Manitoba

ASSINIBOINE RIVER AND LAKE MANITOBA BASINS FLOOD MITIGATION STUDY

Round 2 Open House

WELCOME!

Manitoba Infrastructure and Transportation is studying flooding in the Assiniboine River and Lake Manitoba watersheds and how we can provide greater protection from flooding risks.

Round 1 Open Houses were held in June 2013 in Dauphin, Brandon and Portage la Prairie to introduce the study terms of reference.

The study has helped the province better understand the flood risks and the possible options that can be used to reduce effects from future flood events. The study focused on:

- The main stems of the Assiniboine River and Souris River
- Lake Manitoba
- Lake St. Martin
- Dauphin Lake
- Shoal Lakes

Assiniboine River Dikes
(May 2011)

Fairford River Water Control Structure
(July 2011)

Lake Manitoba
(July 2011)

WE VALUE YOUR FEEDBACK!

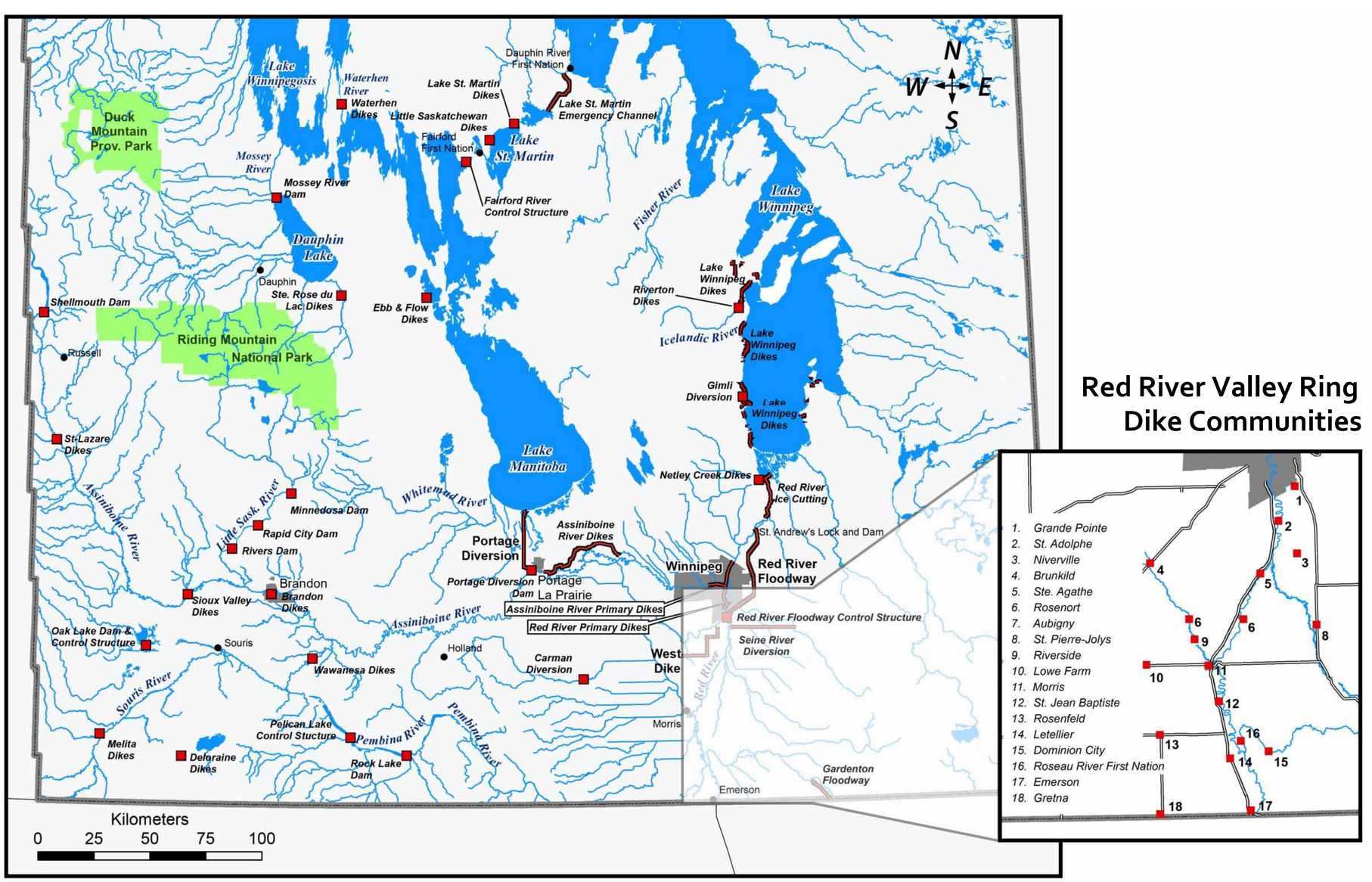
The Round 2 Open House events communicate the results of the study.

Ask us any questions you may have.
Share your thoughts on the presented information.
Fill out a comment form.

MANITOBA'S FLOOD PROTECTION MODEL

- Since the1950 flood, Manitoba has developed an extensive integrated flood protection system consisting of the following components:
  - Floodways and diversions
  - Dams
  - Community diking
  - Linear diking
  - Individual flood protection
  - Development controls
- This integrated flood mitigation strategy has worked well as a system since that time in the areas protected by the constructed works, and has avoided billions of dollars of damages.

Manitoba's Flood Control Infrastructure System

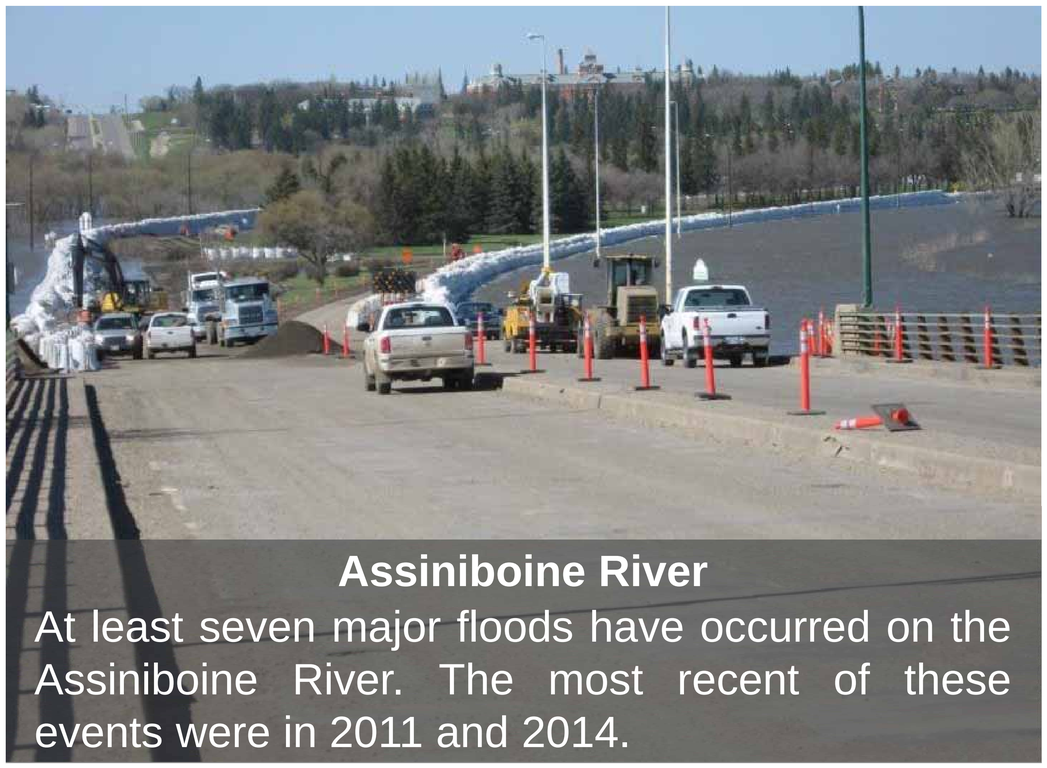


Red River Valley Ring Dike Communities

BACKGROUND

In the last hundred years, Manitoba has experienced several major floods. The flood of 2011 was unique. High flows were recorded on almost all streams and rivers in the Assiniboine River and Lake Manitoba watersheds. For a flood event like this to occur on one or two major rivers is rare, let alone for a flood to occur over all of western Manitoba.

The flood of 2011 highlighted several potential weak links in some of the existing flood control systems. The short comings of the system were emphasized again in the flood of 2014.



Assiniboine River

At least seven major floods have occurred on the Assiniboine River. The most recent of these events were in 2011 and 2014.

Lake Manitoba

Lake Manitoba reached record water levels in July 2011. In 2014, water levels exceeded flood stage for a second time in four years.

Souris River

In July 2011, record-high peaks occurred on the Souris River as a result of significant rain events in May and June.

Dauphin Lake

In 2011, Dauphin Lake began to rise in April due to snowmelt and reached record water levels in mid-June as a result of several major rain events.

STUDY OBJECTIVES

- The study has identified the flood risk, and assessed over 70 potential options to reduce flood risk for communities and major infrastructure along the following lakes and rivers.

  - Assiniboine River
  - Souris River
  - Qu'Appelle River
  - Fairford River
  - Dauphin River
  - Lake Manitoba
  - Lake St. Martin
  - Lake Winnipegosis
  - Dauphin Lake
  - Shoal Lakes

- A massive amount of data and technical input was reviewed as background to this study. In the determination of impacts and the development of a list of mitigation alternatives, a wide range of flood frequencies were considered.

- A number of flood protection works and flood reduction activities to reduce flood effects have been completed or are currently well underway. These works and activities were all considered in the study.

- Results from this study will be used to plan for and carry out future activities.

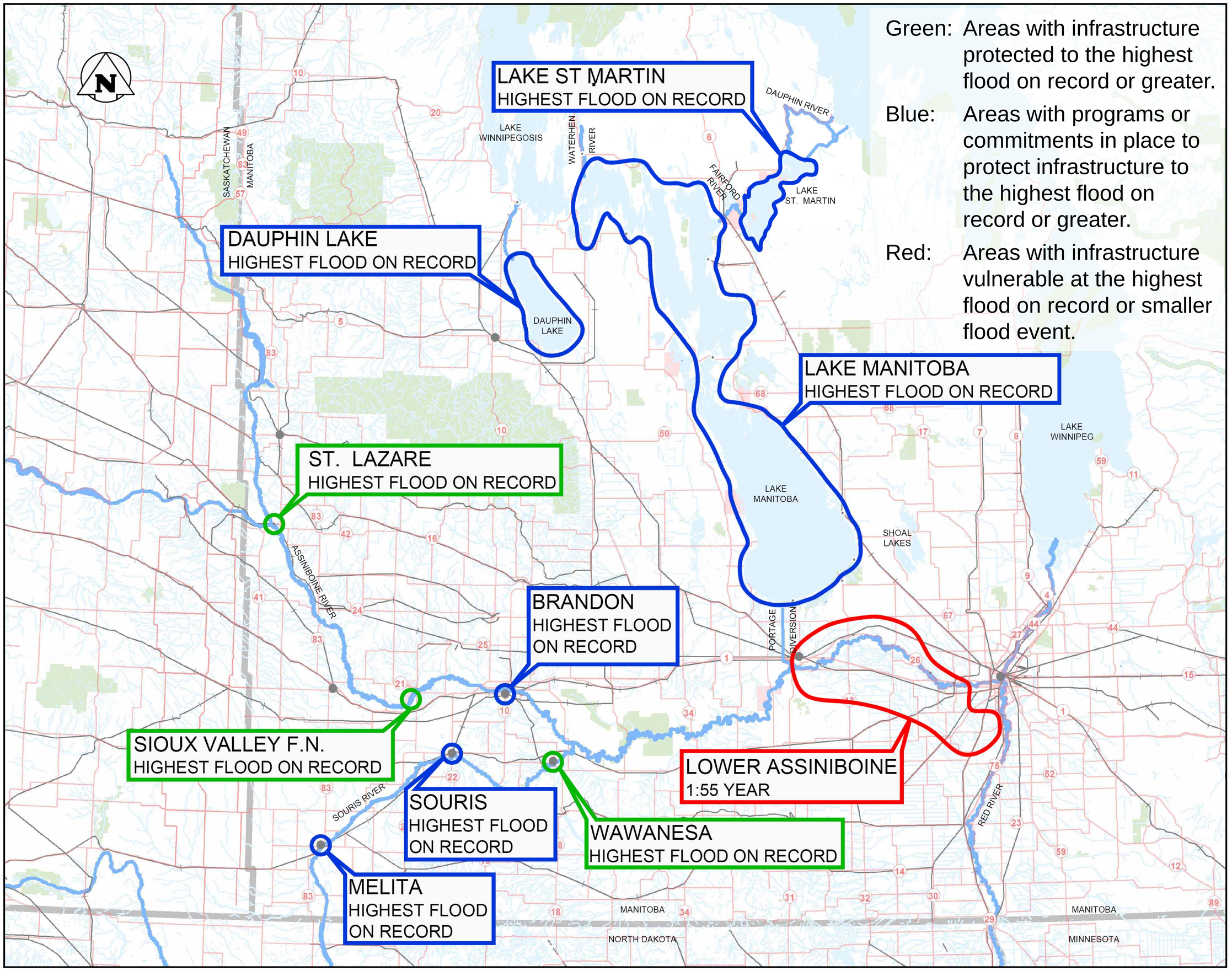
- More studies are needed to address flooding concerns along tributaries and in other areas that are not listed above.

RELATED PROVINCIAL INITIATIVES

- **The 2011 Manitoba Flood Review Task Force**
  - The review was completed in the spring of 2013 and provided many recommendations as a follow up to the 2011 flood.
  - The province accepted the 126 recommendations in April 2013.
- **Lake Manitoba and Lake St. Martin Regulation Review**
  - The review was completed in the spring of 2013 and considered issues with respect to Lake Manitoba and Lake St. Martin.
  - The province accepted the 17 recommendations in April 2013.
- **Surface Water Management Strategy**
  - Work is ongoing on this initiative and will support decision making for the future management of surface water in the province.
  - Proposes 50 actions to be implemented by 2020.
- **Review of operating guidelines for key provincial flood control infrastructure**
  - This review is ongoing and considers the Red River Floodway, Portage Diversion and Fairford River Water Control Structure.
  - The review will be completed in the spring of 2015.
- **Significant investments in flood mitigation**
  - Individual and Community flood protection province-wide including Lake Manitoba, Brandon, Souris, Melita, Reston, Wawanesa and other communities.
  - In the Province's Individual Flood Proofing Initiative, over 1,200 applicants have approved in the two basins, including 885 around Lake Manitoba.
  - Upgrades and rehabilitation to existing flood control infrastructure, including emergency investments in the provincial Assiniboine River dikes and the Portage Diversion.
- **Evaluation of many additional flood mitigation demands**
  - Recent flooding events across the province has increased the demand for additional flood mitigation measures.

LEVEL OF PROTECTION

Assiniboine River and Lake Manitoba Basins

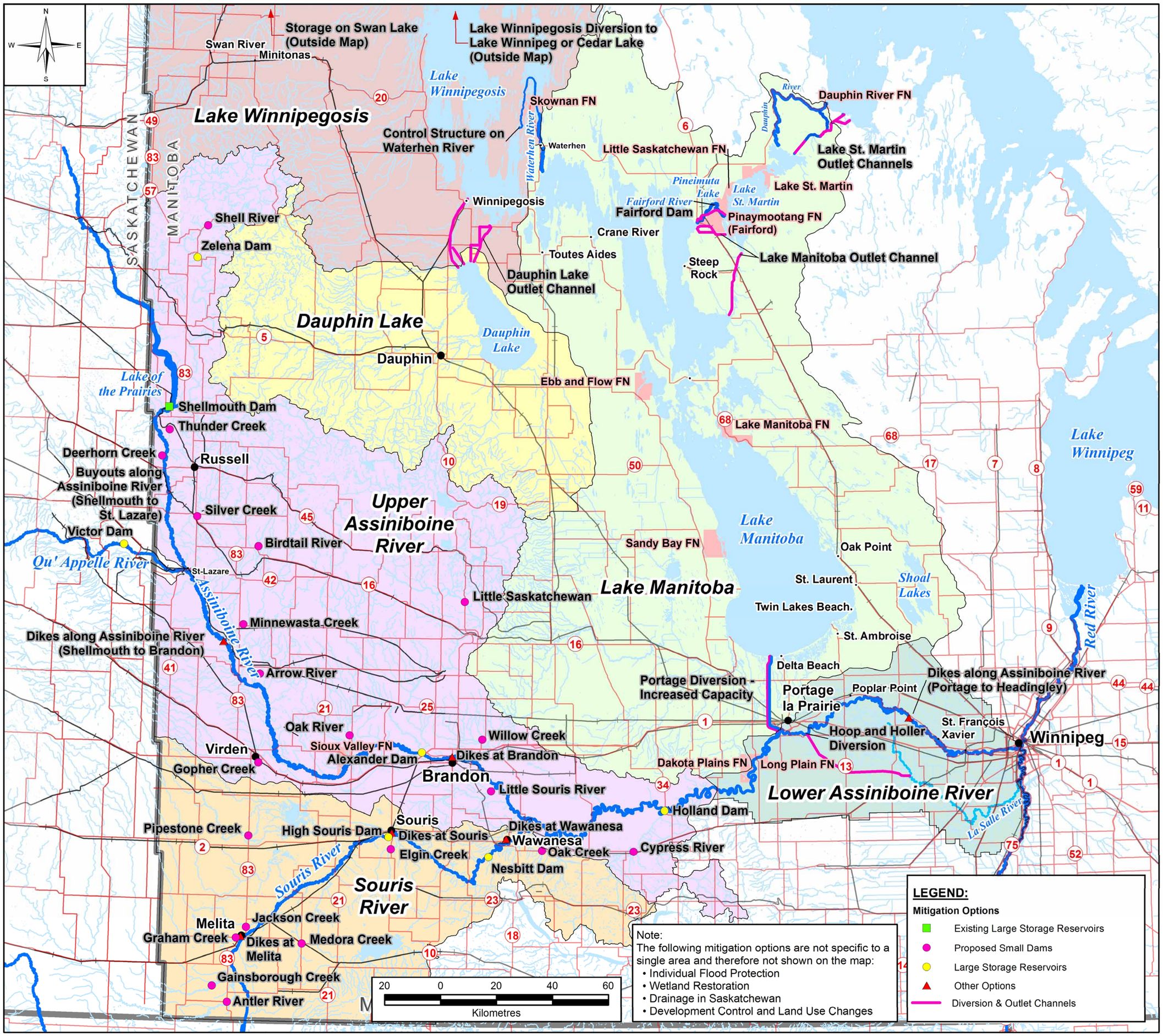


Note: In addition to the vulnerabilities shown on map, there are other vulnerabilities to individual properties and communities that may require further review.

Manitoba

OPTIONS FOR FLOOD MITIGATION

Study Areas and Flood Mitigation Alternatives



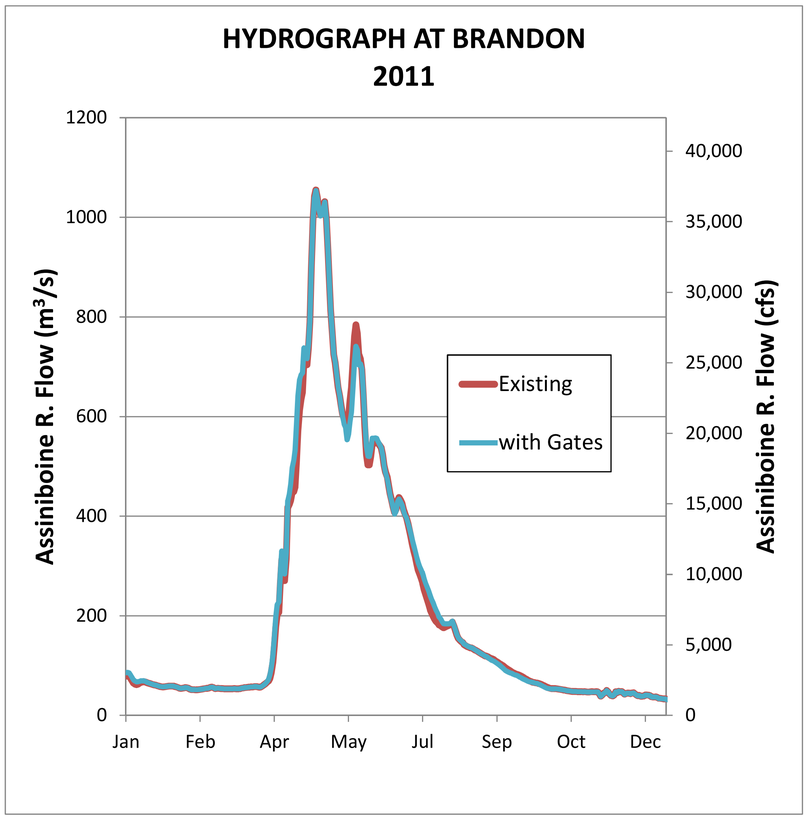
UPPER ASSINIBOINE RIVER

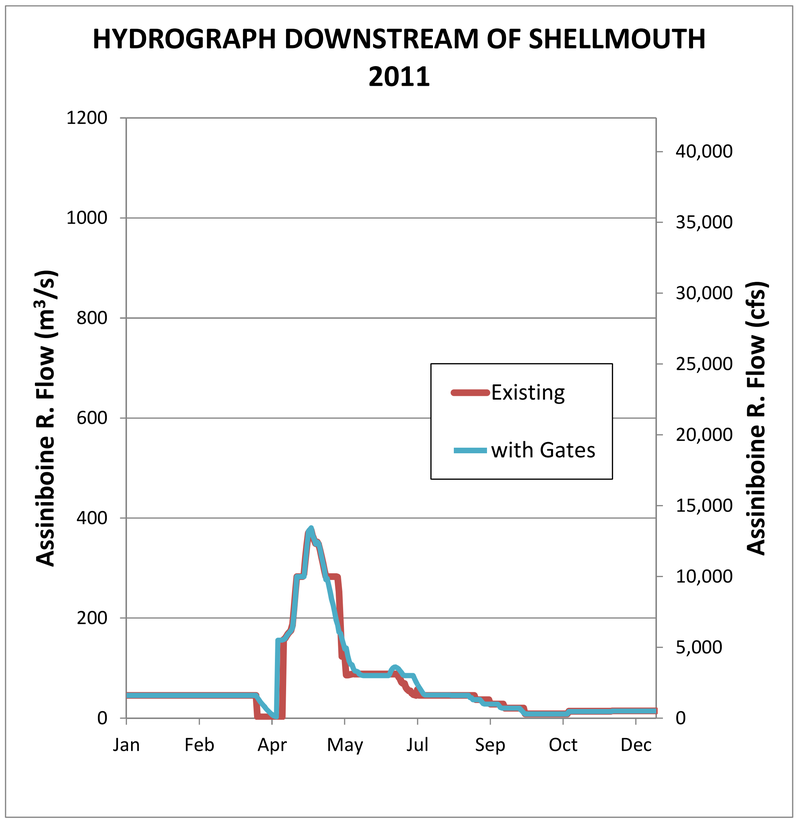
Impacts of Shellmouth Dam Gates on Floods

- The 2011 Flood Review Task Force recommended investigating alternative means to prevent or reduce flood damages on the Assiniboine River below Shellmouth Dam including:
  - Adding leaf gates on the Shellmouth Dam.
  - The purchase of flood prone lands.
  - Constructing dikes along the Assiniboine River.

Shellmouth Dam Leaf Gates

- The current study assessed the impacts of adding the proposed leaf gates on the Shellmouth Dam to water levels and flows during flood events.
- The assessment was based on the current operation guidelines.
- The results show a reduction in the frequency of flooding immediately downstream of the dam and some peak reductions for moderate flood events. However, the gates would have no impact on major flood events as shown on the examples provided below.
- Further downstream, from Brandon to Portage la Prairie, the flood control effects diminish and nearly disappear.





UPPER ASSINIBOINE RIVER

Diking and/or Purchase of Flood Prone Land Affected by Operation of Shellmouth Dam

Diking Along the Assiniboine River

- The study evaluated diking the agricultural land that is affected by operation of the Shellmouth Dam along the upper Assiniboine River.
- Diking options from Shellmouth to St. Lazare as well as to Brandon were considered.
- In addition to the construction of new dikes, permanent pumping stations would be required at regular intervals to pump runoff from the agricultural fields.
- Elimination of flood plain storage would aggravate flooding downstream.

	Shellmouth to St. Lazare	Shellmouth to Brandon
Total Dike Length	180 km	570 km
Number of Pump Stations	40	140
Estimated Cost for 1:5 year protection (approximately 2,000 cfs to 10,000 cfs)	$25 Million	$100 Million
Estimated Cost for 1:50 year protection (approximately 6,000 cfs to 25,000 cfs)	$75 Million	$300 Million

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Purchase of Flood Prone Land

- The land purchase option considered the purchase of flood prone lands at fair market value from Shellmouth to St. Lazare.

	Shellmouth to St. Lazare
Total Area of Land Purchased	1300 ha (3300 ac)
Total Area of Land Flooded (Agricultural Component Only)	700 ha (1700 ac)
Estimated Cost of Land Purchase	$20 Million

- The land purchase option is the preferred alternative over linear diking.

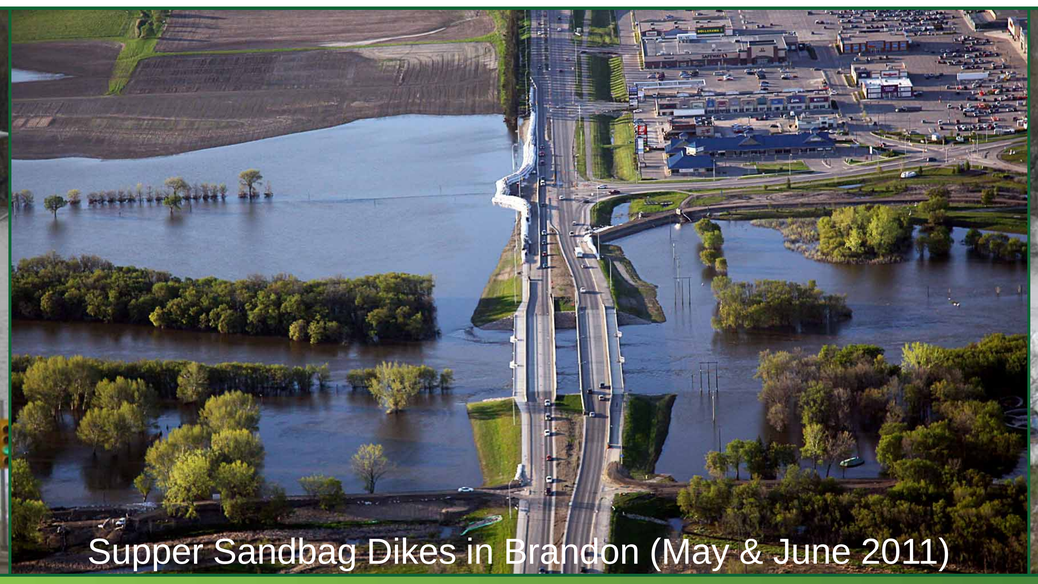
UPPER ASSINIBOINE RIVER

Increasing Flood Protection Level in Brandon

- Linear diking has been found to be the most feasible option to increase the level of protection in the City of Brandon.

- A commitment has been made to upgrade the city's flood protection level to the highest flood on record (2011 and 2014) at a cost of approximately $27 Million.

- The project will include:
  - Enhancements to the linear diking system within the city, including both improvements to the dikes and the dike drainage systems.
  - Upgrades to the lift stations along the Assiniboine River corridor.
  - Raising Provincial Trunk Highway 110.
  - New dike construction has already been completed along 18th Street North in the City of Brandon.



Supper Sandbag Dikes in Brandon (May & June 2011)

SOURIS RIVER

Increasing Community Flood Protection Level

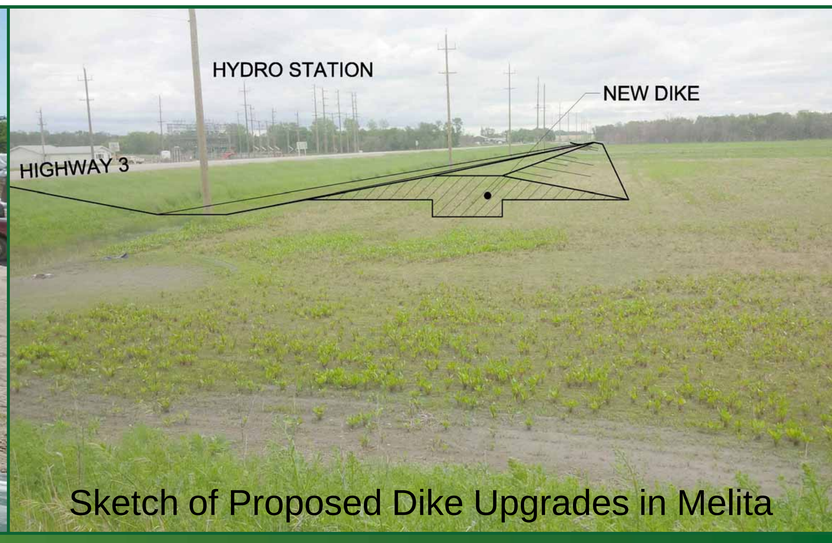
- Linear diking has been found to be the most feasible option to increase the level of protection in the communities of Melita and Souris.

- A commitment has been made to upgrade the flood protection level in the communities of Melita and Souris to the highest flood on record (2011 flood) at a cost of approximately $8 Million to $10 Million.
  - The 2011 flood was roughly a 1:150 year event in the two communities.
  - The projects are currently ongoing with an expected completion in 2015.

- In Wawanesa, the dikes are higher and the community is already protected to levels of at least the highest flood on record.

Sketch of Proposed Dike Upgrades in Souris


Super Sandbag Dike in Souris
(July 2011)

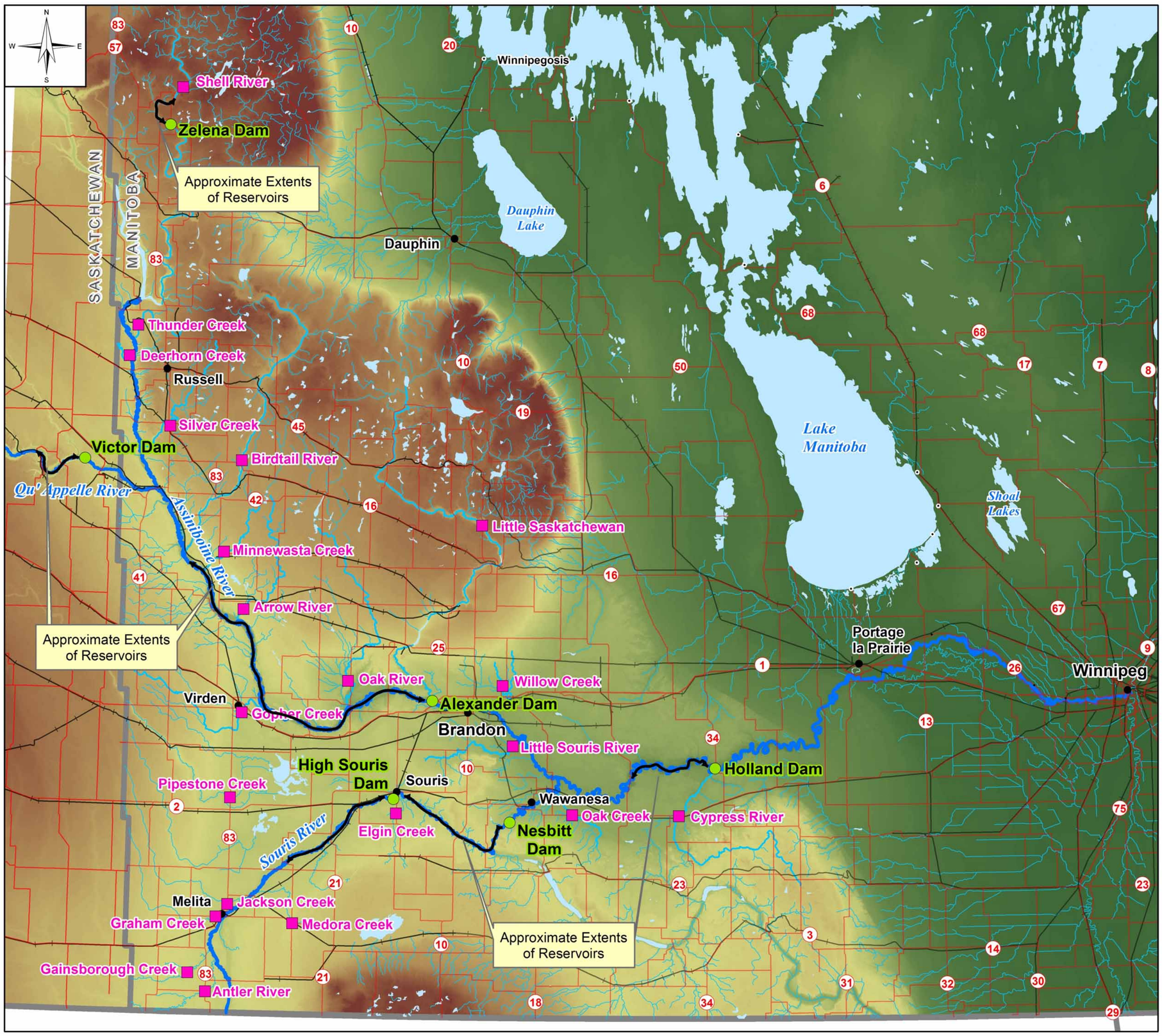


Sketch of Proposed Dike Upgrades in Melita

UPPER ASSINIBOINE RIVER AND SOURIS RIVER

Flood Mitigation with Small and Large Dams

- The study analysed six independent large dams as potential flood mitigation options as well as a combination of 21 small dams.



UPPER ASSINIBOINE RIVER AND SOURIS RIVER

Flood Mitigation with Large Dams

- The study analysed each large dam individually and assumed that they would be operated for flood control only and for peak flow reduction on the Assiniboine River.
- To achieve maximum benefits, the reservoirs must be emptied prior to the start of the flood. Also, the reservoir benefits increase with more accurate long range forecasts of runoff into the river systems.

	Holland Dam	Alexander Dam	Victor Dam	Zelena Dam	High Souris Dam	Nesbitt Dam
River	Assiniboine	Assiniboine	Qu'Appelle	Shell	Souris	Souris
Storage Capacity (dam^3)	880,000	1,600,000	170,000	250,000	39,000	408,000
Maximum Area Inundated by Reservoir (ha)	7,500	26,000	2,000	1,800	1,400	2,900
Average Flow over 3 Months to Empty Reservoir (cfs)	5,300	10,600	< 2,000	< 2,000	< 2,000	2,500
Approx. Peak Flow Reduction at Portage for a 1:200 Year Flood	10%	32%	3%	2%	5 %	8 %
Estimated Construction Cost	$270 Million	$525 Million	$145 Million	$90 Million	$116 Million	$211 Million

Note: Shellmouth Reservoir storage capacity is 480,000 dam^3

- The reservoirs would have significant environmental and social-economic impacts:
  - Post-flood discharge
  - Loss of land
  - Terrestrial habitat
  - Agriculture
  - First Nation
  - Impede navigation
  - Quality of water
  - Groundwater levels
  - Alteration of aquatic life
- Due to the significant environmental impacts the reservoir concepts should not be considered further.

UPPER ASSINIBOINE RIVER AND SOURIS RIVER

Flood Mitigation with a Combination of Small Dams

- The study analysed a combination of 21 small dams that would be operated strategically to reduce peak flows on the Assiniboine and Souris Rivers.
- A small dam was defined as a structure that would have a storage capacity of 35,000 dam^3 or less. In comparison, the existing Oak Lake Dam has a total storage capacity of 39,000 dam^3, and the existing Rivers Dam 30,000 dam^3.
- 21 sites were considered on tributaries of the Assiniboine and Souris Rivers, for a total storage capacity of 200,000 dam^3. In comparison, the Shellmouth Dam has a total storage capacity of 480,000 dam^3.

- The total cost of this option was estimated at $480 Million.

- Operating the dams effectively to achieve the maximum benefits would be very difficult:
  - Forecast dependent (difficult to accurately predict weather and runoff).
  - Must be timed perfectly such that water storage coincides with the flood wave on the Souris and Assiniboine rivers.
  - An operator or remote operation is necessary for each structure.

	Souris River at Wawanesa	Assiniboine River at Portage
Peak Flow Reduction for a 1:200 Year Flood (cfs)	1,800	3,200 to 4,600
Peak Flow Reduction for a 1:200 Year Flood (%)	5 to 9	8

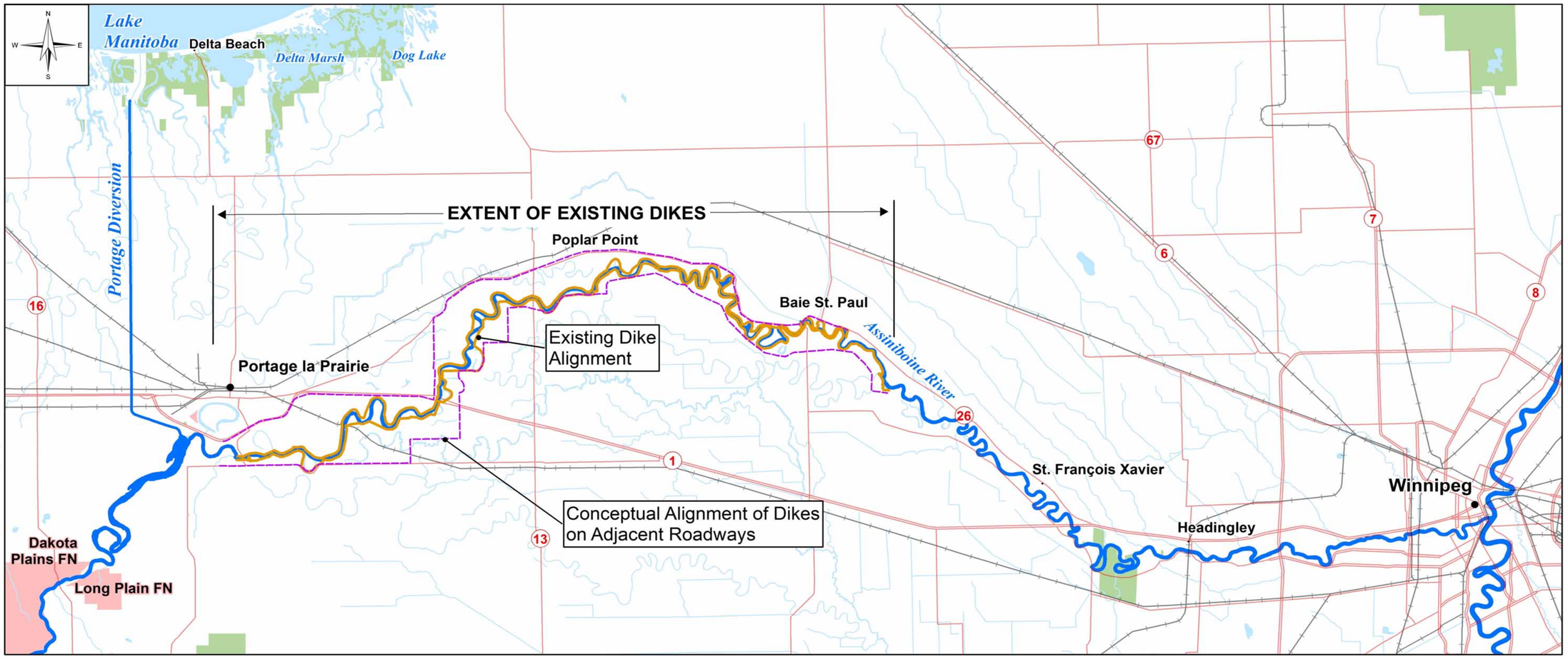
- Some of the dams could have local benefits that may require further review.

- It was concluded that flow reduction benefits on the Souris and Assiniboine rivers are relatively small and that this is not a feasible flood mitigation solution.

LOWER ASSINIBOINE RIVER

Increasing Capacity of Provincial Assiniboine Dikes

- The existing provincial dikes extend from Portage la Prairie to Baie St. Paul.
- The dikes were successful in providing protection during the floods of 2011 and 2014 at a flow of about 18,000 cfs, but required substantial emergency efforts.
- The capacity in 2011 and 2014 was less than in 1976 due to the difference in duration of the floods. As well, the late occurrence of the 2011 and 2014 floods in the season allowed the dikes to thaw, where in 1976 the dikes were frozen.
- The study evaluated three alternatives to increase the capacity of the existing provincial dikes for a range of flows:
    1. Upgrade existing dikes in current location.
    2. Move dikes to adjacent roadways.
    3. Combination of existing dike upgrades in some areas and moving dikes to adjacent roadways in other areas.



LOWER ASSINIBOINE RIVER

Increasing Capacity of Provincial Assiniboine Dikes

- The upgraded dikes would meet modern design standards:
  - Minimum two-feet freeboard above design water level.
  - Rip-rap erosion protection at critical areas.
  - Purchase land which dikes are located on to ensure maintenance access.
  - Minimum 20 feet top width for construction equipment.
  - Gravel topping for all season maintenance access.
  - All season road access at minimum three kilometres spacing.
- The option of moving the dikes to adjacent roadways includes the additional cost of purchasing the agricultural land and of individually protecting infrastructure located between the new dikes and the existing dikes.

Capacity	Portage la Prairie to Baie St. Paul		
	Upgrade Existing Dikes in Current Location	Move Dikes to Adjacent Roadways	Combination of Existing Dike Upgrades and Moving Dikes to Adjacent Roadways
18,000 cfs	$140 Million	$675 Million	$ 425 Million
23,100 cfs	$245 Million	$780 Million	$ 520 Million
28,000 cfs	$350 Million	$900 Million	$ 630 Million

- The most feasible option is to upgrade the existing dikes in their current location with some local upgrades to the alignment to address riverbank instabilities and improve access.

LOWER ASSINIBOINE RIVER

Increasing Flood Protection Level Downstream of Provincial Assiniboine Dikes

- Three options were considered to increase the level of protection downstream of the existing provincial dikes for a range of flows, from approximately Baie St. Paul to Headingley:
    1. Extend the provincial dikes.
    2. Individual flood proofing (ring dikes or raising buildings).
    3. Purchase of vulnerable properties.
- Extending the provincial dikes requires pump stations at about five locations for local drainage.
- The individual flood proofing and purchase options do not address the potential impacts to agricultural land.

Capacity	Baie St. Paul to Headingley		
	Extend Provincial Dikes	Individual Flood Proofing	Purchase of Vulnerable Properties
18,000 cfs	$80 Million	$ 3 Million	$ 37 Million
23,100 cfs	$115 Million	$ 12 Million	$ 85 Million
28,000 cfs	$154 Million	$ 24 Million	$ 121 Million

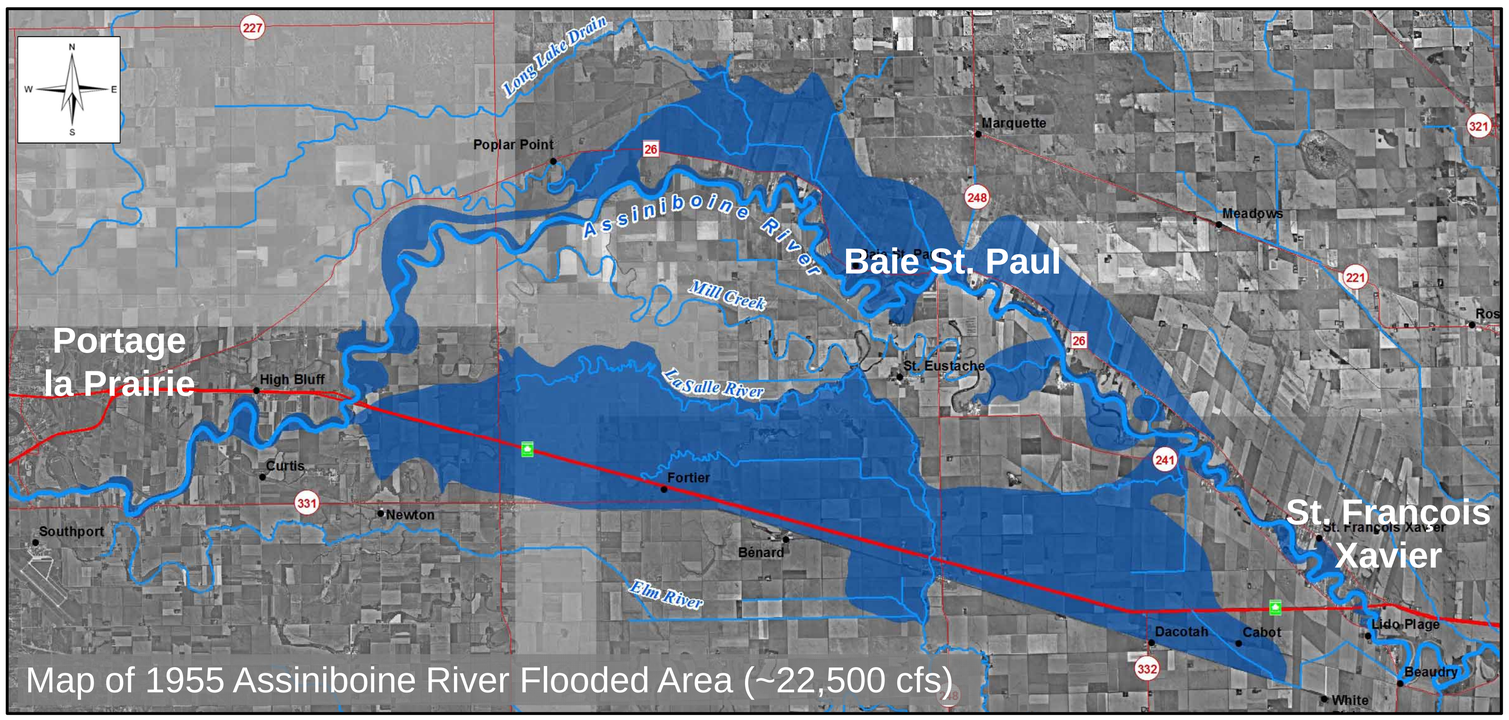
- The most feasible option is the individual flood proofing of vulnerable properties.

LOWER ASSINIBOINE RIVER

Individual and Community Flood Protection

- The study examined the option of protecting the homes and communities individually (similar to Red River Basin) instead of linear dikes along the river.

- Without the linear dikes, there would widespread flooding along the lower Assiniboine River area. Flows would spill into the La Salle River system during large floods which was not considered acceptable.



Map of 1955 Assiniboine River Flooded Area (~22,500 cfs)

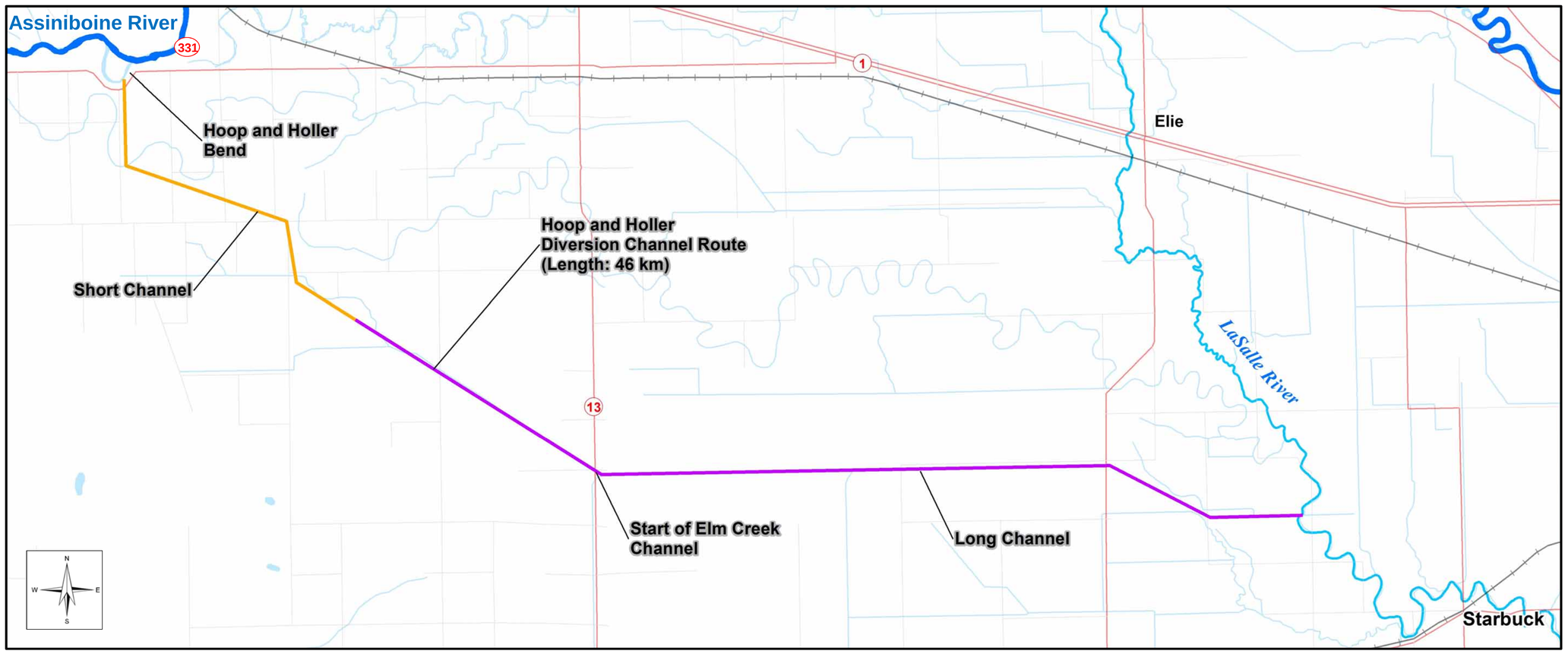
- The estimated cost for individual and community flood protection at 23,100 cfs is estimated to be as high as $240 Million. This does not consider flood damages to existing infrastructure, which is expected to be significant in major floods.

- The study has concluded that this option is not a feasible solution due to the negative impacts and costs of widespread flooding of the lower Assiniboine River area;
  - The transportation network would be severely affected with closures of many municipal and provincial roads.
  - Communities and individuals would need to be evacuated due to the road closures and limited access.

LOWER ASSINIBOINE RIVER

Hoop and Holler Release Diversion

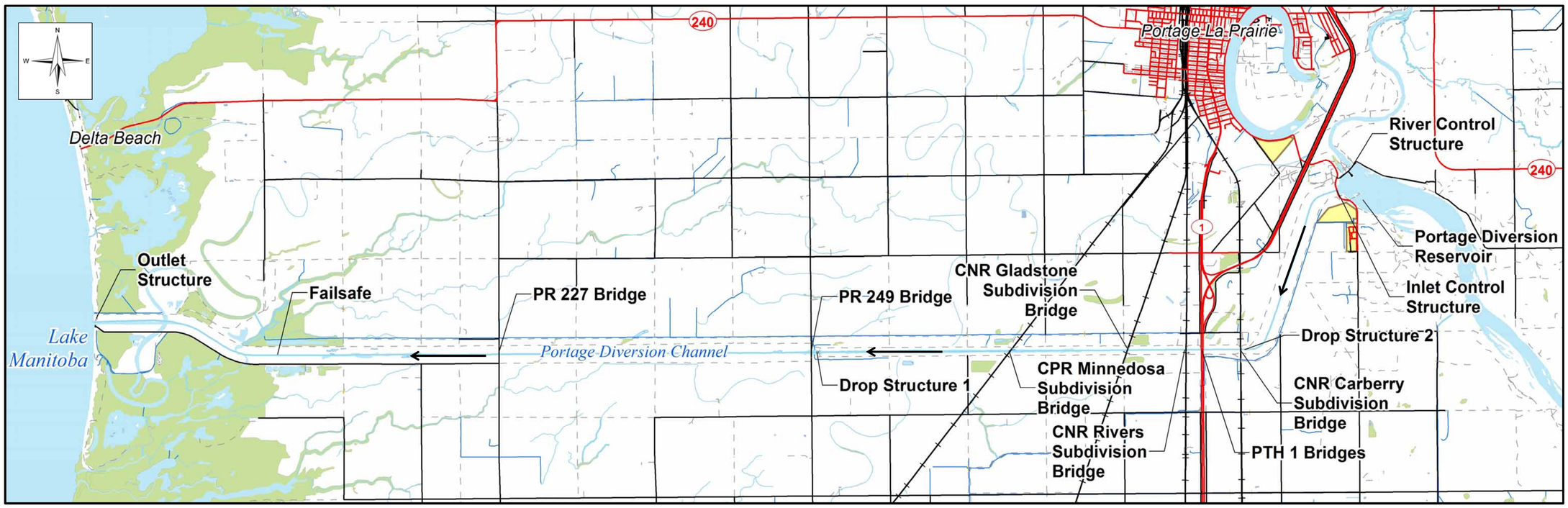
- The 2011 Flood Review Task Force recommended to construct a permanent controlled wasteway to pass Assiniboine River flows in excess of the combined capacity of the Portage Diversion and Assiniboine River channel and dikes.
- The Hoop and Holler Diversion Channel would divert 3,900 cfs towards the La Salle River:
  - The capacity is limited by the La Salle River downstream and the diversion channel could not be used if the La Salle River is full due to local runoff.
  - Estimated cost ranges between $80 to $310 Million depending on where the excavated portion of the channel is terminated.
- It was concluded that Hoop and Holler is not feasible as a permanent option because it:
  - Increases risk of flooding on Elm Creek Drain and the La Salle River.
  - Has significant opposition from local stakeholders.
  - Is not an economical long term strategy compared to other flood mitigation options.



LOWER ASSINIBOINE RIVER

Options to Increase Portage Diversion Capacity

- The Portage Diversion was put into service in 1970 and consists of:
  - Approximately 29 kilometres long channel.
  - Three roadway bridges and four railway bridges.
  - Two drop structures.
  - River control structure and reservoir.
  - Diversion control structure and Outlet structure.
- The original design capacity of the Portage Diversion was 25,000 cfs.
- The capacity was increased to approximately 34,000 cfs on an emergency basis during the floods of 2011 and 2014.
- The Portage Diversion provides significant water level benefits to:
  - City of Winnipeg
  - City of Portage la Prairie
  - Communities, residents, agricultural producers and other stakeholders along the Assiniboine River and La Salle River watershed.
- Operation guidelines are currently under review by the province.



LOWER ASSINIBOINE RIVER

Options to Increase Portage Diversion Capacity

- Three options were evaluated to permanently increase the Portage Diversion capacity to 34,000 cfs.
  - Combined with 23,100 cfs provincial dikes and individual protection on the lower Assiniboine River, 34,000 cfs capacity provides protection for a 1:200 year flood.
- All options include elimination of the existing Failsafe by raising the low portion of the west dike near the outlet.

1. Widening of Existing Diversion Channel – Estimated Costs: $543 Million
   - Channel excavation and moving back of the Portage Diversion dikes on both sides of the channel.
   - Bridges, control structures and drop structures would have to be replaced or upgraded to be wider.

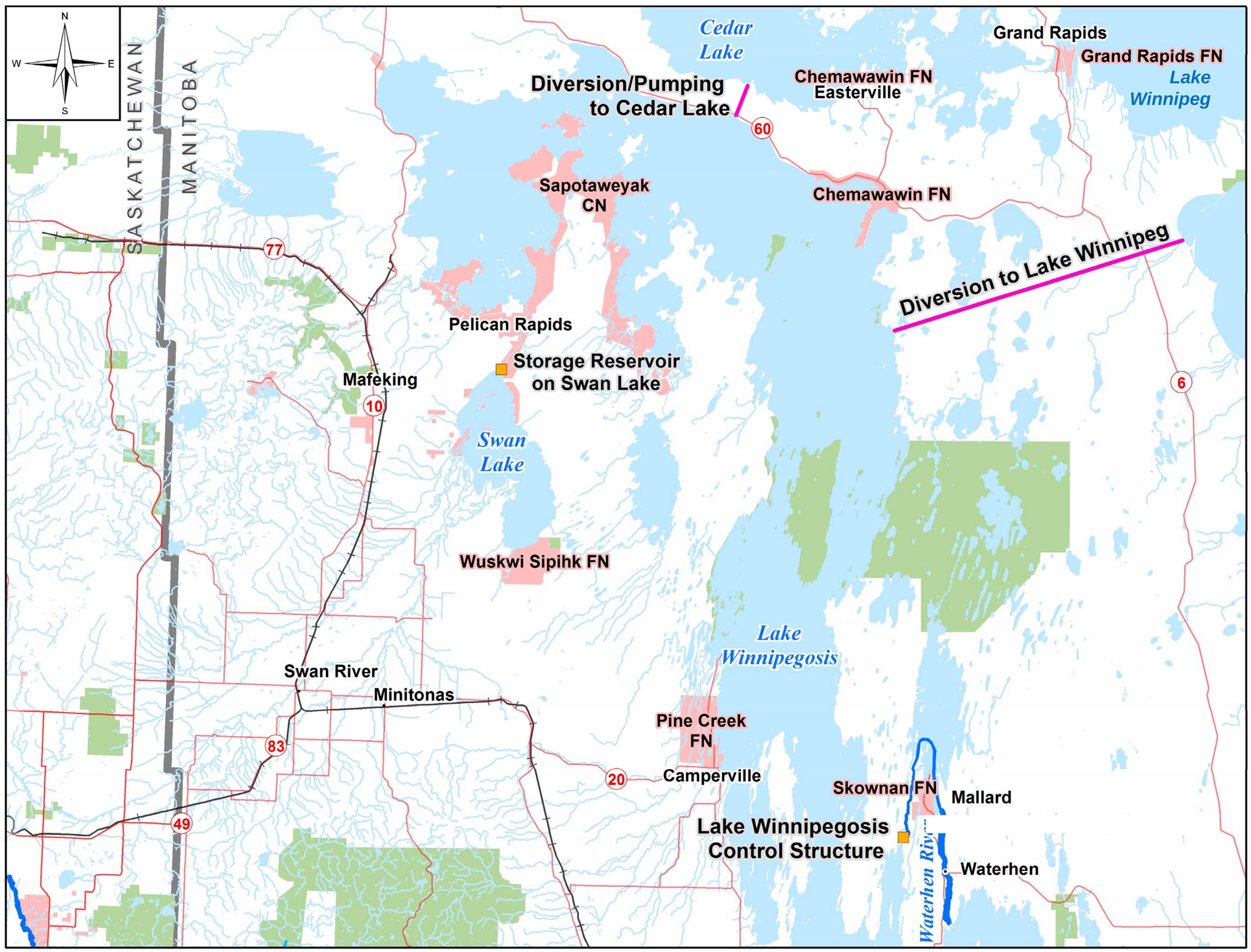
2. Construction of a New Parallel Channel – Estimated Costs: $333 Million
   - Excavation of a new channel and construction of new dikes parallel to the existing Portage Diversion.
   - West side was studied, however the east side could also be considered.
   - New bridges, control structures and drop structures would be required.
   - Has a dis-benefit of “doubling” the infrastructure (ex: increased environmental impact, maintenance activities, operating efforts and monitoring, etc.).
   - Includes the cost of maintaining the existing Portage Diversion infrastructure.

3. “Retrofit” the Existing Portage Diversion – Estimated Costs: $314 Million
   - Raising and upgrading of the dikes in the channel and in the reservoir.
   - Upgrading the control and drop structures, including the river control structure.
   - Several bridges would have to be replaced or upgraded due to the increased water levels in the channel.

LAKE WINNIPEGOSIS

Flood Mitigation Options

- Four flood mitigation options were considered on Lake Winnipegosis:
    1. Diversion Channel from Lake Winnipegosis to Cedar Lake.
    2. Diversion Channel from Lake Winnipegosis to Lake Winnipeg.
    3. Control Structure on Waterhen River.
    4. Storage Reservoir on Swan Lake.



LAKE WINNIPEGOSIS

Flood Mitigation Options on Lake Winnipegosis

- The Diversion Channel option to Cedar Lake is about six kilometres long and requires pumping as the average water levels in Cedar Lake are six feet higher.
- The Diversion Channel to Lake Winnipeg is over 60 kilometres long, which makes the option very costly.
- A control structure on the Waterhen River is not considered a feasible flood mitigation strategy as it would increase the water levels on Lake Winnipegosis.

Option	Design Capacity	Estimated Construction Cost	Effects on Lake Winnipegosis Water Levels in 2011 & 2012	Effects on Lake Manitoba Water Levels in 2011
Diversion to Cedar Lake	2,500 cfs to 10,000 cfs	$ 100 to $ 250 Million	Reduced by 1.0 to 3 ft	Reduced by 0.5 to 1.5 ft
Diversion to Lake Winnipeg	10,000 cfs	> $ 1.3 Billion	Reduced by 1.0 to 1.5 ft	Reduced by 0.5 to 1.5 ft
Control Structure on Waterhen River	n/a	$ 33 Million *	Increased by 0.5 to 4.0 ft	Reduced by 0.5 to 1.5 ft

* Note: This option has additional costs due to water level rises on Lake Winnipegosis.

- Developing Swan Lake into a storage reservoir could reduce water levels by 0.3 feet on Lake Winnipegosis and 0.1 feet on Lake Manitoba during a flood.
- An increase in water levels on Swan Lake would have environmental impacts.
- Field investigations and further studies would be necessary to estimate the cost.
- This study has concluded that Lake Winnipegosis options are not viable flood mitigation solutions due to the comparative costs of other alternatives and environmental issues.

LAKE MANITOBA & LAKE ST. MARTIN

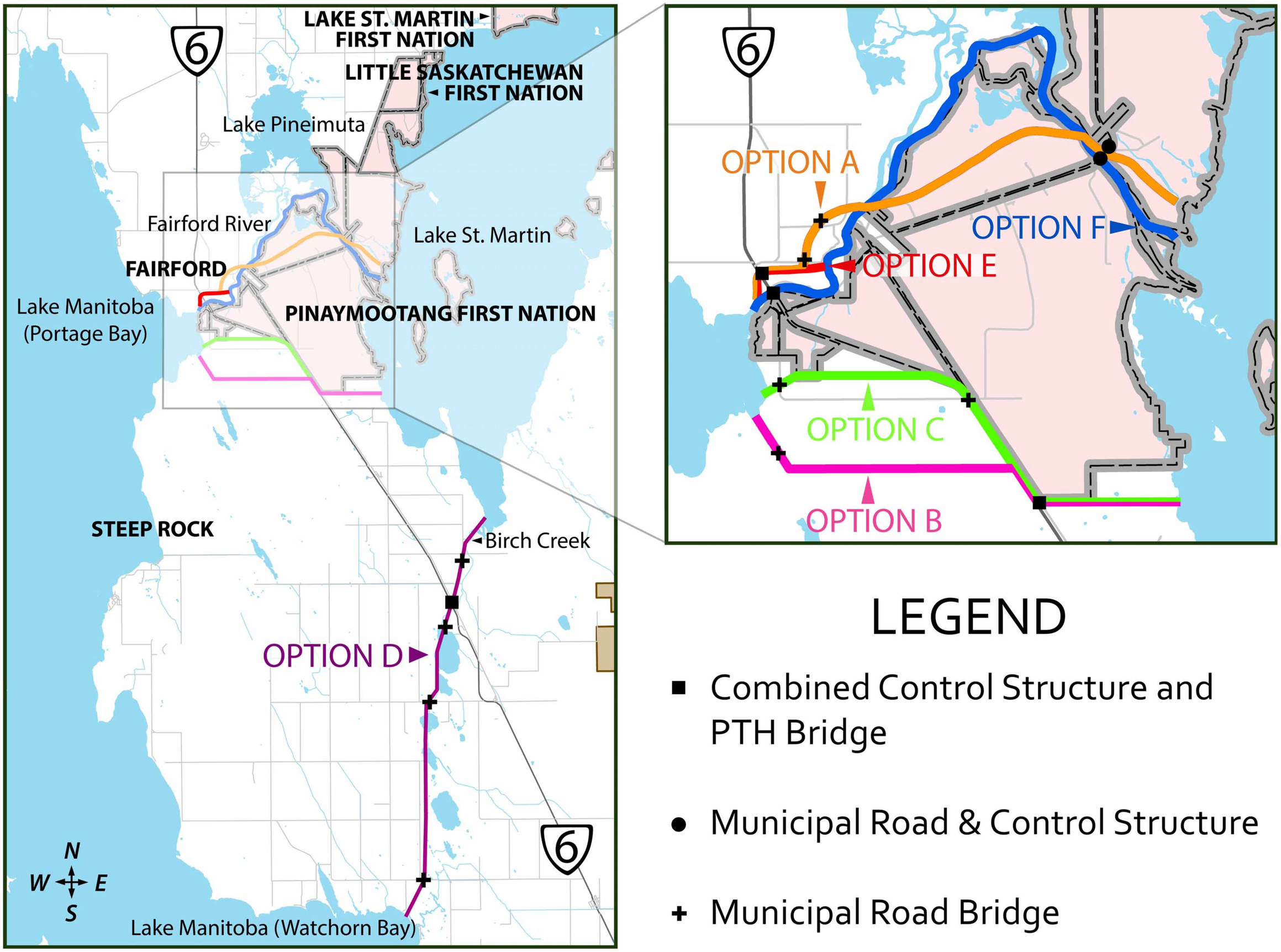
Conceptual Design of Outlet Channels

- The Province is committed to enhancing Lake Manitoba and Lake St. Martin outlet capacities to better regulate water levels on these lakes.
- An open house to solicit public opinion on the conceptual design options was held in September 2014 in Ashern.
- The preliminary recommendation was that the design should consider a 5,000 to 7,500 cfs channel from Lake Manitoba.
- The next stages of the outlet channel project include:
  - Preliminary engineering.
  - Aboriginal consultations.
  - Environmental and regulatory reviews.
  - Further public engagement.
  - Completion of the design.
  - Land acquisition.
  - Construction.
- The Province is currently proceeding with preliminary engineering for the preferred alternatives with a Lake Manitoba design capacity of 7,500 cfs, as announced in the November 20, 2014 Throne Speech.

Manitoba

LAKE MANITOBA

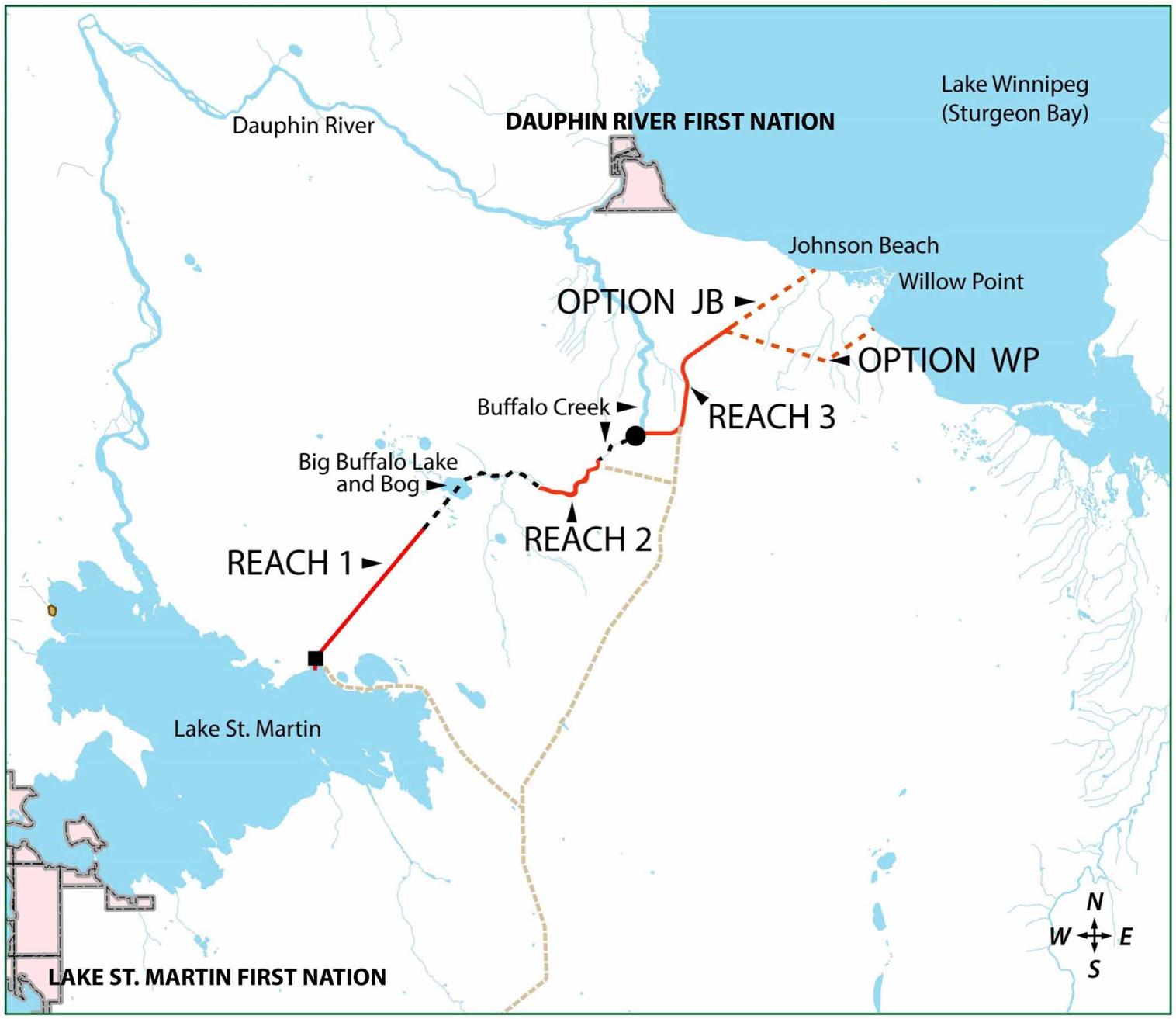
Preliminary Outlet Channel Options



Map showing Lake Manitoba Outlet Channel options

LAKE ST. MARTIN

Preliminary Outlet Channel Options



Map showing Lake St. Martin Outlet Channel options

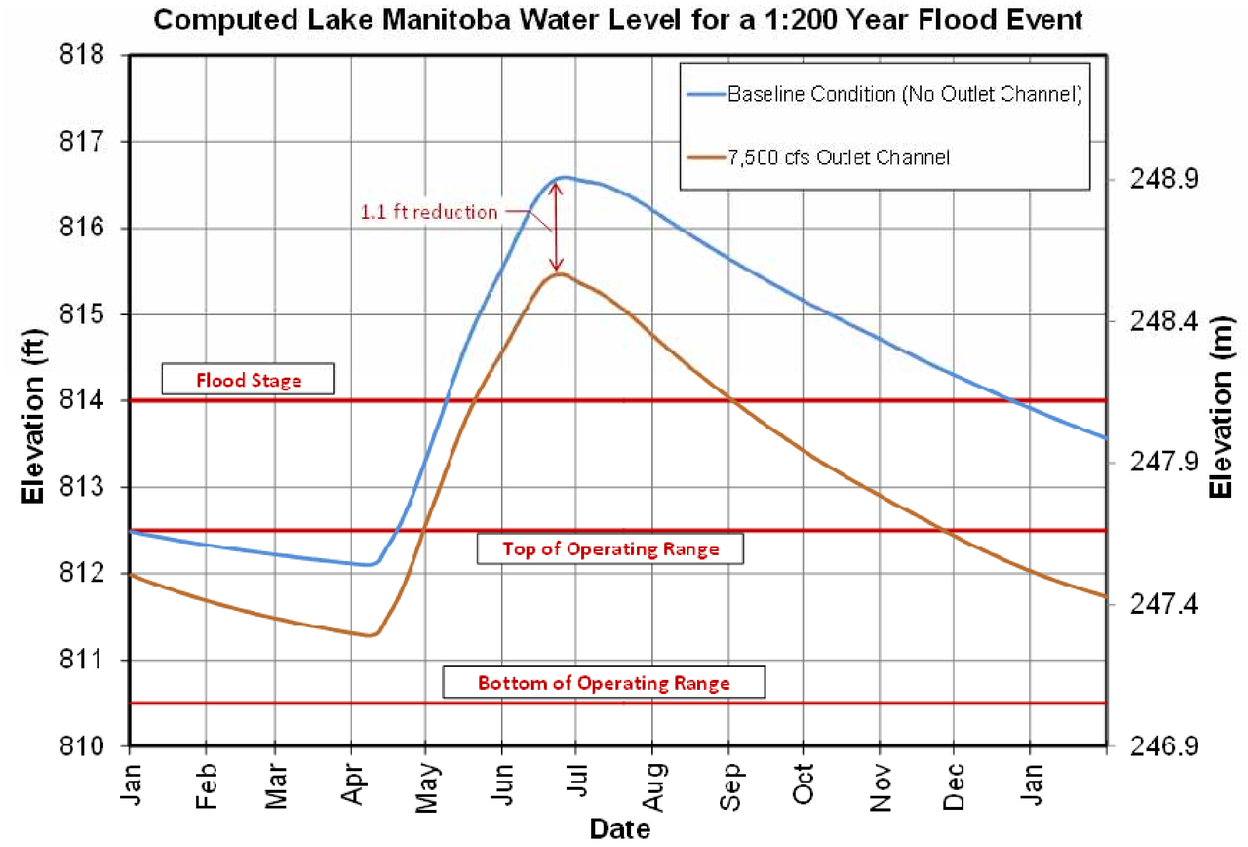
LEGEND

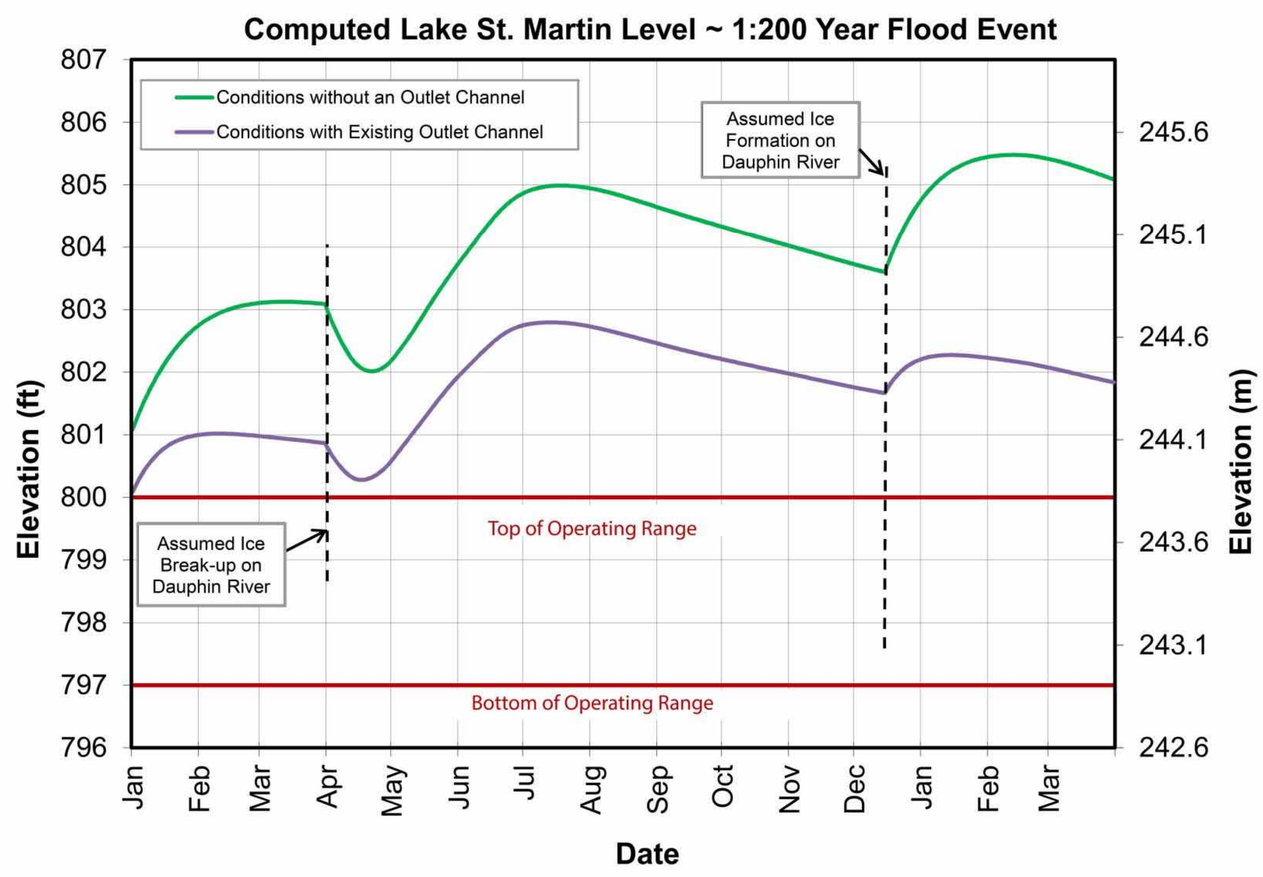
- ■ Inlet Control Structure
  - Regulates flow from Lake St. Martin to Reach 1
- Proposed Access Road
- ● Control Structure
  - Diverts flow from Buffalo Creek to Reach 3 during flood operation

LAKE MANITOBA & LAKE ST. MARTIN

Benefit to Water Levels

- For a 200-year event, without outlet channels, the peak water level without wind would be about 816.6 feet on Lake Manitoba and 805.4 feet on Lake St. Martin.





- A new outlet channel would reduce the peak Lake Manitoba water level by 1.1 feet for a 7,500 cfs channel.
- Existing emergency outlet channel will reduce the 200-year peak Lake St. Martin level by 2.7 feet.
- These peak level reductions would be very similar for all options since a Lake Manitoba outlet channel would be combined with an expanded Lake St. Martin outlet channel.
- The magnitude of these peak level reductions would be very similar for floods ranging from a 100 to a 500-year event.
- Improvements to the lower Assiniboine River capacity will help further reduce water levels on Lake Manitoba.

LAKE MANITOBA & LAKE ST. MARTIN

Preliminary Conclusions and Recommendations

Lake Manitoba Outlet Channel

- The larger capacity of 7,500 cfs was adopted by the province (Throne Speech, November 20, 2014).
- Alignments C and D are preferred based on their cost effectiveness and high environmental ratings.
- Preliminary cost estimated at $240 Million.

Lake St. Martin Outlet Channel

- Should be made permanent with capacity of 11,500 cfs to accommodate the increased inflows from a new Lake Manitoba outlet channel.
- An inlet control structure and permanent access road should be constructed.
- Preliminary cost estimated at $210 Million.
- At this stage, the Willow Point option is preferred.
- The effects of the outlet channels on Lake Winnipeg would be negligible.

Option C Overview Towards Lake Manitoba (June 2011)

Option D Overview Looking South (June 2011)

Option D at Watchorn Bay (June 2011)

ADDRESSING THE LOWER ASSINIBOINE RIVER VULNERABILITIES

- The lower Assiniboine River was identified as an area which has infrastructure that is vulnerable at floods much smaller than the highest flood on record.

- Combinations of options were considered to increase the flood protection level (FPL) in the area.

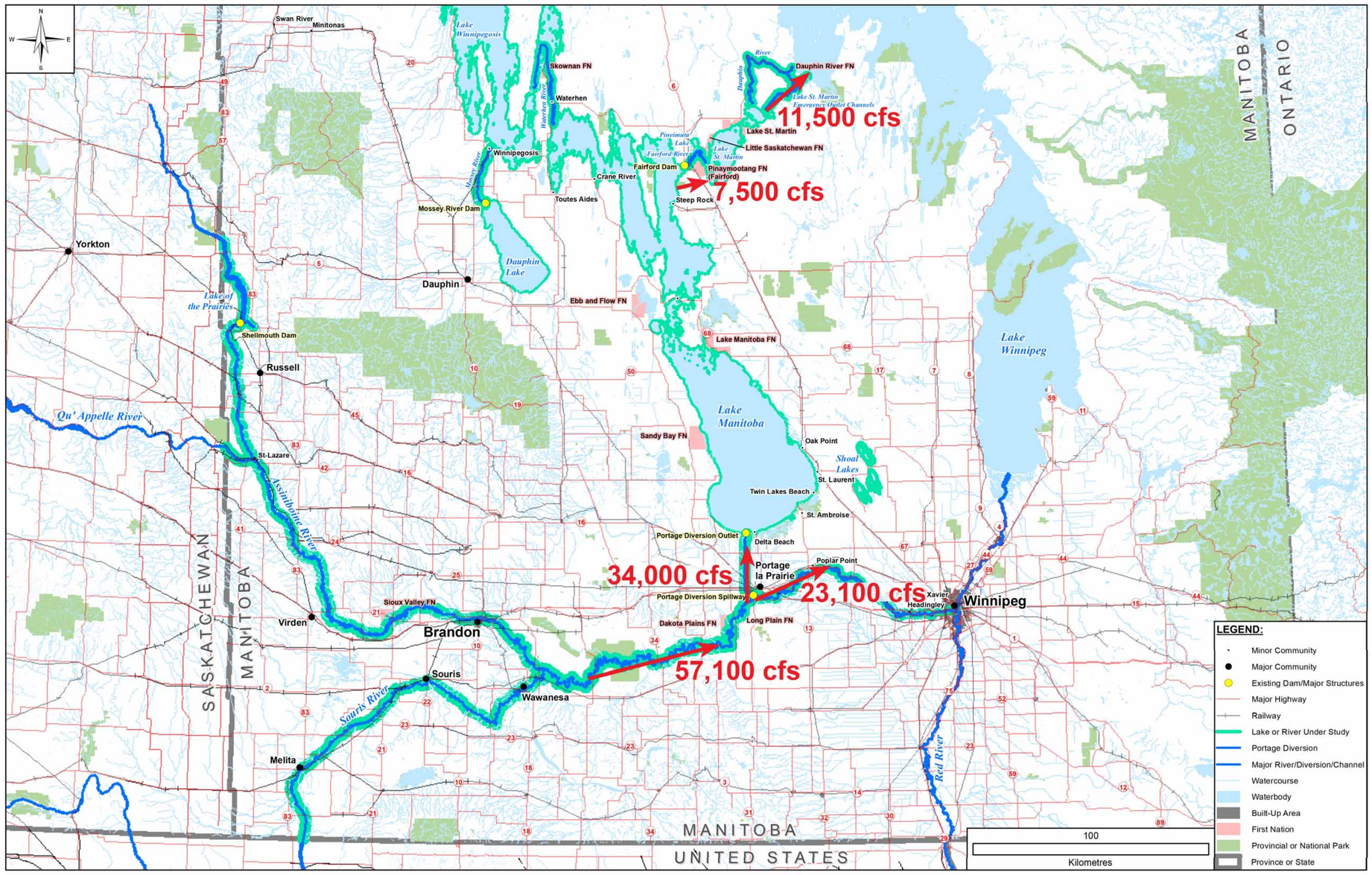
- The 1:200 year flood was selected as a target mitigation FPL as per the 2011 Flood Review Task Force recommendation.

- The alternative recommended in this study consists of:
  - Upgrading the Portage Diversion to 34,000 cfs,
  - Upgrading the Assiniboine River capacity to 23,100 cfs,
  - Constructing a new Lake Manitoba outlet with a capacity of 7,500 cfs, and
  - Making the Lake St. Martin outlet channel permanent with a capacity of 11,500 cfs.

- This alternative is shown schematically on the next board.

ADDRESSING THE LOWER ASSINIBOINE RIVER VULNERABILITIES

Regulated Flood Protection Level – 1:200 year



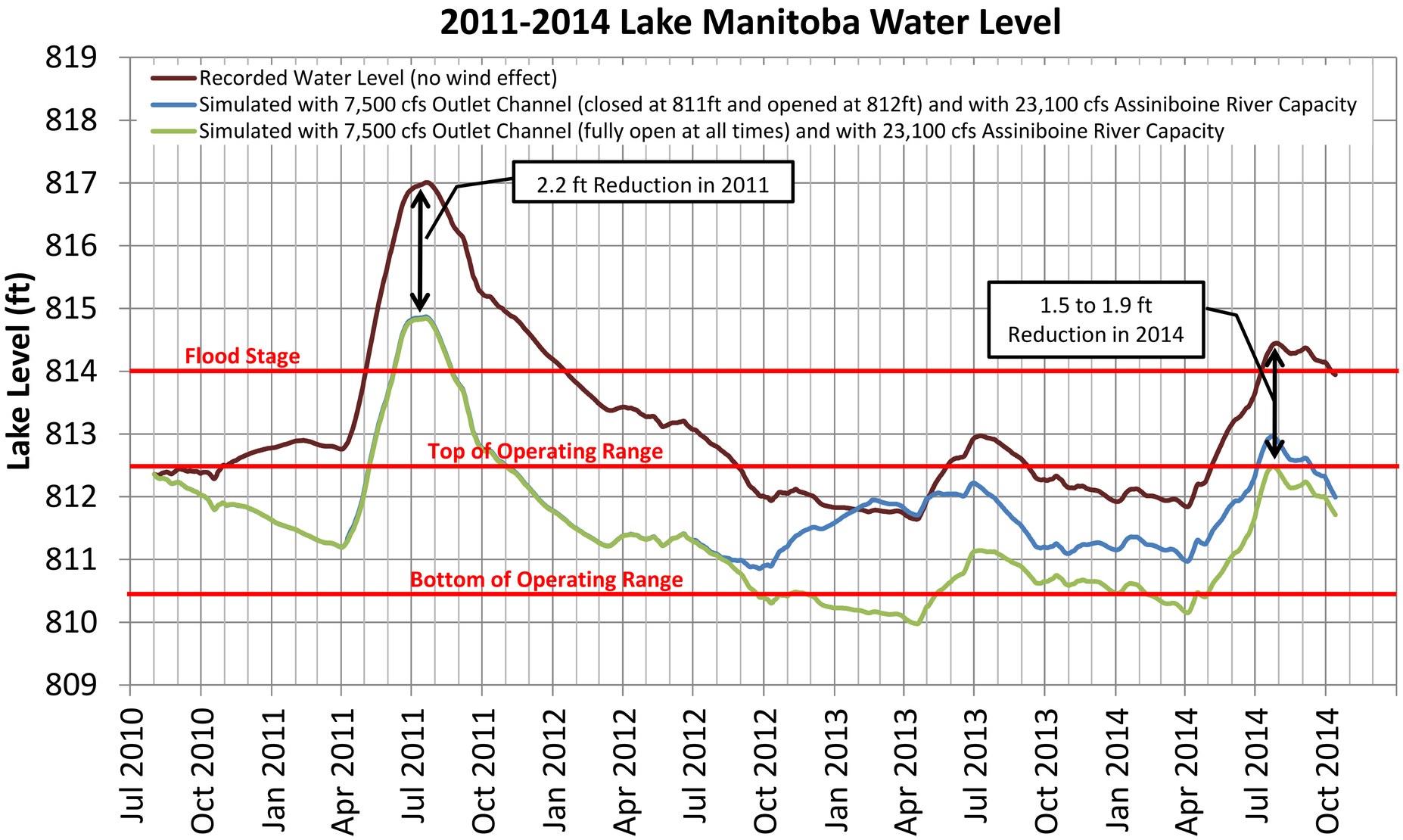
Flood Protection Infrastructure	Existing Capacity	Proposed Capacity	Preliminary Estimated Cost of Upgrade
Provincial Assiniboine Dikes	15,000 cfs	23,100 cfs	$245 Million
Assiniboine River Baie St. Paul to Headingley	17,000 cfs	23,100 cfs	$10 Million
Portage Diversion	25,000 cfs	34,000 cfs	$310 Million
Lake Manitoba Outlet	n/a	7,500 cfs	$240 Million
Lake St. Martin Outlet	4,000 cfs	11,500 cfs	$210 Million
		Total Cost	$ 1015 Million

Note: Estimated Costs do not include Individual Flood Protection on Lake Manitoba.

WATER LEVEL COMPARISON ON LAKE MANITOBA (2011 to 2014)

- Recorded water levels from 2011 to 2014 were compared to simulated water levels assuming:
  - A 7,500 cfs Lake Manitoba outlet channel .
  - Upgraded capacity of 23,100 cfs on the lower Assiniboine River.

- Results show decreased lake water levels due to the increased capacity of the lower Assiniboine River.



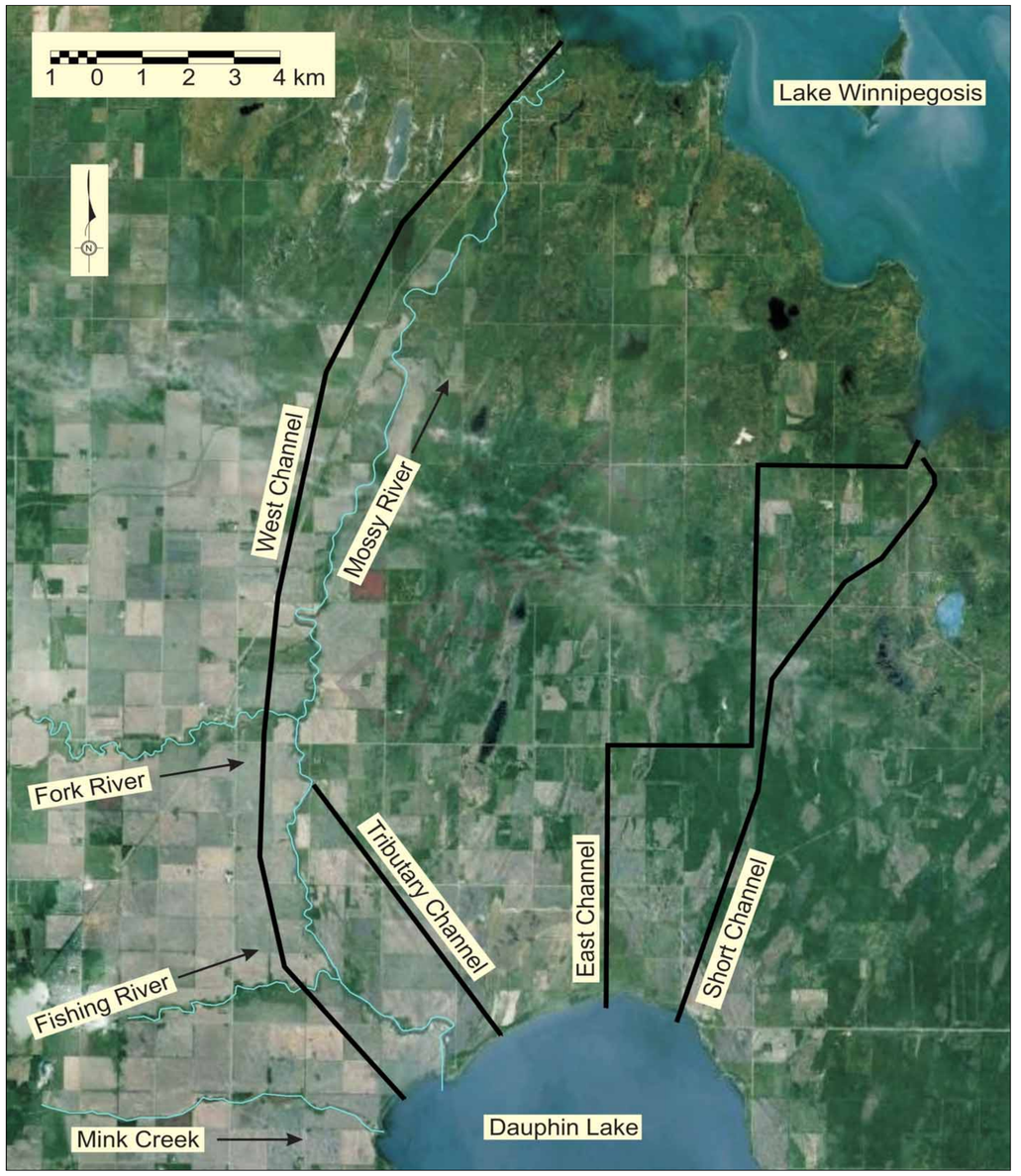
Notes:

- Assiniboine River flows were assumed to equal recorded flows after June 1 of each year.
- There would be additional benefits if flows on the Red River are below normal.
- Simulations assumes a 34,000 cfs Portage Diversion capacity.

DAUPHIN LAKE

Auxiliary Outlet Channel Options

- The peak water level of 861.1 ft on Dauphin Lake during the 2011 flood was the highest on record.
- The 2011 flood event was estimated to have a return period of 1:110 year.
- The second highest peak on record occurred in 2014 at approximately 859.7 ft.
- The study evaluated four auxiliary outlet channel options to lower Dauphin Lake levels in times of flood.



Option	Approximate Length	Approximate Width	Estimated Cost	Estimated Water Level Reduction in 2011
West Channel	27.2 km	30 m	$ 260 Million	2 ft to 2.5 ft
Tributary Channel	7.1 km	30 m	$ 80 Million	2 ft to 2.5 ft
East Channel	19.6 km	30 m	$ 190 Million	2 ft to 2.5 ft
Short Channel	14.7 km	30 m	$ 120 Million	2 ft to 2.5 ft
Short Channel	14.7 km	60 m	$ 225 Million	6 ft to 6.5 ft

DAUPHIN LAKE

Other Options to Lower Lake Levels

The study also considered:

- River channel improvements:
  - Requires the excavation of one foot to three and a half feet in the upper 12 to 15 kilometres reach of the river.
  - Preliminary cost estimates ranged between $14 Million to $50 Million.
  - Water level reduction in a repeat 2011 flood event would be one to two feet.
  - This option has significant environmental impacts such as the destruction and alteration to fish habitat.

- Storage development opportunities in watershed:
  - Over 33 dams on the scale of the Pleasant Valley Dam or 156 dams on the scale of the Vermillion Dam are necessary to reduce water levels by about two feet during a 2011 type flood.
  - This total number of structures is impractical.
  - The total volume of water stored with a lesser number of structures would be insignificant.

- Sediment deposition in the lake:
  - Sediment measurements in the 1990's showed a very slow rate of infill.
  - It would take centuries before the quantity of sediments deposited in the lake would affect the passage of floods.

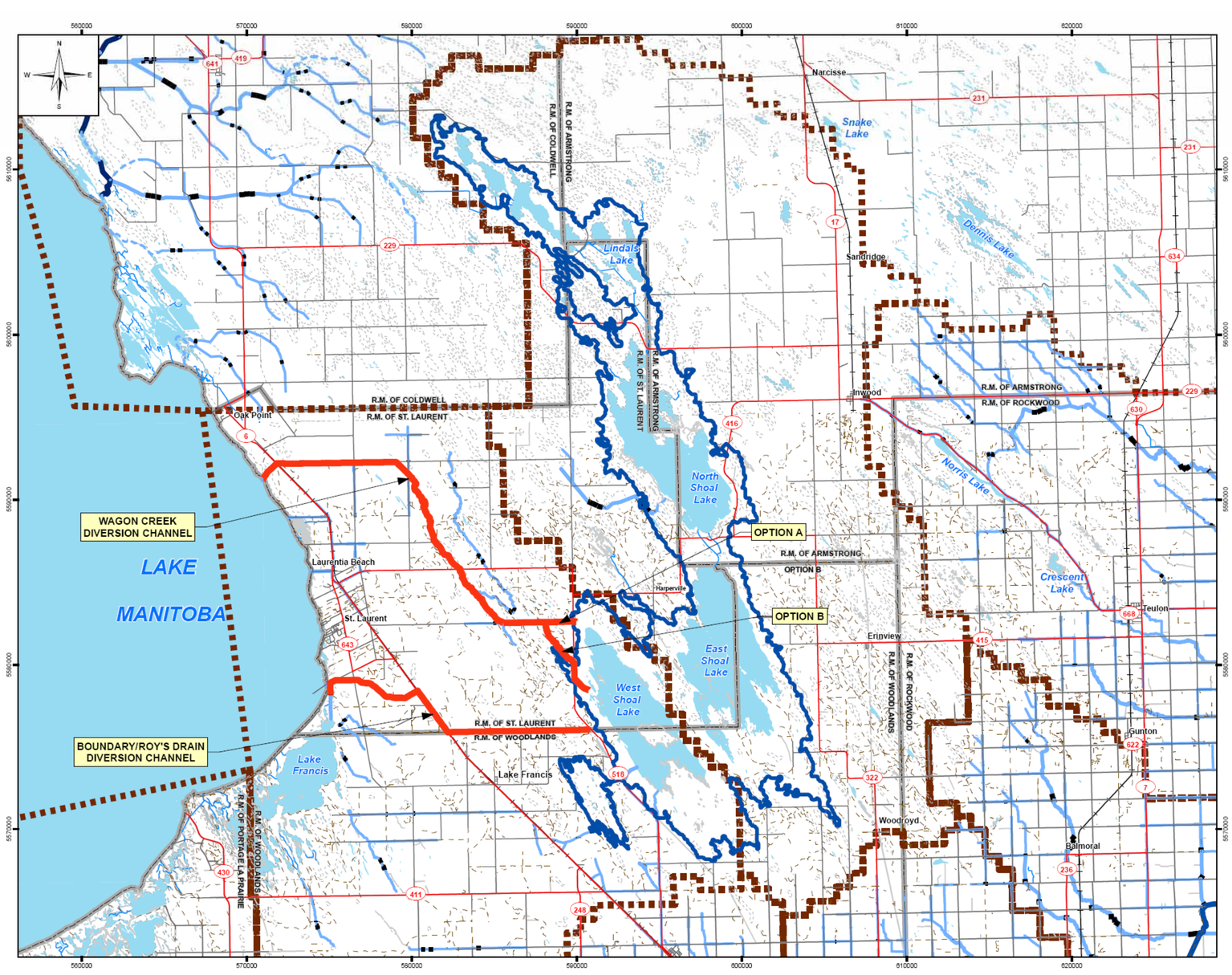
This study has concluded :

- Options investigated are not cost effective and have negative environmental impacts.
- Protection to the highest flood on record through Individual Flood Proofing and Development Controls is the best solution.

SHOAL LAKES

Flood Mitigation in the Shoal Lakes

- Flood mitigation alternatives to address flooding issues within the Shoal Lakes Watershed were previously studied in 2008 to 2010.
- Three options were considered at the time (2009 dollars):
  - Diversion / outlet channel ~ $25 Million – $30 Million.
  - Upland storage ~ $5 Million.
  - Purchase of flood prone lands ~ $11 Million.
- The most attractive option from an economic perspective was the purchase of flood prone lands, which is being pursued by the province. The original study identified approximately 16,900 hectares of land to be purchased, from 117 different property owners.



DEVELOPMENT CONTROLS

- Development controls were considered as a means to restrict future development in a Designated Flood Area (DFA).

- With proper planning, a DFA can effectively limit flood damages that could occur in new developments in flood prone areas. However, it does not address vulnerabilities of pre-existing infrastructure and can also affect growth in existing communities. The impacts of a DFA on future development will vary depending on:
  - Location.
  - Current level of flood protection.
  - Extents of the DFA .

- Currently, only two areas of the province have a legislated DFA:
  1. Red River Valley – all development must be protected to 1997 flood plus two feet.
  2. Red River north of Winnipeg – all development must be at or above the recorded high water level plus two feet (varies between 1997 flood and ice-affected floods).

- The target Flood Protection Level varies by location across the province and is based on the following criteria:
  - The 1:200 year event, recommended by the 2011 Manitoba Flood Review Task Force, which is greater than the previous 1:100 year standard.
  - The highest flood on record, or
  - A higher flood event that can be justified in an economic analysis that considers costs and benefits.

- Where there is no DFA, Planning Districts and Municipalities have the authority to require that developments are flood protected. This authority should be more rigorously enforced.

- Lower Assiniboine River and Lake Manitoba are areas where DFA’s should be considered.

WETLAND RESTORATION

- Analysis and literature review of over 40 documents was completed.

- Report by Dr. John Pomeroy: *Enhancements and Testing of the Prairie Hydrological Model* was released in the spring of 2014.
  - The study was based on the Smith Creek watershed, which is about 460 km^2 (the Assiniboine River Basin at Portage is about 160,000 km^2).
  - Indicates the impact of wetlands on peaks and volumes is also significant for major, large floods.
  - This finding for major, large floods is contrary to the conclusion of the majority of previous studies.

- General findings on wetland loss (pre Pomeroy):
  - No significant increase in peaks of major floods.
  - Increased peaks and total runoff volumes for moderate floods.

- A basin assessment was conducted to determine effects of wetland restoration using information from the Pomeroy Study:
  - For a repeat 2011 flood, a 15% restoration of wetlands could result in a peak flow reduction of approximately 30% at Portage la Prairie.
  - The estimated cost to restore 15% of wetlands is $1.5 Billion.

- Large scale wetland restoration is therefore not cost effective as a mitigation option. However smaller scale projects could be pursued as they arise.

- Manitoba's Surface Water Management Strategy endorses "no net loss" in wetlands and encourages water retention.

SHARING YOUR PERSPECTIVES

The project team would like to know your thoughts based on the information that has been shared here today.

Your input/feedback will help us as we proceed with finalization of the report by the spring of 2015.

- Comment forms are available for you to fill out.

- Forms can also be submitted electronically or by mail, so long as they are received before January 10, 2015.

- Details are provided on the comment form. Please ask a project team member to help you if you have any questions.

Contact information: feedback@floodstudy.ca

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THANK YOU!