity. At the current lake level, any future rise will cost approximately $30 million per foot, much more than what was projected by studies completed by the Corps several years ago when the lake was 25 feet lower. A rise in 1998 similar to what we experienced this year could cause up to $150 million in additional damages. To the people who have lost nearly 60,000 acres of land, their homes and their livelihood to the lake since 1993, I can assure you the outlet is very justified.

Regarding the non-Federal cost share for the project, the 1997 North Dakota Legislature provided sufficient funding for the cost share to the State Water Commission. The State stands ready to provide funds as necessary.

Finally, there seems to be some confusion regarding the relationship of Devils Lake to the Missouri River Basin. Devils Lake physically is not a part of the Missouri River Basin, it is part of the Hudson Bay (Red River) drainage. An outlet from Devils Lake to its natural basin, the Red River, will in no way affect the Missouri River nor the Mississippi River.

Thank you for your time today. And thank you for your careful consideration of this outlet project that will provide relief from this terrible, unfolding disaster and emergency that plagues the Devils Lake region and the State of North Dakota.

DEVILS LAKE FLOOD FACT SHEET

October, 1997

History

Devils Lake is normally considered a closed sub-basin of the Red River of the North Basin. However, evidence suggests that Devils Lake has, on several occasions during the past 10,000 years, reached its spill elevation of about 1,457.5 above mean sea level (msl) and overflowed to the Sheyenne and Red Rivers. Geologists have concluded that Devils Lake water levels naturally vary widely due to climatic swings. Beginning 130 years ago with the first recorded level of 1,438.4 msl, the lake level fell until reaching its recorded low of 1,401.9 msl in 1940. From that point the lake has followed a rising trend, reaching the modern high of 1,442.97 msl in July 1997. The lake is currently at elevation 1,442.6 msl, over five feet higher than it was a year ago.

Flood Problems and Damages

Flooding in 1993 caused Devils Lake to rise five feet in 6 months. The lake has steadily risen each year since, almost 20 feet total. The volume of water in Devils Lake has more than tripled since July 1993. Over 51,000 acres of adjacent land, much of it deeded farm or ranchland, has been flooded since 1993. The lake now covers about 98,100 acres. More than 172 buildings have been affected. In 1997, about 400 damage claims have been filed totaling $20 million in Ramsey and Benson Counties. In addition, 83 homes on the Spirit Lake Nation Reservation have been, or will be moved. Insurance claims paid by the National Flood Insurance in 1996 totaled $7.1 million for damage to private homes and businesses.

Maintaining State and county roads at Devils Lake has cost tens of millions of dollars since 1993. There were 17 highway elevation raising projects in progress around Devils Lake in 1997 at a total cost of $27.2 million.

Highways 20 and 57 south of the city of Devils Lake are key routes in the region for school bus traffic, shopping, commuting for work, and for emergency transportation to the south side of Devils Lake including the Spirit Lake Reservation. Both highways were flooded at the narrows south of Devils Lake last spring. Plans to build a $15 million, 6,400-foot long bridge on Highway 57 are in progress. Contractors worked all summer to raise Highway 20 to elevation 1448.5 msl. Work on raising Highways 281 and 19 north of Minnewaukan, as well as other roads and bridges at 17 project sites around the lake is nearing completion. Top of roadway elevation on most highways adjacent to Devils Lake is now at 1448.5 msl, less than six feet above the current lake level.

The U.S. Army Corps of Engineers is raising the city of Devils Lake levee system. Stages I and II were completed in 1997 at a cost of $7 million. They protect the city to elevation 1445 msl. Another $43 million has been committed to raise the dike for community protection to 1450 msl.

The North Dakota State Park System has four parks adjacent to the lake. The Narrows State Park was flooded and abandoned in 1995. The road to Grahams Is-

land State Park was flooded this spring and the park was closed all year. A project to raise the road should be completed in November. Many camp sites, the marina, and other facilities at Grahams Island State Parks remain flooded. Shelvers Grove and Black Tiger Bay Parks have some flooded facilities but they remain open.

Engineers estimate it will cost $950,000 to relocate pipes and pump stations required to keep the Ramsey County rural sewer system operable. This work must be accomplished this fall. As lakeshore property owners move away to escape the rising water, income to service the system's existing $907,000 debt decreases. Over 125 accounts have been lost due to the flooding.

Basin Water Management Efforts

A multi-faceted approach, including basin water management, infrastructure protection as mentioned above, and an outlet to the Sheyenne River, is critical for addressing Devils Lake flooding problems.

About 60,000 acres of wetlands are drained throughout the basin while about 252,000 acres of wetlands and lakes are still intact and storing water. In 1995, the State Water Commission initiated the Available Storage Acreage Program (ASAP) with a target of 75,000 acre-feet of storage in the upper basin. The program solicits temporary, voluntary, and compensated water storage sites. In 1997, 150 sites provided 22,000 acre-feet of storage for 1997 runoff. The State Water Commission recently approved an additional $1.15 million for 1998 storage. ASAP will continue to seek storage as funding permits.

The U.S. Fish and Wildlife Service has identified 36 projects to provide 12,774 acre-feet of long-term storage potential on public lands. In 1996, eight projects were completed and now provide 1,762 acre-feet of storage. Cost thus far is $471,000 for permanent facilities. In addition, the recent Conservation Reserve Program emphasized wetland restoration in its signup criteria. As a result 164,000 acres of wetlands will be re-established in the counties that are part of the Devils Lake Basin. Over 7,800 acres of Federal wetland reserve will be established. The State's ASAP program and the North Dakota Wetland Trust are helping finance some of the wetland restorations.

Sub-basin committees of local landowners have been established by the Devils Lake Joint Water Board to help achieve water management objectives through direct grassroots involvement. A full-time manager was hired by the Board in early October to help implement their basin management plan.

The Outlet Part of the Solution

Several potential alignments for a Devils Lake outlet have been considered. In all cases, potential water quality impacts and flood risk in receiving waters are major concerns. A "west-end outlet" is critical to attain cost and environmental viability. The preferred alignment is the Peterson Coulee route. Several designs are being considered. Current designs clearly preclude the emergency outlet from being used as an inlet.

Under a fast-track approach, outlet construction will take a minimum of 29 months, including environmental reviews, authorization, and funding. When finished, the project may pump a maximum of 300 cubic feet per second (cfs) to the Sheyenne River. This could remove about 120,000 acre-feet of water annually or about 1.2 feet at today's level.

Devils Lake water will be mixed with the normal flow of the Sheyenne and Red Rivers. At no time during a 10-year simulation of a 200 cfs emergency outlet project were the sulfate standards or international border objectives exceeded. However, outlet operation will also raise total dissolved solids (TDS) levels. Managing TDS to satisfy downstream concerns will be factored into the final project design.

STATE OF NORTH DAKOTA,
OFFICE OF THE STATE ENGINEER,
Bismarck, ND, November 21, 1997.

HON. JOHN H. CHAFEE,
Committee on Environment and Public Works,
United States Senate,
Washington, DC 20510–6175.

DEAR SENATOR CHAFEE: Thank you for the opportunity to respond to questions from members of the committee regarding the proposed flood control project at Devils Lake, North Dakota. The questions are certainly pertinent to the deliberations of the committee and are also pertinent to the considerations of the State of North Dakota as we attempt to move forward and address this most devastating situation to the people of Devils Lake and to the State.

Question 1. What is the position of the State of North Dakota regarding Devils Lake stabilization? My understanding is that this involves transporting Missouri River water into Devils Lake when the lake levels are low, and pumping water out of the lake into the Sheyenne River when levels are high. Is 10 stabilization a part of the statewide water development plan?

Answer: Area residents and State leaders have envisioned a project to stabilize the water level in Devils Lake since the early years of statehood. When the water level is sufficiently high to support a sport fishery, the lake provides a significant recreational resource to a multi-State region (locally valued at $30 million per year in 1988). Early studies concluded that the Missouri River is the best source of water, from the standpoint of quality and reliability, to supplement natural runoff from the Devils Lake watershed during times of drought. The same studies conclude water should be released on a regulated basis to the Sheyenne River during wet cycles to prevent the level from rising too high.

Both the 1983 and 1992, North Dakota State Water Management Plans discuss the need to stabilize Devils Lake. The 1992 North Dakota State Water Management Plan was developed with considerable public input from all across the State and it indicates support for the stabilization of Devils Lake. Bear in mind that in 1992 Devils Lake was approximately 20 feet below its current level.

Question 2. Because it is naturally a closed basin lake, the lake's level has historically swung quite dramatically. Just 4 years ago, it was at one of its lowest points since the mid 1800's. If we had been pumping Missouri River basin water into the lake for years prior to 1993, and then we received all the rainfall and snowfall that we have had since 1993, wouldn't we now have a lot more water in the lake and a lot more flooding than we have right now?

Answer: Please allow me to make a correction in fact and perception to the comments preceding the question. The lowest level of Devils Lake since the mid 1800's was elevation 1400.9 msl recorded in 1940. With some variation, the water level has been on a general rise since that time. I am enclosing a graph that illustrates the lake's recent water level history. Four years ago the lake was at an elevation of approximately 1423 msl. The drought of the late 1980s and early 1990s was causing the lake level to decline rapidly. There was great fear that the level might continue to drop to elevation 1422 msl, a point critical to sustaining the lake's recreational fishery. At that time the State was engaged in emergency studies to find ways to supplement inflow to the lake and thus maintain the fishery. As stated in the response to the previous question, it was concluded that importing Missouri River water was the best solution. It is important to note that those plans were focused on stabilizing Devils Lake through construction of an inlet and an outlet.

In answer to the stabilization question, if the State would have had a project in place to pump water into Devils Lake in 1993, the project would have also included an outlet. In the spring of 1993, Devils Lake was in its proposed normal operating range, and water would not have been pumped into the lake. Thus the level of Devils Lake prior to the current wet period would likely not have been any different than what it actually was in June, 1993.

With the onset of the flood situation in July of 1993, the outlet would have been put into use as conditions permitted. That outlet would have removed an average of 100,000 acre-feet of water each year. Estimating a total withdrawal of 400,000 acre-feet, the lake would now be roughly six feet lower than it is today. At $25 to $30 million damages per foot of elevation on the lake, the outlet project could have provided a significant savings to the nation, the State, and the region compared to what we have experienced without it.

Question 3. What is the State's position regarding the contribution of agricultural drainage to Devils Lake water level rise?

Answer: We at the State level believe that agricultural drainage in the Devils Lake watershed has not contributed significantly to current flood damages at Devils Lake. Nonetheless, the State has initiated an effort throughout the Devils Lake basin to close any illegal drains that may exist.

Determining the amount of flood storage potential that exists in drained wetlands has been a difficult issue that we continue to address. At our request, both the U.S. Geological Survey and the U.S. Bureau of Reclamation have begun test case studies in an effort to address this issue in detail.

Based on current evidence, staff hydrologists, U.S. Geological Survey hydrologists, and ND Geological Survey geologists have concluded that wetland drainage does not contribute significantly to the current Devils Lake flooding problem. These experts point out that the climatic wet cycle we find ourselves in is a far greater factor in the flooding. They point out that Devils Lake has overflowed to Stump Lake a number of times as well as to the Sheyenne River long before European settlement al-

tered the landscape. Attached is an article by Dr. John Bluemle, North Dakota State Geologist, to further explain the situation.

I hope these responses are adequate. If you need further clarification or have additional questions, please contact me at your convenience.

Sincerely,

DAVID A. SPRYNCZYNATYK,
State Engineer.

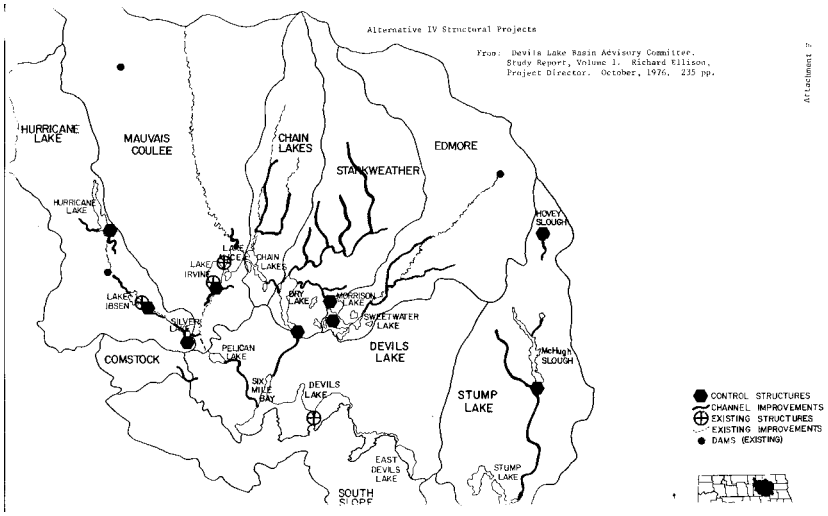
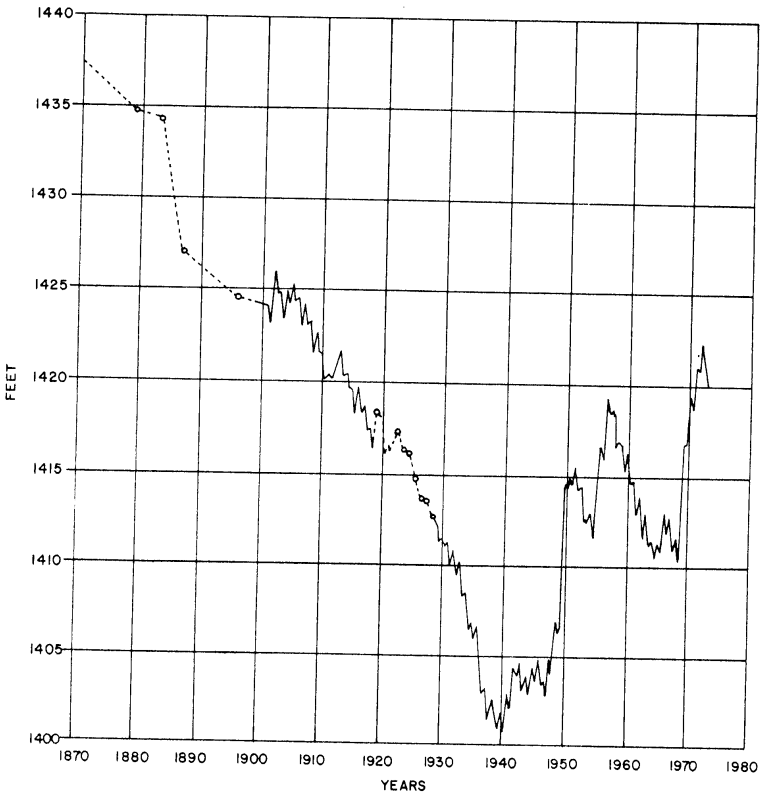


Fig., 17

From Devils Lake Basin Advisory Committee. Study Report, Volume 1. Richard Ellison, Projtec Director, October, 1976. 235 pp.



[From the North Dakota Weekly, July 23, 1996]

DEVILS LAKE "COULD" RISE ANOTHER 20 FEET

(By John Bluemle)

DEVILS LAKE—Once again this summer, many of us are anxiously observing the level of Devils Lake, wondering just how high the water level may rise.

The behavior of Devils Lake seems to cause no end of consternation to any number of people. Residents of the area are rightly concerned as their roads and property are flooded and many of them feel frustrated because it seems to them that little has been done or can be done to deal with the problem.

As a geologist with the North Dakota Geological Survey, I've been studying the geology of the area around Devils Lake. off and on, since 1962. One of the first reports I wrote as a professional geologist with the North Dakota Geological Survey was on Devils Lake. It dealt with the way the glaciers formed the lake basin, Sully's Hill, and related geologic features in the area.

Over the years, I've continued to study Devils and Stump lakes. Most of my work In the area has dealt with the geology, explaining why the lakes are there and how they formed. For example, Devils and Stump Lakes occur In a depression that resulted when the glacier picked up and moved—thrust or pushed—large amounts of material southward, piling them up and forming the range of hills just south of the lakes.

Sully's Hill Is the highest point in this jumble of Ice-thrust material. Maybe I'll devote one of my weekly columns sometime soon to a discussion of the geology of the Devils Lake area.

I also pointed out in my early studies that an important aquifer system, the Spiritwood Aquifer directly underlies the lake chain and that the groundwater in that aquifer can and does interact with the water in the lakes. At times, this interacting relationship causes Devils Lake to behave in an apparently anomalous manner (rising during drought years, falling during rainy times depending upon whether the groundwater is flowing into or out of the lake from the aquifer).

Several of my studies have dealt with the fluctuations In the lake levels and the reasons they occur. A study I did several years ago dealt with some of the problems of understanding the behavior of a lake In an enclosed basin. Without going Into great derail here, my conclusion was that, ultimately, Devils and Slump Lakes fluctuate in response to climatic changes.

These changes are cyclic, extreme, long-term, and inevitable.

Recently, I reviewed data in the North Dakota Geological Survey lakes and I was able to compile a new chart to illustrate how the level of Devils Lake has fluctuated over the past 4,000 years (see chart). The chart is generalized and probably the most important thing to note when looking at it is not the specific limes that the lake dried up or overflowed—it's not that accurate. Rather, the important consideration is the overall frequency and extremes of the fluctuations in the level of the lake.

Devils Lake has dried up completely at least five or six times during the past 4,000 years, and it has overflowed into the Sheyenne River at least three or four times (and probably many more times than that, but my data don't allow me to be more specific). Devils Lake also almost certainly has overflowed into Stump Lake many more times than I've shown on my chart, but again, my data aren't specific enough to allow me to determine how often.

The climatic cycles that result in rising and falling conditions in Devils and Stump Lakes are poorly understood, but they tend to be long-term events. That is, the lakes may experience overall rising or drying conditions for well over 100 years at a time. The current rising cycle began about 1940—only 56 years ago. The previous cycle ended In 1940, or after at least 110 years of generally falling lake levels. That is, In about 1830 or perhaps a little earlier. Devils Lake and Slump Lake were joined as a single lake and there is even some evidence that the water may have overflowed briefly Into the Sheyenne River at about that time.

Going back just a little further, we know that the lakes essentially were dry for a period of perhaps 150 years during the late 15th century to the late 17th century. Oak trees grew on the dry floor of East Stump Lake during that time. Following that dry period, the water levels tended to rise until the early 19th century.

I really only want to make a couple of points today. In at least two of my articles several years ago I noted that the actions of man during the last 100 years or so—since settlement of the area—are not an important factor In determining the behavior of the lake. That should be obvious from a quick look at the chart I've drawn:

the lake rose and fell often and dramatically before European settlers arrived on the scene.

Clearly, the natural condition for Devils Lake is either rising or falling, either toward overflow or dry lake bed.

The lake should not be expected lo maintain a stable level or to remain long at any given level. Only an inlet and an outlet can remedy this situation.

Ideally, the goal should be to stabilize and freshen the lake and, in my opinion, this would be best done by constructing an Inlet near the west end of Devils Lake and an outlet at the east end. However, that's not my decision to make, as the North Dakota Geological Survey is not involved in policy issues relating to the lake.

Barring direct intervention (construction of an inlet and/or outlet to the lake) how high can we expect Devils Lake to rise?

I won't make specific predictions—short-term predictions are better left to the National Weather Service—but I would like to point out that there IS no reason to believe that the lake will not rise another 20 feet—until it overflows into the Sheyenne River—before the present cycle has run its course and a new, long-term cycle of declining water levels begin.

Please note that I did not say that the lake will rise 20 more feet. I said that there is no geologic reason to say that it can't or won't do that. It has happened several times in the past and it can happen again.

STATE OF MINNESOTA,
OFFICE OF THE GOVERNOR,
October 23, 1997.

THE HONORABLE JOHN CHAFEE, *Chairman,*
Committee on Environment and Public Works,
Dirksen Senate Office Building,
Washington, DC 20510.

DEAR MR. CHAIRMAN: Thank you for holding a hearing today to discuss the Devil's Lake "Emergency" Outlet project. This project could have great impact on Minnesota if completed as currently proposed. Because of this fact, I am deeply concerned that no one from Minnesota was asked to participate in today's hearing. I respectfully ask Hat testimony prepared by my Department of Natural Resources be included in the hearing record, and request that if another hearing is called on this project, Minnesota be included.

Thank you for your consideration of this matter.

Warmest regards,

ARNE H. CARLSON,
Governor.

TESTIMONY OF RON NARGANG, DEPUTY COMMISSIONER, MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Mr. Chairman, thank you for this opportunity to brief the Environment and Public Works Committee on Minnesota's concerns regarding the Devil's Lake "Emergency" Outlet project. I am Ronald Nargang, Deputy Commissioner of the Minnesota Department of Natural Resources (MDNR). Historically, the States of Minnesota and North Dakota have a long-standing tradition of working together cooperatively on interstate natural resources issues. The ongoing recovery process from the spring floods of 1997 is one such example of the cooperative nature of this relationship. However, the State of Minnesota is very concerned about the proposed outlet at Devil's Lake and appreciates the opportunity to provide comments. This statement outlines the concerns of the Minnesota Department of Natural Resources and Minnesota Pollution Control Agency.

It is imperative that a comprehensive review of the project, including an Environmental Impact Statement, be performed on the project to determine its potential effectiveness and impacts before any work on the project is initiated. If the review shows the project to be ineffective or environmentally damaging, the project should not proceed.

Issues that must be addressed include:

Cost-benefit Analysis—The U.S. Army Corps of Engineers (USAGE) estimates that an outlet project will cost a minimum of $21,000,000.00, with annual operation and maintenance costs estimated to be $700,000.00. The Emergency Outlet Plan determined that if the project had been in place and in operation from 1985—1995, a lake level reduction of only 1.1 feet would have been realized, at significant construction, maintenance, and operational costs.

In addition, the analysis by the USACE showed that, through 1994, outlet operation would have been constrained largely by the sulfate standard because of the high salinity of Devil's Lake. By 1995, the rising lake was diluted to the point where bank-full and pumping capacities would have been the constraining factors. Significant damage would still have occurred with only this limited amount of project effectiveness. Any review of the project must include a cost-benefit analysis to determine if this is a wise expenditure of Federal tax dollars.

Changes in Red River Water Quality Analysis—The Emergency Outlet Plan states that operation of the outlet will raise Total Dissolved Solids (TDS) along the Sheyenne and Red Rivers. Although the Sheyenne River has no TDS standard, the Red River standard and International Border objective of 500 mg/l TDS is already exceeded under without project conditions; consequently, outlet operation could increase the frequency, duration and magnitude of those occurences.

Specific analyses of the changes in total dissolved solids, total suspended sediment (TSS)/turbidity, chloride, sulfate, and phosphorus levels must be performed for the Red River and the Sheyenne River. Some parameters were analyzed in the Emergency Outlet Plan, but more complete modeling for both rivers should be performed. The analysis of changes in TSS levels should factor in any increases in erosion of the Sheyenne River channel from increased flows. Effects on the fishery of the Red River due to changes in these water quality parameters must also be assessed.

Environmental Effects—The Emergency Outlet Plan states that construction and operation of the emergency outlet will impact an estimated 970 acres of wetlands, woods and grasslands along the Twin Lakes outlet route. In addition, most of the outlet route has not been surveyed for cultural resources, nor has the outlet route been inventoried for traditional cultural properties. Any outlet study must include the development of an extensive monitoring program to address areas of impacts on natural and cultural resources, bank erosion, municipal water supply, etc.

Operational Plan Parameters—Parameters and triggers based on lake level and water quantity and quality impacts on the Sheyenne River were included in the Emergency Outlet Plan. These should be addressed in the current study, and expanded if analysis of the parameters described above shows negative effects on the Red River.

Alternatives Evaluation—The no-action alternative, wetland restoration and upper-basin storage in the Devils Lake Basin, alternative transportation systems and alternative methods of supplying emergency services to residents around the lake should all be explored in the current study. The USACE in earlier reports and studies has stated that an outlet alone will not dramatically lower the level of Devil's Lake.

Relationship to the Garrison Diversion Project—Though separate projects, the Devil's Lake Outlet and the Garrison Diversion Project are often said to be linked together. It is important that any planned connection between the two projects be fully explained. If the projects are in fact "connected actions", the current study should factor effects of the operation of the Garrison Diversion Project into all aspects of the review.

I ask the committee to review these issues very carefully as it deliberates authorizing this project. As the impact of this project on Minnesota could be substantial, I also ask that our State be included in deliberations to the greatest extent possible. To that end, please call on me for any further information you may require regarding Minnesota's position on the Devil's Lake project. Thank you.

Project: Devils Lake Basin, North Dakota

Purpose/River Basin: Flood Control and related purposes—Red River of the North

Status/Schedule: In 1993, the Corps of Engineers and the North Dakota State Water Commission agreed to proceed with a cost-shared feasibility study. Due to increasing lake levels since 1993 and the threat of further flood damages, the Corps is accelerating portions of the flood control project selected in the reconnaissance report at the request of the North Dakota congressional delegation. In February 1996, a contingency plan was prepared that presented possible options that might be implemented if the lake continued to rise. As a follow-up of the Contingency Plan, an Emergency Outlet Plan was prepared in August 1996 that presented a plan for an outlet from Devils Lake to the Sheyenne River that could be implemented in an accelerated time frame, within a 3-year period. The emergency outlet is being debated at the State, Federal and local levels. The other longer term aspects of the feasibility study are proceeding.

Location and Description: Devils Lake is located in a closed basin in semi-arid northeastern North Dakota. Depending on climatological patterns, the lake is subject to extreme variations in stage. Both low and high levels cause major problems.

Devils Lake is highly saline; at low stages, salinity concentrations are so great that fish and wildlife are seriously affected; in addition, boat access around the lake is cut off end the area's recreation-related income (exceeding an estimated $50 million annually) is threatened. High lake levels cause urban, agricultural, and transportation flood damages. A repeat of the highest recorded lake level would cause over $250 million in flood damages.

Background/Discussion: A draft feasibility report, released in April 1988, recommended a flood control outlet from Devils Lake to the Sheyenne River. However, the North Dakota State Water Commission withdrew support for the project, citing a need to include an inlet for lake stabilization. As a result of a 1990 Senate Committee resolution, the Corps issued a draft reconnaissance report in February 1992 addressing both an inlet and an outlet. The likely source of inlet water is the Garrison Diversion Unit; thus, the Bureau of Reclamation has been involved in the study.

Additional Considerations/Issues: The most feasible inlet and outlet routes cross the Fort Totten Indian Reservation. There is concern about biological contamination of Devils Lake should Missouri River/Garrison Diversion water be used to stabilize Devils Lake. Downstream interests in the Red River basin and Canada are concerned about the release of Devils Lake water for flood control purposes, both because of the biotransfer issue and the lake water's high salinity. A major issue with this study is the low priority emphasis the Corps places on a lake inlet, whereas the State of North Dakota is strongly in favor of controlling both high and low levels.

Summarized Financial Data: (The feasibility study is being cost-shared: 50 percent Federal/50 percent non-Federal)

Allocations to Date (Federal)	$2,275,000
Balance to Complete (Federal)	2,170,000
Total estimated Federal Cost	$4,445,000

Authority/Project Authorization: Resolution of the Senate Committee on Environment and Public Works, dated March 27, 1990, which calls for a study of water management, stabilized lake levels, water supply, water quality, recreation, water pollution abatement, and fish and wildlife enhancement and conservation.

Contact Person: William Spychalla, Project Manager Phone: 612–290–5727

Information Paper Prepared by: St. Paul District, U.S. Army Corps of Engineers, February 1997

Project: Devils Lake Levee, North Dakota

Purpose/River Basin: Flood Control—Red River of the North

Status/Schedule: The Stage 1 construction contract was awarded in September 1996 to Wanzek Construction, Fargo, North Dakota. The contractor is making excellent progress. Over 60 percent of the Stage 1 levee has been brought up to final grade and 45 percent of riprap has been placed bringing the city to a current protection level of 1443.0 feet above mean sea level (msl). Modification work at the pump station is complete. Total Stage 1 completion is scheduled in September 1997. In October 1996, the Devils Lake City Council passed a resolution of approval for the final Stage 2 levee alignment adjacent to Highway 20. Stage 2 plans and specifications are underway and are scheduled for completion in February 1997. The final construction contract is scheduled for award in April 1997, with total project completion in October 1997.

Location and Description: The Devils Lake basin is in northeastern North Dakota, in the northwest corner of the Red River of the North basin. The project provides a 5-foot raise of the city of Devils Lake existing levee system (completed in 1985) and approximately 3.7 miles of new levee, designed for a lake elevation of 1445.0 feet above met with 3 to 5 feet of freeboard.

Background/Discussion: By resolution dated 17 June 1996, the city of Devils Lake formally requested emergency assistance from the Corps to raise the city's protection dikes to elevation 1445 plus necessary freeboard of 3 to 5 feet. On 9 July 1996, the State of North Dakota formally requested Corps of Engineers assistance in the construction of the upgrade of the existing levee system protecting the city. Increasing lake levels and wave action could result in catastrophic failure of the existing levee system. If this happened, over $50 million in damages would occur. Given the height of the existing levee, an imminent threat of loss of life would also exist. The

project was approved under Public Law (PL) 84–99 Advance Measures Authority and a Project Agreement was signed on 12 August 1996. The project is being constructed in two stages. Stage 1 consists of raising the existing Creel Bay embankment on the southwestern portion of the city, modifications to the Creel Bay Pump Station, and providing tieback levees. Stage 2 consists of a new levee section on the south side of the city just east of Highway 20 and a new levee section adjacent to Highway 2 at the east side of the city. As designed and constructed, the project will be certified to provide protection for a lake elevation of 1445.0 feet msl. A potential certification concern by the Federal Emergency Management Agency (FEMA) involves the deferred levee construction/road raise at four locations. This issue is being coordinated with FEMA.

SUMMARIZED FINANCIAL DATA

Estimated Federal Cost	$5,250,000
Estimated non-Federal Cost	1,750,000
Cash/In-Kind	(1,496,000)
LERRD's	(254,000)
Total Estimated Project Cost	$7,000,000

AUTHORITY/PROJECT AUTHORIZATION: PL 84–99 Activities (Advance Measures).

CONTACT PERSON: William Spychalla, Project Manager Phone: 612–290–5727

INFORMATION PAPER PREPARED BY: St. Paul District, U.S. Army Corps of Engineers, February 1997

STATEMENT OF GARY L. PEARSON, SOUTH DAKOTA PRAIRIE AUDUBON SOCIETY

The rising level of Devils Lake in recent years has caused millions of dollars of damage to roads and other developments and it has created tremendous hardships for many people living near the lake. The problems are serious, and they require solutions that are rational and effective, are based on sound hydrologic and engineering analyses, and are economically justified and environmentally responsible. Unfortunately, the proposed emergency outlet from Devils Lake to the Sheyenne River fails—and fails dismally—to meet any of these criteria.

In considering the problems created by the high water levels at Devils Lake, it is necessary to recognize that we are dealing with a natural phenomenon, but a man-made disaster.

The geologic record shows that Devils Lake has never been a stable lake and that it naturally fluctuates between wide extremes on a cyclic schedule. The lowest point at the bottom of Devils Lake is 1397 feet above mean sea level (msl), and Devils Lake has gone completely dry five times in the past 4,000 years. The lake also has twice reached a level of 1457 feet msl, where it overflowed naturally into the Sheyenne River, once about 2,200 years ago and again about 1,000 years ago. During the past 4,000 years, the lake has fluctuated between these extremes another eight times.

The last time that Devils Lake was completely dry was about 350 years ago and it then rose to a level of about 1445 feet met in the early 1800's, after which it again began to decline. The first recorded level for the lake was 1438 feet in 1867, so the lake was declining as the area was settled in the early 1880's. In his 1911–1912 Biennial Report, the North Dakota State Engineer outlined a proposal to restore Devils Lake to an elevation of 1439 with water diverted through a canal from the Souris (Mouse) River. In his report, the State Engineer noted that:

"The drainage area of Devils Lake is nearly two thousand square miles, but the land lies so nearly level, and there are so many marshes, meadows, small ponds and lakes which arrest the flow of water and from which it evaporates, that it is not likely that the run-off from more then seven hundred to eight hundred square miles of the total area ever reaches the lake." (Attachment No. 1)

In 1927, a proposal was developed to restore Devils Lake with water diverted from the Missouri River, and the Flood Control Act of 1944 authorized the Missouri-Souris Diversion Unit to deliver water from the Missouri River to irrigate 1,000,000 acres principally in northwestern North Dakota and to restore Devils Lake. When soils studies showed the land was not irrigable, the project was abandoned, and a 250,000 acre Garrison Diversion Unit was then authorized in 1965 to replace it. The Garrison Diversion project also included a plan to "freshen" Devils Lake with Mis-

souri River water while discharging the lake's saline waters through an outlet to the Sheyenne River. However, by 1974, the Bureau of Reclamation had abandoned the outlet because of its adverse impacts on the Sheyenne and Red rivers (U.S. Bureau of Reclamation, 1974).

The Creation of an Emergency

As the level of Devils Lake continued to decline in the first half of this century, roads, railroads and other developments encroached more and more on the dry lake bed, each generation gambling that the lake would not return in their lifetimes. Even after the lake reached its modern day low of 1400 feet in 1940 and began to rise again, development on the lake bed continued. The town of Minnewaukon and the City of Devils Lake located their sewage lagoons on low land near the lake because it was less costly than building them on higher land where they would be less vulnerable to flooding. Despite recognition that the area was too low, the Devils Lake Industrial Park also was located in an area vulnerable to high water tables and flooding as the lake rose (Attachment No. 2). In addition, private individuals and commercial developers were permitted to build homes and businesses on the shore of the rising lake.

Simultaneously with development around Devils Lake itself, agricultural development resulted in extensive drainage of wetlands throughout the watershed, especially in the northern areas of the Devils Lake Basin. As wetland drainage intensified after World War II, flooding problems escalated in the lower portion of the basin, creating momentum for even more drainage to send the water on downstream. By 1955, the problems created by wetland drainage throughout the State had become so great that the North Dakota Legislative Assembly passed a statute requiring permits from county water boards before wetlands were drained. At the same time, flooding problems had become so severe in the lower portions of Devils Lake Basin as a result of wetland drainage in the upper portions of the watershed that the State Water Commission declared a moratorium on drainage in the Basin. However, the chairman of a local water board announced publicly that farmers would continue to drain their wetlands regardless of State laws or the Water Commission's moratorium. The Water Commission made no attempt to enforce its moratorium, the county water boards made no effort to enforce the drainage statute, and rampant wetland drainage continued throughout the Basin, as well as throughout much of the rest of eastern North Dakota. (See Attachment No. 3)

As the problems created in the lower portion of the Devils Lake Basin increased with drainage in the upper watershed, the U.S. Department of Agriculture's Soil Conservation Service, with the support of local drainage interests, the North Dakota Congressional Delegation and the Governor, was authorized in 1967 to begin planning of a 246,477 acre Starkweather Watershed Project in the northern portion of the Basin. Under the guise of controlling flooding of agricultural land, the project would have involved construction of 60 miles of channels to drain some 60,000 additional acres of wetlands and lakes and to carry the water directly into Devils Lake. However, passage of the National Environmental Policy Act in 1969 forced the SCS to prepare an environmental impact statement on the project and this, coupled with congressional oversight hearings, resulted in the Department of Agriculture abandoning the project in 1973. (See Attachment No. 3)

Undeterred by the revelations of the Starkweather Watershed Project's adverse impacts, drainage proponents pushed for the State to build Channel "A," the Starkweather project's 2,000 cfs main drainage channel that would divert the flood waters accumulating in the lower part of the Basin directly into Devils Lake. Consequently, in 1975, the North Dakota Legislature established a Devils Lake Basin Advisory Committee, dominated by drainage interests, to study water management problems in the Basin and to recommend solutions. However, at the same time, the Legislature also authorized construction of Channel "A," thus precluding any chance of the Committee's recommendations not including this feature. One proposal for dealing with the flooding problem in the Basin was restoration of 96,000 acres of drained wetlands (Attachment No. 4). However, the Committee's report instead recommended over 200 miles of channelization, including Channel "A," to facilitate wetland drainage throughout the Devils Lake watershed and rush more water into Devils Lake faster, and it included no specific recommendations for wetland restoration (Devils Lake Basin Advisory Committee, 1976).

Although the cost participation agreement for Channel "A" between the State Water Commission and local water boards was supposed to prohibit further drainage of wetlands in the Starkweather and Edmore watersheds, virtually no effort has been made by the Water Commission or the local drainage boards to enforce the prohibition. In fact, the State Engineer himself approved a dozen drainage projects in the two watersheds between 1977 and 1982 (Attachment No. 5).

Despite escalating flooding problems at Devils Lake, wetland drainage continued in the Basin, aided and abetted by the State Water Commission, county water boards and local drainage proponents. For example, in 1977 the State Engineer approved a permit for the partial drainage of Hurricane Lake, adding up to 7,000 acre-feet of water to Devils Lake whenever run-off was excessive. Rampant wetland drainage was so widespread in the area that a 1979 report by the General Accounting Office cited the Devils Lake Basin as a specific example where extensive wetland drainage was followed by severe flooding in the lower portion of the watershed. Then in 1983, at the same time it was urging the Corps of Engineers to declare Devils Lake a flood disaster area and to construct outlet to the Sheyenne River, the Ramsey County Water Resource Board, without the required permit, constructed a ditch from Lake Irvine to drain up to 6,000 more acre-feet of water into Devils Lake, and a few months later, it approved a permit to drain Morrison Lake into Devils Lake.

It is clear, therefore, that the current "flood emergency" at Devils Lake is not the result of any sudden, unexpected natural disaster, but, rather, is a problem that has been developing over a period decades.

It is now estimated that a minimum of 189,000 acres of wetlands have been drained in the Devils Lake Basin, and that these wetlands had the capacity to store at least 491,000 to 926,000 acre-feet of water (Attachment No. 6). With evaporation, evapotranspiration and seepage, much of this storage was renewable on an annual or even more frequent basis (Attachment No. 6). Instead, however, most of the water from these drained wetlands now finds its way directly into Devils Lake.

It is against this background of ill-advised and frequently irresponsible water resource management, predicated on the water management philosophy of creating a flood and then dumping it downstream, that the current Devils Lake Outlet proposal must be considered.

It is, of course, axiomatic that without high levels of precipitation, flooding in the Devils Lake Basin would less severe, and that with high precipitation levels, Devils Lake would still rise even if there had been no wetland drainage in the Basin. However, common sense tells us that the drainage of 189,000 acres of wetlands capable of storing nearly a million acre-feet of water accelerates the rate and intensifies the severity of flooding around Devils Lake at any given level of precipitation. Thus, the encroachment of development on the bed of Devils Lake coupled with extensive wetland drainage throughout the Basin set the stage for disaster when heavy precipitation returned 4 years ago. Between 1970 and 1993, Devils Lake had fluctuated between elevations of 1420 and 1429 feet, and in 1993 it stood at 1424 feet. However, with the high levels of precipitation since 1993, the lake rose seven feet to elevation 1431 feet in 1994, then seven more feet to elevation 1438 in 1996, and this year it reached 1443 feet msl.

Lack of Economic Justification

In 1990, the Corps of Engineers was authorized to conduct a study of the Devils Lake Basin, including plans for an inlet and an outlet. However, the Corps concluded that an outlet would produce only $0.39 in benefits for each dollar of cost (U.S. Army Corps of Engineers, 1994). In February, 1996, the Corps released a Devils Lake Contingency Plan that had been developed at the request of the North Dakota Congressional Delegation. The plan discussed a variety of measures to deal with the flooding problems in the Devils Lake Basin, including storage of water in drained wetlands (estimated by the Corps to have a potential of 657,000 acre-feet, which is equivalent to about seven feet off the current level of Devils Lake), raising roads, raising the dike protecting the City of Devils Lake, dining and moving houses, and flood insurance, as well as construction of an outlet to the Sheyenne River (U.S. Army Corps of Engineers, 1996a). No benefit/cost analysis was provided for the outlet.

Since the Corps calculated that the benefit/cost ratio of an outlet would be only 0.39/1.00, well over $100 million have been spent to move some 300 houses and other structures, to raise roads, to build and raise dikes and to implement other measures to minimize the damages resulting from the high water levels (Attachment No. 7), thus reducing even further any benefits of an outlet. It is obvious, therefore, that the proposed outlet from Devils Lake is devoid of any economic justification.

Lack of Engineering Feasibility

Disregarding other components of the Corps' 1996 Contingency Plan and the lack of economic feasibility of an outlet disclosed in the Corps' 1994 report, in May, 1996, the North Dakota Congressional Delegation requested that the Corps select an outlet plan from its 1996 report and, within 90 days, develop a Devils Lake Emergency

Outlet Plan which would be compatible with an inlet to bring Missouri River water into the lake (U.S. Army Corps of Engineers, 1996b). With discharges restricted to a period from May through November and limited by water quality in Devils Lake and the channel capacity of the Sheyenne River, the Corps selected a 200 cfs outlet plan. The Corps estimated that, had the outlet been in operation in 1994, it would have lowered the level of Devils Lake by only 13 inches by October of 1995 (U.S. Army Corps of Engineers, 1996b). However, the lake still would have risen five feet with the outlet in operation (U.S. Army Corps of Engineers, 1996b), and it would have risen another five feet since 1995. As the Corps points out:

". . . a 1-day, 1-inch rainfall on the lake is equivalent to an inflow of over 3,000 cfs, 15 times the EOP's 200-cfs design capacity. Big Coulee and Channel A inflows also exceeded 3,000 cfs in the spring of 1995." (U.S. Army Corps of Engineers, 1996b)

The inadequacy of an outlet in solving the high water problems at Devils Lake is further demonstrated by comparing its discharge under optimum conditions of some 75,000 acre-feet per year with the inflows to the lake from Channel "A" alone, which were 145,200 acre-feet in 1993, 73,420 acre-feet in 1994, and 116,756 acre-feet in 1995 (U.S. Army Corps of Engineers, 1996a). In other words, in addition to being economically infeasible, the proposed Devils Lake outlet simply wouldn't work to prevent flooding around the lake.

Lack of Environmental Impact Analysis

Although the proposed outlet would do little to alleviate the high water problems at Devils Lake, it would create substantial problems downstream on the Sheyenne River and on the Red River of the North, which forms the border between North Dakota and Minnesota and flows into Manitoba. In the area where the outlet would discharge, the Sheyenne River could more accurately be characterized as a small prairie creek, with a maximum channel capacity of 500 cfs (U.S. Army Corps of Engineers, 1996b). Typically, prairie streams are characterized by high flows in the spring and at times of heavy precipitation, but generally low flows the rest of the year.

The Corps' Emergency Outlet Plan report notes specifically that the environmental effects of the outlet to Devils Lake and the Sheyenne River had not been addressed, and it emphasizes that:

"Due to the preliminary nature of the EOP and uncertainties regarding effects from operation of the outlet, more detailed information is required to fully identify the impacts of an emergency outlet." (U.S. Army Corps of Engineers, 1996b)

However, the Corps acknowledges that:

"Potential effects include changes in flow conditions, water quality, and groundwater elevations that, in turn, may result in subtle, long-term changes to existing ecosystems and may not be readily noticeable or quantifiable without extensive monitoring programs." (U.S. Army Corps of Engineers, 1996b)

We do know that subjecting the Sheyenne River to prolonged periods of high flows with discharges from the Devils Lake Outlet will alter its hydrologic characteristics and result in destabilization, erosion and remodeling of the stream bed, with the sediments being deposited downstream in Lake Ashtabula where they will cause degradation of water quality and deterioration of the fishery. It will take decades for the channel to adjust to the new flow regimen and to restabilize.

Those living downstream on the Sheyenne and Red rivers know that, when Devils Lake continues to rise after the outlet is constructed, the same pressures will then mount again to increase the discharge from the 200 cfs outlined in the Corps' Emergency Outlet Plan, thus further escalating the downstream impacts. In fact, even before the first spade of dirt has been turned for construction of the outlet, the North Dakota State Engineer already has proposed increasing the discharge to 300 cfs (Attachment No. 7). In the meantime, if the outlet is constructed following this piecemeal approach, the Congress can expect the North Dakota Congressional Delegation to be coming back again and again over the years for more millions of dollars to "mitigate" the impacts of the outlet they are asking this Committee today to endorse.

Other potential adverse impacts of the outlet already identified by the Corps's preliminary reconnaissance-level study include (1) worsening of future low-level situations where removal of water could jeopardize the Devils Lake fishery, (2) increased mercury levels in downstream aquatic systems, (3) persistent high sulfate levels in Lake Ashtabula on the Sheyenne River during drought conditions, (4) higher water treatment costs for cities using river water (which include Fargo and Grand Forks, North Dakota), and (5) increased frequency, duration and magnitude of violations of North Dakota, Minnesota and International Red River Total Dissolved Solids standards (U.S. Army Corps of Engineers, 1996b). These potential ad-

verse impacts have not yet been adequately evaluated to permit a determination of whether or not they can be effectively mitigated or, if they can, the cost of doing so. The Corps notes:

"Consequently, the outlet should not be operated unless a serious flood threat is developing. Unfortunately, lake behavior is not predictable." (U.S. Army Corps of Engineers, 1996b)

Proponents of the Devils Lake Outlet argue that, without the outlet, if Devils Lake continues to rise to 1457 feet msl and overflows to the Sheyenne River, the natural outlet will wash out, causing devastating floods downstream on the Sheyenne and Red rivers (Attachment No. 8). However, Devils Lake has overflowed to the Sheyenne River in the past without washing out the natural overflow channel (Attachment No. 9). As we already have seen, the capacity of the outlet would be only a fraction of the volume of the inflows, so if Devils Lake is destined to overflow to the Sheyenne River, it will do so whether or not the outlet is built. In the meantime, the Devils Lake Basin has the capacity to store an additional 2,000,000 acre-feet of water that would not impact downstream areas even if the lake were to overflow naturally. Of course, if Devils Lake should reach 1457 feet, it will not matter to those downstream on the Sheyenne and Red rivers whether the water comes from the proposed emergency outlet or from the natural outlet, or both.

It would be difficult to imagine a more perfect example of the exact kinds of problems that the National Environmental Policy Act was intended to avoid. In fact, only 3 months ago, Senators Dorgan and Conrad agreed to an amendment to the fiscal year 1998 Energy and Water Development Appropriations Act, which appropriates emergency funding for construction of the outlet, requiring, in part, that:

". . . the construction is technically sound, economically justified, and environmentally acceptable and in compliance with the National Environmental Policy Act of 1969 . . ." (Congressional Record, July 15, 1997, S7484))

However, just last week, under pressure from our North Dakota Congressional Delegation, President Clinton declared the Devils Lake outlet to be "an emergency requirement" (Attachment No. 10). Senator Conrad asserts that this declaration somehow compels construction of the outlet without preparation of a full environmental impact statement, without consideration of other more effective and feasible alternatives and without addressing the adverse impacts of the outlet until after they have occurred (Attachment No. 11). We strongly disagree with this interpretation, which is neither wise policy nor a legal requirement.

Curtailed Public Information and Stifled Debate

The Corps' 1996 report on the Emergency Outlet Plan, Devils Lake, North Dakota, states explicitly that:

"While the EOP lacks much field data to verify existing conditions and a full assessment of impacts, it will be a common reference point for discussions among interested parties regarding the practicability and implementability of an emergency outlet." (Emphasis added) (U.S. Army Corps of Engineers, 1996b)

However, despite widespread opposition to the outlet from downstream residents, other States, Manitoba and Canada, and conservation and water resource organizations (Attachments No. 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22), little factual information on the outlet has been provided to the public, and no forum has been established to permit meaningful public discussion of the outlet proposal. In fact, when residents of the Sheyenne River traveled to Bismarck last winter to present petitions opposing the outlet, Governor Schafer would not even meet with them. Now, the North Dakota Congressional Delegation is attempting to foreclose any further substantive opportunities for public participation in decisions regarding the proposed outlet by circumventing the NEPA process.

Meanwhile, despite the unequivocal evidence that the proposed outlet would be ineffective in controlling the level of Devils Lake, proponents of the plan are misleading the public with fraudulent claims that an outlet is "a permanent solution" to the problems caused by the rising lake (Attachment No. 23). Clearly, there can be no meaningful debate when the public is deprived of factual information on the outlet and is provided instead with such patently false promotional propaganda.

An Outlet Means An Inlet

While the North Dakota Congressional Delegation is telling the Congress that it has abandoned all thoughts of seeking authorization for an inlet and is now interested only in an outlet from Devils Lake, politicians and proponents of the outlet are telling a very different story back in North Dakota. For example, Devils Lake Mayor Fred Bott was quoted in July as saying that an inlet is less important now and:

"We so desperately need the outlet. That's what we need to deal with right now." (Attachment No. 24)

At the same time Devils Lake Emergency Management Committee co-chairman Vern Thompson also was quoted as saying that now is not the time to debate an inlet and:

"We've got to take this thing one step at a time, and an outlet is our big issue now. Let's do what we can today, and deal with the rest of it at a later date."

(Attachment No. 24).

A month later, in typical North Dakota water management style, Thompson was again quoted as saying:

"I'd rather piecemeal this together than take a shot at the grandiose plan and lose it all." (Attachment No. 25)

On July 30, Senators Dorgan and Conrad were reported to have reminded North Dakota water development interests that the Congress still can authorize the inlet later (Attachment No. 24).

Then in an August 1, 1997, letter to Senate Majority Leader Trent Lott, Governor Schafer and the Majority Leaders of the State Legislature protested that:

". . . Abandoning for all time the possibility for an inlet runs contrary to the statewide water development plan, which envisions stabilization of Devils Lake. It represents a significant statewide policy shift, made suddenly at the Congressional level with minimal input from North Dakota." (Attachment No. 26)

When North Dakota State Engineer David Sprynczynatyk was discussing the Devils Lake outlet at the October 2, 1997, meeting of the Red River Basin Board, he was asked by a Canadian official about the State's plans for an inlet. Mr. Sprynczynatyk's response was:

"That's an issue for another day and time."

Thus, by their own admissions, North Dakota politicians and water development interests are steadfastly pursuing a calculated piecemeal strategy to construct an inlet to Devils Lake, and in September, Senators Dorgan and Conrad revealed their plan for getting the inlet built under the same guise they have used for the outlet: now it's an "emergency inlet." (in Attachment No. 27, Senator Conrad and Senator Dorgan outline how the need for an "emergency inlet" could be justified when the lake level begins to decline.)

The Real Motivation Behind the Outlet: the Garrison Diversion Project

It is instructive to note that the North Dakota Congressional Delegation is, at this moment, preparing to introduce legislation to amend the Garrison Diversion Unit authorization to include enhancement of fisheries habitat as a project purpose, thus providing for construction of an inlet whenever in the future the lake begins to decline. Indeed, the future already is here. In his October 2, 1997, "Review of Rough Draft Amendments for Garrison," Garrison Diversion Conservancy District Manager Warren Jamison points out to the Congressional Delegation that:

"You should note that no mention of Devils Lake stabilization is made. I understand that is the result of the February meeting with the conservation interests. This leaves Devils Lake stabilization as an authorized feature of the project by virtue of its inclusion in the 1965 Act. I support this under the circumstances." (Emphasis added) (Attachment No. 28)

Lest there be any doubt, the 1965 Garrison authorization included a 400 cfs inlet to deliver Missouri River water to Devils Lake and a 200 cfs outlet to the Sheyenne River (U.S. Bureau of Reclamation. 1965).

It is important to recognize that the real motivation behind North Dakota's pursuit of an ineffective and economically infeasible outlet from Devils Lake has little to do with any legitimate "emergency," but instead is simply another element of the State's strategy for piecemealing together its plan for a $1,500,000,000 Garrison Diversion project: with the current high water levels in Devils Lake, the outlet is needed before the inlet can be discussed, but as soon as the lake begins to decline, an "emergency inlet" can then be promoted, and of course to deliver Missouri River water to "stabilize" the lake through the inlet would require completion of the stalled Garrison Diversion project's principal supply system (Attachments No. 24, 29). Unfortunately, we are greatly concerned that the Administration has allowed itself to be duped into buying into the ruse, because the only "emergency" that the outlet would address is North Dakota's lack of justification for the Garrison Diversion project (U.S. Department of the Interior, 1990; Garrison Diversion Unit Task Group, 1990).

The impacts resulting from the transfer of Missouri River water into the Hudson Bay Basin under the Garrison Diversion project have been a matter of great concern to the governments of Manitoba and Canada. In 1975, the issue was referred to the

International Joint Commission, and after scientists from both countries studied the project for 2 years, the Commission concluded that:

". . . the impact of [the transfer of fish species, fish diseases and fish parasites indigenous to the Missouri River Basin into the Hudson Bay Drainage Basin] would be irreversible and would become apparent in about 10 years, with full impact in 25 to 50 years. If it were to occur, the undesirable foreign species which have a high reproductive potential could successfully compete for food and space, could replace indigenous forage fish, could alter the balance between existing predators and their prey, could carry parasites and could destroy some valuable present species. The inter-basin transfer could also introduce fish diseases by a water medium. In addition to the general ecosystem destabilization that could occur, the population of whitefish, walleye and sauger could be reduced by 50 percent in Lakes Winnipeg and Manitoba. This would, in turn, cause an annual loss of $6 million (Can.) to the commercial fishing industry of Manitoba and could possibly eliminate it. The Manitoba sports fishery could experience an annual loss of 26,000 recreation days and $130,000 in related revenue . . ." (International Joint Commission, 1977).

It also is important to note that, in the 20 years since the International Joint Commission issued its report, no reliable and economically feasible way has yet been developed to assure that the delivery of Missouri River water to Devils Lake would not result in violation of the Boundary Waters Treaty of 1909.

If this Committee has any doubt that construction of the Devils Lake outlet is simply the next step toward completion of the Garrison Diversion Unit and violation of the Boundary Waters Treaty, we would suggest that you ask Governor Schafer, Senator Conrad, Senator Dorgan, Congressman Pomeroy and the leadership of the State Legislature to sign pledges committing the State permanently to abandoning any and all efforts to secure an inlet to Devils Lake, and to reimbursing the U.S. Treasury for all costs associated with construction of the outlet if the State should violate its commitment.

Real Solutions for the Problems at Devils Lake

The problems at Devils Lake are serious and require solutions, but they are no different than the problems being faced by many others in the upper Midwest where rising lake levels are flooding roads and threatening homes. Unlike the disaster that hit Grand Forks in April, where the entire city was inundated in a matter of hours, the waters at Devils Lake have been rising gradually over a period of years, allowing ample time to move homes, raise roads, build dikes and implement other measures.

The single most effective solution for dealing with the rising level of Devils Lake is to continue progressive evacuation of the flood plain, to elevation 1457 feet met if necessary. As we learned after the 1993 flood on the Mississippi River, this may be the only really permanent solution.

Under the Corps' Emergency Outlet Plan, the trigger elevation for operation of the emergency outlet would be 1428 feet (U.S. Army Corps of Engineers, 1996b). The construction costs for the outlet are estimated at $34,000,000 with annual operation and maintenance costs of $1,500,000 (Attachment No. 7). The Corps estimates that an additional 63,000 acres would be flooded if the lake were to rise to elevation 1455 feet, and it also determined in 1994 that cropland in the Devils Lake area has a value of $557 per acre, pasture land has a value of $203 per acre and other lands including wetlands have a value of $150 per acre (U.S. Army Corps of Engineers, 1994). Therefore, if the full cropland price of $557 per acre were paid for all of the land that would be flooded to elevation 1455, the land still could be purchased for $35,091,000—less than the cost of building the outlet and operating it for 1 year.

In the meantime, the dike protecting the City of Devils Lake already is being raised to provide protection at a lake level of 1450 feet, and the dike could be raised further to provide protection to an elevation of 1457 feet where the lake would discharge naturally to the Sheyenne River. In addition, funding is available through programs such as the Conservation Reserve and Wetland Reserve to compensate farmers for water being held on their lands.

The inundation of roads creates inconvenience, although substantially less than was caused by the flooding of 370,000 acres when Garrison Dam was built 100 miles away on the Missouri River. Nevertheless, consideration could be given to maintaining key highways across the lake, either through continuing to raise the roads or constructing bridges.

Finally, restoration of wetlands should be encouraged, and if necessary required, throughout the Basin. Although this might not prevent Devils Lake ultimately from overflowing to the Sheyenne River, it would be far more effective than the proposed outlet in retarding the rise of the lake, and, unlike the outlet, it would significantly

reduce the volume of the flows if the lake ever were to discharge to the Sheyenne River.

RECOMMENDATIONS

In view of the many people downstream in North Dakota and in other States and Canada who would be affected by an outlet from Devils Lake but have been deprived of meaningful participation in decisions regarding the outlet, and in view of the substantial evidence of the outlet's lack of economic and engineering rationality or environmental acceptability, we strongly recommend that the Committee on Environment and Public Works reiterate to the President and the Executive Branch the requirements that the Congress has specified in the fiscal year 1998 Energy and Water Development Appropriations Act must be met before construction may be initiated on a Devils Lake Outlet. As you know, these involve a long list of prerequisites, including a report by the Secretary of the Army to the Congress confirming that "the construction is technically sound, economically justified, environmentally acceptable and in compliance with the National Environmental Policy Act of 1969."

We would further recommend that you advise the President that funds are available which, if necessary, could be used to expedite full NEPA compliance, but that the many interests that would be affected by the outlet and the substantial questions that exist regarding its economic feasibility, technical soundness and environmental acceptability dictate that standard NEPA procedures not be waived.

Thank you.

Gary L. Pearson, D.V.M. Vice President Dakota Prairie Audubon Society

REFERENCES

Devils Lake Basin Advisory Committee. Study Report, Volume 1. Richard Ellison, Project Director. 235 pp.

Garrison Diversion Unit Task Group. 1990. Garrison Diversion Unit Task Group Report. October 1990. 42 pp.

International Joint Commission. 1977. Transboundary Implications of the Garrison Diversion Unit. An IJC Report to the Governments of Canada and the United States. 144 pp.

U.S. Army Corps of Engineers. 1994. Devils Lake, North Dakota, Stage 1A, Issues Resolution Conference Agenda and Background Information. 20 pp.

U.S. Army Corps of Engineers. 1996a. Devils Lake, North Dakota, Contingency Plan.

U.S. Army Corps of Engineers. 1996b. Emergency Outlet Plan, Devils Lake, North Dakota. St. Paul District.

U.S. Bureau of Reclamation. 1974. Final Environmental Statement, Initial Stage, Garrison Diversion Unit, Pick-Sloan Missouri Basin Program, North Dakota, INT FES 74–3. U.S. Department of the Interior.

U.S. Bureau of Reclamation. 1965. Supplemental Report on Garrison Diversion Unit (Initial Stage—250,000 Acres), Garrison Diversion Unit, North Dakota—South Dakota, Missouri River Basin Project. November 1662 (Revised February 1965). Department of the Interior. 46 pp.

U.S. Department of the Interior. 1990. Final Audit Report. Garrison Diversion Unit Cost Allocation, Bureau of Reclamation. Office of Inspector General. Report No. 9049. 38 pp.

LIST OF ATTACHMENTS

1. Fifth Biennial Report of the State Engineer to the Governor of North Dakota For the Years 1911–1912. State of North Dakota Public Document No. 21. Knight Printing Company, Fargo. pp. 19–31.
2. Zaleski, John Ir. High Water Table Problem at New Industrial Park. Devils Lake Daily Journal (Devils Laker N. D.) August 18, 1981.
3. Pearson, Gary L. Draining the Great Marsh. USA Today. November, 1985. pp. 83–89.
4. Pearson, Gary L. Statement Submitted at the Public Meeting for the Devils Lake Basin Study, Bismarck, North Dakota, June 7, 1976.
5. Pahy, Vern, North Dakota State Engineer. Letter to President, North Dakota Chapter of The Wildlife Society. August 24, 1981.
6. Sapa, Allyn J., Field Supervisor, North Dakota Field Office, U.S. Fish and Wildlife Service. Letter to Steve Blomeke, Director, National Wildlife Federation. January 31, 1997.
7. Weixel, Gordon. State picks an outlet. Devils Lake Daily Journal (Devils Lake, N. D.) July 23, 1997.

8. Stromme, Floyd. Rising lake not just a problem for Devils Lake. The Forum (Fargo, N. D.) July 14, 1996.
9. North Dakota State Water Commission. News Release. Devils Lake Outlet Sedimentation Studies Completed. Undated.
lo. Clinton, William J. Statement by the President. October 13, 1997.
11. Associated Press. Clinton clears way for outlet. Jamestown Sun (Jamestown, N. D.) October 14, 1997.
12. Harris, Greg. Unconvinced. Residents along Sheyenne river respond coolly to Devils Lake emergency outlet proposal. Jamestown Sun (Jamestown, N. D.) October 3, 1996.
13. Thorfinnson, Hugh. Devils Lake outlet will harm Sheyenne River. Other Views. The Forum (Fargo, N. D.) February 2, 1997.
14. Voldal, Henrik. Misconceptions exist about proposed outlet. Jamestown Sun (Jamestown, N. D.) August 26, 1997.

15. Rebuffoni, Dean. North Dakota flood-control. Critics of a project that would divert water from Devils Lake into the Red River range from environmentalists to the Minnesota DNR to Canadian officials. Star Tribune (Minneapolis, Min.) May 22, 1997.
16. Sando, Rodney W., Commissioner, Minnesota Department of Natural Resources. Letter to Senator Paul Wellstone. April 4, 1997.
17. Nixon, Jeremiah W. Attorney General of Missouri. Letter to Kathleen A. McGinty, Chair, Council on Environmental Quality. September 26, 1997.
18. Waddell, D. G., Charge d'affaires, a.i., Canadian Embassy, Washington, D. C. Letter to Congressman Joseph M. McDade. September 11, 1997.
19. Resolution of the Upper Mississippi River Basin Association. September 24, 1997.
20. Inland Rivers, Ports & Terminals, Inc. Resolution. September 17, 1997.
21. Beard, Daniel P., Senior Vice President for Public Policy, National Audubon Society, Mark Van Putten, President, National Wildlife Federation, and Brent Blackwelter, President, Friends of the Earth. Letter to President William J. Clinton. March 14, 1997.
22. Pope, Carl, Executive Director, Sierra Club. Letter to Kathleen McGinty, Council on Environmental Quality. September 15, 1997.
23. Lee, Sonja. Outlet plan gains approval. Bismarck Tribune (Bismarck, N. D.) July 23, 1997.
24. Wetzel, Dale. Lawmakers: Dorgan amendment would wreck chances of Devils Lake Inlet. Jamestown Sun (Jamestown, N. D.) July 30, 1997.
25. Associated Press. Officials cool to lake outlet delay proposal. The Forum (Fargo, N. D.) August 13, 1997.
26. Schafer, Edward T. Governor of North Dakota, North Dakota House Majority Leader Representative John Dorso and North Dakota Senate Majority Leader Senator Gary Nelson. Letter to U.S. Senate Majority Leader Trent Lott. August 1, 1997.
27. Davis, Don. N. D. senators push for emergency inlet. Devils Lake compromise a tough sell. Bismarck Tribune (Bismarck, N. D.) September 11, 1997.
28. Jamison, Warren, Manager, Garrison Diversion Conservancy District. Review of Rough Draft Amendments for Garrison. October 2, 1997. 13 pp.
29. Pearson, Gary L. A Review of the Mid Dakota/Sheyenne Lake Development Plan Proposed by The State of North Dakota and The Garrison Diversion Conservancy District, January 1992. Prepared for The National Audubon Society and The National Wildlife Federation. June, 1992.

RESPONSES BY GARY PEARSON TO ADDITIONAL QUESTIONS FROM SENATOR CHAFEE

DAKOTA PRAIRIE AUDUBON SOCIETY,
Jamestown, ND 58402–1703, November 22, 1997.

THE HONORABLE JOHN H. CHAFEE, *Chairman,*
Committee on Environment and Public Works,
U.S. Senate,
Washington, DC 20510.

DEAR CHAIRMAN CHAFEE: Thank you for your letter of November 7, 1997, with the additional questions regarding my testimony presented at the Senate Committee on Environment and Public Works' October 23, 1997, hearing on the proposed emergency outlet from Devils Lake to the Sheyenne River that have been submitted tty Members of the Committee. I appreciate the opportunity to provide additional information on this controversial proposal. I also appreciate the extension of time grant-

ed by the Committee staff which has enabled me to obtain current data in order to respond to the questions as specifically and factually as possible.

For clarity of reference, in responding to the Committee's questions, additional attachments provided with these answers will be identified alphabetically, while the attachments submitted with my written statement at the October 23 hearing will retain their numerical designations.

Question No. 1: You note that some 189,000 acres of wetlands capable of storing nearly a a million acre-feet of water has been drained for various purposes. What is being done to reverse this situation?

Response: The "short answer" to this question is, virtually nothing. However, in responding more fully to this question, I believe that i' would be helpful to the Committee first to provide some background on the Devils Lake Basin. Therefore, Attachment A is a copy of a map of "Surface Water Systems: Devils Lake Basin" from the 1976 Devils Luke Basin Advisory. Committee Study Report, showing the principal lakes and natural drainages in the Basin. Attachment B is a copy of a map from the from the U.S. Bureau of Reclamation's 1974 Final Environmental Impact Statement on the Garrison Diversion Unit, which shows in greater detail the four bays (West Bay, Main Bay, East Bay and East Devils Lake) that comprise Devils Lake, as well as their relationship to West and East Stump lakes. The principal point of natural inflows to Devils Lake is from Big Coulee (not shown on Attachment A), an extension of Mauvais Coulee that discharges into West Bay of Devils Lake (U.S. Army Corps of Engineers, 1988). Water from Edmore Coulee, St. Joe Coulee and Calio Coulee in the northern part of the Basin drains into the Chain Lakes, Dry Lake, Morrison Lake, Sweetwater Lake, and at times of high run-off, these lakes overflow to the west and ultimately discharge into Big Coulee and then into West Bay.

Attachment C from the 1976 Devils Lake Basin Advisory Committee Study Report shows the extent of wetland drainage in the various watersheds of the Devils Lake Basin two decades ago. It should be noted that, by 1976, 40 percent of the wetlands in the Chain Lakes Watershed had been drained, 41 percent of the wetlands in the Edmore Watershed had been drained, and 73 percent of the wetlands in the Starkweather Watershed had been drained. The Devils Lake Basin Advisory Committee estimated that a total of 98,000 acres of wetlands had been drained in the Devils Lake Basin at that time (Devils Lake Basin Advisory Committee, 1976). The Nonh Dakota State Office of the U.S. Fish and Wildlife Service estimates that 189,000 acres of wetlands have now been drained in the Devils Lake Basin (Attachment D)—nearly double the number of acres of wetlands that had been drained 21 years ago at the time of the Devils Lake Basin Advisory Committee Study.

Attachment E from the 1976 Devils Lake Basin Advisory Committee Study Report shows the "Primary Flood-Prone Areas: Devils Lake Basin." This, of course, was before the recent flooding problem developed around Devils Lake proper, and it shows that the most severe flooding was occurring in the lower portions of the Chain Lakes, Starkweather and Edmore watersheds—the same watersheds having the most extensive wetland drainage. Although drainage proponents deny it and North Dakota politicians try to ignore it, the flooding problems in the tower portions of these watershed had been exacerbated by the extensive wetland drainage throughout the watersheds, especially in their upper reaches (See Attachment No. 3, p. 86, and Attachment No. 29, pp. 61–63, to written statement and pp. 3–4 of written statement).

Attachment F from the 1976 Devils Lake Basin Advisory Committee Study Report shows the "Structural Projects" recommended by the Committee. As noted in my written statement, most of these have now been constructed, including the drainage channels from Hurricane Lake, Lake Irvine, Morrison Lake, and Dry Lake. It should be noted that the drainage channel from Dry Lake to Six-Mile Bay of Devils Lake (Channel "A" of the Soil Conservation Service's abandoned Starkweather Watershed Project, See pp 3–4 of written statement), which was completed by the State of North Dakota in 1978, now drains the runoff, including the water from drained wetlands, from the Chain Lakes, Starkweather and Edmore watersheds directly into Six-Mile Bay of Devils Lake. The direct discharge of this water from these extensively drained watersheds into Devil Lake reduces the opportunities (time and surface area) for evaporation and infiltration, so Channel "A" not only accelerates the rate of flow of water from the northern part of the Basin into Devils lake, but it also increases the volume. Attachment G from the February 26, 1985, Devil.s Lake Daily Journal shows that Devils Lake, where an average of 25 percent of the watershed was estimated to have been drained, rose 13.2 feet between 1964 and 1984, while nearby West Stump Lake, where only 8 percent of the watershed was estimated to have tureen drained, rose only 1.8 feet.

As the attached copy of a story from the August, 14, 1975, Jamestown Sun reports, the rising level of Devils Lake already was causing problems:

". . . But today too much water plagues the lake and nearby residents.

". . . Between 1972 and 1975, the lake rose six feet—[to 1425 feet msl], becoming a threat to low-lying roads and private property along the shore.

". . . Now the city is planning to build a dike between the lake and the town and the Army Corps of Engineers is working with local officials to plan for a possible flood during spring runoff.

"A heavy runoff could raise the water level one or two feet and flood businesses and private property, city and State authorities said.

"The State Highway Department says North Dakota 57, at the narrows between the main lake and East Bay, has been damaged most by high water . . .

"County and township roads have also been damaged by high water . . ." (Attachment H).

Despite the clear recognition by Federal, State and local officials as early as 1975 that the rising level of Devils Lake was threatening roads, businesses and private property, in 1975 the State Legislature authorized construction of Channel "A," in 1976 the Devils Lake Basin Advisory Committee recommended over 200 miles of channelization in the Devils Lake Basin, in 1977 the Ramsey County Water Management District, with the approval of the Corps of Engineers (See Attachment 1) and funding from the State, proceeded to construct Channel "A," in 1977 the State Engineer approved the drainage of Hurricane Lake into Devils Lake, and in 1983, when the Ramsey and Benson County Commissions already had been seeking disaster designation for the area (Attachment J) and again with the approval of the State Engineer, the Ramsey County Water Resource District drained Lake Irvine arid Morrison Lake into Devils Lake.

When the North Dakota Chapter of The Wildlife Society suggested to the North Dakota State Engineer in 1982 that the operating plan for Channel "A," which is based solely on the level of Dry Lake and does not consider the impacts of discharges on flooding problems in Devils Lake, be modified as pan of an integrated flood control program for both Dry Lake and Devils Lake (Attachment K), the State Engineer said that would be "impractical" (Attachment L). As the following figures from the Corps of Engineers' 1996 "Devils Lake, North Dakota, Contingency Plan" (U.S. Army Corps of Engineers, 1996a) show, the inflows to Devils Lake from Channel "A" approach and frequently exceed those from Big Coulee:

Year	Big Coulee inflow (ac-ft)	Channel A inflow (ac-ft)
1979	171,900	NA
1987	47,470	69,950
1993	76,250	145,200
1994	88,220	73,420
1995	199,242	166,756

As noted above, with Devils Lake reaching an elevation of 1427 feet msl, the Ramsey and Benson County Commissions already were seeking disaster designation for the area in 1982 (Attachment J). However, the attitude of drainage proponents in the face of these escalating problems created by the rising level of Devils Lake was still being expressed 3 years later in 1985 by Ramesy County Water Resource District chairman and Devils Lake Basin Advisory Committee member Robert Garske:

"Wetland drains are a "round robin" that profit both farmers and businessmen, Garske said. Farmers can raise wheat instead of ducks on drained wetlands, and businessmen profit from more customers drawn to the Devils Lake fishery, which runoff water supports by keeping the lake from getting too salty and killing the fishery, he said.

"Rather than trying to hold (water) back, we need to figure out how to get more in," Garske said" (Attachment G).

Thus, at the same time that the rising lake already had been threatening roads, businesses and private property around Devils Lake for a decade, instead of implementing measures to curtail wetland drainage in the Devils Lake Basin, local water resource district officials were trying "to figure out how to get more Iwaterl in" the lake, and the State Engineer was approving more drainage in the Basin (See Attachment 5 to written statement and pp. 3–4 of written statement).

At a June 22, 1983, public meeting held by the Corps of Engineers on water related problems in the Devils Lake Basin, the North Dakota Chapter of The Wildlife

Society reviewed the history of water resource mismanagement in the Devils Lake Basin and recommended that the Corps 1) place a ban on further wetland drainage in the Basin, 2) initiate a study of the impacts of current water management practices on Devils Lake, 3) conduct a comprehensive hydrologic investigation to identify the factors contributing to flooding and other water resource problems in the Basin, 4) assume the lead in developing a comprehensive water resource management program for the Basin, and 5) reject the alternative of an outlet to the Sheyenne River and require that the water resource management problems be resolved within the Basin (Attachment M). A decade and a half later, the Corps remains focused on the construction an outlet from Devils Lake to the Sheyenne Rivet, while still having not done the studies necessary to determine the causes of the problem and whether an outlet would be feasible or effective in alleviating it.

Against this background, the question, therefore, becomes, what has been done in the last decade, and especially in the last 4 years since Devils Lake started its accelerated rise, to reverse this situation? Regrettably—and incredibly—the answer remains, virtually nothing.

Neither the State Legislature, nor the Governor, nor the State Engineer, nor the county water resource districts in the Devils Lake Basin has imposed a prohibition against further wetland drainage in the Basin.

The operating plan for Channel "A" has not been modified to reduce the flows into Devils Lake or to retard the rate of rise of Devils Lake at critical periods. In fact, on the rare occasions when the gates on Channel "A" have been closed, they reportedly have been surreptitiously opened under cover of darkness, and when chains were placed on the gates, they reportedly were cut, presumably by irate upstream farmers.

No comprehensive program of wetland restoration has been implemented in the Devils Lake Basin.

The State has initiated only token efforts to fabricate a facade for claiming that it is changing the irresponsible and destructive record of water resource mismanagement in the Devils Lake Basin which it has condoned and encouraged for the last half century.

The Corps of Engineers' August 12, 1996, "Emergency Outlet Plan, Devils Lake, North Dakota" describes the State's purported efforts at Upper Basin Storage:

"The Contingency Plan discussed the State's $5,800,000 plan to retain runoff on public and private lands to prevent or delay an estimated 75,000 ac-h from reaching Devils Lake, equivalent to nearly I foot off the current 1437.7+. This proposal included (1) $2,600,000 for the U.S. Fish and Wildlife Service (USFWS) to develop 14,900 ac-ft of storage on public lands (to supplement 1,300 ac-ft of storage completed in the fall of 1995), (2) a $50,000 NDSWC grant to the Devils Lake Basin Joint Water Resource Board to acquire the rights to 3,000 ac-ft of retention on Conservation Reserve Program (CRP) lands, (a) $800,000 to raise the outlet sills in the Chain of Lakes and to add 38,000 ac-ft to the lakes' capacity, and (4) $2,450,000 to store 18,000 ac-ft on small private tracts (farmland, potholes, etc.), including an estimated $1,000,000 to construct control structures and an estimated $1,450,000 annually to lease the land for water storage. The North Dakota Congressional Delegation is supporting the State's efforts via Federal funding and coordination." (U.S. Army Corps of Engineers, 1996b)

Of course, the Fish and Wildlife Service was not responsible for the wetland drainage in the Devils Lake Basin, so development of additional storage on public lands at Federal expense does not represent reversal of the wetland drainage situation in the Basin. The $50,000 North Dakota State Water Commission grant to acquire rights to 3,000 ac-ft of retention on CRP lands provides farmers with a double payment for those lands, but it is not clear how much of the 3,000 acre-feet of storage is simply on land already flooded and how much actually is in restored wetlands.

The 18,000 acre-feet of storage proposed on private lands represents only 1.9–3.7 percent of the storage capacity of the 189,000 acres of wetlands that have been drained in the Devils Lake Basin, so it does not represent a significant reversal of wetland drainage in the Basin. Since the State Water Commission announced the "Available Storage Acreage Program" (ASAP), approximately 13,000 acres of privately owned wetlands at 167 sites and having 22,000 acre-feet of storage have been restored in the Devils Lake Basin. However, this still represents only 2.3–4.5 percent of the storage capacity of the 189,000 acres of wetlands that have been drained in the Basin.

The North Dakota Legislative Assembly habitually has refused to fund the State Water Bank Program, but recently $500,000 were provided for the program through a Memorandum of Understanding with the North Dakota Game and Fish Department, which likely means that a good portion of the funds will come from sports-

men's license revenues and the Department's budget. The funds are targeted for the upper Devils Lake Basin with 5–10 year easement contracts. To date, 114 acre-feet of storage at 4 sites have been acquired in the upper Devils Lake Basin under the State Water Bank Program.

In June of this year, Governor Schafer ordered the State Water Commission to identify and close illegal drains in the Devils Lake Basin [Attachment N). Under the Governor's order, the State Engineer is to identify illegal drains and the county water resource boards are to conduct investigations and determine what action is to be taken (Attachment O). Of course, putting the State Engineer and the county water resource hoards in charge of investigating illegal wetland drainage in the Devils Lake Basin is akin to putting John Erlichman and Gordon Liddy in charge of the Watergate investigation—it simply is not reasonable to believe that they are going to document their own violations of the law for the past 40 years. Not surprisingly, therefore, at the time the Governor issued his order, the State Engineer already was minimizing the amount of illegal drainage in the basin by estimating it at "at least 20,000 acre-feet of water" (Attachment N). If it is assumed that the illegally drained wetlands averaged 2.5 feet in depth, this would put the State Engineer's estimate at only 8,000 acres of wetlands drained illegally in the Basin. Of course, this would imply that valid permits were issued for the remaining 181,000 acres of drained wetlands, or that they all occurred in watersheds under the 80 acre minimum requiring a drainage permit, neither of which is even remotely plausible.

As is pointed out in Attachment 3 (p. 88) and Attachment 29 (pp. 86–87) to my written statement, the North Dakota wetland drainage statute is neither enforced nor enforceable and, consequently, it is routinely ignored and circumvented by drainage interests, including the State Engineer and county water resource districts through such ploys as 1) denying that drainage has occurred, 2) arbitrarily determining that a watershed is under the 80-acre minimum where a permit is required, 3) determining that the watershed is drained by several ditches, each draining an area under the minimum requiring a permit, 4) determining that the drainage is a "clean-out" of an existing drain, therefore, not requiring a permit, or if these fail, simply (a) issuing a permit after-the-fact. There is little question that these same tactics will continue to he employed to "legalize" drains identified under the Governor's order (Attachment O).

It is not surprising, therefore. that less than a month after the Governor had announced his order, the Bismarck Tribune reported that:

"So far, the State Water Commission has found 22 drains that it suspects are illegal, said Wayne Simon, chairman of the Ramsey County Water Resource District.

Simon said the district will investigate some of the drains to determine whether to close them. But he said the district needs the money, and doesn't want to do the job anyway.

"We don't feel that there are illegal drains up there," Simon said. "We would like to find a way to make them all legal." (Attachment P)

Mr. Simon has since become the coordinator for the Devils Lake Task Force, which ostensibly is seeking solutions to the water problems in the Devils Lake Basin.

Shortly after the Governor's order was issued, the Devils Lake Daily Journal reported:

"But water board directors aren't very enthusiastic about going out and declaring established drains illegal. They feel it will increase tensions among a group—the agricultural community—that is already stressed by 4 years of flooding, insect infestations and Crop disease."

"If people start pointing fingers they are probably going to get shot at," says Ramsey County water board member Robbin McMorrin, who urged that Sprynczynatyk and Governor Schafer be on hand when water boards attempt to close the 'illegal drains'." (Attachment O)

Of course, "tension" and "stress" are no excuse for violating the law, creating hardships for others or threatening to shoot those who might hold opposing views. Nevertheless, the intimidation had the desired effect, and the Grand Forks Herald reported that:

". . . IGovernorl Schafer and the North Dakota State Water Commission said they are not blaming upper Basin drainage as a significant contributor to the Devils Lake situation.

Schafer said he doesn't foresee a mass closing of drains to stop flooding nor does he think upper basin drainage is the main reason for flooding." (Attachment Q).

And the Bismarck Tribune reported that:

"The Governor said he has worked diligently on solutions such as an outlet, and he admits illegal drains are an insignificant part of the problem at Devils Lake, which has tripled in volume since 1993.

Schafer said the point of closing illegal drains is to assure downstream people who are hesitant to accept water from an outlet that other measures also are being taken.

"I don't want anybody to be able to say North Dakota isn't doing it's [sic] job," Schafer said. "I suppose you could say that is politics." (Attachment P)

Consequently, with renegade farmers in the Devils Lake Basin openly making implied threats that anyone—apparently including the Governor and the State Engineer—with the temerity to suggest that the 491,000 to 926,000 acre-feet of water from the 189,000 acres of wetlands they have drained might be contributing to the flooding problem at Devils Lake could be shot, with the State Engineer assuring them that drainage is not the problem and that he will make only a token effort to identify illegal drains, with county water resource district officials assuring them that any illegal drains that are identified will simply be made legal, and with the Governor telling them that they are not responsible for the flooding problem at Devils Lake and that his order to close illegal drains is only a perfunctory political ploy designed to quell criticism of the State's abysmal record of failure to regulate wetland drainage in the Basin so they can get on with building an outlet to the Sheyenne River, it is not surprising that nothing has been done to reverse the deplorable wetland drainage situation in the Devils Lake Basin.

Question 2: You state that, "If Devils Lake is destined to overflow to the Sheyenne River, it will do so whether or not the outlet is built." Please explain this further.

Response: First, it is important to recognize that the likelihood of Devils lake overflowing to the Sheyenne River is extremely remote. Despite a long geologic record of wide cyclic fluctuations in the level of Devils Lake, it has overflowed to the Sheyenne River only twice in the last 4,000 years (Attachment R).

(Note that, although Dr. Bluemle states that wetland drainage is not responsible for the overall behavior of the lake and that only an inlet and an outlet can remedy the fluctuations of the lake, he does not address the incremental contribution of wetland drainage to current flooding problems, nor does he address the feasibility of delivering and removing the volumes of water to and from Devils Lake that would be required to stabilize the lake at an elevation of 1428 feet msl and at a surface area of 56,000 acres, and the resulting environmental impacts to Devils Lake itself and to the Sheyenne and Red rivers.)

Second, as Attachment R shows, when Devils Lake begins to rise or fall, it is not possible to predict with any certainty just how far it will go. Thus, although Devils Lake appears to have reached its current level of 1443 feet msl eight times over the last 4,000 years, it has increased to a level of 1445 feet where it overflowed to Stump Lake only five of those times, and it has increased to a level of 1457 feet where it overflowed to the Sheyenne River only twice (Attachment R). Even in the short term, the level of the lake has fluctuated widely (Attachment S). As the Corps of Engineers points out:

"Unfortunately, lake behavior is not predictable." (U.S. Army Corps of Engineers, 1996b)

This unpredictability is the result of the interaction of multiple complex factors, some of which, such as precipitation, are highly variable and unpredictable, and others, such as the area/depth/volume relationship of the lake, which are variable but predictable. The area/depth/volume relationship is, however, a major determinant in the rise of Devils Lake, in the likelihood of it overflowing to the Sheyenne River, and in the efficacy of the proposed emergency outlet in preventing such an overflow from occurring. Table I in Attachment T shows the relationships between the elevation, area and capacity of Devils Lake at elevations from 1415 to 1440 feet msl. Between elevation 1419 and 1420 feet, the area of the lake increases by only 1500 acres and the capacity increases by only 39,800 acrefeet. Between elevation 1429 and 1430 feet, the area increases by 2200 acres and the capacity increases by 59,200 acre-feet. Between 1439 and 1440 feet, the area increases by 3,500 acres and the capacity increases by 85,900 acre-feet. Thus, nearly one and a half times as much water is required for Devils Lake to raise one foot at 1429 feet as was required to produce a one foot rise at 1419 feet, and over twice as much is needed to produce a one foot rise at 1439 feet.

At elevation 1445 feet, Devils Lake overflows eastward into West and East Stump Lake. Because the Stump Lakes are significantly lower than Devils Lake (See Attachment G), should Devils Lake reach 1445 feet, there will then be a period during which Devils Lake will not rise significantly while the Stump Lakes are filling, and after they are filled, the increased surface area will result in even greater inflow volumes being required to produce incremental rises in the level of Devils Lake. At elevation 1440, Devils Lake has an area of 85,000 acres and a capacity of 1,680,000 acre-feet, at 1445 feet it has an area of 110,000 acres and a capacity of 2,000,000 acre-feet and at elevation 1450 feet, the area increases to 250,000 acres and the ca-

pacity increases to 3,000,000 acre-feet. Thus, the storage capacity increases three times as much as the lake rises from 1445 to 1450 feet as it did going from 1440 to 1445 feet.

Figure 6 (p. 32) in Attachment D shows the actual inflows to Devils Lake since 1990, with an estimate of the 1997 inflow. These figures are:

Year	Annual Inflow (Acre-feet)
1990	10,800
1991	15,500
1992	38,100
1993	295,600
1994	184,300
1995	375,300
1996	279,800
1997	418,000

Thus, the 295,000 acre-feet of inflows that caused a seven foot rise (from 1424 to 1431 feet) between 1993 and 1994 would produce only a 2.7 foot increase at a lake elevation of 1445 feet, and the 697,800 acre-feet of inflows that caused another seven foot rise (from 1436 to 1443 feet) between 1995 and 1997 would produce only a 2.8 foot rise at elevation 1450 feet.

Another factor enters into the equation as the lake expands in area, however, and that is evaporation, which averages 30 inches annually in the area (Attachment D, Appendix 2, p. 3). At an elevation of 1440 feet and a surface area of 85,000 acres, approximately 212,500 acre-feet of water would be expected to evaporate from Devils Lake in a year. However, at an elevation of 1445 feet and an area of 110,000 surface acres, this increases to 275,000 acre-feet a year, and at an elevation of 1450 feet and an area of 250,000 acre-feet, 625,000 acre-feet—1.5 times this year's record 418,000 acre-feet inflows—could be expected to evaporate from Devils Lake in a year.

What this means, of course, is that progressively larger increases in precipitation and runoff would be required to sustain the same rate of rise in the level of Devils Lake that has occurred over the past 4 years. Or it means that, even if the recent high levels of precipitation should be sustained, the rate at which the lake rises will progressively decrease, admit will reach a level substantially below elevation 1450 feet where it will stabilize. This is the basis of the U.S. Geological Survey's conclusion that the lake is about to stabilize and then begin slowly to fall (Attachment U).

What this also means is that it is extremely unlikely that Devils Lake will overflow to the Sheyenne River in the foreseeable future, and that, even if it should, the declining rate at which the lake would rise would provide ample time to implement appropriate measures. And, of course, this means that there is no urgency to rush ahead with construction of the proposed Devils Lake Emergency Outlet before doing the studies necessary to demonstrate that it is technically sound, economically feasible, and environmentally acceptable.

The area/depth/volume relationships of Devils Lake also demonstrate the ineffectiveness of the proposed emergency outlet in preventing the lake from overflowing to the Sheyenne River in the event that the increasingly large volumes of inflows required for that to happen should occur.

The Corps' Emergency Outlet Plan proposes a 200 cubic-foot/second (cfs) outlet (U.S. Army Corps of Engineers, 1996b), and:

"Operation is assumed to be limited to a 7-month "window" from 1 May through 30 November to prevent pump damage from ingested ice and to avoid adding flow to the river during spring runoff in the lower Sheyenne River. Within that "window," operation would be restricted by (a) the Sheyenne River's estimated 500-cfs channel capacity in the vicinity of the outlet confluence and (b) the State's 450-mg/l sulfate standard for the river. Operation would also be suspended when any portion of the Sheyenne River was threatened by high stages." (U.S. Army Corps of Engineers, 1996b)

As a result of these restrictions, the Corps calculates that, had the outlet been in operation from October 1985 to October 1995, it would have operated a total of 535 days at an average rate of 76 cfs and it would have removed a total of 81,000 acre-feet of water from the lake (U.S. Army Corps of Engineers, 1996b). Even assuming a Sheyenne River channel capacity of 600 cfs and a 300 cfs outlet as is being

proposed by the State Engineer (Attachment 7 to written statement), the Corps calculates that the outlet would have operated for only one additional day (536 days) at an average rate of 99 cfs, and it would have removed only 105,000 acre-feet of water from the lake.

(It should be noted that the 200 cfs emergency outlet plan proposed by the Corps in its Emergency Outlet Plan involves a series of pumped lifts and channels [U.S. Army Corps of Engineers, 1996b). However, when he was asked at the October 23 hearing about the size and configuration of the outlet, North Dakota State Engineer David Sprynczynatyk told the Committee that it would be an 84inch pipe. The explanation for this discrepancy between the Corps' plan and what Mr. Sprynczynatyk told the Committee is that the State is planning on a pipe outlet so it can be converted into an inlet for Devils Lake simply by reversing the pumps.)

Of course, the water quality restrictions are reduced as the lake level rises and the pollutants become more diluted, but because increasingly higher levels of precipitation are required to sustain the rate of rise of the lake, this also increases the likelihood of high natural flows simultaneously occurring in the Sheyenne River that would funkier restrict discharges from the outlet. For point of illustration, however, it is instructive to consider how the operation of a Devils Lake outlet under even the most optimistic assumptions would affect the level of Devils Lake if it should continue to rise. If a 200 cfs outlet were to operate at full capacity for 7 months, it would remove (400 acre-feet/day x 210 days =) 84,000 acre-feet of water a year from Devils Lake, and a 300 cfs outlet operating at full capacity for 7 months would remove 126,000 acre-feet each year. These figures then should be compared with the inflows to Devils Lake over the past 5 years:

Year	Inflows (acre-feet)	200 cfs outlet (maximum acre-feet)	300 cfs outlet (maximum acre-feet)
1993	295,000	84,000	126,000
1994	184,000	84,000	126,000
1995	375,300	84,000	126,000
1996	279,000	84,000	126,000
1997	418,000	84,000	126,000

Of course, if the precipitation and runoff should increase so the lake continues to rise, the outlet would become progressively less effective in preventing it from happening. For example, a net increase in volume of 1,000,000 acre-feet of water would be required for Devils Lake to rise from elevation 1445 feet to 1450 feet, but it would take 12 years for a 200 cfs outlet operating at maximum capacity to remove that volume of water, and 8 years for a 300 cfs outlet to do it. Of course, if the high levels of precipitation and runoff necessary to produce that rise were to continue, the lake also would continue to rise while the outlet was operating. Therefore, if precipitation and runoff should increase to the levels necessary to cause Devils Lake to overflow to the Sheyenne River, it is evident that there is only a very limited scenario, where the precipitation and runoff would begin to decline before the lake reached 1457 feet, when the outlet might prevent the overflow from occurring. However, because precipitation and runoff are not predictable, and because lead time is necessary in order to implement other measures, if Devils Lake should continue to rise, it still would be necessary to continue raising roads and dikes and evacuating the areas below 1457 feet because it would be impossible to known whether or not the narrow scenario in which the outlet would make a difference would actually occur.

It also is important to recognize that, under the narrow scenario where the outlet would prevent Devils Lake from overflowing to the Sheyenne River, downstream residents would in the meantime have had to deal with the additional millions of acre-feet of water that would have to be pumped from Devils Lake to prevent it from overflowing. And in the more likely scenario where the outlet ultimately world not prevent the lake from overflowing, they would still have to deal with the additional water coming from the natural outlet, as well as that which already had been coming for years from the emergency outlet. It should be noted, however, that, at the elevation of 1457 feet where it would overflow to the Sheyenne River (that elevation may actually be 1460 feet msl IU.S. Army Corps of engineers, 1988), Devils Lake would have a surface area of well in excess of 300,000 acres, so even a 500,000 acre-feet inflow would raise the lake by less than six inches. With a surface area of more

than 300,000 acres and a "head" of less than half a foot, flows from the natural outlet, while prolonged, would nevertheless be relatively low.

The efficacy of an outlet in reducing the high water problems if Devils Lake should continue to rise is perhaps best put into perspective by comparing its maximum 84,000 to 126,000 acre-feet per year capacity under the most unrealistically optimistic conditions with the rate of evaporation as the lake expands in area, and with the storage potential of the 189,000 acres of wetlands that have been drained in the Basin. As rioted above, at 1445 feet, some 275,000 acre-feet of water—2 to 3.3 times the maximum capacity of the outlet—would evaporate from the lake. At elevation 1450 feet, the annual 625,000 acre-feet of evaporations would be 5 to 7 times the maximum capacity of the outlet. Similarly, if even half of the storage capacity of the 189,000 acres of drained wetlands were renewable on an annual basis (See Attachment D, Appendix 2, pp. 2–3), this would prevent from 2 to 6 times as much water from reaching Devils Lake as the outlet could remove in a year if it were operating at maximum capacity.

Question 3: Your written testimony (under the "Recommendations" portion on page 12) reads as follows:

"[We] strongly recommend that the Committee on Environment and Public Works reiterate to the President and the Executive Branch the requirements that the Congress has specified in the fiscal year 1998 Energy and Water Development Apropriations Act must be met before construction may be initialed on a Devils Lake outlet."

My question is, do you think that the Congress has done an adequate job of not only preserving the requirements of NEPA and the Army Corps project procedures...but stipulating,that the Executive Branch must abide by such requirements? Where does the burden lie as a result of this legislation?"

Response: As you noted a number of times during the October 23 hearing, Chairman Chafee, in the fiscal year 1998 Energy and Water Development Appropriations Act, the Congress has specified that, before initiating construction on the proposed Devils Lake Emergency Outlet, the Corps of Engineers must demonstrate that:

". . . the construction is technically sound, economically justified, and environmentally acceptable and in compliance with the National Environmental Policy Act of 1969 . . ." (Congressional Record, July 15, 1997, S7484)

It might be argued that the Congress has, therefore, met its burden, and that the burden now shifts to the Executive Branch to follow Congress' directive—and in a perfect world that probably would be sufficient. However, I believe that Senator Wyden's questions to Acting Assistant Secretary of the Army for Civil Works Dr. John H. Zirschky regarding bid rigging, collusive practices and price fixing in the Corps' dredging program demonstrate the need in the real world for continuing Congressional oversight of Executive agencies to assure that the directives of the Congress are honored and the interests of the public are protected. Regrettably, this also is notably true in the case of the proposed Devils Lake Emergency Outlet, where extreme political pressures are being brought to bear on the Administration by the North Dakota Congressional Delegation to circumvent Army Corps project procedures and the clear directive from the Congress in order to construct a technically unsound, economically infeasible and environmentally unacceptable "emergency" outlet from Devils Lake.

I have discussed above the reasons that the proposed emergency outlet is not technically sound. Hopefully, the Corps will address these issues in a thorough, factual, objective and straightforward manner. However, I believe it would be naive to assume that this would automatically occur without the prospect of Congressional review.

The same is true regarding the Corp's determination of the economic feasibility of the proposed emergency outlet. Figure 4 of Attachment T shows the cumulative damages (in 1982 dollars) to residential, commercial and public property (including farm land) as Devils Lake rises from elevation 1430 feet to elevation 1450 feet. It should be noted that the cumulative damages increase from about $2,500,000 at elevation 1430 to about $52,500,000 at elevation 1445 feet, or by an average of about $3,333,000 per foot. However, from elevation 1445 feet to 1455 feet, the cumulative damages increase by about $24,500,000 to $77,000,000, or by an average of $2,450,000 per foot. Although inflation and subsequent development on the lake bed have increased some of these figures, data from North Dakota State University show that the value of farm land in the area actually has declined, from an average of $534 per acre in 1982 to $423 per acre in 1997. Nevertheless, the relationships remain valid, and the lake reached a level of 1443 feet this year. Consequently, the data from this 1982 memorandum by the State Engineer refute the testimony of current State Engineer David Sprynczynatyk at the October 23, 1997, hearing where he told the Committee that the Corps' 1994 economic analysis, which showed

that an outlet would return only $0.39 in benefits for each dollar of cost (U.S. Army Corps of Engineers, 1994), no longer is valid because the amount of the damages at current elevations is greater with each foot of rise in the lake than it was at the time the Corp did its benefit/cost analysis. Thus, contrary to what Mr. Sprynczynatyk told the Committee on October 23, the incremental damages that would occur with each incremental rise in the lake will be lower, not higher, than when the Corps did its economic analysis in 1994.

With an outlet having a progressively diminishing effect on the level of the lake if it continues to rise, with incremental potential damages diminishing as the lake rises, and with other measures that are being implemented reducing even further those potential damages, it is evident that the beneft/cost ratio of an outlet would not improve and undoubtedly would decline even further. However, a story in yesterday's Jamestown Sun reports that:

"Col. Mike Wonsik, commander of the corps' St. Paul, MN, district . . . said the [Devils Lake] dike project is one of the biggest advance projects the corps has ever done. The corps also is working on plans to justify to the Congress the need for an emergency Devils Lake outlet to ease flooding.

Wonsik said formulas normally used by the Corps to evaluate the benefits of such outlets deal with rivers, so the corps is using a different formula to evaluate the Devils Lake project." (Emphasis added) (Attachment V)

Thins, despite the Congressional directive contained in the fiscal year 1998 Energy and Water Development Appropriations Act, it is evident that the Corps has decided to abandon its established project procedures and to use a different formula in its "plan to justify to the Congress the need for an emergency Devils Lake outlet." Unfortunately, rather than performing an unbiased and factual analysis to determine if an emergency outlet is, in fact, economically feasible as directed by the Congress, it appears that the Corps is deliberately preparing its economic analysis for the explicit purpose of justifying the project to the Congress. Clearly, the Executive Branch is not meeting its burden under the legislation adopted by the Congress.

Proponents of the outlet are similarly planning to circumvent the Congress' requirement that the emergency outlet must be environmentally acceptable and in compliance with the National Environmental Policy Act. As is shown by Attachment H. the high water problem at Devils Lake has been developing for more than two decades, so it is not the kind of "emergency" that has required immediate action in a matter of days or weeks to deal with a sudden disaster that is over in a few hours or days. It is not the type of situation where insufficient time is available to conduct a thorough environmental impact analysis and prepare a full environmental impact statement before action is taken, and for which provisions have been established to waive regular National Environmental Policy Act procedures where it is necessary to begin actions immediately in order to save lives and property.

Nevertheless, in its Emergency Outlet Plan, the Corps specifically outlined how the normal 60-month NEPA process for the outlet could be shortened to 29 months by "modifying NEPA compliance and waiving other requirements" (U.S. Army Corps of Engineers, 1996b). In the meantime, the North Dakota Congressional Delegation has pressured the Administration into designating the Devils Lake outlet an "emergency requirement" (Attachment No. 10 to written statement), and Acting Assistant Secretary Zirschky testified at the October 23 hearing that the Secretary of the Army had made a determination that the flooding at Devils Lake constitutes an emergency. Although it appears that the President's October 13, 1997, designation of the outlet as an "emergency requirement" may have been done strictly for budgetary purposes, as is reported in Attachment 11 (to written comments) the Nonh Dakota Congressional Delegation is now claiming that it provides an emergency waiver of standard NEPA requirements:

"President Clinton cleared the way for construction to begin as early as next summer on an outlet for Devils Lake by granting an emergency designation that will speed environmental review.

The designation will allow construction to start before environmental studies are completed, and also makes the project a top priority for the Army Corps of Engineers, Sen. Kent Conrad, D-N.D., said Monday.

"If you go through the regular process, it would take six to 10 years to start construction, Conrad said. "We don't have 6 to 10 years." (Attachment II to written statement)

There is no question that the North Dakota Congressional Delegation is going to pressure the Administration and the Council on Environmental Quality for an emergency waiver of the standard N EPA process that will permit construction of the outlet without preparation of a full environmental impact statement, without consideration of other more effective and feasible alternatives, without addressing the

adverse impacts of the outlet until aher they have occurred and before knowing whether or not they can be effectively mitigated or the costs of doing so if they can.

Although the burden for complying with the stipulations imposed on the emergency outlet by the Congress may rest with the Executive Branch, if the public interest is to be protected, there clearly is a critical need, if not a responsibility, for the Congress to continue to provide close oversight to ensure that the Executive Branch meets the burden which the Congress has imposed for assuring that the proposed emergency outlet from Devils Lake is technically sound, economically feasible and environmentally acceptable and in full compliance with the National Environmental Policy Act.

Chairman Chafee, I would again like to thank you and the Members of the Committee for your interest in and attention to this important issue, and for this opportunity to provide additional information relating to the testimony I presented at the October 23 hearing on the Devils Lake Emergency Outlet. If I can be of any funkier assistance to the Committee, I would appreciate it if you would let me know.

Sincerely,

GARY L. PEARSON, D.V.M.,
Jamestown, ND 58401.

REFERENCES

Devils Lake Basin Advisory Committee. 1976. The Devils Lake Basin Study, Study Report, Volume 1. Prepared by TPI Consultants, Inc. Richard Elision, Project Director, Office of the Governor, State of North Dakota. 235 pp.

U.S. Army Corps of Engineers. 1988. Devils Lake Basin, North Dakota, Integrated Draft Feasibility Report and Environmental Impact Statement. U.S. Army Corps of Engineers, St. Paul District. 167 pp.

U.S. Anny Corps of Engineers. 1994. Devils Lake, North Dakota, Stage IA, Issues Resolution Conference and Background Information. 20 pp.

U.S. Army Corps of Engineers. 1996a. Devils Lake, North Dakota, Contingency Plan. Department of the Army, St. Paul District, Corps of Engineers. 49 pp.

U.S. Army Corps of Engineers. 1996b. Emergency Outlet Plan, Devils Lake, North Dakota. Department of the Army, St. Paul District, Corps of Engineers. 26 pp.

LIST OF ATTACHMENTS

Attachment A. Illustration from Surface Water Systems: Devils Lake Basin. From Devils Lake Basin Advisory Committee. 1976. Devils Lake Basin Study, Study Report, Volume 1. Prepared by TPI Consultants, Inc. Richard Ellison, Project Director, Office of the Govemor, State of North Dakota. 235 pp.

Attachment B. [*omitted in this report]* Illustration of Garrison Diversion Unit, Devils Lake—Stump Lake Recreation Development. From U.S. Bureau of Reclamation. 1974. Final Environmental Statement, Initial Stage, Garrison Diversion Unit. INT FES 74–3.

Attachment C. Illustration of Wetlands and Drainage by Watershed: Types 1, III, IV, V. From Devils Lake Basin Advisory Committee. 1976. Devils Lake Basin Study, Study Report, Volume 1. Prepared by TPI Consultants, Inc. Richard Ellison, Project Director, Office of the Governor, State of North Dakota. 235 pp.

Attachment D. North Dakota Field Office, U.S. Fish and Wildlife Service. 1997. Devils Lake Feasibility Study, Lake Stabilization, Devils Lake, North Dakota, Planning Aid Letter and Substantiating Report. [*Note: portions of report omitted and retained in committee files.]*

Attachment E. Illustration of Primary Flood-Prone Areas: Devils Lake Basin. From Devils Lake Basin Advisory Committee. 1976. Devils Lake Basin Study, Study Report, Volume 1. Prepared TPI Consultants, Inc. Richard Ellison, Project Director, Office of the Governor, State of North Dakota. 235 pp.

Attachment F. Illustration of Alternative IV Structural Projects. From Devils Lake Basin Advisory Committee. 1976. Devils Lake Basin Study, Study Report, Volume 1. Prepared by TPI Consultants, Inc. Richard Ellison, Project Director, Office of the Govemor, State of North Dakota. 235 pp.

[Note: The following attachments are retained in committee files, but are not reproduced here for cost reasons:]

Attachment G. Buttz, Harris. Comparison of Stump Lake, Devils Lake water levels shows effects of drainage. Devils Lake Daily Journal, Devils Lake, North Dakota. February 26, 1985.

Attachment H. Zaleski, Jack, Jr. Excess Water Plagues Devils Lake Residents. Jamestown Sun, Jamestown, North Dakota. August 14, 1975.

Attachment I. Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota. Notice of Application for Permit. January 2, 1979.

Attachment J. Associated Press. Disaster label sought for Devils Lake. The Forum, Fargo, North Dakota. July 14, 1982.

Attachment K. Richard D. Crawford. Letter from President, North Dakota Chapter of The Wildlife Society to Vernon Fahy, North Dakota State Engineer. January 5, 1982.

Attachment L. Vern Fahy. Letter from State Engineer to Richard D. Crawford, President, North Dakota Chapter of The Wildlife Society. February 18, 1982.

Attachment M. Gary L. Pearson. Statement of the North Dakota Chapter of The Wildlife Society Submitted at the U.S. Army Corps of Engineers Public Meeting on Water Related Problems in the Devils Lake Basin. Devils Lake, North Dakota. June 22, 1983. 12 pp.

Attachment N. Associated Press. Schafer: Identify, close illegal drainage system. Jamestown Sun, Jamestown, North Dakota. June 6, 1997.

Attachment O. Weixel, Gordon. In Search of . . . Illegal drains. Devils Lake Daily Journal, Devils Lake, Nonh Dakota. 1997

Attachment P. Associated Press. Landowners' group raps Schafer plan. The Bismarck Tribune, Bismarck, North Dakota. July 3, 1997.

Attachment Q. Campbell, Erin. Schafer orders illegal drainage systems closed. Grand Forks Herald, Grand Forks, North Dakota. July 1, 1997

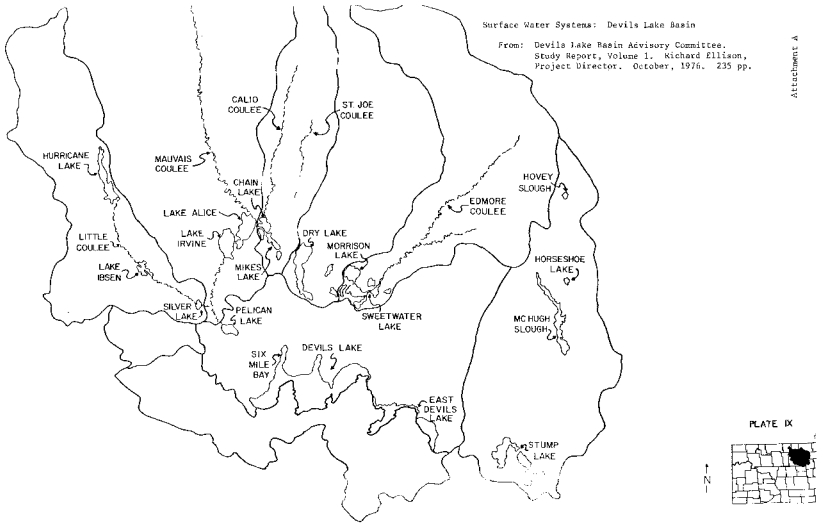
Attachment R. Bluemle, John P. From the State Geologist. North Dakota Geological Society Newsletter 23(1): 1 -2)

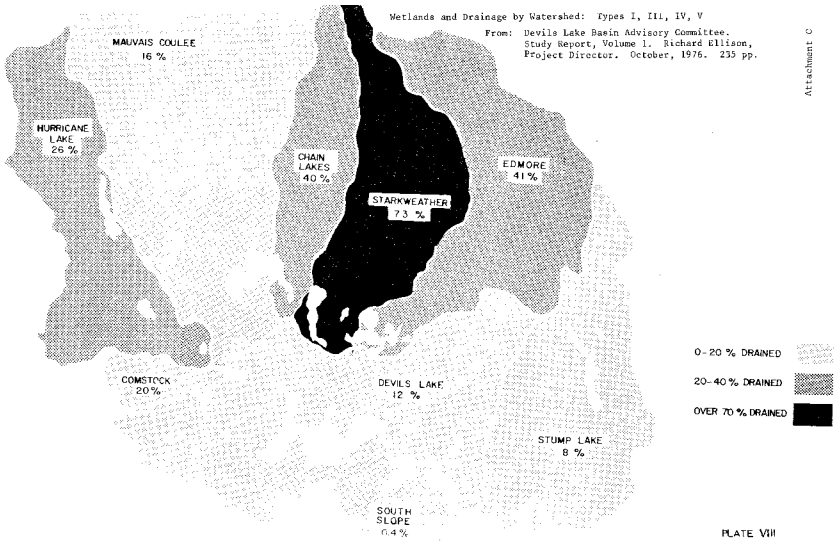
Attachment S. Fluctuations in Levels of Devils Lake. From Devils Lake Basin Advisory Committee. 1976. Devils Lake Basin Study, Study Repon, Volume 1. Prepared by TPI Consultants, Inc., Richard Ellison, Project Director, Office of the Govemor, State of Nonh Dakota. 235 pp.

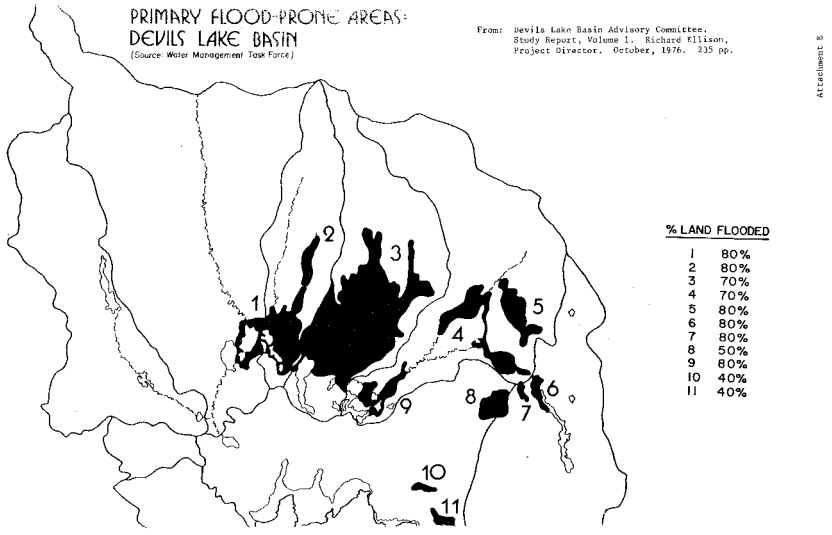
Attachment T. Vern Fahy, State Engineer. Memo to Govemor Allen 1. Olson and Members of the State Water Commission. Subject: Devils Lake Flood Control—SWC Project #1712. November 8, 1982. 6 pp.

Attachment U. Associated Press. Odds are lake will stabilize and then fall. Jamestown Sun, Jamestown, North Dakota. October 20, 1997.

Attachment V. Associated Press. Project to raise dike no small feat. Jamestown Sun, Jamestown, North Dakota. November 21, 1997.







UNITED STATES DEPARTMENT OF THE INTERIOR,
Fish and Wildlife Service, Washington, DC, October 3, 1997.

MR. ROBERT J. WHITING, *Chief,*
Environmental Resources Section
Management and Evaluation Branch
St. Paul District, Corps of Engineers
St. Paul, Minnesota 55101

DEAR MR. WHITING: The U.S. Fish and Wildlife Service (Service) is providing you this Planning Aid Letter (PAL) for the Devils Lake Feasibility Study. Lake Stabilization, Devils Lake, North Dakota, and its accompanying Substantiating Report. The PAL and Substantiating Report have been prepared by the North Dakota Field Office, in response to the Corps of Engineers' (Corps) Fiscal Year 1997 Scope of Work dated October 21, 1996, for fish and wildlife activities associated with the Feasibility Study. It is prepared under the authority of and in accordance with the Fish

and Wildlife Coordination Act (16 U.S.C. 661–67e), and in accordance with the provisions of the Endangered Species Act (16 U.S.C. 1531 et seq.).

Water levels in Devils Lake have been rising since 1993. In an effort to stabilize the lake level, the 1993 Energy and Water Development Appropriations Act (Public Law 102–77) directed the Corps to conduct a Feasibility Study to address water management, stabilization of lake levels, water supply, water quality, recreation, and conservation of fish and wildlife resources.

The scope of this PAL and Substantiating Report is to provide a description of the existing resources in the project area. derived from: a) a literature review of published reports detailing fisheries, wildlife, vegetation, wetlands, threatened and endangered species, water quality, and unique or identified natural areas within the study area; b) participation in Habitat Evaluation Procedures (REP) activities; and c) identification of future study needs. Most features of the Scope of Work were addressed prior to suspension of the study in order to proceed with the outlet proposal. Those activities that were not completed or require additional work will be addressed when the feasibility study is reinitiated.

Various lake stabilization components studied in the Feasibility Study have the potential to impact a wide range of fish and wildlife resources. Of particular importance in accomplishing the objectives of this project will be the protection and restoration of wetland resources in the basin. the longterm maintenance of a viable fishery resource in Devils Lake, and minimizing the potential impacts to fish and wildlife resources on the Sheyenne and Red Rivers.

The current situation at Devils Lake has its origin from the higher levels of precipitation, but equally important is the impact brought on by inadequately planned development that has occupied an active lake plain, and alteration of the contributing watershed that has increased flooding vulnerability.

It will be essential to maintain the integrity of the valuable fish and wildlife resources in the basin. The wetlands and lake fishery continue to remain vulnerable to the types of development activities witnessed in the past, and are subject to negative impacts by developing this project in an incomplete manner. A comprehensive approach that determines a cost effective and environmentally sound project needs to be thoroughly scoped through the National Environmental Policy Act (NEPA), or some other process, to ensure that potential impacts from oversights of the past and the compatibility of future actions are addressed and effectively implemented.

The following list of issues have been identified through the development of the Substantiating Report. They represent some of the major unresolved issues and data needs relative to the Feasibility Study.

1. The Long-Term Resolution of Devils Lake Flooding Requires a Basinwide Plan. The Corps, in cooperation with the State sponsor, should develop actions for the Devils Lake flooding solution as part of a comprehensive approach, and seek authorization language and implementation strategies that endorse the comprehensive approach. The goal should be to maximize the actions that contribute to the solution within the basin, and minimize the amount of water that may be released outside the basin. To facilitate this approach, a detailed survey of the basin's storage potential, including natural restorable and managed sites, should be completed and analyzed as part of the basin's storage component.

2. What is the Effect of Land Use Chances in the Basin on the Lake's Runoff? The Corps should seek updated hydrologic predictions that include the current runoff potential in the basin incorporating the changes to runoff potential caused by land use manipulation. These updated predictions should be provided in a timely manner to allow use in the development of specific actions and operation strategies.

3. Operation Criteria. Operating criteria for the various parts of a comprehensive solution should be proposed and analyzed. Additionally, a specific hydrologic analysis between surface and ground water on the Sheyenne River in western prairie fringed orchid range will be required to assess potential for impacts to the threatened plant. The result of this study will be needed to work out an acceptable operating plan prior to implementation.

4. Determining Optimum Lake Levels. For purposes of resolving the flooding issue and minimizing the harm to natural resources, a minimum lake level target and operating range should be identified and used to devise operating strategies, and develop expectation for resolution of the flooding issue.

5. Water Quality Maintenance. Based on predictive models, operating criteria should be established that minimize the harm to the Devils lake and downstream receiving waters. Also, a comprehensive program to enhance remaining water will be necessary if an outlet is proposed to remove the lake's freshwater.

There is considerable potential within the Devils Lake Basin to protect, restore, and enhance fish and wildlife habitats while simultaneously providing positive benefits towards solving the Devils Lake flooding problem. We urge the Corps to make

this a foundation of the Devils Lake solution, and are committed to working closely with the Corps on these issues.

The Service will continue to work within our authorities to implement practical solutions to the Devils Lake flooding. We will also participate with the Corps when the Feasibility Study is reinitiated. Questions regarding information contained in our report should be directed to Bill Pearson at (701) 250–401.

Sincerely,

ALLYN J. SAPA,
Field Supervisor, North Dakota Field Office.

SUBSTANTIATING REPORT FOR DEVILS LAKE FEASIBILITY STUDY FOR LAKE STABILIZATION DEVILS LAKE, NORTH DAKOTA

I. IDENTIFICATION OF PURPOSE, SCOPE, AND AUTHORITY

The elevation of Devils Lake has been steadily rising since 1993. Currently, Devils Lake stands at elevation 1442.6 feet (September 28, 1997). Forecasts for the future of Devils Lake are uncertain, as the lake has a long history of fluctuation. Wiche and Vecchia (1996) suggest that a rising or declining lake level may in fact be a more normal condition than a stable lake level.

In an effort to stabilize the lake level, the 1993 Energy and Water Development Appropriations Act (Public Law 102–77) directed the Corps of Engineers (Corps) to conduct a Feasibility Study to address water management, stabilization of lake levels (including an inlet and outlet), water supply, water quality, recreation, and conservation of fish and wildlife resources.

In response to a negotiated scope of work, the U.S. Fish and Wildlife Service (Service) is providing a Planning Aid Letter (October 3, 1997), and this Substantiating Report for the Devils Lake Feasibility Study, Lake Stabilization, Devils Lake, North Dakota. It is prepared under the authority of and in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661–67e), and in accordance with the provisions of the Endangered Species Act (16 U.S.C. 1531 et seq.).

The scope of this Substantiating Report provides a description of the existing resources in the project area, derived from an extensive literature review of published reports detailing fisheries, wildlife, vegetation, wetlands. threatened and endangered species, water quality, and unique or identified natural areas within the study area.

II. IDENTIFICATION OF PRIOR STUDIES AND REPORTS

Since 1980, several studies and reports on Devils Lake have been published. The Corps has produced the following studies: 1996 Emergency Outlet Plan: 1996 Environmental Assessment and Plans and Specifications for Raise of Existing Levee; 1996 Contingency Plan; 1992 Reconnaissance Report for Flood Control, Lake Stabilization. and Comprehensive Purposes; 1988 Devils Lake Basin Integrated Draft Feasibility Report and Environmental Impact Statement; 1983 Section 205 Detailed Project Report for Flood Control. These reports provide a significant background of information from the basin.

The Service has published the 1988 Draft Fish and Wildlife Coordination Act Report for Fish and Wildlife Resources in Relation to the Devils Lake Basin Flood Control Project; and the 1992 Substantiating Report.

III. DESCRIPTION OF THE STUDY AREA

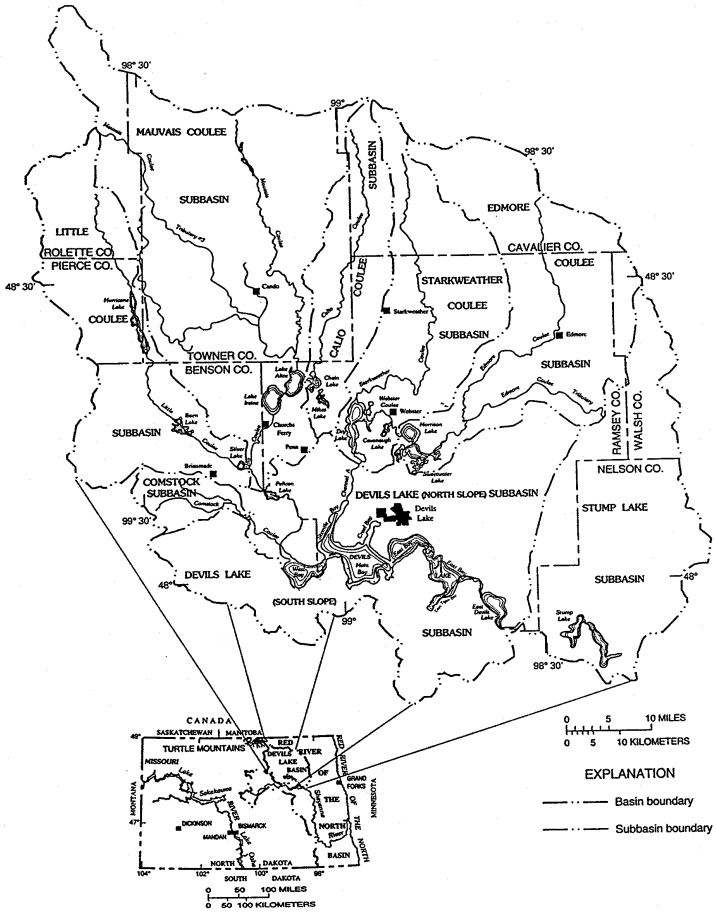
Devils Lake Basin

The Devils Lake Basin, located in northeastern North Dakota, is a closed basin encompassing 3,814 square miles or roughly 5 percent of North Dakota's land surface (Figure 1), and is divided into nine watersheds (Figure 2). Devils Lake Basin is bounded on the south by the Sheyenne River Basin, on the north by the Pembina River Basin, and on the east by the Park, Forest and Turtle River Basins. Devils Lake is considered part of the Red River-Hudson Bay drainage system, although no flow into the Red River-Hudson Bay system has occurred in recorded time. The topography of the Devils Lake basin results in a north-to-south drainage pattern, with Devils Lake receiving 87 percent of the basin's runoff, and Stump Lake receiving the balance of 13 percent. Not all of the basin contributes directly to Devils Lake or Stump Lake, as many wetland basins do not contribute, except when they reach overflow during above average precipitation.

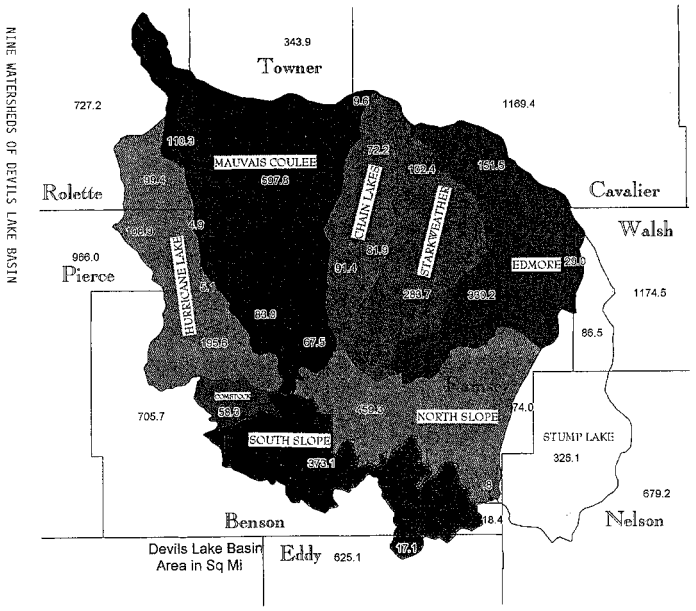
The Devils Lake Basin is the result of the last advance of continental ice sheets in North Dakota. Glacial Devils Lake was maintained at about elevation 1450 feet

above mean sea level (msl) by glacial meltwater flowing from the retreating ice sheet to the north and by precipitation. Evidence in the basin suggests that water levels have fluctuated from the time the glacial ice sheets completely melted away through recent recorded time (Figure 3). The underlying causes of the long-term changes in water levels are not fully understood.

FIGURE 1



LOCATION OF THE DEVILS LAKE BASIN



NINE WATERSHEDS OF DEVILS LAKE BASIN

FIGURE 2

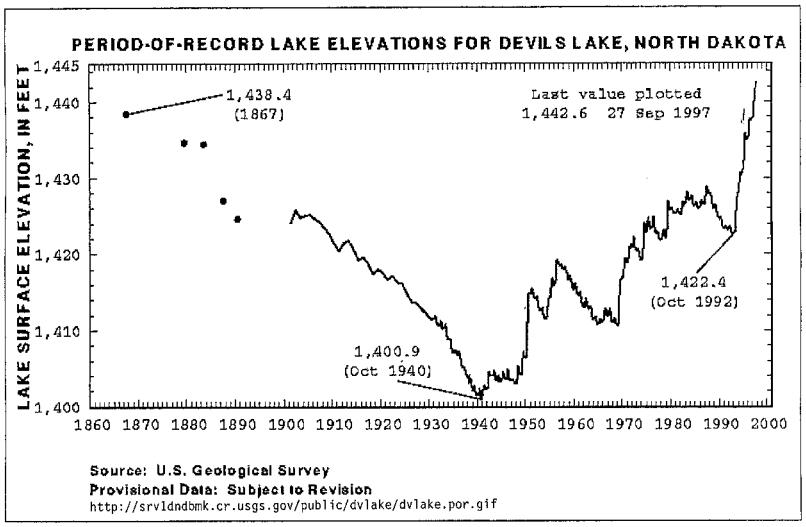


FIGURE 3

Within the Devils Lake Basin lie a chain of waterways beginning with the Sweetwater group, and extending through Mauvais Coulee, Minnewauken Flats, West Bay Devils Lake, Main Bay Devils Lake, East Bay Devils Lake, and East Devils Lake to Stump Lake (Figure 1). Mauvais Coulee, a principal tributary to Devils Lake, is the largest drainage channel in the Devils Lake system. Water flows intermittently, largely in response to precipitation and wetland drainage. Devils Lake and its wetlands are maintained by spring runoff, precipitation, and ground water. The potential of the basin to store water has been greatly influenced by man's alter-

ation of the land. Most notably by land tillage, expansion of runoff by drainage of non-contributing wetland basins, and alteration of drainage patterns. The result is water that would normally be stored and subjected to evapotranspiration in the basin is now adding to lake levels. Eisenlohr (1966) defined evapotranspiration as that water lost to the air by means of evaporation, and transpiration by vegetation. Evapotranspiration is the primary mechanism that exports water from the basin. In addition, seepage into groundwater stored in the basin removes surface waters. The average annual precipitation for the Devils Lake Basin is 16.98 inches, with 11.8 inches occurring during the growing season. The average annual evaporation is 30.00 inches, with a seepage average of 7.10 inches (Ludden et al. 1983).

The weather of Devils Lake varies widely with the season. Records at the Devils Lake weather station show mean monthly temperatures from 68—F in the summer, to 4—F in the winter. The maximum recorded temperature is 112—and the minimum is 46—below zero. The frost free growing season lasts from about May 15 to September 23. Mean annual snowfall is 36 inches.

Sheyenne River

The Sheyenne River is one of four major tributaries to the Red River in North Dakota, with a watershed of 6,910 square miles (Figure 4). For descriptive purposes, the Sheyenne River can be divided into three segments. From its headwaters in northwestern Sheridan County, the first segment flows east across the drift plain into Nelson County, where it turns southward. flowing to central Ransom County. From this point, the river turns northeast to its confluence with the Red River. From the town of Sheyenne, North Dakota, to Lake Ashtabula, the Sheyenne flows through a valley 100–50 feet deep, and ¼ to 1 mile wide, carved into Cretaceous Pierre Formation shale.

Lake Ashtabula, located about midway along the river's length, is a 5,430-acre impoundment formed by Baldhill Dam. Both the lake and dam were authorized in 1944. The construction of Baldhill Dam began in 1947, and was completed in 1951. The Corps of Engineers operates the lake for water supply and flood control.

This reservoir is a popular recreation area for eastern North Dakota residents providing swimming, boating, and a diverse sport fishery for walleye, northern pike, muskellunge, yellow perch, and white bass. Lake Ashtabula also provides an annual source for northern pike and walleye eggs for the Valley City National Fish Hatchery.

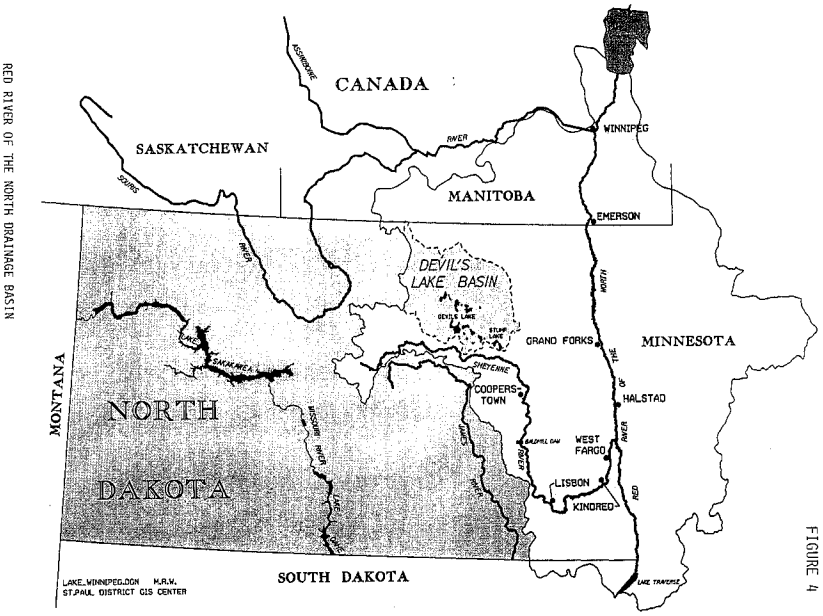


FIGURE 4

The second reach, from Lake Ashtabula to just below Lisbon, North Dakota, flows through a valley ½ to 1 mile wide and as deep as 200 feet, through glacial till and Cretaceous Niobrara and Pierre Formations. The third segment flows from below

Lisbon to the confluence of the Red River, across the Sheyenne Delta, through an extensive sandhills area and the floor of glacial Lake Agassiz, forming the Red River Valley.

The Sheyenne is approximately 550 miles in length with an average slope of 1.5 feet per mile on the drift prairie, 2 feet per mile as it enters the Red River Valley, and approximately 1 foot per mile as it flows across the Red River Valley.

Red River

The Red River of the North is a part of the Hudson Bay drainage system which drains parts of North Dakota, South Dakota, and Minnesota in the United States, and parts of Manitoba and Saskatchewan in Canada (Figure 4). The Red River, formed at the confluence of the Bois de Sioux and Otter Tail Rivers, has a total drainage area in the United States of 39,200 square miles, of which 20,820 square miles are in North Dakota (including the non-contributing Devils Lake Basin).

In recent geologic times, the Red River region was covered by a large continental ice sheet. Retreating glaciers left a massive saltwater lake known as Lake Agassiz. The present day Red River Valley formed the bottom of the lake. The Red River flows north into Canada across the floor of the glacial lake bed for 394 river miles, forming the North Dakota-Minnesota boundary. The lake bed is nearly flat, with an average slope of about 0.4 feet per mile. The river has a high sediment load of silts and clays which results in the muddy character of the Red. Additionally, the river is characterized by a low gradient and high sinuosity.

IV. DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDITIONS

EXISTING RESOURCES

Fishery

Devils Lake: The sport fishery of Devils Lake is a valuable resource which greatly improved during the 1980's with rising water levels. Devils Lake is a brackish lake, developed through lake level fluctuations which are beneficial to the support of the current fishery. The fishery remained relatively stable during the drought of 1988–990. Primary species pursued by anglers are walleye, northern pike, yellow perch, and white bass. White suckers and black bullheads are also present but have not increased sufficiently to degrade the quality of the sport fishery. Tiger muskellunge are also present in low numbers. Previously, virtually all game fish were artificially stocked due to low reproduction potential from brackish water quality. With current high lake levels freshening the lake, yellow perch, northern pike. white bass. crappie, and possibly walleye are experiencing successful natural reproduction. Forage species such as fathead minnows have increased dramatically with the high lake levels (Hiltner, pers. common.). Table 1 lists the fish species that occur in Devils Lake.

Game fish reproduction in East Bay (east of Highway 57) has been lower than western bays, due to high salinity levels. Reproductive success of fish other than fathead minnows and brook sticklebacks in East Bay has been low. The only young-of-the-year fish caught in any number in Black Tiger Bay and East Bay Devils Lake during sampling with seine nets and small frame nets were fathead minnows and brook sticklebacks (Hendrickson 1990). Yellow perch and black crappie reproduction has been verified in Black Tiger Bay where fresh water flows from Spring Lake (Hendrickson 1990). Only adult fathead minnows and brook sticklebacks were caught in West Stump Lake in 1987 and 1988 (Hendrickson 1990). Fathead minnows and brook sticklebacks were found in East Stump Lake during 1996 (Hiltner, pers. common.). However, with recent high water conditions in Devils Lake it is suspected, by North Dakota Game and Fish Department, that game fish reproduction could occur in East Bay. Young-of-the-year northern pike have been found in East Bay in 1997 (Hiltner, pers. common.).

Prior to 1965, no game fishery existed in Devils Lake (U.S. Fish and Wildlife Service 1992). Routine stocking of game fish was initiated in 1965. During the 1980's, the fishery improved, which resulted in a dramatic increase in recreational use of the lake. Most fishing activity occurs in Devils Lake west of Highway 57.

Long-term maintenance of the fishery in Devils Lake is dependent on the balanced relationship of nutrients, salinity, water levels, and Total Dissolved Solids (TDS) concentrations. This balance helps to prevent oxygen depletion from occurring, has limited fish reproduction, and regulates algae blooms. The result has been a simple but highly-valued fishery. Historically, East Stump Lake did not support a recreational fishery due to high levels of TDS, (241,000 mg/l in January 1961). As of June 1997, the lake level has risen to 1.404 feet msl, with TDS levels at 13,460 mg/l. Yellow perch fingerling survival in East Stump Lake was investigated by the North Dakota Game and Fish Department (Department) June 25—July 2,

1997 (North Dakota Game and Fish Department 1997). Adult yellow perch can tolerate sodium-sulfate levels up to 15,000 mg/l. This study resulted from a request by local groups to stock yellow perch into East Stump Lake. The Department performed yellow perch fingerling survival tests to determine if survival rates would sustain a recreational yellow perch fishery.

Table 1. Fishery Resources of the Sheyenne and Red Rivers, and Devils Lake.

Scientific name	Common Name	Sheyenne River	Red River	Devils Lake
Ambloplites rupestris	rock bass	X	X	
Ameiurus melas	black bullhead	X	X	X
Ameiurus nebulosa	brown bullhead			X
Aplodinotus grunniens	freshwater drum	X	X	
Catostomus commersoni	white sucker	X	X	X
Culaea inconstans	brook stickleback	X	X	X
Cyprinus carpio	carp	X	X	
Esox lucius	northern pike	X	X	X
Esox lucius X E. masquinongy	Tiger muskie			X
Esox masquinongy	muskellunge			X
Etheosoma exile	Iowa darter	X	X	
Etheosoma nigrum	Johnny darter	X	X	
Ictalurus punctatus	channel catfish	X	X	X
Lepomis gibbosus	pumpkinseed	X	X	
Lepomis humilis	orange spotted sunfish	X	X	
Lepomis macrochirus	bluegill	X	X	
Lota lota	ling			
Micropteris dolomieui	smallmouth bass	X		
Micropterus salmoides	largemouth bass	X	X	
Morone chrysops	white bass	X	X	X
Morone saxatilis	striped bass			X
Moxostoma macrolepidotum	shorthead redhorse	X	X	
Notemigonus chrysoleucas	golden shiner	X	X	
Notropis cornutus	common shiner	X		
Notropis hudsonius	spottail shiner	X		
Notropis spilopterus	spotfin shiner	X		
Notropis stramineus	sand shiner	X		
Noturus flavus	stonecat	X		
Noturus gyrinus	tadpole madtom	X		
Osmerus mordax	rainbow smelt		X	
Perca flavescens	yellow perch	X	X	X
Percina maculata	blackside darter	X		
Percopsis omiscomaycus	trout-perch	X	X	
Pimephales notatus	bluntnose minnow	X	X	
Pimephales promelas	fathead minnow	X	X	X
Pomoxis annularis	white crappie	X	X	
Pomoxis nigromaculatus	black crappie	X	X	X
Rhinichthys atratulus	blacknose dace	X	X	
Rhinichthys cataractae	longnose dace	X	X	
Semotilus atromaculatus	creek chub	X	X	
Stizostedion canadense	sauger	X	X	
Stizostedion vitreum	walleye	X	X	X

Perch fingerling survival ranged from 56 percent to 93 percent, with an overall survival of 78 percent. The results of necropsies performed on the live yellow perch indicated some stress associated with an osmotic pressure gradient. There was also evidence that the perch fingerlings had been feeding on zooplankton or small macro invertebrates while confined in the nets. The Department recommended that because the short-term yellow perch fingerling survival was above expected levels, East Stump Lake could be considered for stocking with yellow perch fingerlings in 1998.

Sheyenne and Red Rivers: Both the Sheyenne and Red Rivers' systems provide spawning habitat and nursery areas for forage fish, as well as a migrational avenue for sport fish, including channel catfish, northern pike, walleye, sauger, rock bass

and crappie. Lake Ashtabula provides the primary recreational fishing site on the Sheyenne River.

There are 13 species of freshwater mussels inhabiting the Red and Sheyenne Rivers (Cvancara 1974). Of these 13 species, 8 are found in the Red River and 9 in the Sheyenne River. The most common species found are White heelsplitter (*Lasmigona complanata*), Giant floater (*Anodonta grandis*), Fatmucket (*Lampsilis siliquoides*), and Cylindrical papershell (*Anodontoides ferussacianus*). Less common species include Wabash pigtoe (*Fusconia flava*), Three-ridge (*Amblema costata*), Mapleleaf (*Quadrula quadrula*), Creek heelsplitter (*Lasmigona compressa*), Fluted-shell (*Lasmigona costata*), Squaw Foot (*Strophitus rugosus*), Pink heelsplitter (*Proptera alata*), Black sandshell (*Ligumia recta latissima*), and Pocketbook (*Lampsilis ventricosa*).

Wildlife

Devils Lake: Wildlife in the Devils Lake Basin is closely associated with water and wetlands (Table 2). Historically, the Devils Lake Basin has had one of the highest concentrations of prairie wetlands in the Northern Great Plains. These wetlands range from numerous large lakes to thousands of small, shallow potholes or marshes.

Shallow water wetland habitats are clearly the most valuable habitat types for waterfowl. Shallow, seasonally flooded wetlands provide important pair habitat and breeding sites for dabbling ducks, including mallard, pintail, gadwall, and teal. Over-water nesters such as scaup, canvasback, and redhead build nests in vegetation which grows in water depths of 5 feet and less. Broods feed and take cover in shallow, vegetated wetlands. Other wildlife such as white-tailed deer, fox, raccoon, muskrat, mink, beaver, and ring-necked pheasant rely on shallow water wetlands for food and cover. Vegetation associated with these wetlands are especially valuable during winter, as cover for upland species. Drainage of shallow wetland habitat for agricultural purposes has been significant in the Devils Lake Basin.

Table 2. Partial list of wildlife species found in the Devils Lake Basin and the Red and Sheyenne River corridors.

Common Name - Mammals	Scientific Name	Common Name - Birds	Scientific Name
Beaver	*(Castor canadensis)*	American kestrel	*(Falco sparverius)*
Eastern chipmunk	*(Tamias striatus)*	American Robin	*(Turdus migratorius)*
Cottontail rabbit	*(Sylvilagus floridanus)*	Bald eagle	*(Haliaeetus leucocephalus)*
Coyote	*(Canis latrans)*	Black-capped chickadee	*(Parus atricapillus)*
Fox squirrel	*(Sciurus niger)*	Broad-winged hawk	*(buteo platypterus)*
Grey squirrel	*(Sciurus carolinensis)*	Brown thrasher	*(Toxostoma rufum)*
Jackrabbit	*(Lepus townsendi)*	Canada goose	*(Branta canadensis)*
Mink	*(Mustela vison)*	Chipping sparrow	*(Spizella passerina)*
Moose	*(Alces alces)*	Common crow	*(Corvus brachyrhynchos)*
Muskrat	*(Ondatra zibethica)*	Cooper's hawk	*(Accipiter cooperii)*
Raccoon	*(Procyon lotor)*	Downy woodpecker	*(Dendrocopos pubescens)*
Red fox	*(Vuples fulva)*	Grackle	*(Quiscalus quiscula)*
Red squirrel	*(Tamiasciurus hudsonicus)*	Great horned owl	*(Bubo virginianus)*
Striped Skunk	*(Mephitis mephitis)*	Greater prairie chicken	*(Tympanuchus cupido)*
Long-tailed weasel	*(Mustela frenata)*	Grey partridge	*(Perdix perdix)*
White-tailed deer	*(Odocoileus virginianus)*	Hairy woodpecker	*(Dendrocopoc villosus)*
		Hooded merganser	*(Lophodytes cucullatus)*
		House wren	*(Troglodytes brunneicollis)*
		House sparrow	*(Passer domesticus)*
		Mallard	*(Anas platyrhynchos)*
		Mourning dove	*(Zenaida asiatica)*
		Northern Harrier	*(Circus cyaneus)*
		Peregrine falcon	*(Falco peregrinus)*
		Pheasant	*(Phasianus colchicus)*
		Piping plover	*(Charadrius melodus)*
		Purple martin	*(Progne subis)*
		Red-tail hawk	*(Buteo jamaicensis)*
		Sharptail grouse	*(Pedioecetes phasianellus)*
		Swainson's hawk	*(Buteo swainsoni)*
		Wild turkey	*(Meleagris gallopavo)*
		Wood duck	*(Aix sponsa)*
		Yellow warbler	*(Dendrocia petechia)*

Open water habitats provide, to varying degrees of importance, brood, migratory, molting, and staging areas for most ducks, geese. and swans. Some diving ducks such as scaup, ringneck and redhead use these wetlands as feeding areas. Sub-irrigated meadows are used to some extent by feeding waterfowl, but to a greater extent by feeding and nesting shorebirds.

Saline wetland habitats are used heavily by nesting and feeding ducks. Saline wetlands or bays less than 4 feet deep, which permit growth of aquatic vegetation, are more productive for waterfowl and shorebirds than deeper, open water areas. Because of their physical and chemical nature, few of these wetlands are drained.

In addition to waterfowl, many other species of marsh and shorebirds use the lakes and wetlands of the basin for migration and nesting habitat, including black-crowned night herons, great blue herons, great or common egrets, American bit-

terns, western and eared grebes, white pelicans, double-crested cormorants. and ring-billed gulls.

The Chain of Lakes located north of Devils Lake in the middle of the basin provides a unique combination of feeding and resting habitats utilized by migrating waterfowl. Large concentrations of migrating geese, ducks (primarily canvasbacks, scaups, and mallards), cranes, swans, cormorants, and pelicans congregate in this area during spring and fall migrations. It is one of the most important areas remaining in eastern North Dakota for recreational activities such as hunting of small game, white-tailed deer, and waterfowl: photography; bird watching; and nature study.

Sheyenne River: The Sheyenne River flows southeast through land dominated by agriculture to its confluence with the Red River of the North near Fargo. The riparian areas along the Sheyenne River provide valuable habitat for a variety of wildlife species. Game species found along the river's riparian corridor and adjacent uplands include white-tailed deer, moose, wood duck, dabbling ducks, pheasant, greater prairie chicken, sharptail grouse, grey partridge, mourning dove, wild turkey, squirrels (grey, red, and fox), and rabbits (cottontail and jackrabbits). Another important wildlife resource is the numerous forbearing species such as red fox, coyote, muskrat, beaver, mink, weasel, and raccoon. Migratory non-game birds use the river corridor for migration or the wooded areas along the river for feeding and nesting areas. These birds include many species of passerine song birds, wading and shore birds, and captors including Swainson's hawk, northern harrier, Cooper's hawk, redtail hawk, broad-winged hawk, and migrating bald eagles.

The Sheyenne River flows through a unique natural area in southeastern North Dakota known as the Sheyenne Sandhills. The Sandhills are home to 17 different State listed species as Endangered, Threatened, or Peripheral in ;orth Dakota (Link 1989). Additionally, the U.S. Forest Service manages the 70,000-acre Sheyenne National Grasslands located in Ransom and Richland Counties, in southeastern North Dakota. An important State Wildlife Management Area (WMA) along the Sheyenne River is Mirror Pool WMA, consisting of three public tracts in the Sheyenne Sandhills, scattered along 4 miles of the Sheyenne River, southeast of Enderlin, North Dakota (Heidel 1988).

Red River: Although the habitats supporting fish and wildlife resources along the Red River have been substantially altered, the remaining areas provide several important functions. Shelterbelts and riparian woodlands provide donning and nesting sites, food, escape and winter cover, and travel lanes for many wildlife species, including red and gray squirrels, chipmunk, cottontail rabbit. striped skunk, red fox, raccoon, and white-tailed deer. Common bird species include brown thrasher, American kestrel, yellow warbler, crow, robin, downy and hairy woodpeckers, flycatchers, black-capped chickadee, and warblers. Passerine birds use shelterbelts and riparian forests along the river corridor, as migrational routes. Species which have adapted to man's activities on the river include the house wren, robin, chipping and house sparrows, grackle, and purple martin.

The riverine habitat provides feeding and resting areas, primarily during migrational periods, for several species of waterfowl, namely mallards, Canada geese, and hooded mergansers. Wood ducks commonly breed in the area, nesting in cavities provided by the mature trees. Mink and muskrat also utilize the riparian zone, along with migrating shorebirds and birds of prey.

Vegetation

Devils Lake: The Devils Lake basin is located within the transitional zone between the tall grass and mixed grass prairies. Historically, nearly 2 million acres of the Devils Lake Basin was native grasslands, interspersed with wetlands, woodlands, and shrub lands. By the mid-1970's, only 127,875 acres of native grassland remained, comprising 8 percent of the basin's cover type (Devils Lake Basin Advisory Committee 1976). Conversion of native grassland to cropland continues, but at a much reduced rate, because most lands suitable for farming have already been plowed. Remaining grasslands are grazed or cut for hay. Various conservation programs such as Conservation

Reserve Program, waterbank, and planted wildlife cover have established tamegrass as an important habitat in the basin. Currently, there about 200,000–250,000 acres of tamegrass in the basin.

Grassland in association with wetlands is vital to upland nesting waterfowl and other migratory birds. Native grasslands are also important habitat for resident species such as sharp-tailed grouse, ring-necked pheasant, gray partridge, white-tailed deer, jack rabbit, skunk, badger, fox coyote, and many nongame bird species.

There are three major types of native grassland sites in the basin, each with its own distinctive plant community. These types are silty, overflow. and thin upland

range sites. Silty range sites are the most common, occurring on nearly-level to rolling glacial till plains, lake plains, and on high stream terraces. This grassland type is dominated by cool season grasses. In good condition, this type would be expected to have needle and thread, green needlegrass, western wheatgrass, porcupine grass, numerous forte species, and a few shrubs. The overflow range site occurs on nearly level swales and depressions in glacial till plains and on stream terraces and floodplains, and is the second most frequently occurring grassland site. Dominant species of this type include big bluestem, switch grass, little bluestem, green needlegrass, and porcupine grass. Forbs and shrubs such as Maximilian sunflower, fringed sagebrush, western snowberry, chokecherry, and Juneberry are also common. The other common grassland site in the basin is the thin upland site. This site is found on gently sloping to moderately steep glacial till uplands. A mixture of both cool and warm season grasses dominate this type. Principal species are needle and thread, porcupine grass, green needlegrass, and little bluestem. All native grassland areas, regardless of type, are extremely important to both game and nongame wildlife species.

The Conservation Reserve Program (CRP), administered by U.S. Department of Agriculture, is designed to retire agricultural acreage for soil and water conservation, and to provide wildlife benefits. The Service has estimated that approximately 201,463 acres of CRP exists in the Devils Lake basin. Table 3 is a breakout of each county in the basin and the CRP acreage.

Table 3. CRP Acreage in Devils Lake Counties.

	CRP Acres	Percent of County in the Basin	Estimated CRP Acres in the the Basin
Benson	43,621	50	21,810
Cavalier	29,848	22	6,566
Nelson	108,756	32	34,802
Pierce	87,367	11	9,610
Ramsey	69,288	100	69,288
Rolette	68,328	22	15,031
Towner	54,336	67	36,405
Walsh	88,348	9	7,951
TOTAL	549,887		201,463

Woodlands cover 3 percent of the basin. The native forest surrounding the Devils Lake chain ranks as one of the three largest blocks of contiguous forest remaining in the State. The North Dakota Forest Service classifies the native forest in the basin into four types: lowland hardwoods, aspen-birch, oak timber, and brush timber. Acre-for-acre prairie woodlands are second only to wetlands in providing diverse breeding habitat and cover for birds and mammals.

The lowland hardwoods type is composed primarily of American elm, green ash, box elder, cottonwood, and basswood. This type predominates along water draineues and river bottoms.

The primary species in the aspen-birch type are trembling aspen, balsam poplar, and paper birch. Stands of these trees prefer northern and eastern slopes or other sites where soils are well drained, but moisture is abundant.

The oak timber type is composed primarily of bur oak. It dominates dry forest sites in the area. Especially in the area south of Devils Lake. Bur oak also grows on moist sites, but in association with other species such as green ash.

The brush timber type is composed of native forest shrubs such as willows, chokecherry, American or beaked hazel, red-stemmed dogwood, hawthorne, juneberry, pincherry, silverberry, buffaloberry, American plum, highbush cranberry. and others. Scattered native trees like bur oak and green ash are normally associated with the shrubs.

A forest inventory of the Devils Lake area by the North Dakota Forest Service in January 1980, revealed that during 1971–1977, about 6.700 acres of native forest were converted to other uses. Agricultural clearing for cropland, hayland, and pastures, along with clearing for residential development were the principal causes for forest conversion. In addition to the losses from clearing, about 25 percent of the native forest lands in the area are grazed by livestock.

Because North Dakota has such limited woodlands, prairie woodland habitat in the basin is valuable to a wide variety of wildlife. Prairie woodlands are especially important during winter when they provide protective cover for both game and

nongame wildlife. Raptors such as the Swainson's hawk and great horned owl require prairie woodlands for nesting.

Sheyenne River: Deciduous woodlands are the most important habitat type in the Sheyenne River Valley. Primary tree species include bur oak, basswood, American elm, box elder, aspen, and cottonwood.

Mirror Pool Wildlife Management Area in southeastern North Dakota includes Mirror Pool Swamp, the largest fen or peatland (dense alder and bog birch brush) on the Sheyenne River (Heidel 1988).

Red River: Most of the original prairie which once stretched beyond the river corridor has been replaced by farmland. Dominant tree species along the Red River include American elm, box elder, cottonwood, green ash. and basswood. Common understory species in riparian areas include willow, gooseberry, hawthorne, juneberry, and buck brush. Species such as Solomon's seal, nodding trillium, asters, wood nettle, violets, Canada anemone, hawksbeard, bedstraw, and columbine are common in the herb layer. The riparian vegetation also provides shading along the bank and the fallen trees in the river provide spawning areas, create eddies, and scour holes which are used by the fisheries resource.

Riparian habitats: Riparian habitats are generally defined as the zone of vegetation influenced by the hydrology of streams and rivers. Riparian vegetation usually exhibit a higher degree of robustness than that located in adjacent areas, and as such, represents a transitional zone between wetland and upland environments. Riparian corridors along intermittent streams and tributaries to the Red River, Sheyenne River, and Devils Lake provide valuable habitat for fish and wildlife. Marsh habitat within riparian corridors often provide waterfowl habitat as good as prairie wetlands. Riparian areas in the Devils Lake Basin and along the river corridors are important not only as habitat for fish and wildlife, but also for flood control, streambank stabilization. and to improve water quality.

During high precipitation or runoff events, riparian corridors slow the rate of surface water runoff or overland flow. The dense, thick vegetation of a healthy, unaltered riparian corridor, and its deep humus layer of soil act as retardants, holding back and slowing runoff. Cottonwood, ash, and elm with their deep roots, and willow, dogwood, and buck brush with shallow, dense roots effectively hold the soil in place and defect water to reduce streambank erosion. Riparian areas can improve water quality by acting as filters to remove chemical compounds, toxic substances, sediments, and trash as the water moves slowly through the system.

Description of Wetland Resources

Devils Lake Basin: Wetland habitats of Devils Lake and its watershed can be grouped into broad categories which provide several functions and values unique to wetlands such as flood water storage, habitat for wildlife, filtering of polluted water, and groundwater recharge. Using "Classification of Wetlands and Deepwater Habitats of the United States" by Cowardin, et al. (1979), and the National Wetlands Inventory (NWI), prairie pothole habitats found in the Devils Lake Basin can generally be grouped into palustrine, emergent, temporarily, seasonally and semipermanently flooded wetlands (PEMA, PEMC, and PEMF, respectively). The upper basin chain of lakes can be described as a lacustrine, limnetic, unconsolidated bottom, intermittently exposed wetland (L1UBG), with a shallow ring of lacustrine, littoral, aquatic bed, semipermanently flooded habitat (L2ABF).

Sheyenne River: The Sheyenne River is classified as a riverine, lower perennial, unconsolidated bottom, intermittently exposed (R2UBG), for the upper one-third, and riverine, lower perennial, unconsolidated bottom, permanently flooded (R2UBH), for the lower two-thirds of the river's length. In addition to the river habitat, there are several other types of floodplain wetlands that occur in the Sheyenne River floodplain. For the most part. they are characterized as palustrine, emergent, temporarily, and seasonally flooded wetland habitats (PEMA and PEMC, respectively). In some areas, sedge meadow wetlands are found adjacent or near the Sheyenne River and are maintained by river flows and ground water tables. An occasional palustrine, forested, temporarily flooded (PFOA) linear or polygon situated adjacent to the river may be found along the Sheyenne River.

Red River: The Red River is characterized as a riverine, lower perennial, unconsolidated bottom, permanently flooded (R2UBH). There are occasional exposed river bars which have been typed as riverine, lower perennial, unconsolidated shore, temporarily or seasonally flooded (R2USA, and R2USC, respectively). Unlike the Sheyenne River, the Red River floodplain is largely void of wetland polygons of PEMA and PEMC. Floodplain wetlands, when identified. typically exist in old river scars and oxbows.

Existing Resources

Devils Lake: The wetland resources of the Prairie Pothole Region, including the Devils Lake Basin, perform and provide,many functions and values. In general, wetlands follow a yearly cycle, beginning with the spring catch of snowbelt runoff. Through the summer months, wetlands receive direct precipitation and runoff from the surrounding watershed, while simultaneously exporting water through evapotranspiration and losing surface water through seepage. By late summer, the wetlands are generally drawn down or dry and enter the fall and winter months in a condition that prepares them to repeat the cycle the next spring. In describing their many roles, Dahl (1996) documented that wetlands provide the following functions and values unique to the Prairie Pothole Region:

- At least 15 duck species depend on prairie pothole wetlands throughout the nesting season.
- Wetlands provide a vital role in waterfowl reproduction, feeding, and body conditioning prior to and during spring migration.
- Prairie pothole wetlands are used by a total of 352 animal species, including federally listed endangered species.
- Wetlands perform a number of other functions, such as nutrient sinks, which help to purify water, recharge ground water, and provide a source of water and forage for domestic animals.
- Wetlands have the ability to attenuate flood waters.

In light of the rising lake levels of Devils Lake and massive flooding along the Red River in 1997, it is important to recognize and understand the role that wetlands do or could play in flood control, through their ability to collect and attenuate flood water. These functions, particularly when lost through drainage, effect the accuracy of predicting runoff events.

When a wetland depression has collected runoff and precipitation to its maximum storage, it will spill additional water, therefore, it is accurate to suggest that full wetlands are performing their flood retention function. The other functions such as evapotranspiration and seepage continue. When the full storage capability (non-contributing) of these wetlands is drained, this storage function is lost or largely eliminated. Likewise, other functions such as evapotranspiration and seepage are also lost. If these wetlands are restored so that runoff and precipitation are again captured to the full storage level, that water is again non-contributing downstream.

There is little doubt that the devastating floods witnessed in 1997, in the Devils Lake Basin and the Red River Valley, due to the higher than average precipitation experienced over the past several years, has been exacerbated by man's manipulation of the land. The impact of flooding is also magnified by man's encroachment on the floodplain. This situation illustrates the critical need for wetlands and their role in capturing and attenuating flood waters.

It has been shown through scientific studies that wetlands store vast amounts of water. Tiner (1984) reported that agricultural drainage between the mid-1950's and mid-1970's was responsible for 87 percent of the wetland loss in the United States. The ability to naturally store water in North Dakota is greatly reduced due to the fact that approximately 50 percent of the wetland base has been drained in North Dakota (Dahl 1990). It is important to note that undrained wetlands in the Devils Lake Basin are currently storing large volumes of water that are minimizing the amounts of inflows that could occur to the lake.

Currently, there is a three-part approach to solving the Devils Lake flooding problem. Along with infrastructure protection and an outlet, storage of water in the basin represents the third component to the solution. Previously noncontributing drained wetlands are having an impact on lake levels by not capturing runoff and precipitation in the watershed. In addition. these drained wetland depressions are not further regulating inflow to Devils Lake through evapotranspiration and groundwater seepage.

The Devils Lake Basin is a closed system. Within the system, it is important to understand how the sub-systems within the basin function. Richardson (1994) offers some insight by stating that the "glaciated landscape of the Prairie Pothole Region is a mosaic of closed system catchments that vary in size, topographic position, and relationship to the groundwater," which suggests that most of the wetlands within the larger closed Devils Lake Basin are themselves closed systems. However, through artificial drainage, as many as 200,000 acres of wetlands, previously noncontributing, now function as open systems. This drainage, which by surface is twice the surface of Devils Lake, generally contributes to rising lake levels.

Rude and Walker (1968) defined two distinct kinds of landscapes: (1) open systems, where the drainage grades form small streams to larger trunk streams. and (2) closed systems, where the drainage is trapped within a common depository and where surface flow, if it occurs, is mostly in ill-defined drainageways to trunk

streams. The Interagency Floodplain Management Committee's report, "Science for Floodplain Management into the 21st Century" (1994), describes closed landscapes as:

. . . areas of glacial drift in the drainage basin. Closed landscapes lack well defined stream outlets: thus water, sediment, and other materials from the surrounding area are trapped in potholes or other depressions. Trapped or ponded water must either evaporate or recharge the ground water. During large storms, the smaller depressions may fill and any excess water may overflow in undefined surface drainage to other depressions or eventually to a stream. Constructed open ditch drainage systems change closed landscapes so that they function more like open landscapes with respect to both surface and ground water hydrology. Before agricultural drainage, closed landscapes were considered non-contributing, with respect to surface water runoff, although they might contribute during storms large enough to cause the depressions to "fill and spill."

Hubbard (1988) concluded that as wetland basins are drained, the size of the receiving watershed is increased, along with the probability that a given runoff event will produce flood levels in the receiving water body. While the hydrological functions of flood attenuation is complex, it is generally excepted that artificial drainage has diminished the effectiveness of prairie pothole wetlands to lessen flood damage (Dahl 1996). Similar conclusions have been supported by research conducted by Vining et al. (1983), Brun et al. (1981), Rannie (1980), Campbell and Johnson (1975), and Kloet (1971). Additionally, the correlation between increasing drainage area and increasing discharge measurements has long been known to hydrologists (Strahler 1964). When Devils Lake is at lower elevations, or in dry cycles, this process seems insignificant. However, when elevations are at current levels, each inch of water added to Devils Lake becomes critical.

Stichling and Blackwell (1957) documented an interesting phenomenon relative to closed drainage systems on the glaciated Canadian prairie. The condition they describe can be a corollary to the current Devils Lake flooding situation. Hubbard (1988) discussed the finding of their research and states:

Following several years of below normal runoff, the depressions within the gross drainage area (gross drainage area is that plane area enclosed within its divide that would entirely contribute runoff to the main stream in extremely wet years) are empty, or nearly so, providing large amounts of storage. The net drainage area (that portion of the gross drainage area that will contribute runoff to the main stream in a particular year) under dry conditions can therefore be relatively small. Stichling and Blackwell (1957) measured a typical watershed in Canada and determined that the net drainage area under dry conditions for that particular basin was only 20 percent of the gross drainage area. Thus, during a major runoff event 80 percent of the gross drainage area would be non-contributing. After several years of above average runoff, the depressions would be full, or nearly so. and available storage would be low. The net drainage area under these conditions would approach the gross drainage area in size. A major runoff event that under dry antecedent depression conditions would yield little to the main stream, would contribute large amounts of runoff to the main stream under wet antecedent conditions.

The above described situation may be relative to the basin, in that the Devils Lake Basin experienced a drought from mid-summer 1987 through mid-summer 1993, with above average precipitation following the drought for several years. Stichling and Blackwell's findings that during wet antecedent depression conditions, large amounts of runoff would be contributed to the main stream, may serve as a parallel to the basin for the last 10 years (1987–997). This phenomenon is important when considering the effects that agricultural drainage and an increased contributing watershed has had on the stream flow within the Devils Lake Basin.

As already discussed, the artificial drainage system in the basin functions similar to the drainage pattern of an open system. In recent years, the above average runoff has yielded nearly full depressions with lowered amounts of available storage. According to Stichling and Blackwell, this condition would result in the runoff from a particular drainage area approaching the gross drainage area, thus, large runoff events could be expected. If the phenomenon described by Stichling and Blackwell is occurring in the Devils Lake Basin, it could be the result of a basin-wide drainage network, operating as an open system, providing the necessary foundation for this event to occur.

Wetland Acreage Determination: Using the 1979 National Wetland Inventory data (as a baseline for wetland acreage), 1980 Natural Resources Conservation Service (NRCS) drained hydric soil determinations, and the Service's Private Drainage Survey information, several conclusions can be made regarding the status of wetlands in the basin. From 1966 through 1980, the Service conducted a statewide drainage

survey in North Dakota. The survey documented a 2.5 percent wetland drainage rate for the Devils Lake Basin counties (U.S. Fish and Wildlife Service 1966–980).

Historic wetlands: The Service has determined at least 400,000 acres of wetlands historically occurred in the basin. With the basin accounting for 2,400,000 acres, the wetland base would be 16.6 percent, which is similar to other parts of the Prairie Pothole Region.

Current wetlands: According to the 1979 NWI data, there are approximately 252,000 acres of undrained wetlands in the basin (Table 4). The drainage survey conducted by the Service between 1969–0 documented wetland drainage in the Devils Lake Basin, averaging 2.5 percent per year. Using this drainage rate to calculate drainage between 1980–985, 41,000 acres of additional wetland could have been drained. Drainage since 1985 is considered to be minimal (due to the enaction of the Swampbuster provision of the Food Security Act). Removing 41,000 from 252,000 produces a 1985 wetland acreage estimate for the basin of about 211,000 acres or about 55 percent of the original 400,000 acres. These acres, which are more than twice the surface acreage of Devils Lake, are providing significant regulation of inflow through storage and evapotranspiration to the lake, and as result reducing potential impacts.

Wetland drainage: There are two ways to arrive at an acre estimate for wetland loss due to drainage.

1. In 1980, the NRCS published an estimate of drained and undrained hydric soils by county for North Dakota. The Devils Lake Basin accounted for approximately 142,000 acres of drained hydric soils. Adding the 41,000 drained wetland acres described previously, it is estimated that approximately 183,000 acres of wetlands have been drained in the basin.

2. By subtracting 211 000 current wetland acres from the estimated 400,000 historic wetland acres a figure of 189 000 acres is produced which represents the total acres of wetlands that may have been drained in the basin.

* When adjusted to 1997. this wetlands.

Storage Studies

Table 4. The Acreage and Type of Wetlands Existing in the Devils Lake Basin Based on National Wetland Inventory Data (1979).

Subbasin	Temporary Acres	Seasonal Acres	Semi-Permanent Acres	Permanent Acres	Total Acres
Hurricane	7,255	7,234	7.296	5,340	27.125
Comstock	857	2,066	1.347	0	4,270
Mauvais	10,119	15,313	12,894	7.608	45,934
Chain Lakes	2,178	5.114	2,446	1,831	11,569
Starkweather	1,756	10,071	2,601	6,254	20,682
Edmore	2,919	17,194	3,791	6,530	30,434
Stump Lake	8,436	23,323	11,916	8,875	52,550
DL North	4,094	17,259	9,253	3,374	33,980
DL South	4,997	6,147	8,817	5,955	25,916
Totals	42,611	103,721	60,361	45,767	252,460*

When adjusted to 1997, this total includes 211,000 acres of undrained wetlands.

Storage Studies

Drained Basin Study: The Service and the North Dakota State Water Commission conducted a Drained Basin study to further describe the potential storage in restored drained wetland depressions within the Devils Lake Basin. The results of this study were presented in a response to the Director of the North Dakota office of the National Wildlife Federation and Vice Chairman of the Devils Lake Basin Joint Water Resource Board (Sprynczynatyk and Sapa 1997) (Appendix 1). The Service continued to analyze and refine the data in response to a second request for information from the Director of the North Dakota Wildlife Federation (Sapa 1997) (Appendix 2).

Sprynczynatyk and Sapa (1997) used four studies to conclude that restoring 60,000 acres of drained wetlands to their expanded maximum depressional storage could result in a potential stored volume of 156,000 to 294,000 acre-feet. Sapa (1997) used the same ratio of expansion to show that when applied to the 189,000 acres of drained wetlands estimated in the Devils Lake Basin. could have a maximum depressional storage of 491,000 to 926,000 acre-feet of water.

The results of these studies show that the potential for wetland restoration to allow natural basins to capture and store runoff water, and allow evapotranspiration to export water out of the basin while re-establishing seepage connections to the basin, is large. Figure 5 shows a cross section that may be helpful in understanding maximum storage potential relative to the restored wetland boundary.

Additional Storage to Upper Lakes: There are several lakes that are located in the mid-basin that have the potential for additional storage by modifying their existing outlets. The SWC developed information on the current holding levels of 11 lakes within the basin and has noted the necessary modification and the additional storage that is attainable (Table 5).

A total of 33,250 acre-feet of water storage is available for additional storage to the upper basin lakes, impacting a total of 8,720 acres that are currently not flooded. The 33,250 acre-feet of storage is above what is normally incorporated into the existing wetland storage of these lakes.

Table 5. Upper Lakes Storage (1997).

Lake	Natural Overflow Level msl	Natural Overflow Volume ac-ft	Potential Holding Level msl	Additional Storage Acre-feet	Total Storage ac-ft
Dry Lake	1447.5	23,500	1449.0	8,500	32,000
Sweetwater-Morrison	1459.0	27,000	1460.0	7,000	34,000
Lake Irvine/Alice	1441.6	9,300	1443.0	9,000	18,300
Chain Lake	1442.0	1,750	1443.0	1,350	3,100
Mikes Lake	1442.0	500	1443.0	500	1,000
Hurricane Lake *	1549.5	4 300	1550.5	3,500	7,800
Lake Ibsen *	1489.5	7,150	1490.5	1,500	8,650
Silver Lake *	1441.0	2,698	1444.0	1 250	3,948
Cavanaugh Lake *	1453.5	2,700	1455.0	650	3,350
Totals		78,898		33,250	112,148

* Estimated overflow level and volume.

The potential for water storage in the upper basin is not limited to lakes. Topographic setting of wetland basins can be modified using dykes and dams to increase storage capacity beyond normal levels.

Sheyenne and Red Rivers: The Red River Valley drainage basin reacts in much the same way as the Devils Lake Basin, in that artificial drainage enlarges the contributing watershed and increases runoff, thereby increasing the possibility of flooding in the receiving water body, e.g., Red and Sheyenne Rivers.

In the winter of 1993, the North Dakota State Geologist published an article in the North Dakota Geological Survey (NDGS) Newsletter in which he wrote:

Artificial drainage ditches facilitate draining of valuable farmland, but they also result in faster and more complete transfer of rainfall and snow melt to the main stream or river. Water that was once stored on flatlands bordering the river can pour into the river quickly during spring thaws. Similarly, drained wetlands, which were once available to hold back water, can release water quickly, thereby contributing to the flooding problem (Bluemle 1993).

The NDGS article is consistent with other research regarding the effects of agricultural drainage and its impact on flooding. Several researchers have shown that increases in stream flow are a likely result of agricultural drainage.

Vining et al. (1981), found that yearly stream flows at Hillsboro (42 years of data, beginning in 1936 on the Goose River) and Grafton (47 years of data, beginning in 1932 on the Park River) increased during the study period, while at Hazen (37 years of data, beginning in 1944 on the Knife River) the yearly streamflow had not changed. Precipitation affected the yearly stream flows in the Knife and Park Rivers, but did not have an affect on the Goose River. Subsequent land surveys in the Goose River drainage showed the basin to have been enlarged due to artificial drainage. It appears that artificial drainage has affected the streamflow in the Goose River. The study suggests that other rivers in eastern North Dakota may be affected in the same way as the Goose River.

Brun et al. (1985), concluded that predicted flow rates were shown to be closely related to changes in basin size due to land drainage in the Maple and Goose River Basins. Brun's regression analysis showed that an increase in predicted flow is strongly related to increases in drainage area in each basin. Flow rates were shown to be related to precipitation, however, there appeared to be no change in precipita-

tion patterns to account for the increase in flow rates, suggesting that artificial drainage is a major factor in increasing stream flow.

While many studies tend to show that increased drainage leads to increased stream flow, what has not been shown to date, is how much of the increased flow adds to the peak flows on flooding rivers.

Hydric Soils: Hydric soils have been defined by NRCS as those soils that, in an undrained condition, are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that supports the growth and regeneration of hydrophytic vegetation. While not interchangeable with wetland data, hydric soil information, particularly artificially drained hydric soil, can be very helpful for highlighting and supporting much of the wetland data previously discussed. Cowardin (1982) found that because water regimes and their characteristic vegetation fluctuate over a period of years, soils can be used to predict long-term average conditions. Under normal circumstances, hydric soils support wetland vegetation, and therefore can be used as a wetland indicator (Dahl 1990).

Hydric soil acreage listed by county is shown in Table 6. The figures in the table have been determined by NRCS and compiled over various years. The table lists the hydric soil estimates by county, the percentage of each county in the Devils Lake Basin, and the hydric soil acres in the basin. Ramsey County is the only county that is entirely within the basin. All other hydric soil acres are determined by the percentage of each county total within the basin.

Table 6. Hydric Soil Acres for Devils Lake Counties and the Basin.

County	Hydric Acres by County		% Co. Basin	Hydric Acres in the Basin	
	1980	1997		1980	1997
Ramsey	109,000	222,596	100	109,000	222,596
Towner	105,000	165,167	67	70,350	110,662
Cavalier	128.000	253,999	22	28,160	55,880
Pierce	119,000	135,210	11	13,090	14,873
Nelson County Area	122,000	163,133	32	39,040	52,203
Rolette	115 000	73,153	22	25,300	16,094
Benson County Area	140,000	195,545	50	70,000	97,773
Walsh	283,000	209,293	9	15,120	18,836
TOTALS	1,121,000	1,418,096		370,060	*588,917

*This figure was generated through the Service's calculations of raw hydric soil acreage data provided by NRCS.

The difference in the total hydric soil acreage by county, as explained by the NRCS, is due to the completion of about 10–5 county soil surveys in North Dakota. The completion of these surveys allow for a more accurate assessment of hydric soil acreage.

Numerous programs are available through various State and Federal agencies that offer income incentives to farmers and ranchers. These programs are designed around environmental benefits, but offer a variety of opportunities to affect storage and runoff in the basin. The details of these programs are described in the NDSU Extension Service brochure entitled "Income Alternatives for Farmers and Ranchers," August 1992 (Appendix 3). This brochure is currently being reprinted.

Threatened or Endangered Species and Rare Species

Threatened or Endangered Species: Federally endangered and threatened species that may be present in the Devils Lake Basin include the bald eagle (*Haliacetus eucocephalus*), peregrine falcon (*Falco peregrinus*), and piping plover (*Charadrius melodus*). The bald eagle and peregrine falcon migrate through, but are not known to nest in the Devils Lake Basin. Piping plovers migrate through the project area and are recorded as nesting on exposed alkaline shoreline within the basin.

Federally endangered and threatened species that may be present along the Sheyenne and Red Rivers' corridors include the bald eagle (*Haliacetus eucocephalus*), peregrine falcon (*Falco peregrinus*), and western prairie fringed orchid (*Platanthera praeciara*). The bird species often utilize water courses and river valleys as migration routes and temporary feeding sites. The Red River Valley and its tributaries, including the Sheyenne River, are primary migration routes across eastern North Dakota.

A list of federally endangered and threatened species for each county in the project areas is provided in Table 7. This list fulfills requirements of the Fish and Wildlife Service under Section 7 of the Endangered Species Act.

If a Federal agency authorizes funds, or carries out a proposed action, the responsible Federal agency, or its delegated agent. is required to evaluate whether the pro-

posed action "may affect" listed species. If it is determined that the action "may affect" a listed species, then the responsible Federal agency shall request formal Section 7 consultation with this office. If the evaluation shows a "no effect" situation on the listed species, further consultation is not necessary.

Table 7. County Occurrence of Threatened and Endangered Species in North

Western prairie fringed orchids, a federally listed threatened species, are located throughout the Sheyenne National Grasslands and adjacent areas in Ransom and Richland Counties. The wester prairie fringed orchid is a perennial orchid of the North American tallgrass prairie and is found most often on unplowed. calcareous prairies and sedge meadows. In North Dakota, the orchid most frequently occurs in the sedge meadow community on the Glacial Sheyenne Delta and also in the moist tallgrass prairies.

The Service is concerned with the Sheyenne River flowing at or near bank full conditions for extended periods of time. The concern is that such conditions may affect the surrounding water table and aquifers, resulting in the inundation of low lying swales and their margins, which is the habitat of the orchid. Sustained or more frequent inundation would likely alter the vegetation community. If this or other impacts are likely to occur, formal Section 7 consultation with this office will be required to determine whether this project will jeopardize the existence of the orchid. Specifically, project data needs to be developed that characterizes and projects impacts for the interaction between surface and ground water in the orchid range in Richland and Ransom Counties. This surface/ground water interaction must also address the long-term affects of sustained bank flow conditions and overlay an alyses of average precipitation and above normal precipitation events.

Rare species: The North Dakota Parks and Recreation Department, Natural Heritage Inventory, compiles and maintains a database documenting the statewide status and location of rare flora and fauna, ecological communities, and unique geological features. Appendix 4 are the tables detailing the Natural Heritage Inventory listings for the Devils Lake Basin, and the Sheyenne and Red Rivers.

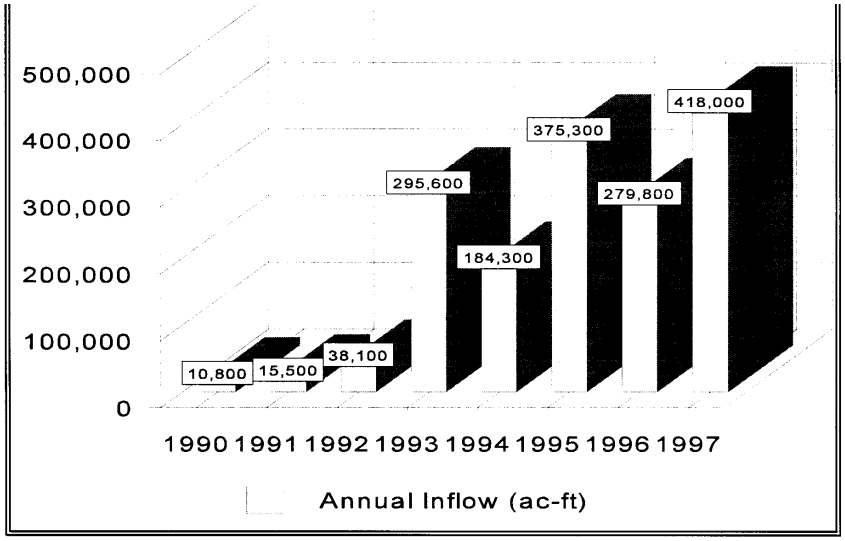
The Devils Lake Basin listing was compiled using 110. 7.5-minute quadrangles, which encompass the basin. The Sheyenne River table lists species and features found within a corridor approximately 6 miles wide (3 miles on each side of the river). The Red River corridor is approximately 3 miles wide, and only presents species and features found in North Dakota.

The Nature Conservancy administers the Pigeon Point tract located in Owego Township, T. 135 N.. R. 53 W., Section 19, and T. 135 N.. R. 53 W., Section 18, SE¼, and T. 135 N.. R. 53 W., Section 18, W½ of the NE¼.

Water Resources/Water Quantity

Devils Lake: In October of 1992, Devils Lake was recorded at elevation 1422.4, the lowest elevation registered thus far for the decade of the 1990's (Figure 6). At elevation 1422.4, Devils Lake was approximately 46,034 surface acres. The spring of 1993 marked the beginning of a steady rise in lake levels. Currently, the lake has risen 20.2 feet to 1442.6 (September 28. 1997) in just over 4 years. At its current elevation, Devils Lake is 96,900 surface acres. The estimated mean annual inflow to Devils Lake for 1950–993 is 65,500 acre-feet (Wiche and Vecchia 1995). The annual inflow from 1990 to 1997 is shown on Figure 6. Preliminary inflow estimates for 1997 through June is 418,000 acre-feet (Pers. common., S. Vecchia, USGS, Bismarck 1997).

Figure 6. Annual Inflow to Devils Lake, with a 1997 inflow estimate.



Devils Lake: The water quality of the Devils Lake Basin is affected by factors such as climate, topography, and geology. Warm dry periods generally increases evaporation efficiency, which results in a concentration of dissolved solids, while during wet periods, increased runoff, stream flow and lake levels tend to dilute dissolved solids. Topography and drainage also affect water quality by influencing the amount and rate of runoff (Lent and Zainhofsky 1995).

The most recent water quality data has been developed by the U.S. Geological Service (USGS) and published in "Lake Levels, Stream Flow, and Surface-Water Quality in the Devils Lake Area, North Dakota", by Wiche 1996. The data covers a variety of periods ending in 1995. The North Dakota Department of Health is continuing to monitor water quality at nine sites along the Chain of Lakes and Devils Lake. four to six times a year. Raw data is being compiled and will be analyzed in the future (North Dakota Dept. of Health, oral commun. 1997).

The issue of water quality in Devils Lake, and its relationship to the fishery and the proposed outlet to the Sheyenne River, is difficult to address, largely because it is not entirely understood. Because freshwater flows enter Devils Lake on the west end, TDS concentrations are the lowest there. The TDS gradient increases eastward in Devils Lake resulting in more saline conditions on the east side.

The following tables list the average dissolved-solids concentrations for Devils Lake Basin locations, upstream and downstream tributaries, Devils Lake and Stump Lake (Tables 8 and 9). Figure 7 displays the TDS gradient from west to east across Devils Lake.

Table 8. Average Dissolved-Solids Concentration for Streams and Lakes in the Devils Lake Basin (Wiche 1996).

Site	Location	TDS (mg/l)
Tributaries Upstream of the Chain of Lakes:		
1	Edmore Coulee	450
2	Starkweather Coulee	361
3	Mauvais Coulee	618
Chain of Lakes and Downstream Tributaries:		
4	Sweetwater Lake	585
5	Lake Alice	768
6	Lake Irvine	607
7	Channel A	683

Table 8. Average Dissolved-Solids Concentration for Streams and Lakes in the Devils Lake Basin (Wiche 1996).—Continued

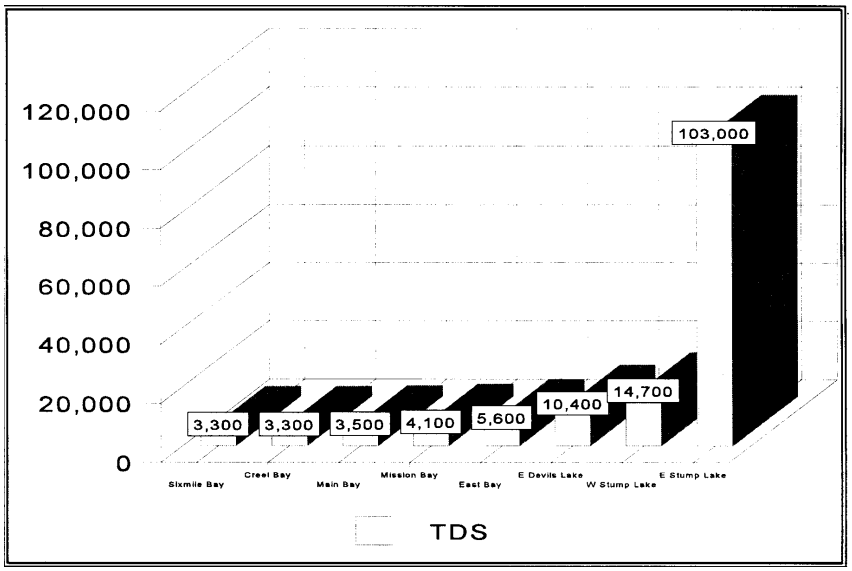
Site	Location	TDS (mg/l)
Chain of Lakes and Downstream Tributaries:		
8	Big Coulee	645
9	Sheyenne River (near Warwick)	476

Table 9. Average Dissolved-Solids Concentration for Selected Locations in Devils Lake and West and East Stump Lakes (Wiche 1996).

Location	TDS (mg/l)
Devils Lake	
Sixmile Bay	3,300
Creel Bay	3,300
Main Bay	3,500
Mission Bay	4,100
East Bay	5,600
East Devils Lake	10,400
Stump Lakes	
West Stump Lake	14,700
East Stump Lake	103,000*

* TDS levels continue to improve.

Figure 7. TDS Gradient from West to East Across Devils Lake to Stump Lakes.



Based on field data gathered at Devils Lake, it is generally agreed that the existence of a healthy fishery depends on a balance between TDS and nutrient levels. Operation criteria for each of the features designed will have an impact on future fishery. To maximize protection of the valuable fish resource operation criteria should consider long-term impact to the fish resource.

Nutrient loading is believed to be occurring in Devils Lake, in part, due to runoff from the intensively farmed basin, and to a lesser degree from livestock operations.

Wetland drainage, fall cultivation, and fertilizer application are some of the agricultural practices suspected of contributing to water quality degradation.

Removal of fresh water from the west end of Devils Lake by a proposed outlet will result in a general degradation of water quality in the future. To lessen potential impacts from the water quality degradation, all steps should be taken to enhance remaining water quality. These include, but are not limited to, protection and enhancement of riparian zones, reduce inflow nutrient and soil through grassed waterways. and in connecting historic waterflow routes, which will slow water movement and remove nutrients, and encourage Best Management Practice that enhance water quality.

Lorenz (1996) details the sampling design for a comprehensive regional assessment of water quality in the Red River of the North Basin, as a study unit under USGS's National Water-Quality Assessment (NAWQA) Program. The sampling design was developed to address questions about the presence, distribution, and nutrient loads and pesticides associated within the basin. The report describes the environmental framework and sampling design for the the water quality assessment during 1993–995. Due to the report's comprehensive attire, a copy of its Selected References has been appended to this report (Appendix 5). This reference list represents an excellent resource for literature relating to water quality issues of the Red River basin.

Public Wildlife Lands

There are a number of public wildlife lands within the basin that are managed for the benefit of fish and wildlife resources. The North Dakota Game and Fish Department manages seven Wildlife Management Areas (Black Swan, Crary, Minnewaukan, Nesvig, Pelican Township, C.C. Underwood, and Kenner Marsh) within the Devils Lake Basin, totaling 2,513 acres.

The Service is currently developing a digital database that will depict all Service fee title and wetland easement tracts. This database is being produced for the Devils Lake Basin, eventually expanding statewide. It is the Service's intention to provide the Corps with the Devils Lake Basin database as soon as it's completed (mid-FY98).

Within the Devils Lake Basin, the Service administers Waterfowl Production Areas (WPA), wetland easements, and a National Wildlife Refuge (Lake Alice). All tracts are managed by the Devils Lake Wetland Management District Complex located in Devils Lake, North Dakota. The following table is a summary of the acres of wetlands administered by the Service (U.S. Fish and Wildlife Service. 1995). Table 10. Service Land Interests in Devils Lake Basin

Land Interests	Acres
Wetland Easements	112,598
WPA's	10,666
National Wildlife Refuge (Lake Alice)	8,000
Sullys Hill National Game Preserve	1,674

The Service also operates the Valley City National Fish Hatchery (on the Sheyenne River) immediately upstream from the town of Valley City.

International Considerations as they relate to Fish and Wildlife Resources

Preliminary analysis of proposed emergency outlet plan have been undertaken by the Garrison Joint Technical Committee. This committee of Canadian and U.S. officials have not officially reached conclusion on the proposal. In addition, the issue of Devils Lake has been elevated to the International Joint Commission for further consideration.

V. Identification of Fish and Wildlife Related Issues and Recommendation Influencing Lake Stabilization

The following list of issues have been identified through the development of this Substantiating Report. They generally represent some of the major unresolved issues and data needs relative to the Feasibility Study.

1. The Long Term Resolution of Devils Lake Flooding Requires a Basinwide Plan.

Resolution of Devils Lake flooding has been characterized by the State sponsor and others as the three-part approach. The three parts are:

a. Infrastructure protection/removal/zoning

b. Storage/management of runoff (flood water) throughout the basin

c. Outlet

Without a comprehensive approach to solving the flooding situation, any or all of the solutions are likely to have disappointing results. Infrastructure protection/removal/zoning, is needed to protect roads and maintain needed services for the area, provide flexibility in lake elevations by removing difficult-to-protect low-lying structures, and securing long-term management flexibility through zoning restrictions. Storage, management, and evaporation of runoff throughout the basin will provide immediate relief to the amount of runoff entering the lake, increase regulation of basin runoff. accelerate lake draw down. minimize the amount of water that might be processed through an outlet. and directly addresses a source of man-controlled runoff to the lake. An outlet would be used to provide additional relief after the basin actions (a and b) have been implemented.

Recommendation: The Corps, in cooperation with the State sponsor develop actions for the Devils Lake flooding solution as part of a comprehensive approach, and seek authorization language and implementation strategies that endorse the comprehensive approach. The goal should be to maximize the actions that contribute to the solution within the basin, and minimize the amount of water that may be released outside the basin. To facilitate this approach, a detailed survey of the basin's storage potential, including natural restorable and managed sites, should be completed and analyzed as part of the basin's storage component.

2. What is the Effect of Land Use Chances in the Basin on the Lake's Runoff?

Predictive hydrologic models need to be developed to understand how land use manipulation has increased the amount of contributing land, and altered run off potential in the basin. This information is needed to increase accuracy of run off predictions, and set realistic expectations and operating criteria for all three of the building block solutions.

Recommendation: The Corps should seek updated hydrologic predictions that include the current run off potential in the basin incorporating the changes to runoff potential caused by land use manipulation. These updated predictions should be provided in a timely manner to allow use in the development of specific actions and operation strategies.

3. Operation Criteria. Goals and operating criteria for all parts of the solution need to be established. This is necessary to plan development in an orderly manner, and determine the environmental impacts to the basin, the lake and its resources, and downstream on the Sheyenne and Red Rivers. It is also necessary to develop practical and compatible plan strategies for an effective resolution of the flooding issue.

Recommendations: Operating criteria for the various parts of a comprehensive solution should be identified and analyzed. Additionally, a specific hydrologic analysis between surface and ground water on the Sheyenne River in western prairie fringed orchid range will be required to assess potential for impacts to the threatened plant. The result of this study will be needed to work out an acceptable operating plan prior to implementation.

4. Determining Optimum Lake Levels. Modifying the hydrology of the Devils Lake basin is likely to change the lake in the future. To minimize the potential for these changes to be harmful, development of criteria for lake level operations is necessary. These criteria should address the desired lake levels and water quality necessary to maintain a vigorous fishery resource, should establish the minimum draw down necessary to achieve relief from the flooding and provide flexibility in lake management, and address basin storage from a standpoint of reducing downstream impacts on the lake, and Sheyenne and Red Rivers.

Recommendation: For purposes of resolving the flooding issue and minimizing the harm to natural resources, an operational management plan needs to be developed. This should include a minimum lake level target, operating ranges be used to devise operating strategies. and develop expectation for resolution of the flooding issue.

5. Water Quality Maintenance. Protection against the degradation of water quality from the flooding solution, in Devils Lake, and the Sheyenne River (Lake Ashtabula) and Red River will be essential to minimize impacts to fish and wildlife resources, downstream water users, and Canada.

Recommendation: Based on predictive models, operating criteria should be established that minimize the harm to the Devils lake, and downstream receiving waters. Also, a comprehensive program to enhance remaining water will be necessary if an outlet is proposed to remove the lake's freshwater.

VI. REFERENCES

Best, R.G. 1978. Utilization of color infrared aerial photography to characterize prairie potholes. Pages 180–187, in Pecora IV, Proceedings of the Symposium. Natl. Wildl. Fed. Sci. Tech. Ser. 3.

Bluemle, J.P. 1993. Flooding in North Dakota in 1994? North Dakota Geological Survey Newsletter. Vol. 20, No. 4, Winter 1993.

Brun, L.J.. J.L. Richardson, J.W. Enz, and J.K. Larsen. 1981. Stream flow changes in the southern Red River Valley of North Dakota. North Dakota—Farm Res. 33(5):11–4.

Campbell, K.L., and H.P. Johnson. 1975. Hydrologic simulation of watersheds with artificial drainage. Water Resour. Res. 11:120–26.

Cowardin, L.M. 1982. Wetlands and deepwater habitats: A new classification. J. Soil and Water Cons. 37:83–5.

Cowardin. L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS—79/31, Washington, DC.

Cowdery, T.K. 1997. Shallow ground water quality beneath cropland in the Red River of the North Basin, Minnesota and North Dakota, 1993–5. U.S. Geological Survey, Water-Resources Investigations Report 97–001. 52 pp.

Cvancara. A.M. 1974. Mussels and pollution in the Red River drainage, North Dakota and Minnesota. Research Project Technical Completion Report. Research Report No. WI-221–19–4. Dept. of Geology, Univ. of North Dakota, Grand Forks, North Dakota.

Dahl, T.E. 1990. Wetland losses in the United States 1780's to 1980's. U.S. Dept. of the Interior, Fish and Wildlife Service. Washington, DC.

Dahl, T.E. 1996. Status of prairie pothole wetlands in the United States North Dakota, South Dakota, and Minnesota, In Draft. U.S. Fish and Wildlife Service, National Wetlands Inventory Center. St. Petersburg, Fla.

Devils Lake Basin Advisory Committee. 1976. The Devils Lake Basin Study, Vol. 1, Study Report. Bismarck, North Dakota.

Duxbury, A. 1989. Natural history of the Sheyenne Delta. North Dakota Outdoors, Vol. 52. Issue 02. 14–8.

Eisenlohr, W.S., Jr. 1966. Water loss from a natural pond through transpiration by hydrophytes. Water Resources Research, Vol. 2, No. 3, p. 443–53.

Euliss, N.H., D.M. Mushet. 1996. Water-level fluctuation in wetlands as a function of landscape condition in the Prairie Pothole Region. Wetlands Vol. 16, No. 4, December 1996, Pages 587–93.

Goldstein. R.M., J.C. Stauffer. P.R. Larson, and U.L. Lorenz. 1996. Relation of physical and chemical characteristics of streams to fish communities in the Red River of the North Basin, Minnesota and North Dakota. 1993–5. U.S. Geological Survey. Water Resources Report 96–227.

Goldstein, R.M., M.E. Brigham, and J.C. Stauffer. 1996. Comparison of mercury concentrations in liver. muscle, whole bodies. and composites of fish from the Red River of the North. Can. J. Fish. Aquat. Sci., Vol. 53, Pages 244–52.

Guenthner, R.S. 1991. Methods for estimating monthly mean concentrations of selected water-quality constituents for stream sites in the Red River of the North Basin, North Dakota and Minnesota. U.S. Geological Survey, Water-Resources Investigations Report 91–086. 52 pp.

Heidel, B. 1988. Mirror Pool Wildlife Management Area. North Dakota Outdoors, Vol. 50, Issue 08. 19 pp.

Hendrickson, J.C. 1990. Salinity and fish reproduction in Devils Lake Basin, North Dakota. North Dakota State University. M.S. Thesis.

Hiltner, R.J. 1997. Aquatic investigations of Devils Lake. 1996. North Dakota Game and Fish Department, Bismarck, North Dakota.

Hiltner, R.J. 1996. Aquatic investigations of Devils Lake, 1995. North Dakota Game and Fish Department, Bismarck, North Dakota.

Hiltner, R.J. 1992. Creel survey information for Devils Lake. Spirilwood Lake, Heart Butte, Lake Elsie and Velva Sportsmans Pond. North Dakota Came and Fish Department-Bismarck. North Dakota.

Hiltner, R., and T. Steinwand. 1996. Addendum to analysis of long term survival, natural reproduction and potential hybridization of striped bass (Morone saxatilis) in Devils Lake, North Dakota. North Dakota Game and Fish Department, Bismarck, North Dakota.

Hoberg. T. 1992. Reptiles and amphibians of North Dakota. North Dakota Outdoors, Vol. 55, Issue 01, 7–6.

Hubbard, D.E. 1988. Glaciated prairie wetland functions and values: A synthesis of the literature. U.S. Fish and Wildlife Service Biological Report 88(43). 50 pp.

Hubbard, D.E., and R.L. tinder. 1986. Spring runoff retention in prairie pothole wetlands. J. Soil and Water Cons. 41:122–25.

Hubbard, D.E. 1982. Surface area-volume relationship of wetland basins in the interior of the Coteau des Prairies. Pages 154–58 in Proc. S.D. Acad. Sci. Vol. 61 (1982).

Interagency Floodplain Management Review Committee, Science for floodplain management into the 21st Century. Floodplain Management Task Force, Washington, DC., 1994.

Johnson, R.R., C.L. Milewski, and K.F. Higgens. 1996. Summary and selected annotated bibliography of the ecology of the Upper Mississippi and Missouri River drainage basins with emphasis on wetlands and riparian zones and the impact of flood control and flooding on the ecosystem, in Galat, D.L., and Frazier, A.G., eds., Overview of River Floodplain Ecology in the Upper Mississippi River Basin, Vol. 3 of Kelmelis, J.A., ed., Science for Floodplain Management into the 21st Century: Washington, DC., U.S. Government Printing Office, 115 pp.

Kloet, L. 1971. Effects of drainage on runoff and flooding within the Pembina River Basin, North Dakota-Manitoba. U.S. Fish and Wildlife Service, Bismarck, North Dakota (Unpublished report).

Lent, R.M., and S.D. Zainhofsky. 1995. Variations in surface-water quality in the Chain of Lakes and its tributaries, Devils Lake Basin, North Dakota, 1957–2. U.S. Geological Survey, Water Resources Investigations Report 95–102. 87. pp.

Lent, R.M. 1994. Sources and cycling of major ions and nutrients in Devils Lake, North Dakota. U.S. Geological Survey. Water-Resources Investigations Report 94–171. 63 pp.

Link, G. 1989. The secret and splendor of the Sheyenne Sandhills. North Dakota Outdoors, Vol. 52, Issue 02, 19–1. Lorenz, D.L., and J.D. Stoner. 1996. Sampling design for assessing water quality of the Red River of the North Basin. Minnesota, North Dakota, and South Dakota, 1993–995. U.S. Geological Survey, Water-Resource Investigations Report 96–129.

Ludden, A.P., D.L. Frink, and D.H. Johnson. 1983. Water storage capacity of natural wetland depressions in the Devils Lake Basin of North Dakota. J. Soil and Water Cons. 38:45–8.

Moretti, C.J. 1996. Research Project Technical Completion Report: Evaluation of water quality impact caused by winter wastewater discharges into the Red River. North Dakota Water Resources Research Institute, Grand Forks, North Dakota. 35 pp.

North Dakota Game and Fish Department. 1997. Short term survival of yellow perch fingerlings in cages. Special Project Fact Sheet, 3:97. Devils Lake, North Dakota.

North Dakota Parks and Recreation Department. 1987. North Dakota Rivers Study. Bismarck, North Dakota.

North Dakota State Department of Health and Consolidated Laboratories. 1990. The status of water quality in the State of North Dakota, 1988–989. The 1990 Report to the Congress of the United States. Division of Water Supply and Pollution Control, Bismarck, North Dakota.

North Dakota State Department of Health and Consolidated Laboratories. 1992. North Dakota Water Quality Assessment, 1990–991. The 1992 Report to the Congress of the United States. Division of Water Supply and Pollution Control, Bismarck, North Dakota.

North Dakota State Department of Health and Consolidated Laboratories. 1994 North Dakota Water Quality Assessment, 1992–993. The 1994 Report to the Congress of the United States. Division of Water Supply and Pollution Control, Bismarck, North Dakota.

Peggerla, A.K. 1994. A study of the impact of discharges into a reach of the Red River of the North. North Dakota Water Resource Research Institute. Grand Forks, North Dakota. 42 pp.

Rannie, W.F. 1980. The Red River flood control system and recent flood events. Water Resour. Bull. 16:207–14.

Richardson, J.L. 1994. Report on various aspects of upland hydrology, wetlands and soils for the SAST Project. In Draft. Dept. of Soil Science. North Dakota State University, Fargo, North Dakota.

Richardson, J.L., and C.L. Lura. 1986. Soils and vegetation in the Stand Zones of Devils Lake, North Dakota. Dept. of Soil Science, North Dakota State Univ., Fargo, North Dakota.

Richardson, J.L., J.L. Arndt, and J. Freeland. 1994. Wetland soils of the Prairie Potholes, Dept. of Soil Science. North Dakota State Univ., Fargo, North Dakota.

Ruhe, R.V., and P.H. Walker. 1968. Hillslope models and soil formation. I. Open Systems: International Congress of Soil Science, 9th, 1968, [Transactions 4] Pages 551–560.

Sando, S.K. 1993. Physical-property, water-quality, plankton, and bottom material data for Devils Lake and East Devils Lake. North Dakota, September 1988 through October 1990. U.S. Geological Survey, Water-Resources Investigations Report 91–086. 52 pp.

Sando, S.K., and R.M. Lent. 1995. Spatial and seasonal variability in water quality of Devils Lake, North Dakota, September 1988 through October 1990. U.S. Geological Survey, Water Resources Investigations Report 954081. 41 pp.

Sapa, A. 1997. Letter to National Wildlife Federation analyzing and defining data.

Schlueter, L. 1995. The Red River of the North. North Dakota Outdoors, Vol. 57, Issue 10, 6–9.

Sprynccznatyk, D., and A. Sapa. 1997. Letter to National Wildlife Federation on drained basin study.

Stichling, W., and S.R. Blackwell. 1957. Drainage area as a hydrologic factor on the glaciated Canadian prairies. Pages 356–76 On General assembly of Toronto, Vol. 3: surface waters, prevision [sic.], evaporation. Intern. Assoc. Sci. Hydrol. Pub. No. 45.

Strahler, A.N. 1964. Quantitative geomorphology of drainage basins and channel networks. Pages 39–6 in V.T. Chow, ed. Handbook of applied hydrology. Section 4. McGraw-Hill Book Co., New York.

Strobel, M.L. 1995. Salinity in surface water in the Red River of the North Basin, Northeastern North Dakota. U.S. Geological Survey, WaterResources Investigations Report 95–082. 14 pp.

Tiner, R.W. 1984. Wetlands of the United States: Current status and recent trends. U.S. Fish and Wildlife Service, National Wetlands Inventory, Washington, DC.

U.S. Army Corps of Engineers (St. Paul District). 1983. Section 205 Detailed Project Report: Flood control project at Devils Lake, North Dakota. St. Paul, Minnesota. 89pp.

U.S. Army Corps of Engineers (St. Paul District). 1988. Devils Lake Basin Integrated Draft Feasibility Report and Environmental Impact Statement. St. Paul. Minnesota. 167 pp.

U.S. Army Corps of Engineers (St. Paul District)-1992 Reconnaissance Report for Flood Control, Lake Stabilization and Comprehensive Purposes, Devils Lake Basin, North Dakota. St. Paul, Minnesota. 75pp.

U.S. Army Corps of Engineers (St. Paul District). 1996. Emergency Outlet Plan, Devils Lake, North Dakota. St. Paul, Minnesota. 26 pp.U.S. Army Corps of Engineers (St. Paul District). 1996. Environmental Assessment and Plans and Specifications for Raise of Existing Levee. Devils Lake, North Dakota. St. Paul, Minnesota.

U.S. Army Corps of Engineers (St. Paul District). 1996. Devils Lake, North Dakota Contingency Plan. St. Paul, Minnesota. 49 pp.

U.S. Fish and Wildlife Service. 1988. Draft Fish and Wildlife Coordination Report, Devils Lake Basin Flood Control Project.

U.S. Fish and Wildlife Service. 1992. Substantiating Report. Devils Lake Basin Project, Devils Lake, North Dakota. Bismarck. North Dakota.

U.S. Fish and Wildlife Service. 1995. Devils Lake Wetland Management District Fact Sheet. Devils Lake, North Dakota.

U.S. Fish and Wildlife Service. 1966–980. Private drainage survey. Unpublished file data.

U.S. Fish and Wildlife Service. 1996. North Dakota s federally listed endangered, threatened, and candidate species. Bismarck, N. Dak.

Vining, R.C., L.J. Brun, J.W. Enz, and J.L. Richardson. 1983. An analysis of stream flow variability for three rivers in North Dakota. Proceedings, Fifth Conference on Hydrometerology, American Meteorology Society. Pages 50–51.

Wiche, G.J. 1996. Lake levels, stream flow, and surface-water quality in the Devils Lake Area, North Dakota. U.S. Geological Survey, Fact Sheet FS-189–6. 4 pp.

Wiche, G.J., and A.V. Vecchia. 1995. Probability of future lake levels of Devils Lake, North Dakota. U.S. Geological Survey, Fact Sheet FS-158–5.

Wiche, G.J., and A.V. Vecchia. 1996. Lake-level frequency analysis for Devils Lake, North Dakota. U.S. Geological Survey. Water-Supply Paper 2469. 57 pp.

Wiche, G.J., and T. Williams-Sether. 1997. Streamflow characteristics of streams in the Upper Red River of the North Basin, North Dakota, Minnesota, and South Dakota. U.S. Geological Survey, Open-File 97–16, 374 pp.

Williams-Sether, T., R.M. Lent, and G.L. Wiche. 1996. Variations in surfacewater quantity and quality as a result of the 1993 summer flood in the Devils Lake

Basin, North Dakota. U.S. Geological Survey, Water-Resources Investigations Report 96–028. 32 pp.
Winter, T.C. et al. 1984. Synopsis of ground-water and surface-water resources of North Dakota. U.S. Geological Survey. Open-File Report 84732.

STATEMENT OF JOE BELFORD, COMMISSIONER, RAMSEY COUNTY, NORTH DAKOTA

Chairman Chafee, and members of the authorization committee on Senate Environmental and Public Works: For the record my name is Joe Belford. I am a Ramsey County Commissioner in North Dakota. I Co-chair the Lake Emergency Management Committee, which includes elected officials from the Devils Lake Basin. I also am Vice-Chairman and the North Dakota representative of the Red River Basin Board, which includes North Dakota, South Dakota, Minnesota, and Manitoba.

With me to answer any questions are two elected officials. Fred Bott is the Mayor of Devils Lake and a member of the Lake Emergency Management Committee. Vern Thompson is a State Senator and Mayor of Minnewaukan. Mayor Thompson is also Co-chair of the Lake Emergency Management Committee with me.

Emergency Today—Started In 1993

Thank you for the opportunity to testify before your committee. We have a serious emergency flood on our hands in the Devils Lake Basin. The flooding started in June 1993. At the time, the lake was at an elevation of 1422.6 mean sea level (msl). Devils Lake continues to be one of the most important lakes in North Dakota for milking walleye and northern pike eggs to reproduce and stock fish across the State. The low elevation caused concern for a fish kill potentially impacting the whole State's fishery.

About the same time flooding started in the Missouri and Mississippi River regions, we began to receive heavy rains. The summer of "93" we received about 45 inches of rain in the upper part of the Devils Lake Basin. Since that time, we continue to receive heavy precipitation through rain or snow. A Presidential disaster declaration has been signed for our area every year since 1993. The lake started out covering about 40,000 acres of land in 1993. Since then, the lake has risen over 20 feet. The lake has more than doubled in size, and tripled in volume. Devils Lake peaked this summer just under 1443 msl. The lake now covers about 105,000 acres. In 1993 there was 500,000 cubic feet of water in Devils Lake. The lake raised 5 feet just this summer, increasing the volume of water in it as much as it had in 1993 (500,000 more cubic feet).

Unlike A River Flood—No End To Damages

This flood is unlike any river flood, such as you saw this spring in Grand Forks. A river flood will crest by a certain date and elevation. The flooding in Devils Lake continues to grow like a cancer, with no end. To date, estimated damages are over $200 million dollars. The question we must answer is, do we want to manage the water, or let the water manage us? If we continue to let the water manage us, we are looking at another $260 million dollars in damages, before the lake rises to an elevation of 1457 msl and overflows uncontrollable into the Sheyenne River.

Lake Moves 8 Miles—Flooding Thousands of Acres

To illustrate how the lake has grown, the town of Minnewaukan which Mayor Thompson represents, was located 8 miles from the shores of Devils Lake. The lake moved to the town's edge causing them to move their lagoon system. Included in the 8 miles of new lake bottom are thousands of acres of deeded agricultural land under 20 feet of water. Farmers and ranchers, who contribute heavily to the $350 to $500 million dollar annual economic impact to the State, are being driven off the land and are losing their livelihood.

City Levee Raised 10 Feet—$51 Million Cost

Mayor Bott and the city of Devils Lake are in the process of building an extension to the levee system. It protects the lagoon system and a major portion of the town. This is the second 5 foot levee raise in 2 years. The cost of the levee raises will total $51 million dollars. The city is the economic hub of this region of the State, providing airport and hospital care facilities.

County And Township Disasters

As a county commissioner we are in the process of trying to deal with over 200 homes being moved or destroyed because of the rising water. A number of homes had to be burned onsite because there are not enough movers to relocate the homes fast enough. This is causing catastrophic impacts to our local government. Property

owners are asking for abatements, in fact on Tuesday night the commission acted on 105 property abatements on their property taxes. This affects schools, townships, city, county, and eventually State government services. If the lake continues to rise as much last year as it did this year another 50 homes in Ramsey County will be affected valued at another $3 to $4 million dollars.

Hundreds of county and township roads are inundated by the rising lake. This is causing severe health and safety concerns. Emergency services for health and safety are at risk because of the closed roads. State and U.S. highways are closed at times because of the wave action flowing across the roads makes them unsafe.

Spirit Lake Nation Emergencies

The Spirit Lake Nation Indian Reservation is experiencing economic disaster because of road closings to the $14 million dollar resort and casino. The roads closed cause emergency vehicles to travel up to 55 miles, when normally it is a 6 mile drive to the local hospital. It will cost in excess of $15 million to build a bridge across the lake to provide emergency access. About 83 homes are in the process of being moved on the reservation, and thousands of acres of tribal trust lands are being affected.

Comprehensive Solutions

We are trying to come up with a comprehensive solution to our flooding problems. They include a partnership of Federal, State, and local governments working together toward a holistic approach. The 3 legged stool approach we talk about includes;

1. management of water in the upper basin;
2. protection and moving of infrastructure;
3. an emergency outlet;

No leg can stand on its' own!

Upper Basin Management

To manage water in the upper basin, we are encouraging farmers to sign-up for various programs. Some of these programs include; Conservation Reserve Program (CRP), Wetlands Reverse Program (WRP), State Water Bank Program, Available Storage Acreage Program (ASAP) and other Federal or State programs.

Last springs' CRP sign-up had 1 out of every 5 farmers sign up. A new sign-up is taking place this fall. We anticipate a record sign-up, taking more land out of production and producing new wetland areas. We expect nearly all the available State Water Bank moneys to be spent in the Devils Lake Basin. The ASAP program is providing valuable returns for additional wetlands storage. Agriculture is the main economy of our region and the State. It is a challenge to convince farmers, who at one time were subsidized by the government to create drains, to get them to plug the same dredged channels. We recognize this is not the total answer. As our State Geologist Dr. John Blumlie says, agriculture practices have little to do with the flooding of Devils Lake. Since the glacier period the lake has risen and overflowed to the Sheyenne different times before man ever settled the area. We continue diligently in our efforts in this area.

Emergency Infrastructure Response

To protect the infrastructure we move and relocate threatened structures, raise essential roads, and build dikes and levees to protect other infrastructure. Over 5 million cubic yards of dirt have been added to the State roads to raise them out of the water. About $62 million has been spent on State and U.S. road raises in our area. The cost escalates dramatically as the lake raises higher.

Emergency Outlet Tool

The emergency outlet is a management tool that will allow us to release a controlled quantity and quality of water without harming our downstream neighbors. We believe it is an environmentally and economically smart project. A controlled emergency outlet can prevent a possible environmental and economic disaster down the road. The proposed west end outlet, uses the best quality of water in Devils Lake. This water is very similar to what is in the Sheyenne presently. It would be released into the Sheyenne River during non-flooding or flood potential times. We are confident that a properly managed outlet will meet water quality standards in North Dakota, Minnesota, and Manitoba. In our view, it would be irresponsible to do nothing and let the waters continue to rise uncontrollable.

House On Fire—Livelihoods At Risk

Our homes, schools, churches, communities, and livelihoods are at risk. Quite frankly our house is on fire and we need tools to work with to put out the fire. In

our view, we need to move forward with authorization and funding, so downstream people in North Dakota, Minnesota, and Manitoba do not have to suffer the pain and heartache we have been going through the last 5 precipitation seasons.

We thank you for your support to date, and plead for your continued help as we deal with this monster of a problem. If you have any questions Mayor Bott, Sen. Thompson, or I would be happy to try and answer them.

VERN THOMPSON, MAYOR OF MINNEWAUKAN, STATE SENATOR;
JOE BELFORD, RAMSEY CO. COMMISSIONER, RED RIVER BASIN BOARD;
FRED BOTT, MAYOR OF DEVILS LAKE, MEMBER LEMC.

Lake Emergency Management Committee consists of elected officials from the Devils Lake Basin.

MISSION STATEMENT

"Solve short-term emergency needs that are in harmony with the long-term goals of the Devils Lake Basin. Seek implementation of a project that considers the social and environmental needs of our residents, and residents of downstream communities."

STATE OF MISSOURI, DEPARTMENT OF NATURAL RESOURCES,
Jefferson City, MO, November 7, 1997

THE HONORABLE JOHN CHAFEE, *Chairman*
Committee on Environment and Public Works
Dirksen Senate Office Building
Washington, DC 20510

DEAR MR. CHAIRMAN: Thank you for holding a hearing on the Devils Lake "Emergency" Outlet project on October 23, 1997. The project could potentially have a significant impact on Missouri and over downstream States in the Missouri River Basin and all States bordering the Mississippi River.

I respectfully request that the attached testimony for the State of Missouri be included in the hearing record and that Missouri be included in any subsequent hearings on this project

Thank you for your consideration in this matter.

Very truly yours,

DAVID A. SHORR,
Director.

STATEMENT OF DAVID A. SHORR, DIRECTOR, MISSOURI DEPARTMENT OF NATURAL RESOURCES

Thank you for the opportunity to provide comments to the Committee on Environment and Public Works related to the October 23, 1997 hearing on the Devils Lake "Emergency" Outlet Project. I am David Shorr, Director of the Missouri Department of Natural Resources. The State of Missouri is very concerned about the outlet proposed for Devils Lake and appreciates the opportunity to provide comments to the Committee.

There are many issues surrounding the proposed outlet for Devils Lake. These issues could have a very real impact on many other parties both within and outside the State of North Dakota. Factual information must be provided to the public on all proposals and a forum established to permit full, open and meaningful public discussion. information on all aspects of the full array of options should be discussed, including costs, benefits and environmental effects of each proposal.

Following are some of the issues that should be considered in a public discussion.

Economic Analysis

The U.S. Army Corps of Engineers reports indicate that the proposed outset alone would be incapable of lowering the water levels of Devils Lake sufficiently to provide relief. At the same time, significant investments for construction and maintenance of the outlet facility would be required resulting in only $.39 of benefits for every dollar of cost, estimated by the U.S. Army Corps of Engineers to be at least $21,000,000.

Environmental Impacts

A comprehensive analysis is needed of the proposed project, that includes a complete Environmental Impact Statement in compliance with requirements of the National Environmental Policy Act. All possible alternatives to the construction of the proposed outlet and Me impacts associated with construction, operation and mainte-

nance of the proposed outlet under each of the possible alternatives must be given careful consideration in the Environmental Impact Statement.

Diversion

Any proposed diversion of water from the Missouri River Basin for out-of-basin uses is of grave concern to Missouri. Missouri's population is dependent on Missouri River water for municipal and industrial water supply, power plant cooling, wastewater treatment facilities, ports and navigation. In dry periods, the Missouri River represents 65 percent of the flow of the Mississippi River at St. Louis. When the Port of St. Louis is not operational, downstream and upstream ports are immediately affected, impacting navigation on the entire inland waterway system.

Growing depletions in the Missouri and Mississippi River Basins are a concern. According to recent estimates, Tom the U.S. Geological Survey, depletions in the Missouri River amount to 18.7 million acre feet per year (MAF/yr), while the average discharge of the Missouri River near its mouth is about 58 MAF (1929–1995). This diversion, along with other potential growth in depletions should be assessed us the NEPA process.

Plans for an inlet and outlet to Devils Lake have been considered jointly for at least several years as documented by U.S. Army Corps of Engineers reports begun in 1990. It is often said that the current proposed "emergency" outlet is directly related to completion of an inlet as another piece of the Garrison Diversion Project. If, as the U.S. Army Corps of Engineers reports, an outlet would be ineffective alone in reducing the water levels of Devils Lake' careful consideration should be given before authorizing tax dollars for a project that would not even address the "emergency" need.

I ask the Committee to review these issues carefully as it considers this project. As the impact to the State of Missouri and other downstream States court be significant, I ask that we be included in any farther discussions or consideration of projects affecting the Missouri River Basin. I would be happy to provide any additional information related to Missouri's position on the proposed Devils Lake "Emergency" Outlet Project.

3417 OLD 10 R,
Valley City, N.D. 58072, November 17, 1997.

THE HONORABLE JOHN H. CHAFEE, *Chairman,*
Committee on Environment and Public Works,
United States Senate,
Washington, DC 20510.

DEAR MR. CHAIRMAN: I am chairman of People to Save the Sheyenne, a group of ordinary citizens living along the Sheyenne River in North Dakota. We organized earlier this year to oppose the proposed outlet from Devils Lake to the Sheyenne River. We gathered over 1,300 signatures on petitions opposing the outlet (copies enclosed,. We gathered those 1300 plus signatures in a short period of time during the worst winter we've seen in a long while and, it is worth noting, in a sparsely populated area. These signatures demonstrate the feelings of people who live and work along the Sheyenne River—they do not want any more water—they have their own problems with water without getting additional water from Devils Lake.

Although we are a small grass roots group, with no source of funding except donations, we have sponsored two trips(four of our members went on the first one, two on the second) to Washington, DC. to tell our story to the U.S. Congress. Our members have contributed significant amounts of time and money to oppose construction of the outlet.

I wrote you on 9–21–97 asking that you let me know when the hearing would be held on the proposed outlet from Devils Lake to the Sheyenne River. We were hoping to appear to testify against it. I have not heard from you, but, I have learned from another source that you have scheduled the hearing for October 23. I am disappointed that you did not let me know. I have also learned that you are permitting testimony from only one opponent while scheduling testimony from several proponents. I had hoped that this would be a fair and balanced hearing which would shed light on both sides of this contentious issue. But,I guess I was wrong.

Since you have denied us an opportunity to appear and make our case at the hearing, I have decided to do the next best thing and submit written testimony. Please share this testimony with the other members of the Senate Committee on Environment and Public Works.

People to Save the Sheyenne have many concerns and unanswered questions about this project. We are convinced it will increase bank erosion, which is already

a serious problem, along the Sheyenne River. We do not see how it can help but intensify summer flooding such as we had because of heavy rains in 1993. The proponents say the pumps would be stopped in the event of heavy rains in the area. But, it would take about 10 days for the Devils Lake water already in the river to pass Valley City. There are also serious unanswered questions as to what this project will do to water quality in the Sheyenne River. Devils Lake is not known for its water quality.

People to Save the Sheyenne are upset that other alternatives to deal with Devils Lake flooding have not been given serious consideration. Thousands of acre feet of water could be stored in the upper basin by restoring drained wetlands. A large area, mostly north of Devils Lake, has been artificially drained into the lake. Closing those drains and restoring those wetlands could according to a January 1997 report from the N.D. State Engineer and U.S. Fish and Wildlife Service provide 327,000 acre feet of storage. An earlier study suggests the potential of two or three times that amount of storage. Upper basin storage can do much more to reduce flooding at Devils Lake than the proposed outlet would do.

We are especially troubled by the current attempt to build the outlet without studying the costs and benefits of the various alternatives to determine which would be the best and most cost effective approach to reduce Devils Lake flooding. We contend that storing thousands of acre feet of water in the upper basin would be more cost effective.

Sincerely,

HENRIK VOLDAL, CHAIRMAN,
People to Save the Sheyenne.

CANADIAN EMBASSY,
Washington, DC, October 22, 1997.

THE HONOURABLE JOHN H. CHAFEE, *Chairman,*
Committee on Environment and Public Works,
United States Senate,
Dirksen Senate Office Building,
Washington, DC 20510.

DEAR CHAIRMAN CHAFEE: I understand that the Senate Environment and Public Works Committee will hold a hearing on October 23 on the Army Corps of Engineers' flood control project at Devils Lake, North Dakota. This project would divert water through an outlet from Devils Lake through the Sheyenne to the Red River, which runs north into Manitoba, Canada, and has the potential for irreversible environmental damage. I am therefore particularly grateful to Members of the Committee who ensured that project construction is contingent on a number of conditions, including the need for consultation with the International Joint Commission to ensure that the project will not violate the requirements or intent of the Canada-U.S. Boundary Waters Treaty of 1909. I commend the Committee for exercising its oversight responsibility and urge that you ensure full compliance by the Executive Branch with those conditions, prior to commencement of any construction.

In view of the recent appropriation of funds for this project without the benefit of public review by your Committee, Canada is particularly concerned about the degree of objectivity possible in the interpretation and fulfillment of conditions attached to a project which is continually changing in scope and design. As originally planned, the outlet would increase the volume of water flowing into the Red River basin, where there are already significant flooding and water quality problems, in both the United States and Canada. In spite of this, we understand from North Dakota media reports that discussions are underway between the State Water Commission and the Corps of Engineers that could involve a significant increase in proposed flows by:

(i) moving from the original, Twin Lakes route, involving a series of pools, pumps and a canal, to using a pipeline along the Peterson Coulee Route; and (ii) changing to year-round pumping.

Canada sympathizes with North Dakota's problems with Devils Lake flooding. This year, Manitoba, North Dakota and Minnesota residents in the Red River valley, downstream from the proposed outlet, experienced the worst flooding in centuries. We understand that many genuine emergency mitigation measures for Devils Lake flooding are already being implemented in North Dakota, such as construction of an emergency dike. We also understand there are other approaches that have not yet been fully examined that might avoid Devils Lake problems from being exported downstream. According to a Corps of Engineers report, the proposed outlet would

take several years to complete and, even then, would not have a significant impact on water levels in Devils Lake.

Canada has expressed longstanding concern with any part of the Garrison Diversion project which might lead to transfers of water, carrying foreign fish diseases and biota, from the Missouri River basin to the Hudson Bay basin. The International Joint Commission has stated in the past that such interbasin transfers have the potential to seriously damage Canadian waters and Manitoba's multi-million dollar fishery, in violation of the Boundary Waters Treaty.

As originally designed, and even in current North Dakota plans, the question of an outlet from Devils Lake cannot be separated from that of an inlet, since the lake has traditionally suffered from drought. In dry years, the lake would be fed by water from the Missouri River through an inlet which, together with the outlet, would complete North Dakota's plans for Devils Lake stabilization and a feature of the Garrison Diversion project. While I am aware that none of the appropriated funds may be used for an inlet, the fact remains that an inlet is a high priority in North Dakota. This has been repeatedly and publicly made clear in the local media by politicians and other State leaders.

The Garrison Diversion Unit Reformulation Act of 1986 and other U.S. laws outline the process for seeking domestic consensus on and approval of Garrison-related projects. The Reformulation Act also provides for consultations between Canada and the U.S. on water projects that might affect Canadian waters. Canada will formally address any U.S. proposals after the U.S. domestic process is complete.

I would be pleased to provide you with any further information on the Canadian position that you may require. I urge you to give serious consideration to Canada's concerns and I request that you include this letter in the official record of the October 23 hearing.

Yours sincerely,

RAYMOND CHRETIEN,
Ambassador.

NOVEMBER 30, 1997.

SENATOR JOHN H. CHAFEE,
Committee on Environment and Public Works,
Washington, DC 20510–6175.

DEAR SEN. CHAFEE: I just received your letter with ref; to the questions in regard to the Devils Lake Basin with the answers below.

1. They are a very limited factor in the flooding conditions at Devils Lake. According to the North Dakota State Water Engineer, he said that drainage only contributes about 7 percent to the lake it self.

2. Yes we are having some success with the various programs,as we are currently holding about 25000 acre feet in the upper basin. It is an educational process that we have undertaken in the basin a seems to be working. We just recently hired a basin manager with one of his main duties is to promote upper basin storage.

3. There is very much universal support for the outlet,asconsiderable damage has happened and the economy is very bad due to the high lake levels.

Once again I want to thank you for having the hearings and allowing me to testify in behalf of our community.

Sincerely,

JOE BELFORD.

NORTH DAKOTA CHAPTER, THE WILDLIFE SOCIETY,
P.O. Box 1442, Bismarck, ND, October 1, 1997.

MR. ROBERT J. WHITING, *Chief,*
Environmental Resources Section,
Management and Evaluation Branch,
U.S. Army Corps of Engineers,
St. Paul MN, 55101–1638

DEAR MR. WHITING: This letter is in response to your September 5, 1997 letter requesting comments on the proposed Devils Lake outlet. We appreciate the opportunity to provide our thoughts on this issue.

The most obvious omission from Enclosure 1 (Project Information Summary Sheet) and Enclosure 2 (General Concerns) is the cost benefit examination of the project. The Corps of Engineers own study concluded that an outlet from Devils Lake would return only $0.39 in benefits for every dollar of cost. Since publishing

this study in 1994, the estimated benefits have diminished because of federally completed flood mitigation while the costs have at least doubled. Construction of raised highways, flood plain evacuation, and the new dike protecting the city, all done with Federal funds, are examples where the flood protection has been achieved and reduced the need for and expected benefits from an outlet. These current costs do not include the environmental consequences of draining water from the Devils Lake basin to the Sheyenne River, or increased drainage potential in the upper basin as a result of construction of an outlet. The double counting of these benefits or the omission of these costs is not acceptable. The bottom line is that this proposal had a negative cost benefit ratio in 1994 and the figures have gotten worse since then.

The Section entitled Proposed Outlet Operation should include criteria to which the project sponsor will be held responsible during outlet operation such as goals for upper basin storage, implementation of a plan for investigation and closure of illegal drainage and a regional education campaign addressing consequences of building in a lake and draining wetlands.

The Alternatives Investigated section should be renamed. True alternatives to construction of an outlet have never been promoted much less analyzed by the project sponsor or by the Corps. While the Governor insists the need for an outlet was determined through the development of a detailed action plan established in 1995 by the Devils Lake Basin Interagency Task Force, he neglects to mention that the Corps in its August 12, 1996 report on the proposed outlet stated explicitly that: "While the [Emergency Outlet Plan] lacks much field data to verify existing conditions and a full assessment of impacts, it will be a common reference point for discussions among interested parties regarding the practicability and implementability of an emergency outlet." Since 1996 has the Corps and Congress come to the conclusion that the outlet is now practical?

Looking at the issue of the outlet without examining a major contributing factor, basin management, is irresponsible and inconsistent with the expectations of the public on your agency. The State sponsor of this project has not accepted any responsibility for the current situation and expects the Federal Government to construct an environmentally unacceptable outlet that creates a multitude of problems out of one. The burden of responsibility for construction has shifted to the Corps and with that burden comes the focus of public scrutiny. We reiterate our previously expressed concerns that to design an outlet prior to investigation of the source of the problem and an analysis of alternative solutions to the problem is irresponsible and contrary to the spirit of NEPA. What major efforts have been implemented within the basin for long term water management?

There must be strict enforceable criteria in place that are acceptable to downstream interests in North Dakota, Minnesota, and Canada for operation of the outlet prior to construction. Leaving this issue until after construction is a mistake that could halt the eventual operation of a completed project resulting in an expenditure of taxpayer funds with no realized benefits.

The effectiveness of the outlet is mentioned under the Stabilized Lake Level section. There is no plan for discussing the sustainability in the long term of this solution versus moving the town, holding water in the basin with a control structure at the natural outlet, and upper basin storage and management.

We ask that you add these concerns to the list you have developed and coordinate with the sponsor and determine if they will be responsible to assure that environmental commitments and downstream interests are actually going to be considered in development of the project.

The list of concerns should also include the cumulative impacts of construction of this outlet including but not limited to expedited loss of public trust for the Federal Government and more specifically the Corps of Engineers.

Sincerely,

MICHAEL OLSON, *President.*

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