2018

Drumheller Flood Mitigation and Climate Change Adaptation System

INVESTING IN CANADA INFRASTRUCTURE PROGRAM (ICIP)
EXPRESSION OF INTEREST - APPENDICES

GOVERNMENT OF ALBERTA

MORRIS THE MIKE-A-SAURUS

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MORRIS THE HIKE-A-SAURUS

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The Story: Protecting the Dinosaur Capital of the World from the Impacts of Climate Change – Drumheller, Alberta

What at first seems like just another infrastructure funding application turns out to have the makings of the great summer 2018 blockbuster. To set the scene, think "Night at the Museum" meets "Jurassic World" meets "The Day After Tomorrow."

On the surface, the Drumheller Flood Mitigation and Climate Change Adaptation System is about building a dyke to save a town of 8,000 in the heart of the Canadian Badlands, but dig a little deeper and you will see that this is about a small town with a big heart that continuously experiences significant flooding, and it's only a matter of time before the next big one hits. With the changing climate, this is not a question of "if?" but rather, "when?" and "how big?"

Senator Grant Mitchell, Deputy Chair of the Senate's Committee on Energy, the Environment and Natural Resources recognizes that "climate change is real in Canada and Drumheller is evidence of this. We need to fix this community, so it no longer experiences flooding."

Settled over 100 years ago by hardy miners from across the globe, Drumheller's residents have seen adversity from mother nature and the economy. Coal was king until the mid 1940s and the Leduc oil discovery. Drumheller spent the 1950s and early 60s fighting to gain back their economy and also against continuous flooding. The 1960s saw the federal government open the Drumheller penitentiary, which this year celebrated 50 years. To keep the community strong in the 1980s, the provincial government completed the Dickson Dam that principally provides storage for drought protection and plays as a minor role in flood mitigation. The past two decades have seen Drumheller challenged with rising waters, ice jams and storms with declarations of a State of Local Emergency to combat rising floodwaters. Drumheller residents are resilient, tough, and they make their own luck. Right now, in the face of a changing climate, they need a hand from Alberta and Canada

Maybe you are asking, why do people live in such an area? How do people live like that? It's simple. They are the guardians of Canada's ecological wonder of the world, a paleontologist's dream and the dinosaur capital of the world. They know this is about more than their beloved town of Drumheller, saving their homes and businesses and protecting their families from financial ruin and physical harm. Like Albertan's do, time and time again, they've pulled themselves up by their boot straps, made their own luck and relied on the good will and assistance of neighbors. Together they have survived the floods of 2005 and 2013 but they know this is bigger than them and it's even bigger than their neighbours. This effort is going to require the heroes from the federal government to step in and invest in a vision where all levels of government work

together to create a unique and powerful solution that will not only save this endangered community but all that it has to offer the world. In fact, with this project, that offering continues to expand. For so many years, Drumheller has been the place where people come to learn about Canada's paleontological past and its rich coal mining history. In the future, when they come, they will learn about what it is like to live in a flood plain. You see, the intent is to use this much needed and appreciated grant funding to build a climate adaptable dyke system along a 40 km stretch of the Town of Drumheller in the Red Deer River Basin and augment existing dykes so that the entire system is built to the current standard but can also be enhanced to meet future requirements if necessary due to climate change. Additionally, the project will make room for the river to flow as nature intended by removing structures and returning riparian areas to their former state and preserving them as such.

Another dyke you say? We were looking for something a little different and innovative. Where is the forward-thinking here? Wait. The dyke is the oyster and here is the pearl. The new infrastructure will feed into the Canadian Badlands Trail system creating an additional amenity and educational opportunity for the thousands of people who visit Drumheller every year. Yes, as their letter of support suggests, 450,000 people visit the Royal Tyrrell Museum every year from across Canada and 140 different countries. What a golden opportunity to educate a captive audience of thousands about critical flood mitigation and climate change information. Fun fact, this idea builds on a long-standing tradition of interpretive trails with town mascot, Morris the Hike-asaurus, guiding people along the much-travelled Dinosaur Trail built as part of the federal government's initiative to connect communities across Canada. Once again, this legacy project has the opportunity to connect Canadians. This initiative far transcends Drumheller and makes this so much more than an infrastructure program that will ensure Drumheller is protected from escalating flood risk due to climate change. It is also about creating a resilient citizenry. Let Drumheller be where the world comes to experience Canada's rich history and to prepare itself for the future.

Now here are some additional facts to support the making of a positive ending to this real like blockbuster:

- The objective is to formulate a permanent plan to reduce existing flood damage potential. Funding for the construction and improvement of dykes will provide greater protection to this community and improve public safety. This proactive investment will reduce recovery costs and minimize the requirements for Federal Disaster Financial Assistance and the Provincial Disaster Recovery Program.
- The Town of Drumheller consists of several unique communities along the Red Deer River and they have experienced significant flooding in both 2005 and 2013 that resulted in declaring States of Local Emergency. An ice jam flood in Spring of 2018 also resulted in the declaration of a State of Local Emergency.
- As demonstrated in the Drumheller Flood Mitigation Climate Change Assessment attached to this application, flooding in the area is expected to become more

frequent with increasing temperatures, increasing amounts of precipitation, and increasing risk of extreme climates as a result of warmer temperatures, flooding in the area is indeed affected by climate change and it is expected that flooding in the area will become more frequent.

- This community is home to the Royal Tyrrell Museum, Canada's only Museum dedicated exclusively to the science of paleontology. Every time this area is faced with potential flooding this archeological landscape is at risk making this a project of national importance.
- This transcendent importance is well known in the region. While neighbouring communities have not been directly impacted by historic flooding events they have always been an integral part of mitigation efforts and have been integrated into the plan.
- A comprehensive stakeholder engagement plan has been developed including proactive dialogue with Indigenous officials and elders to ensure meaningful cultural elements are incorporated into the trail system where possible.
- While dinosaurs put Drumheller on the map, the town is also home to a medium security prison, the Drumheller Institution. In a flooding situation, peace officers change from uniform to work gear to assist in flood protection measures which creates issues in the community which will be avoided in the future. In so many ways, investing in efforts such as the Drumheller Flood Mitigation and Resiliency Program pays off in spades. It not only saves governments from costly repairs down the road it decreases the risk of serious unforeseen consequences.

Valleys are special places. Not only do they bring people closer because they are held together by this geographic phenomenon, but they hold the history of the land like a book. The Drumheller Valley tells a story of a tropical zone roamed by incredible dinosaurs leaving behind a treasure trove of fossils and coal deposits that powered the economy for many years. Today, it tells a story of flood mitigation and a hardy people that come together to ensure survival. Tomorrow, with the federal government's assistance, it will tell the story of flood resiliency and how a nation invested in the future by preserving the story of the past.

Drumheller is at a crossroads. Climate changes makes the next flood inevitable and the time to prepare is now. It is going to take all levels of government to make this happen. As Gilbert White says, "Floods are 'acts of God,' but flood losses are largely acts of man." In this case, the potential losses are too high and will be felt by all Canadians for generations to come. The federal government has a prime opportunity to help create a positive ending to this epic story.

Chapter X
Floods and Bridges in General

1948, Midland C.N.R. bridge during flooding of the Red Deer River on April 21.

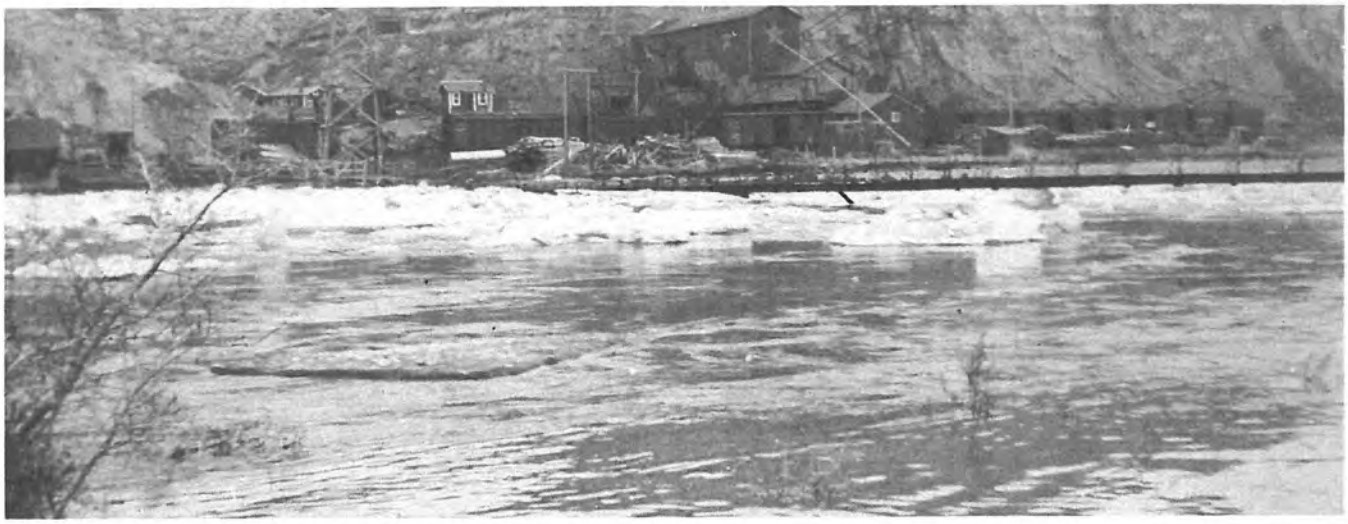
April 21, 1948, the Rosedale C.N.R. bridge across the Red Deer River flooded.

The old Drumheller traffic bridge.

April 21, 1948, another view of the flooded Rosebud Creek at Rosedale.

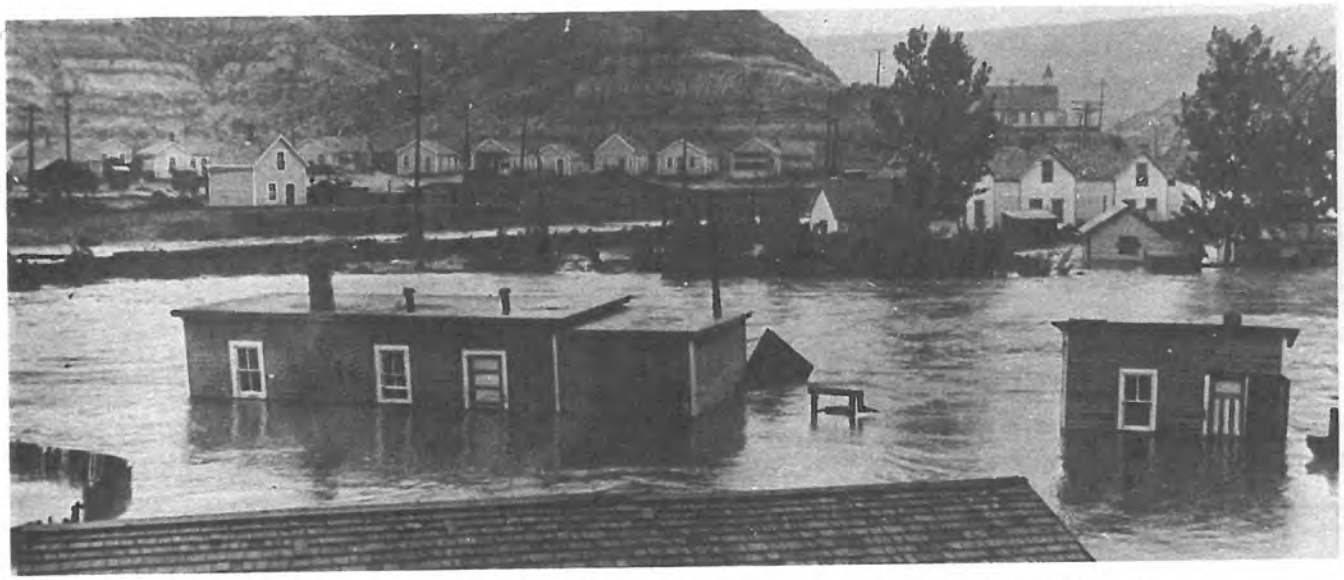
April 21, 1948, the old traffic bridge across the Rosebud Creek in Rosedale was flooded over by back up water from the flooded Red Deer River.

How the flooded Red Deer River flooded the whole town of Aerial.



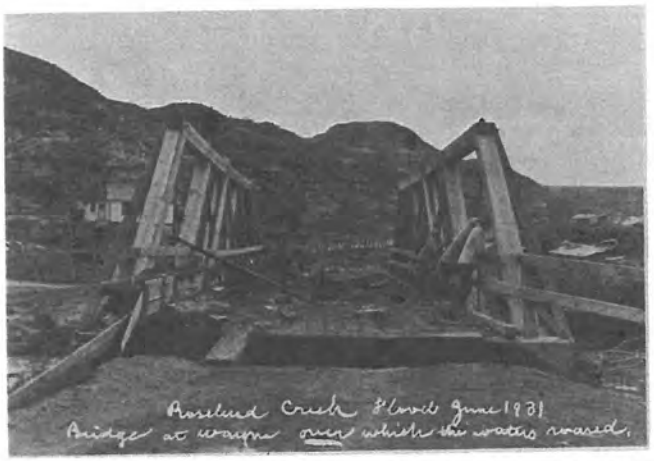
April 21, 1948, the Red Deer River took out the Pedway suspended bridge. It has now been rebuilt and is now called the "Suspension"/"Swinging" Bridge at Aerial.

April 21, 1948, flooding in Rosedale



June 1931, flooding of the Jewel mining camp by the Rosebud Creek. (Credit: Provincial Archives of Alberta)

Flash flood from the June 1931 cloud burst in Wayne. (Credit: Provincial Archives of Alberta)



June 1931, the aftermath of a cloud burst and the Rosebud Creek on the traffic bridge in the Commercial Camp area of Wayne, Alberta. (Credit: Provincial Archives of Alberta)

June 1931, the other bridges in Wayne in the Commercial business area taken out in a flash flood. (Credit: Provincial Archives of Alberta)

June 1931, the "Chicken Coop" flooded by flash flood when a cloud burst over Wayne. (Credit: Provincial Archives of Alberta)

A view of the C.P.R. bridge in Cambria. It was built in 1928 and is still there in 1988 although there is no rail leading to the bridge or away from it now.

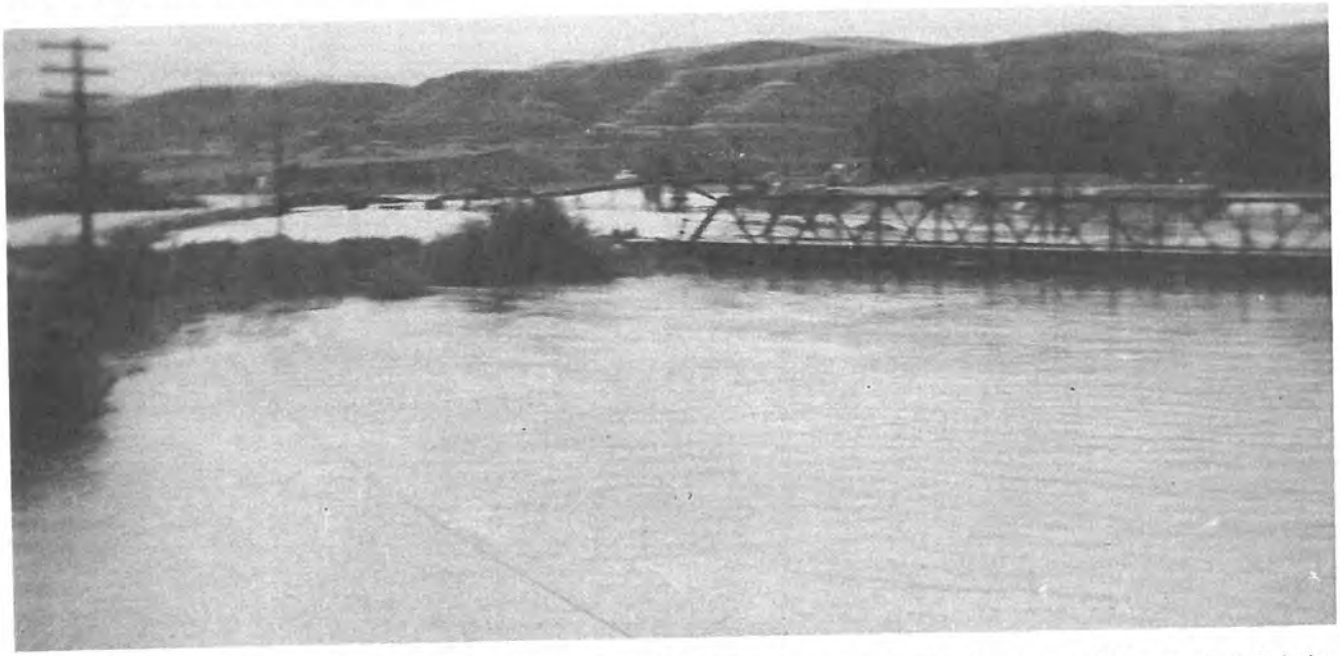
June 1931, Mr. Baker's vehicle caught in the flash flood at Wayne (Credit: Provincial Archives of Alberta)

June 1931, pulling the Baker vehicle out of the Rosebud Creek at Wayne. (Credit: Provincial Archives of Alberta)

A view of the old traffic bridge (it is now at Dorothy) and the C.P.R. birdge at Cambria. (Credit: Vogue Studio)

A view of the old traffic bridge in Cambria when it was completed in 1948. (Credit: Vogue Studio)

Wayne Camp flooded in June 1931.



A view downstream from the Cambria C.P.R. bridge of the old traffic bridge and the new one in the distance which is being built.

April 21, 1948, a view of the "Lehigh Cut" during the famous big flood of the Red Deer River. When the "Lehigh Cut" became flooded over, it isolated East Coulee from the rest of the Valley.

April 21, 1948, the west end of East Coulee is flooded.

April 21, 1948, flooding at the east end of East Coulee.

April 21, 1948, another view of the flooding at the east end of East Coulee.

April 21, 1948, the C.P.R. pump house at East Coulee is undermined by the flood waters and ready to topple over.

1936, this is how the East Coulee C.P.R. bridge looked like after it was built.

April 21, 1948, this wooden pier of the third span of the East Coulee C.P.R. bridge is starting to lose its metal plate protection from the damaging effects of the ice floes. The side metal plate is already gone, only the "V" shaped point is left remaining. Note: The piers were originally constructed of wooden pilings with a wooden framework around them. The centre area was filled with rocks as can be seen.

2005 Floods:

2013 Floods:

Hon. Kevin Sorenson, M.P.

Battle River - Crowfoot

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Mayor Heather Colberg
224 Centre Street
Drumheller AB
T0J 0Y4

HColberg@dinosaurvalley.com

Dear Heather,

As the Member of Parliament for Battle River-Crowfoot, I have too often witnessed the devastating, often yearly, flooding of the town of Drumheller. I have been the MP for this community since 2000 and can attest to the struggles Drumheller faces when their current system fails and the town is flooded.

I am writing this letter to support your efforts in securing funding from the Disaster Mitigation and Adaption Fund (DMAF). The development of a comprehensive flood mitigation strategy and resiliency plan is greatly needed.

As home to the Royal Tyrrell Museum, Canada's only museum dedicated exclusively to the science of paleontology, this area is unique and must be protected.

Funding for the construction and improvement of dykes will provide greater protection to this community and improve public safety. This proactive investment will reduce recovery costs and minimize the need of future use of the Disaster Financial Assistance Arrangement.

Let me know if there is anything further I can do to assist with your application.

Sincerely,

Hon. Kevin Sorenson, MP
Battle River - Crowfoot

Legislative Assembly of Alberta

July 23rd, 2018

Drumheller Disaster Mitigation Adaption Funding

Attention: Mayor, Heather Colberg

Your worship, I'm writing this letter of support for your submission to the Disaster Mitigation Adaption Fund (DMAF).

Flooding from the Red Deer River is a recurring safety hazard facing Drumheller since the early 1900's. With the construction of the Dickson Dam in 1984, upstream of Drumheller, the Government of Alberta built dykes in Drumheller to improve flood protection, but the originally planned extent of the dykes was never completed. This initiative will complete the dyke system and will allow it to function as it was originally intended to. Recently, Drumheller faced severe flooding, resulting in declarations of States of Local Emergencies in 2005, 2013 and once again this spring in 2018.

The DMAF application that will implement a long awaited comprehensive flood mitigation strategy and construction of dykes along 40 km of the Red Deer River is greatly needed.

As your MLA, I applaud the efforts of Drumheller for your continuous proactive efforts with your emergency response plans and resiliency efforts to improve the protection of your community.

Sincerely,

Rick Strankman, MLA
Drumheller Stettler

Drumheller Stettler Constituency Office, Box 1929, Drumheller, Ab, T0J 0Y0

Correctional Service Canada | Service correctionnel Canada
Prairie Region | Région des Prairies

Your file | Votre référence

2018-07-25

Our file | Notre référence

Mayor Colberg
Town of Drumheller

Dear Ms. Colberg

Drumheller Institution is writing this letter of support for your submission to the Disaster Mitigation Adaption Fund (DMAF) to the Federal Government for Drumheller's flood mitigation and resiliency program.

As the largest Federal employer in Drumheller, we are concerned annually with the potential flooding that may occur in Drumheller. While the institution is not in the flood plain, our concern every spring is whether our employees may need to evacuate due to flooding.

The Institution houses approximately 700 inmates, so our business continuity plans are extensive to mitigate employee absenteeism from flooding. When Drumheller declares a State of Local emergency, our employees are at risk of being evacuated. This impedes on our ability to operate the Institution and replacement staff are not readily available.

We applaud the efforts of Drumheller for their continuous proactive efforts to protect our community during a flood.

This application, if approved will make a significant change to the lives of our residents. I wish you luck with the process and let us know if there is anything else, we can do to assist.

Yours truly,

Pattie Krafchuk

Pattie Krafchuk
Warden
Drumheller Institution

Alberta Culture and Tourism

Heritage Division
Royal Tyrrell Museum of Palaeontology
Box 7500
Drumheller, Alberta T0J 0Y0
Canada
Telephone 403-820-6231
www.alberta.ca

July 25, 2018

Mayor Heather Colberg
Town of Drumheller
224 Centre Street
Drumheller, AB T0J 0Y4

Subject: Disaster Mitigation Adaptation Fund (DMAF)

Dear Mayor Colberg:

This letter is in support of the Town of Drumheller's flood mitigation and resiliency program and its application to the Canadian Government's Disaster Mitigation Adaptation Fund (DMAF).

Situated in the dramatic Alberta badlands, the Royal Tyrrell Museum of Palaeontology welcomes over 450,000 visitors annually from more than 140 countries to discover the province's palaeontological past. As a major tourism destination in Alberta, and in Canada, the Museum also employs over 120 year-round staff, with an additional 40 to 50 individuals in the summer months, all of whom live primarily in Drumheller.

With an economic impact in the tens-of-millions of dollars, it is critical that visitors and staff have safe, and easy, access to the Museum. This access includes travelling through Drumheller's flood plains and traversing the one bridge that connects the Museum to a major highway and the downtown core.

Through the years, and through several floods, the Museum has commended the Town of Drumheller in its efforts to mitigate the impact of rising river waters on the community and visitors. However, each new flood brings greater risk and it is imperative for the Town to work towards a more reliable flood control system.

It is the Museum's hope that should this application be approved that the Town of Drumheller will be able to use the funds to successfully provide a flood mitigation and resiliency program that ensures the safety of the community and visitors.

Yours truly,

...on behalf of...
Andrew Neuman
Executive Director
Royal Tyrrell Museum of Palaeontology

CANALTA

July 24, 2018

Mayor Heather Colberg
Town of Drumheller
703 – 2nd Avenue, West
Drumheller, Alberta
T0J 0Y3

Dear Mayor Colberg:

Re:- Disaster Mitigation Adaption Fund

We are writing this letter of support for your submission to the Disaster Mitigation Adaption Fund (DMAF) to the Federal Government for Drumheller's flood mitigation and resiliency program.

As one of the largest employers in Drumheller, with our corporate head office located in the community, we are concerned annually with the potential flooding that may occur. As a major hotel operator, we have often opened our doors as a reception center for residents and housed volunteers assisting with the response efforts from neighboring communities. We were also the first hotel to open the doors during the 2013 High River response efforts to provincial first responders.

During a flood event we are concerned with the well-being of our own employees. When Drumheller declares a State of Local emergency, our employees are at risk of being evacuated. This impedes on our ability to operate our business.

We applaud the efforts of the Town of Drumheller for their continuous, proactive efforts to protect our community during a flood however, it is time to permanently fix this problem. This application, if approved, will make a significant change to the lives of our employees. Good luck with the process and let us know if there is anything else we can do to assist.

If you require anything further, please do not hesitate to contact me at (403) 820-6268 (direct phone); (403) 820-6269 (direct fax) or blair@canalta.com (email).

Sincerely,

CANALTA

Per:

Blair Christianson
Vice-President

545 Highway 10 East
Box 2109 Drumheller, Alberta T0J 0Y0
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F 403 / 823 2039

ALBERTA
TOURISM, PARKS AND RECREATION

Office of the Minister
MLA, Vermilion-Lloydminster

March 17, 2014

His Worship Terry Yemen
Mayor
Town of Drumheller
703 – 2 Avenue West
Lethbridge, AB T0J 0Y3

Dear ~~Mayor Yemen~~, Terry -

Thank you for your March 6, 2014 email regarding the status of decisions for flood mitigation for the Town of Drumheller.

I commend your interest in keeping residents informed on the steps being taken to mitigate against future floods. For those Albertans still recovering from the impacts of the June disaster, the fears and anxiety they are experiencing as the spring melt and rain season approaches is understandable. I can assure you there is a great deal of work underway by our government to better prepare and lessen the impacts of future floods on Alberta's communities and people. I have discussed current status of Drumheller's mitigation plan with my colleague, Honourable Ken Hughes, Minister of Municipal Affairs, and I am pleased to provide the following update.

We greatly appreciate that the initial mitigation proposals from the Town of Drumheller were submitted in such a timely manner. This comprehensive plan has given our government full confidence in the exemption from our floodway policies that has been provided to the Town, and it has enabled us to work closely with your administration to finalize the technical details of the proposed mitigation measures.

The ongoing discussions with the Town, the Flood Recovery Task Force and their consultants (Stantec) have been extremely helpful in clarifying potential impacts of the Town's proposed measures on the entire watershed, as well as identifying those areas of the Town where additional discussion and consideration need to take place.

The engineering consultants' reports and recommendations for all watersheds, including Stantec's, are due to the Flood Recovery Task Force by March 31, 2014. It is expected that our government will make decisions on the overall recommendations within a month of that date. As the Town of Drumheller has already submitted a detailed plan, and the consultants' overall report is being assembled with that plan in mind, we anticipate that specific project approvals for the Town will follow very quickly afterward.

In the meantime, if there are urgent measures that need to be put in place for this spring, such as erosion control measures or the stockpiling of emergency readiness supplies, I urge you to communicate these needs to the Flood Recovery Task Force as soon as possible. Funding is available to address these immediate spring readiness priorities in advance of the full implementation of the mitigation plan, which will occur over a longer period of time.

.../2

229 Legislature Building, Edmonton, Alberta T5K 2B6 Canada Telephone 780-427-4928 Fax 780-427-0188
5036 - 49 Avenue, Vermilion, Alberta T9X 1B7 Canada Telephone 780-853-4202 Fax 780-853-5770
3907 - 51 Avenue, Lloydminster, Alberta T9V 2Z2 Canada Telephone 780-875-0467 Fax 780-875-0871

It is critically important that we continue to work together to communicate with residents about short-term spring readiness measures, as well as our longer term mitigation plans. In addition to our mainstream communications efforts that include advisories, warnings, online updates, print ads, media interviews, etc., one important outreach initiative is our community information sessions. Departmental experts from Environment and Sustainable Resource Development, the Alberta Emergency Management Agency, the Flood Recovery Task Force, and the Disaster Recovery Program have been in attendance at each session to provide reassurance that mitigation efforts are occurring at the regional and local levels, and to answer questions about spring melt, river forecasting and emergency preparedness. We have heard very positive feedback about the session held in Drumheller on March 12, 2014. An even more heavily targeted communications plan for municipalities in flood impacted areas like Drumheller is being prepared. Your ideas and suggestions on the best ways to reach your area residents about spring readiness and mitigation are most welcome.

While media reports are an important way to receive information, you are encouraged to work closely with the Honourable Greg Weadick, Associate Minister of Regional Recovery and Reconstruction for the Southeast, and Minister Hughes, as face-to-face communication between our respective governments is often the best way to exchange ideas and information. I am very pleased you reached out to me as I enjoy our good working relationship.

Since the June 2013 floods, our government has been focused on the recovery of Albertans and our province. This focus is renewed and reinforced through Budget 2014. The budget provides $1.1 billion in operational expense and capital spending over the next three years to address flood recovery and mitigation initiatives, with $518 million coming next year alone. These initiatives and others build on nearly $3.8 billion approved for flood recovery in 2013.

Thank you again for contacting me with your concerns. By working together, I am confident we can continue building an Alberta that is as resilient as its people.

Best Regards,

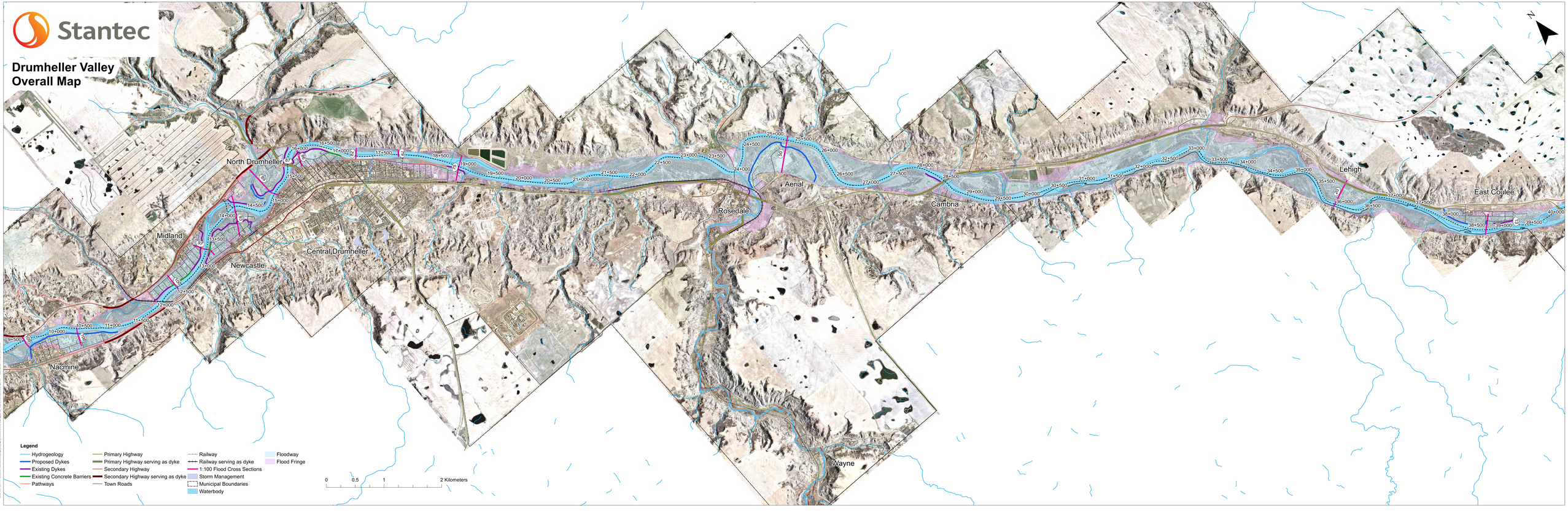
Dr. Richard Starke
Minister

cc: Honourable Ken Hughes
Minister of Municipal Affairs

Honourable Robin Campbell
Minister of Environment and Sustainable Resource Development

Honourable Greg Weadick
Associate Minister of Regional Recovery and Reconstruction for the Southeast

Drumheller Valley
Overall Map



Legend

- Hydrogeology
- Proposed Dykes
- Existing Dykes
- Existing Concrete Barriers
- Pathways
- Primary Highway
- Primary Highway serving as dyke
- Secondary Highway
- Secondary Highway serving as dyke
- Town Roads
- Railway
- Railway serving as dyke
- 1:100 Flood Cross Sections
- Storm Management
- Municipal Boundaries
- Waterbody
- Floodway
- Flood Fringe

Drumheller Flood Mitigation Climate Change Assessment for DMAF Application

Prepared for:
Town of Drumheller

Prepared by:
Stantec Consulting Ltd.

DRAFT

July 27, 2018

Table of Contents

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by the Town of Drumheller to assist in their application to Infrastructure Canada's Disaster Mitigation and Adaptation Fund (DMAF) to improve its flood protection infrastructure in the context of increasing extreme weather events and future climate uncertainty. This report has been completed to meet the objectives outlined in the Guide (see: http://www.infrastructure.gc.ca/alt-format/pdf/dmaf-faac/DMAF-Applicant's-Guide.pdf), which indicates:

> "The Hazard Risk Assessment (details in Annex E)
>
> Applicants are required to confirm the data source and type for hazard risk indicators as per section H.1.For the main hazard in an affected area, Applicants must provide two risk assessments:
>
> 1. Current Risk Assessment (e.g., the identified hazard impacts on the identified area, before the DMAF project is completed); and
> 2. Future Risk Assessment (e.g., the identified hazard impacts on the identified area, after the DMAF project is completed to demonstrate the expected improvement in resilience after project completion).
>
> Applicants must demonstrate how the proposed project will reduce the identified natural hazard risks on the identified area. Consideration of climate change impacts and the asset vulnerabilities must also be included in each of the two risk assessments."

In the context to this DMAF application, the focus of this report is on the potential impacts on the existing physical assets. When applicable, risks related to service disruptions are included.

2.0 LIMITATIONS

The analysis and recommendations in this assessment are based on information available within the timeline and scope of this project, and on the author's experience with the application of Engineers Canada's Public Infrastructure Engineering Vulnerability Committee (PIEVC) vulnerability and risk assessment tool - the PIEVC Protocol. This report does not constitute a comprehensive PIEVC Protocol assessment of the existing or proposed assets in the DMAF Application. However, the process used for this assessment is aligned and compatible with the PIEVC Protocol methodology as described in Section 4 of the report.

The focus of the assessment presented in this report is on the existing and proposed physical assets proposed in the DMAF Application and does not consider other elements (such as third-party goods or services suppliers, personnel, and administration, etc.) that are usually included in a PIEVC Protocol study. A review of this assessment possibly leading to a more in-depth analysis

will be required at the pre-design or design stages of the proposed flood protection assets improvements or new assets.

Climate data and trends – current and future projections – used in this study were obtained from published literature, Environment Canada weather station data, and from the Risk Sciences International (RSI) climate data portal (CCHIP). Cross-verification between climate information sources was conducted to identify possible discrepancies between the data sources used.

Information regarding the impacts of past climate events for the Town Drumheller was obtained from past reports. Stantec did not conduct inspections or review incident reports to validate this information.

3.0 GENERAL CLIMATE PROFILE

3.1 CURRENT CLIMATE OVERVIEW

The Drumheller climate is classified as BSk in the Köppen and Geiger system (B: dry climate characterized by little rain and a huge daily temperature range; S: semiarid or steppe; k: dry-cold with a mean annual temperature under 18°C). The average annual rainfall (based on 1981 to 2010 records) is 301.71 mm; the average annual snowfall is 70.5 cm.

Figure 1[1] illustrates the temperature normal for Drumheller; Figure 2[2] shows the precipitation normals.

[1] Source: https://www.theweathernetwork.com/forecasts/statistics/summary/cl30221lg/caab0097 accessed July 15, accessed July 15, 2018

[2] Source: Environment Canada Drumheller Andrew weather station, http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=drumheller&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=2078&dispBack=1 accessed July 15, 2018

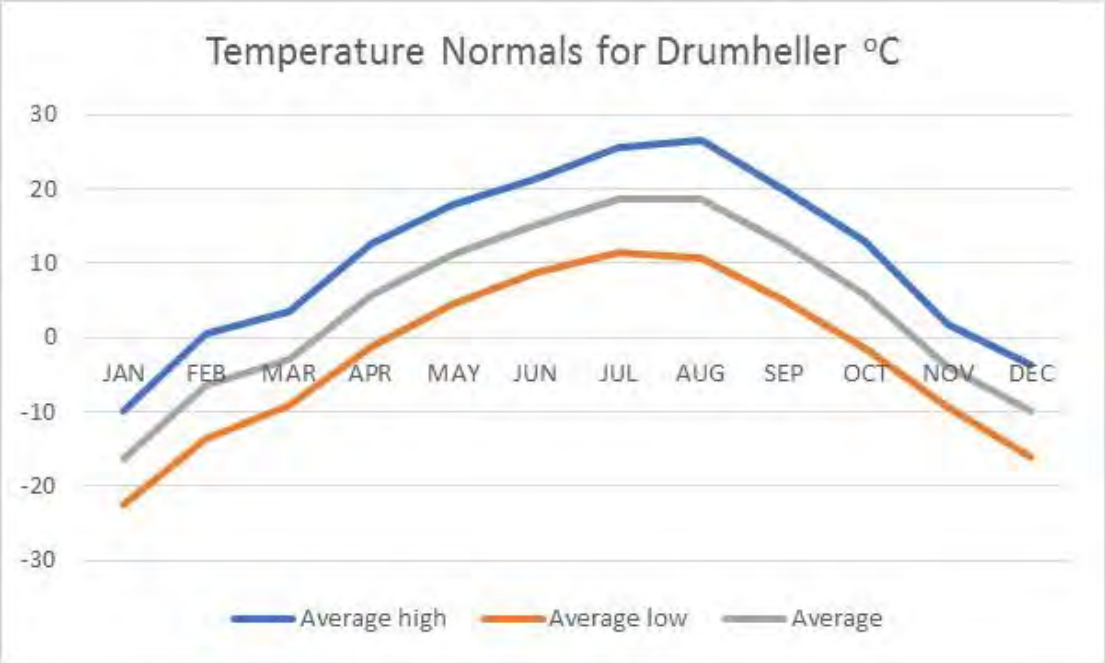


Figure 1: Temperature Normals for Drumheller (source: theweathernetwork.com)

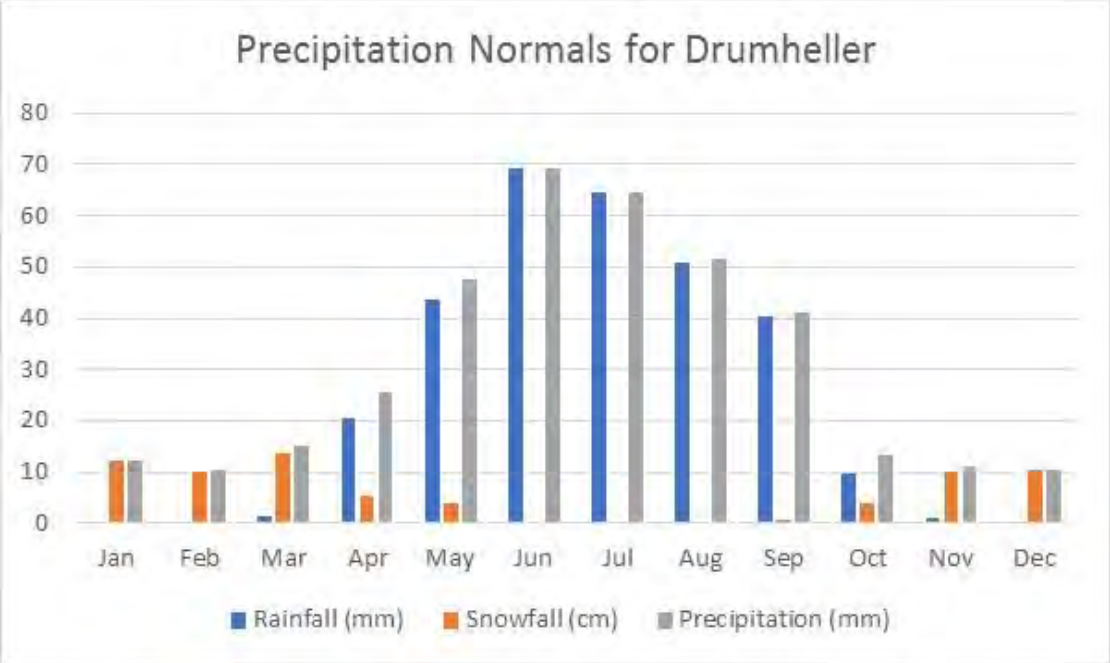


Figure 2: Precipitation Normals for Drumheller (source: theweathernetwork.com)

The area is prone to F0 and F1 tornados; Figure 3 below illustrates tornado records within a 50km radius of the Town

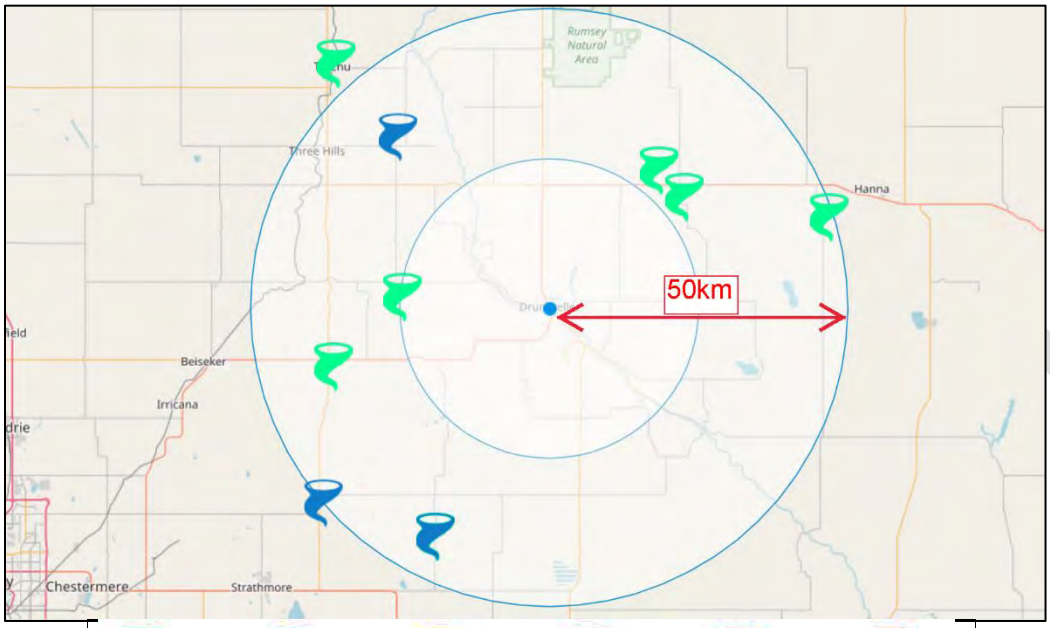


Figure 3: Recorded Tornadoes and Fujita Scale Rating. Canadian Tornado Database 1980-2009

3.2 CLIMATE TRENDS AND FUTURE CLIMATE PROJECTIONS

The figures below illustrate the mean seasonal temperature and precipitation trends for the region. Future projects are based on the Intergovernmental Panel on Climate Change (IPCC) RCP[3] 8.5 scenario, which is characterized by increasing greenhouse gas emissions over time, representative of scenarios in the literature that lead to high greenhouse gas concentration levels[4]. The IPCC is the international body for assessing the science related to climate change.

[3] RCP: Representative Concentration Pathways – a greenhouse gas concentration (not emissions) trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC) for its fifth Assessment Report (AR5) in 2014.
[4] By comparison, RCP 4.5 is a stabilization scenario in which total radiative forcing is stabilized shortly after 2100 while RCP 2.6 emission pathway is representative of scenarios that lead to very low greenhouse gas concentration levels.

The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

IPCC assessments provide a scientific basis for governments at all levels to develop climate related policies, and they underlie negotiations at the UN Climate Conference – the United Nations Framework Convention on Climate Change (UNFCCC). The assessments are policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take.

Future climate projections were generated using Risk Sciences International (RSI) CCHIP Climate Data Portal. The detailed results of the climate data collection and analysis is provided in Appendix A.

Within Drumheller itself, an Environment Canada weather station collected data from 1974 to 1990; it was replaced by another station that collected data from 1995 to 2015. These stations however, did not have complete data with many years missing several days of data. There is a station about 13 km West of the town, with fairly complete data from 1954 to 2008 but it's location is out of the Red Deer River valley and thus has an elevation almost 100m higher than that of the town of Drumheller, making this a less than optimal station for representing the Town's climate (see Figure 4 below).

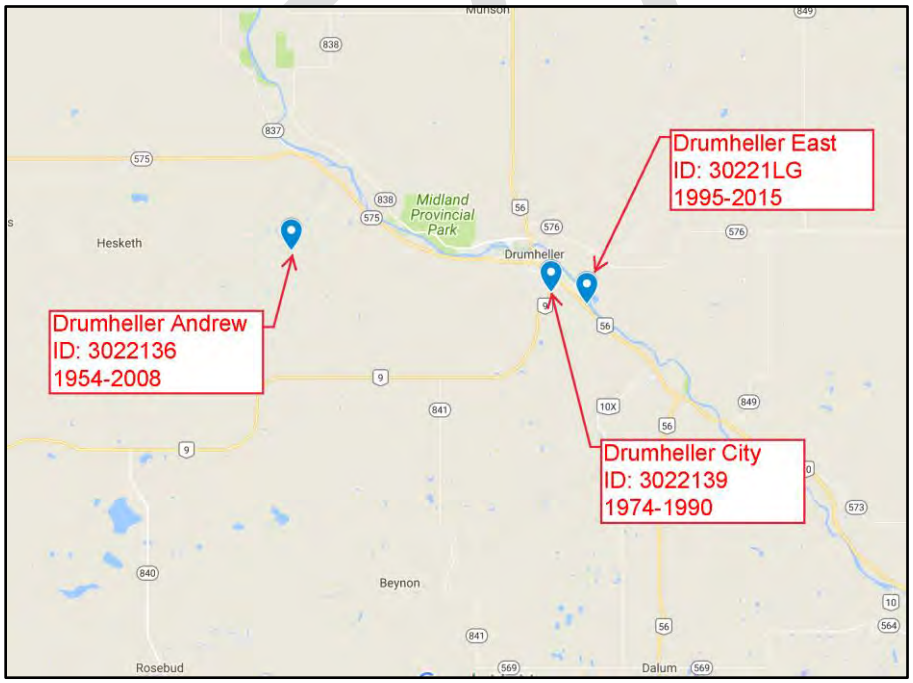


Figure 4: Location of Environment Canada Weather Stations

Climate data for these weather stations was obtained through the Climate Change Hazards Information Portal (CCHIP) created by Risk Sciences International (RSI). In addition to assembled climate data from weather stations, CCHIP also publishes data sets for the entire country, on a 10km by 10km grid – known as the CANGRD data. This gridded data was developed in a collaboration between Natural Resources Canada and Environment and Climate Change Canada (ECCC), and although data from a real weather station is preferable, this CANGRD is well accepted and researched. The CANGRD data is interpolated from stations in the Adjusted and Homogenized Canadian Climate Data group and thus can provide reasonable approximations for any point in Canada when historic data is not available. CANGRD data for the latitude and longitude of Drumheller were used for this climate profile of Drumheller.

Future climate projections were performed for the following 30-yr periods[5]:

- 2020s: 2011 to 2040
- 2050s: 2041 to 2070
- 2080s: 2071 to 2100

3.2.1 Temperature

The following Tables and Figures present a summary of the temperature trends and future projections for the Drumheller area.

Table 1: Average Change in Mean Temperature from Baseline

Average Change in Mean Temperature from 1981-2010 Baseline (°C)			
	RCP 8.5		
Season	2020s	2050s	2080s
Annual	1.3	3.1	5.3
Winter	1.6	3.6	6.0
Spring	1.3	2.8	4.6
Summer	1.3	3.1	5.5
Autumn	1.2	3.1	5.1

[5] The World Meteorological Organization (WMO) defines Climate as the statistical description in terms of the mean and variability of relevant quantities over a period of time; the classical period is 30 years.

Table 2: Average Change in Maximum Temperature from Baseline

Average Change in Maximum Temperature from 1981-2010 Baseline (°C)			
	RCP 8.5		
Season	2020s	2050s	2080s
Annual	1.3	3.0	5.1
Winter	1.4	3.1	5.2
Spring	1.2	2.7	4.5
Summer	1.3	3.3	5.8
Autumn	1.2	3.0	5.0

Table 3: Average Change in Minimum Temperature from Baseline

Average Change in Minimum Temperature from 1981-2010 Baseline (°C)			
	RCP 8.5		
Season	2020s	2050s	2080s
Annual	1.4	3.3	5.6
Winter	1.9	4.3	7.1
Spring	1.3	2.9	4.8
Summer	1.3	3.0	5.2
Autumn	1.3	3.2	5.2

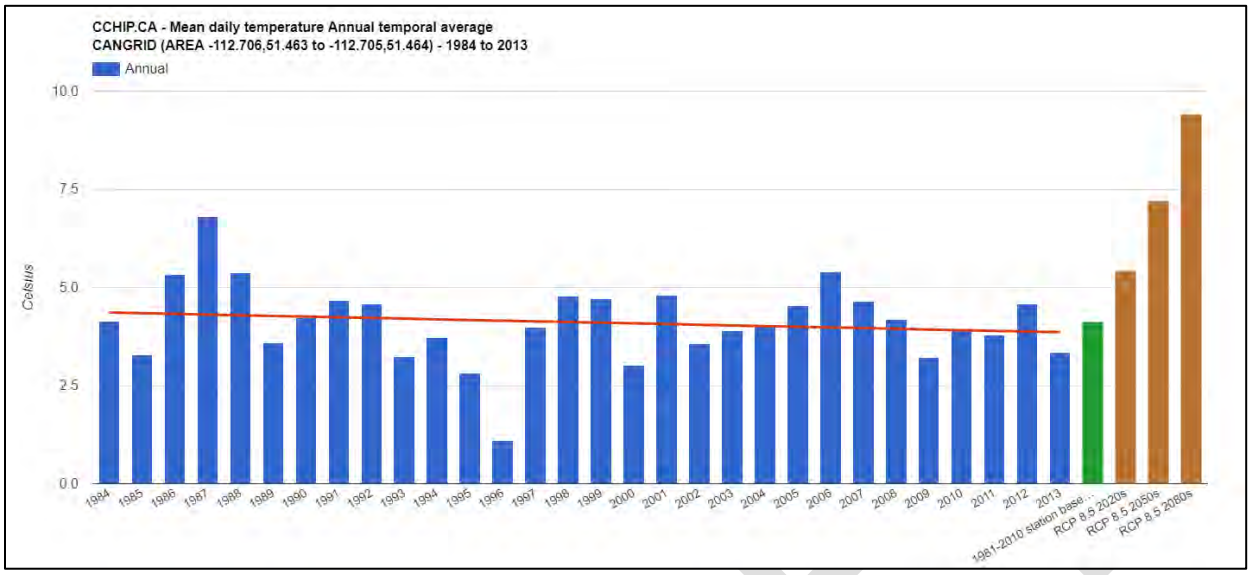


Figure 5: Annual Temporal Average - Mean Daily Temperature (RCP 8.5)

Although the annual mean daily temperature trend of the past 30 years in Figure 2 seems to indicate a slight decrease, this may be due to the missing data in the weather station records. Figure 3 below shows an increasing trend in annual average mean daily temperatures over 2 climate periods (60 years).

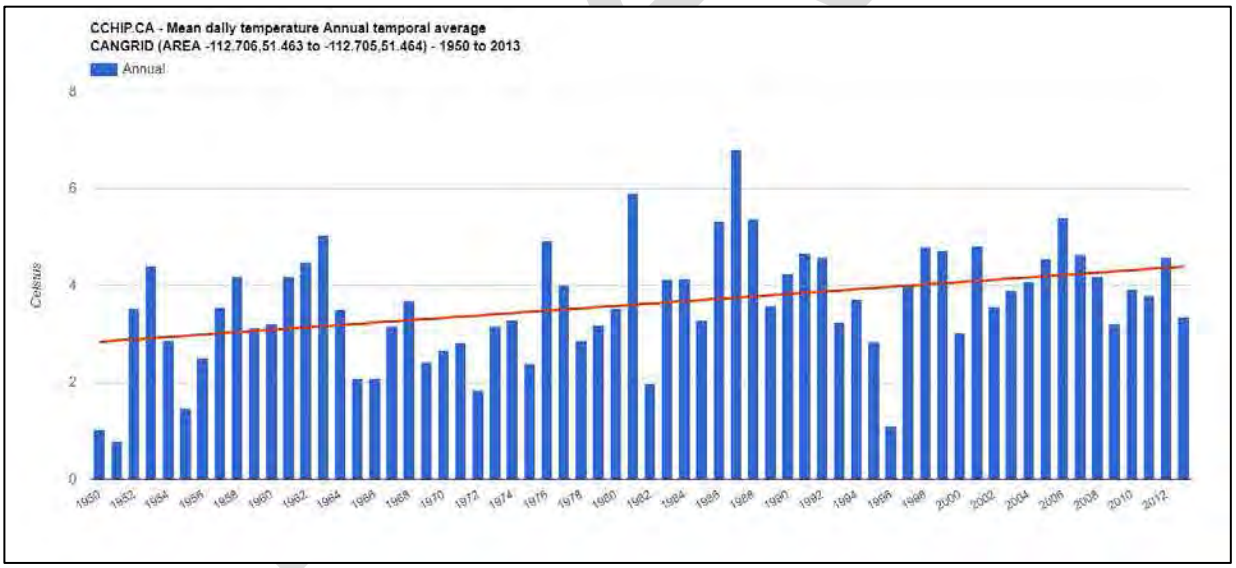


Figure 6: Annual Temporal Average - Mean Daily Temperature (Long Term)

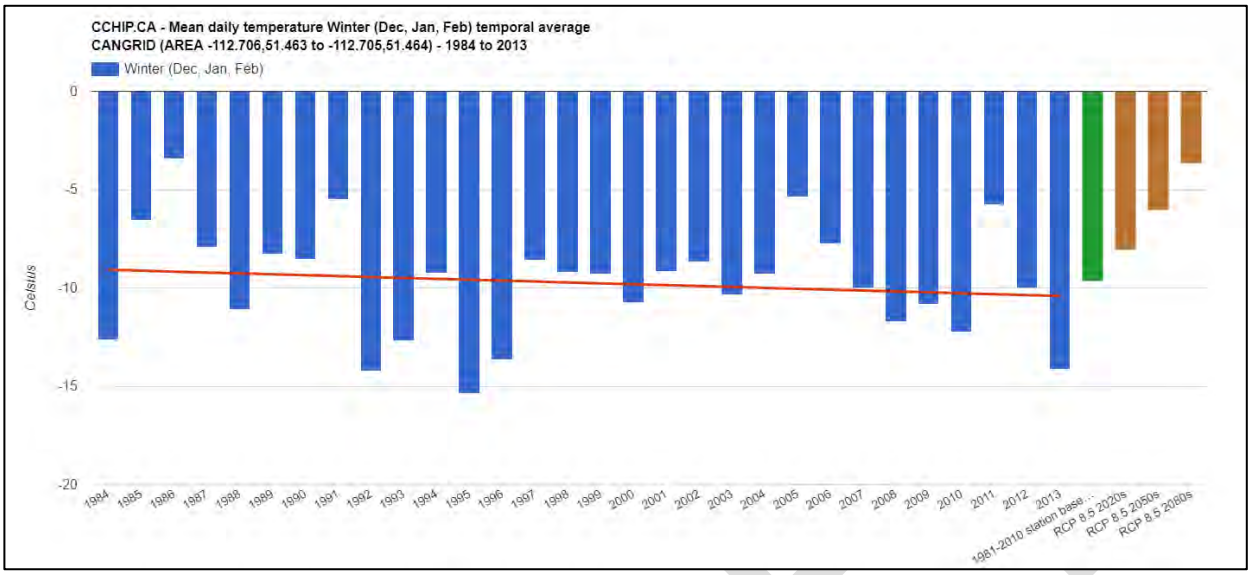


Figure 7: Winter Temporal Average – Mean Daily Temperature (RCP 8.5)

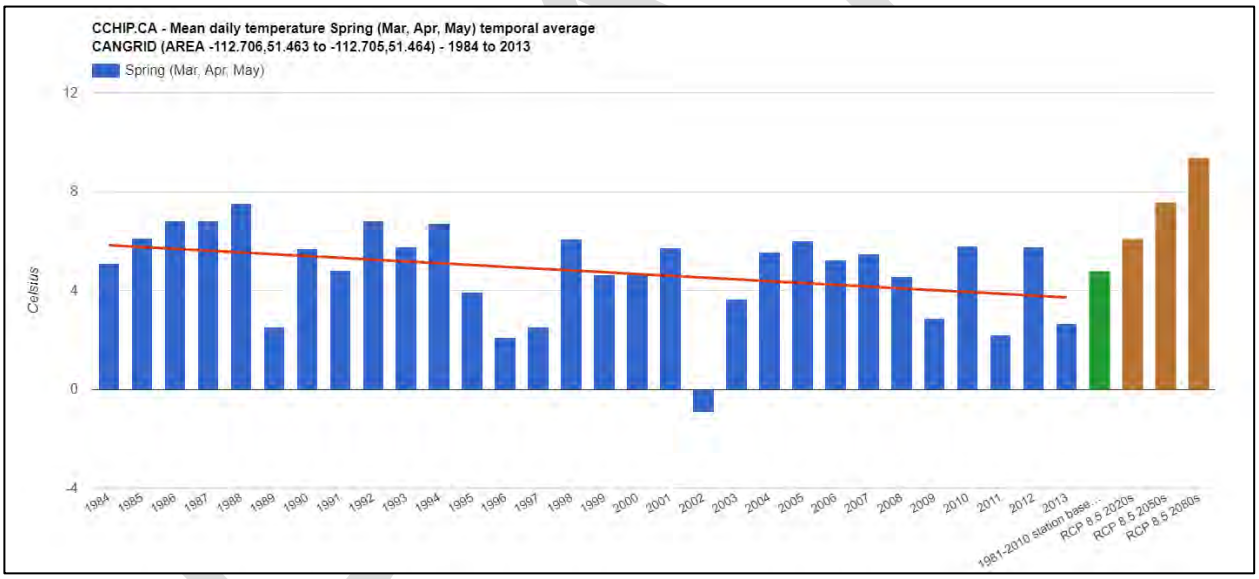


Figure 8: Spring Temporal Average – Mean Daily Temperature (RCP 8.5)

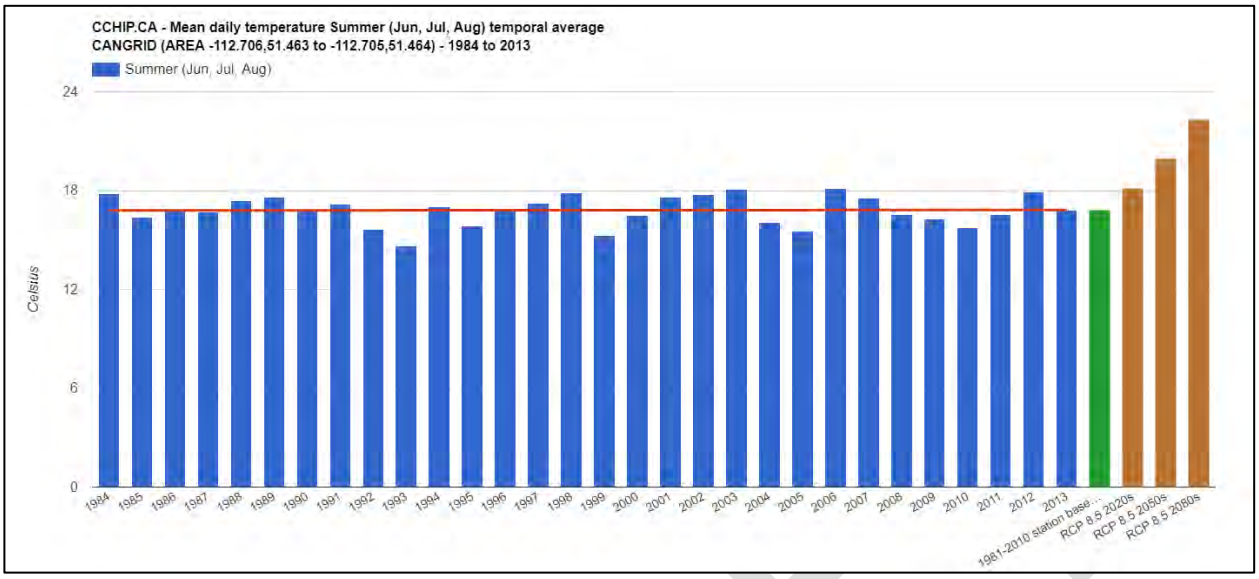


Figure 9: Summer Temporal Average – Mean Daily Temperature (RCP 8.5)

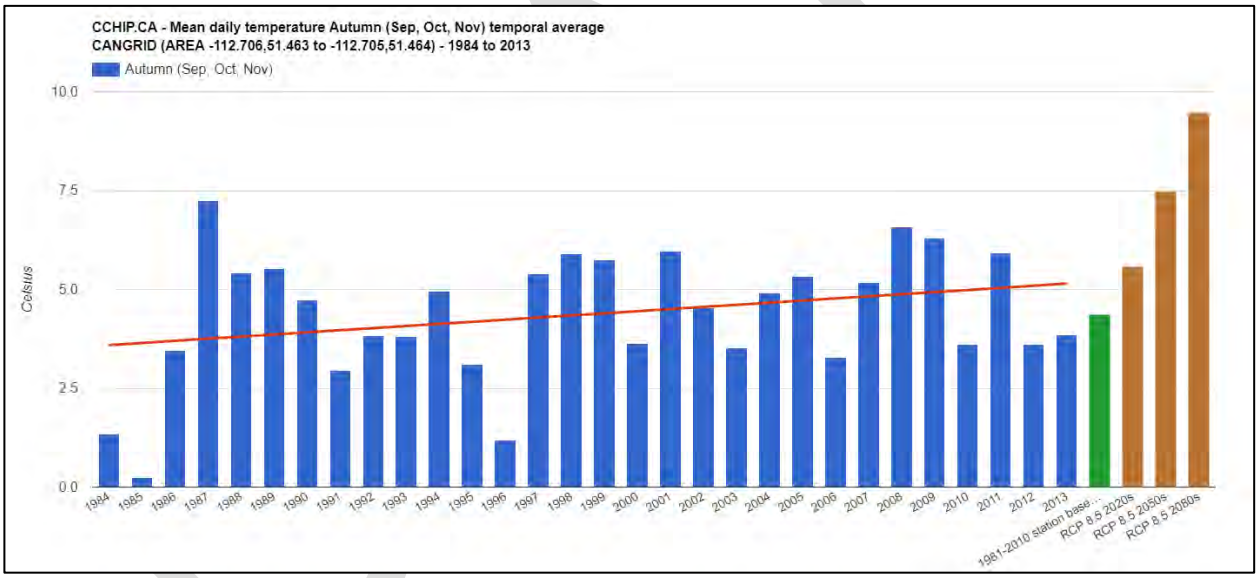


Figure 10: Autumn Temporal Average – Mean Daily Temperature (RCP 8.5)

3.2.2 Precipitation

Total Precipitation

The following Tables and Figures present a summary of the precipitation trends and future projections for the Drumheller area.

Table 4: Average Percent Change in Total Precipitation from Baseline

Average Percent Change in Total Precipitation from 1981-2010 Baseline (%)			
	RCP 8.5		
Season	2020s	2050s	2080s
Annual	2.9	7.2	10.0
Winter	5.0	11.3	20.0
Spring	8.2	17.6	27.3
Summer	0.4	0.2	-3.3
Autumn	1.7	7.8	12.7

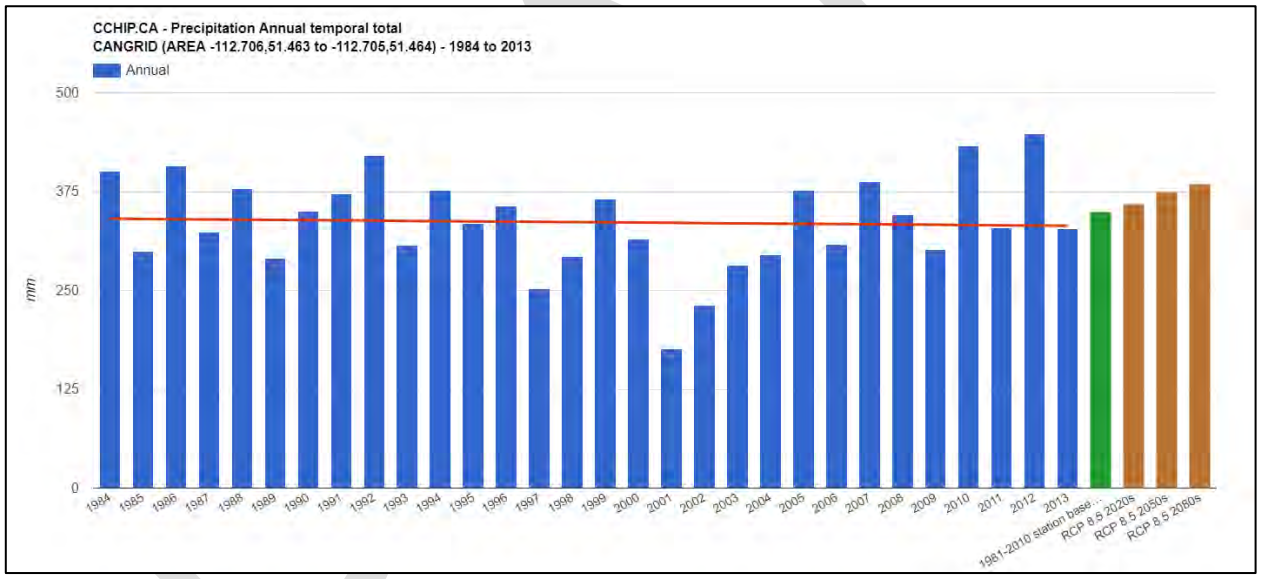


Figure 11: Annual Precipitation Temporal Total (RCP 8.5)

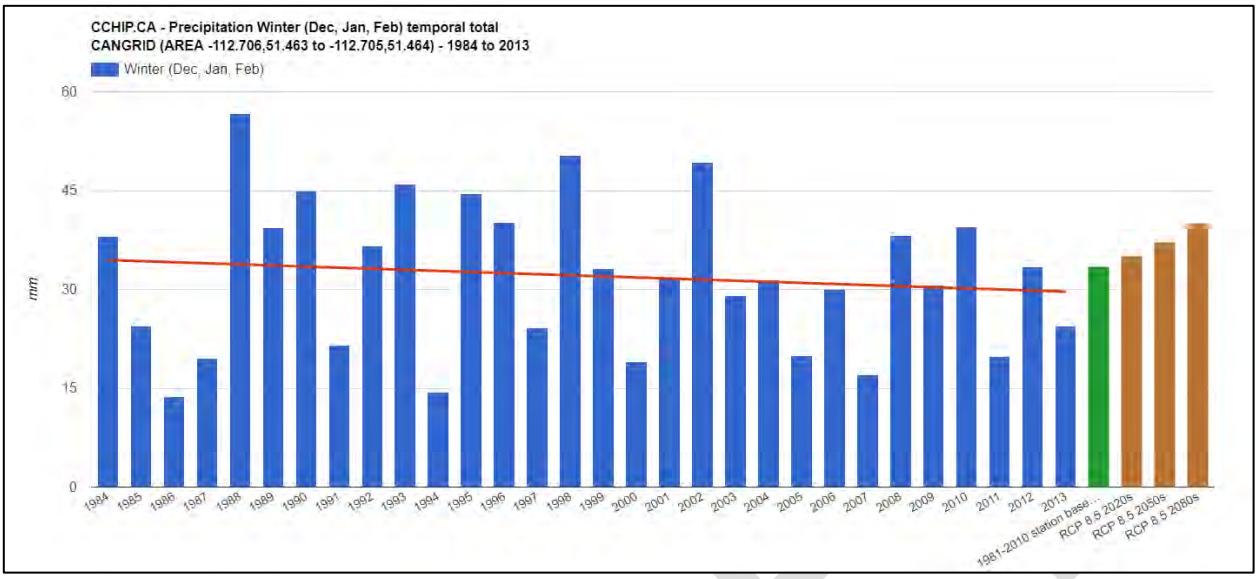


Figure 12: Winter Precipitation Temporal Total (RCP 8.5)

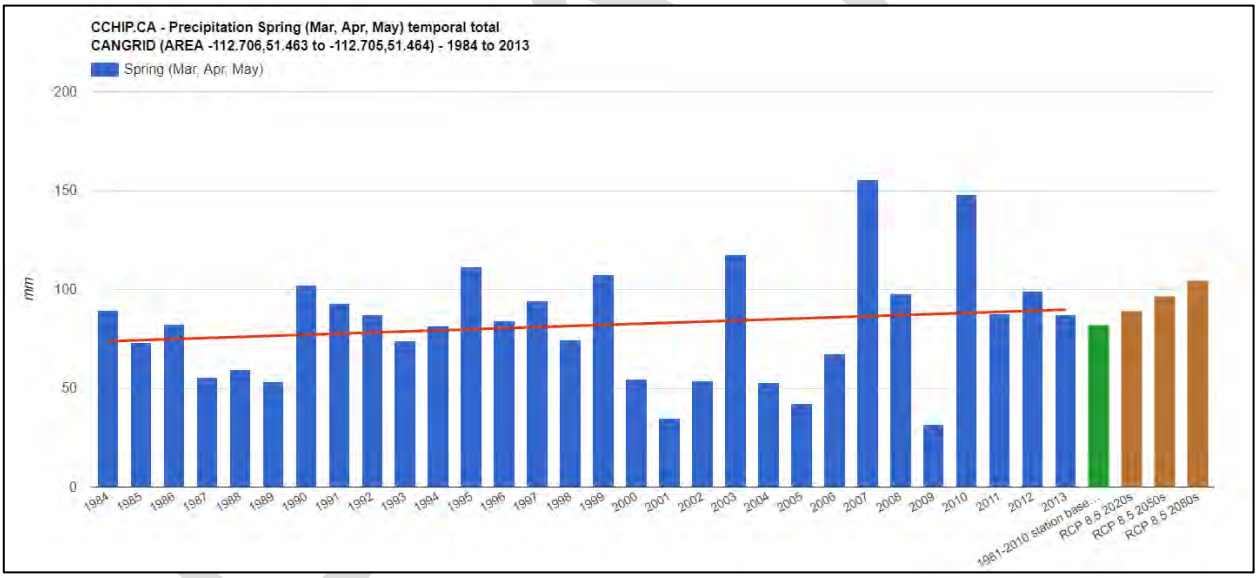


Figure 13: Spring Precipitation Temporal Total (RCP 8.5)

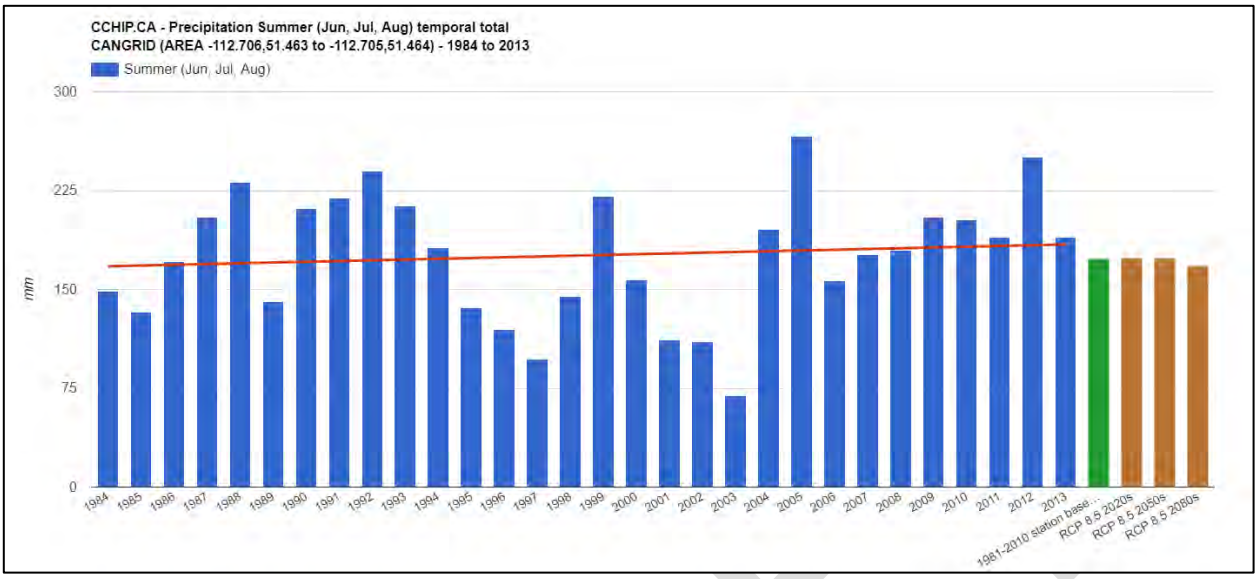


Figure 14: Summer Precipitation Temporal Total (RCP 8.5)

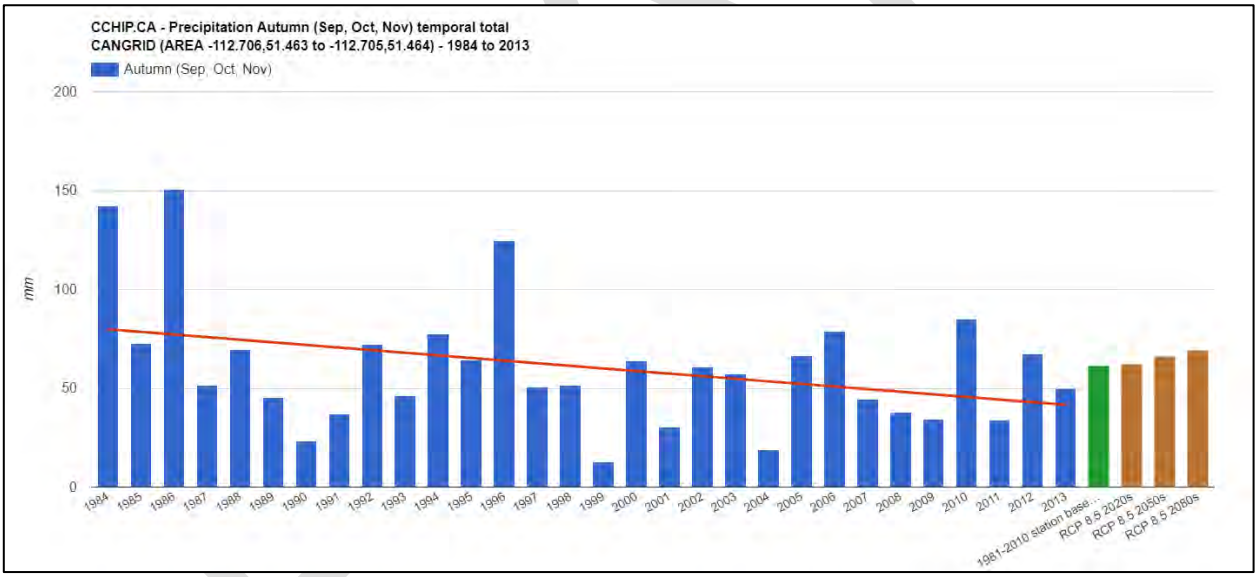


Figure 15: Autumn Precipitation Temporal Total (RCP 8.5)

Precipitation: Intensity-Duration-Frequency data

Total precipitation amount (mm) in specific time interval (5 minutes to 24 hours) for various return periods (2 years to 100 years) – i.e., intensity/duration/frequency (IDF) data, are shown in the Tables below. The "historical" data shown here for Drumheller is based on computer simulation and interpolation between Environment Canada weather stations. The "ungauged" interpolation and projections are published by

the Institute for Catastrophic Loss Reduction (ICLR) at Western University. The projections apply results from 24 Global Circulation Models that simulate future climate conditions and use a 50-year temporal period.

Table 5: Historical IDF data – interpolated

T (years)	2	5	10	25	50	100
5 min	5.30	7.78	9.55	11.94	13.86	15.89
10 min	7.99	11.64	14.15	17.45	20.02	22.69
15 min	10.02	14.51	17.55	21.49	24.53	27.65
30 min	12.32	18.43	22.82	28.76	33.49	38.47
1 h	15.62	22.37	27.24	33.93	39.30	45.04
2 h	18.02	24.87	29.84	36.68	42.21	48.13
6 h	25.32	33.37	38.83	45.96	51.45	57.12
12 h	31.39	41.61	48.98	59.14	67.41	76.34
24 h	36.82	51.22	62.14	77.98	91.58	107.00

Table 6: Future projected (2025 – 2075, RCP 8.5) IDF data – interpolated

T (years)	2	5	10	25	50	100
5 min	5.78	8.90	11.46	16.02	18.78	21.69
10 min	8.70	13.31	16.97	23.41	27.13	30.96
15 min	10.92	16.60	21.05	28.83	33.24	37.73
30 min	13.42	21.08	27.38	38.59	45.38	52.49
1 h	17.01	25.58	32.69	45.51	53.26	61.46
2 h	19.63	28.45	35.81	49.21	57.20	65.67
6 h	27.57	38.17	46.60	61.66	69.72	77.95
12 h	34.19	47.59	58.77	79.34	91.34	104.18
24 h	40.10	58.59	74.56	104.62	124.09	146.02

3.2.3 Frost Profile

Table X below shows the current (baseline) average annual frost-free[6] days and the projected (RCP 8.5) changes.

[6] Definition of Frost-Free Days: The number of frost free days is calculated based on the last occurrence of frost in spring and the first occurrence of frost in autumn (Source: Environment Canada).

Table 7: Average Frost-Free Days

Period	RCP 8.5
Baseline (Historical 1984-2013)	168
2020s	183
2050s	208
2080s	236

4.0 METHODOLOGY

The methodology used to assess the future climate impacts on the proposed assets and associated infrastructure was designed to identify the potential risks associated with future changes in climate and extreme weather events. The objective was to perform a high-level assessment of risks to the infrastructure, buildings, or facilities due to extreme weather and climate uncertainty based on current climate and future climate projections in the area. This could include, but would not be limited to impacts due to heat waves and droughts, high intensity / short duration precipitation, and high winds. It is a process that is compatible with Engineers Canada's PIEVC Protocol[7] which has been used in more than 50 risk assessments is Canada and internationally. The proposed approach is well-suited for the funding application under the DMAF Program.

Engineers Canada describes the Protocol as a methodology that "systematically reviews historical climate information and projects the nature, severity and probability of future climate changes and events. It also establishes the adaptive capacity of an individual infrastructure as determined by its design, operation, and maintenance. It includes an estimate of the severity of climate impacts on the components of the infrastructure (i.e., deterioration, damage, or destruction) to enable the identification of higher risk components and the nature of the threat from the climate change impact. This information can be used to make informed engineering judgments on what components require adaptation as well as how to adapt them e.g., design adjustments, changes to operational or maintenance procedures."

The PIEVC Protocol assessment focuses on the potential risks associated with the interaction between a specific climate event and an infrastructure asset or component as illustrated in

[7] PIEVC is the acronym for Engineers Canada's Public Infrastructure Engineering Vulnerability Committee that in 2007 developed the PIEVC Protocol, a vulnerability and risk assessment tool to evaluate the impacts of climate (current and projected) on infrastructure. More details available at www.PIEVC.ca

Figure 16[8]. It offers the user flexibility in adapting the process to the assessment context and constraints (e.g., time, resources, etc.).

The vulnerability and risks assessment performed for this DMAF application uses the principles of the PIEVC Protocol since the objective is to inform the feasibility and pre-design teams of potential risks that will have to be considered once the project is approved.

Figure 17 shows the process used for this assessment.

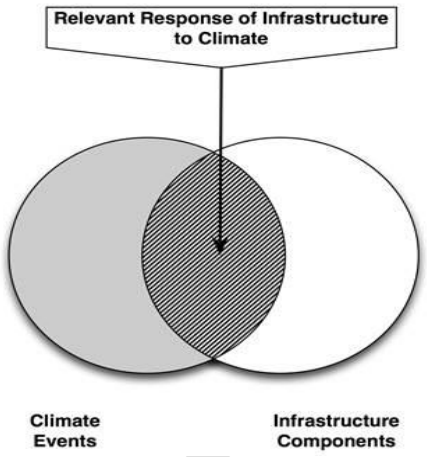


Figure 16: PIEVC Protocol Principle

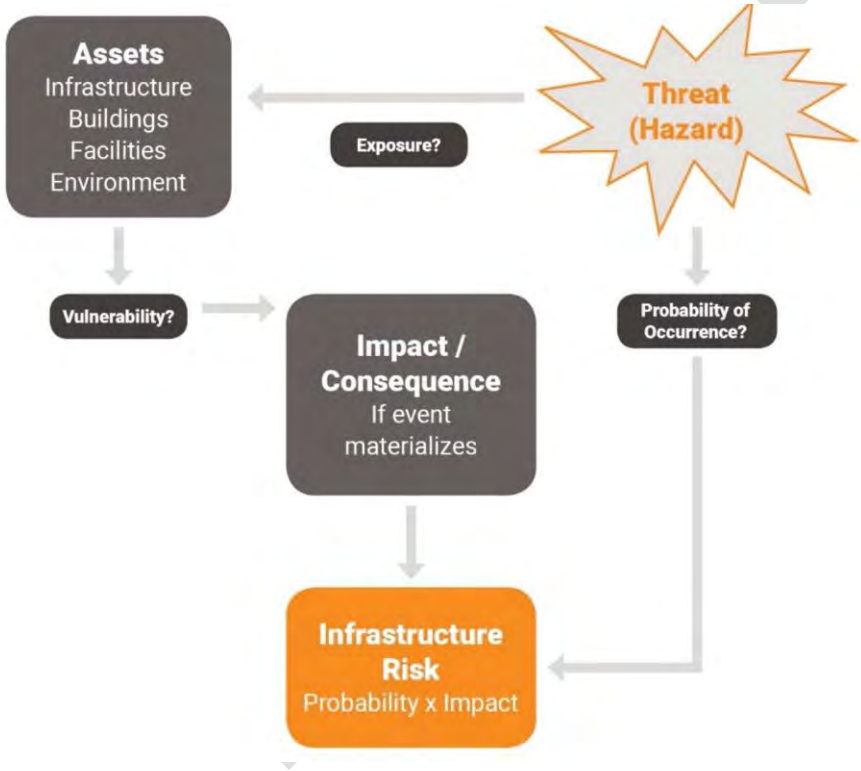


Figure 17 Risk Assessment Process used in this DMAF Study

[8] Source: Engineers Canada

4.1 KEY ASSETS

As a first step, we compiled a high-level catalog of the assets and the associated infrastructure that are in proximity of the Red Deer River flood protection system and are or could be exposed and affected by different meteorological events.

Table 8: Catalog of assets to be assessed for risks under different meteorological events.

SURFACE
Town Streets (Asphalt/Curbs/Sidewalks)
Ditches
Gordon Taylor Bridge (@Bridge Street)
Roper Rd Bridge
Hwy 10 Bridge (@ Cambira)
Hwy 10 Bridge (@ East Coulee)
Railway Bridge
East Coulee Railway Bridge
Above Ground 3rd Party Utilities
UNDERGROUND
Drainage Appliances (Outfall/Sewers/MHs etc.)
Below Ground 3rd Party Utilities
Catch Basins
MISCELLANEOUS/OTHER
RCMP Detachment
Town Hall
Fire Dept
Rosedale Firehall
Health Centre
Drumheller Wastewater Treatment Plant
Drumheller Water Treatment Plant
East Coulee WWTP
Flood Protection Dykes (All)

Figure 18 shows a schematic of the existing flood protection system at Gordon Taylor Bridge.

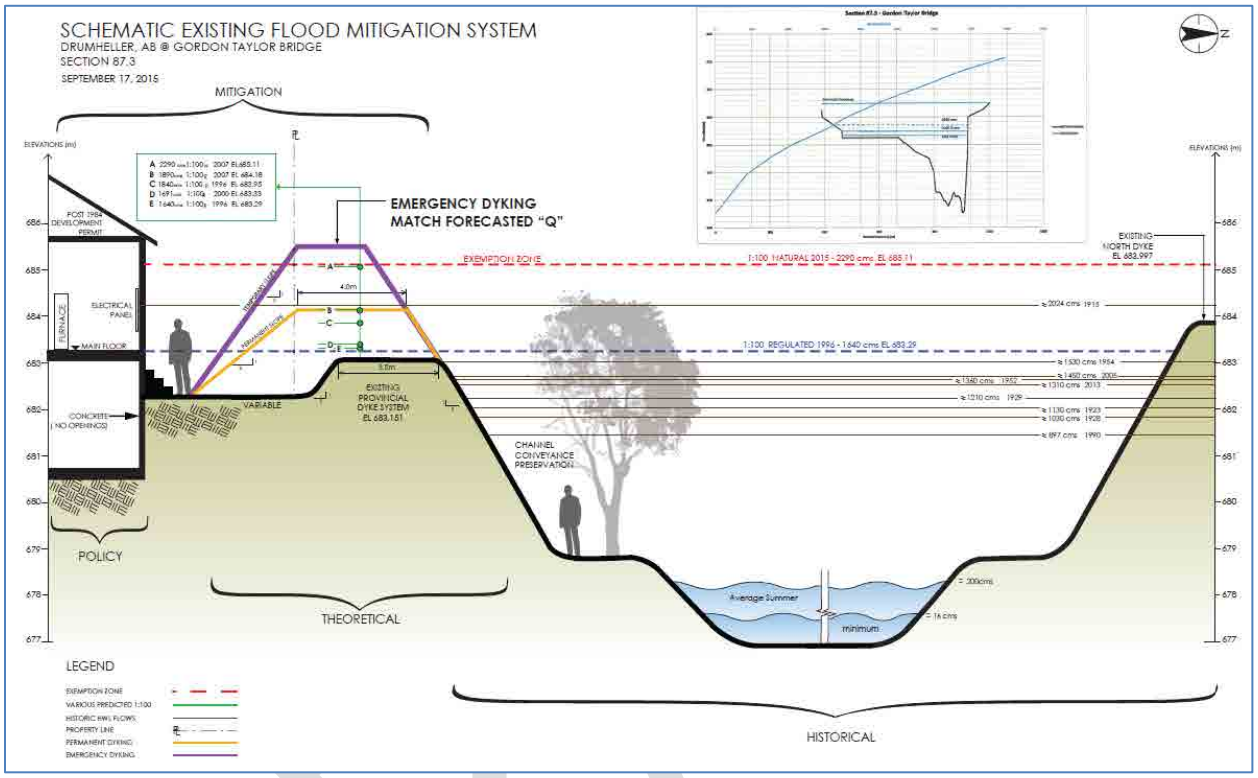


Figure 18. Schematic of Flood Protection System

4.2 FUTURE CLIMATE PROJECTIONS

In addition to the future climate projections presented in Section 3, the following sources of current and future climate projection data and information were reviewed and used:

- Phillips, A., and Towns, W. (2017). The Prairies. In K. Palko and D.S. Lemmen (Eds.), *Climate risks and adaptation practices for the Canadian transportation sector* 2016 (pp. 105-137). Ottawa, ON: Government of Canada. The report states:

  "Temperatures in the Prairies are projected to rise under all climate scenarios, with associated changes in evapotranspiration leading to increased aridity in many areas (Sauchyn and Kulshreshtha, 2008). Under a low-emissions scenario, warming will increase only slightly from historic trends; however, under a high-emissions scenario, increases exceeding 6˚C are possible this century (Bush et al., 2014). The greatest warming will continue to be experienced in winter, with the least occurring during summer.

Projections of precipitation changes show total precipitation increasing over the northern Prairies, with relatively minor changes projected for southern areas (Bush et al., 2014). Again, changes are more significant under higher emission scenarios. In the southwestern Prairies, decreases in summer precipitation are projected under high-emission scenarios. While the southern Prairies have been identified as a region with a higher likelihood of experiencing more frequent drought in future (Bonsal et al., 2013), there is no strong agreement between projections of various climate models (Bush et al., 2014). Instances of extreme rainfall are likely to increase in tandem with warmer temperatures, while instances of freezing rain are likely to increase while snow cover declines over the 21st century (Kharin and Zwiers, 2000; Bush et al., 2014)."

- Environment and Climate Change Canada (2016), *Climate Data and Scenarios for Canada: Synthesis of recent observation and modelling results*. One of the report's observations relevant to this study indicates "…the recurrence time or return period, for these [temperature and precipitation] extremes is projected to decrease, for both quantities, in the future. That is, extremes of a particular magnitude will become more frequent.

The climate trends and future climate projections performed for study confirm the statements of the above references. Of particular interest is the extreme precipitation patterns that can impact the flow in the Red Deer River but also cause disruptions in the Towns stormwater management system. For example, a comparison of the IDF data in Tables 5 and 6 shows that the intensity of the 1:100 year, 24hr rainfall could, under RCP 8.5, increase by more than 35% in the 2050s; an alternative interpretation of this projection is that the 1:100 year, 24hr rainfall today could have a return period of 1:30 in future climate.

The effect of increased rainfall event frequencies and intensities on river flows was summarized in Stantec's May 2014 Report prepared for the Government of Alberta Flood Recovery Task Force, entitled "*Red Deer River Basin Flood Mitigation Study*". The report indicates that based on hydrologic modelling of the Little Red Deer in the Upper Red Deer, Muzik (2001)[9] noted that small to moderate increases in rainfall intensity may have substantial impacts on flood flows, suggesting that the existing man-made infrastructures may be insufficient to deal with future floods. These results suggested that a 25% increase in extreme rainfall could lead to 40% increase in 100-year flood, 50% increase in 10-year flood, 60% increase in 3-year flood and 90% increase in 2-year flood.

As mentioned above, Drumheller's 1:100 year, 24hr rainfall could, under RCP 8.5, increase by more than 35%. This degree of projected increase is consistent for all extreme events as shown in Table 9 below.

[9] Muzik, I. 2001. Sensitivity of Hydrologic Systems to Climate Change. Canadian Water Resources Journal. 26:233-252.

Table 9: Projected increase of accumulated rainfall from historical Drumheller IDF information to projected 2050 scenarios under RCP 8.5.

Storm Duration (hours)	1	2	6	12	24
Increase in 1:50 year rainfall under RCP 8.5 - 2050s projection (%)	35	35	35	35	35
Increase in 1:100 year rainfall under RCP 8.5 - 2050s projection (%)	36	36	36	36	36

Finally, when researching historic floods in the Drumheller area, the most common season for major flood events is the Spring, coinciding with winter snowmelt and spring rains in the Red Deer River basin. As summarized in Table 4, the spring season has the greatest projected increase in precipitation in Drumheller, with 17.6% increase projected in 2050s and 27.3% increase projected in the 2080s. Similar increases are projected for much of the Red Deer River basin upstream of Drumheller.

4.3 RISK ASSESSMENT

4.3.1 Assets and Infrastructure

The assessment of risks related to current and future climate is based on the intensity of a climate event impacting the performance of the asset or its components. The performance considerations related to climate impacts selected for this assessment consist of:

- Structural performance: considerations of safety, load carrying capacity, fracture, fatigue, deflection and permanent deformation, cracking and deterioration, vibrations, and foundations
- Functionality: effective capacity of the asset or component to provide the intended function or service, and
- Operations and maintenance: occupational safety, access to worksite, equipment performance, maintenance and replacement cycles, electricity demand, and fuel use.

4.3.2 Climate Parameters

Based on the climate information reviewed, the relevant climate events selected for the proposed facilities risks and their corresponding future climate (time horizon: 2050s and 2080s) trends are shown in Table 10. Remarks are also provided in the Table regarding an assessment of the confidence in future climate projections based on the literature reviewed.

Table 10 Current and Proposed Infrastructure Risks and Corresponding Future Climate Trends

Climate Parameter	Trend	Remarks
Temperature		
Mean seasonal temperatures	Mean temperatures project to increase	See Table 1, this report
Maximum temperatures	More frequent heat waves projected, including even higher temperatures	See Table 2, this report
Precipitation		
Short Duration – High Intensity Rainfall	Increase in Frequency and Intensity of Short Duration Rainfalls	See Table 5 and Table 6 this report
Long Duration Rainfalls	Increase in Frequency and Intensity of Long Duration Rainfalls	See Table 5 and Table 6 this report
Seasonal Precipitation – Flooding	Increase in Spring total rainfall in Red Deer River basin - i.e. Increased river flows	Higher than historical flood flows expected as per Section 4.2 this report

4.3.3 Consequence of Future Climate Changes on the Assets

For the current assessment, the trends relating to climate events that have been identified as relevant to the proposed facilities are used in identifying potential climate impacts as shown in the following table.

Table 11 Potential Climate Change Impacts

Climate Parameter	Asset/Infrastructure Relevance	Potential Impacts
Temperature		
Mean seasonal temperatures	N/A	Average temperatures have little impact on infrastructure selected.
Maximum temperatures	Greatest effect on population health and Town services	• Increase in demand on HVAC systems. • Impacts on control systems (e.g., loss of calibration) • Higher energy consumption.
Precipitation		
Short Duration – High Intensity Rainfall	Town infrastructure	• Historic events have seen street flooding, catch basin blockages, etc. • Operations personnel need to work overtime

Long Duration Rainfalls	Town infrastructure	• Same potential impacts as short-term rainfalls but historically the town has not had as many issues with long term, lower intensity rain
Seasonal Precipitation – Flooding	Bridges, Town Infrastructure, Dykes, Town Services	• Bridges vulnerable to river flows beyond their intended design • Dykes vulnerable to river flows beyond their intended design • Should a dyke fail, there is major impacts to Town population and services

4.3.4 Risk Profile

Risk is a function of the probability (likelihood) of an event occurring and of the impacts this event will have, if it occurs, on the assets. Risks are categorized in Table 12.

Table 12 Risk Classification

Risk Classification	Description
Low	Minor asset/equipment damage or service disruption can occur. No permanent damage. Minor repairs or restoration expected.
Medium	Expected limited damage to asset or to equipment components. Some loss of service may occur. Minor repairs and some equipment replacement may be required.
High	May result in significant permanent damage or complete loss of asset or equipment that may require complete replacement. Significant disruptions to the service provided by the asset or equipment can result. Loss of asset or equipment may require temporary translocation to maintain the service.

The risk profile for the proposed assets and retained climate parameters is provided in Tables 13 and 14. The confidence in future climate projections was considered in assessing the risks shown in the profile.

A total of100 climate / asset or infrastructure interactions were assessed resulting in 8 high risks and 16 medium risks. All remaining interactions were found to be low, negligible, or not relevant.

Table 13. Risk Profile for the Proposed Assets

FUTURE CLIMATE 2050's

Infrastructure Components	Primary Infrastructure Response Considerations			1 Temperature			2 Temperature			3 Precipitation			4 Precipitation			5 Precipitation - Seasonal		
	Structural	Functionality	Operations and Maintenance	Increase in Mean Seasonal Temperatures			Increase in Extreme Maximum Temperatures			Increase in Frequency and Intensity of Short Duration Rainfalls			Increase in Frequency and Intensity of Long Duration Rainfalls			Increase in Spring total rainfall in Red Deer River basin - ie. Increased river flows		
	Mark Relevant Responses			P	S	R	P	S	R	P	S	R	P	S	R	P	S	R
SURFACE				High			High			High			High			High		
Town Streets (Asphalt/Curbs/Sidewalks)		✓	✓								Med	Med					Med	Med
Ditches	✓	✓	✓								Med	Med					Low	Low
Gordon Taylor Bridge (@Bridge Street)	✓	✓									Med	Med					High	High
Roper Rd Bridge	✓	✓															High	High
Hwy 10 Bridge (@ Cambira)	✓	✓															High	High
Hwy 10 Bridge (@ East Coulee)	✓	✓															High	High
Railway Bridge	✓	✓															High	High
East Coulee Railway Bridge	✓	✓															High	High
UNDERGROUND																		
Drainage Appliances (Oufall/Sewers/MHs etc.)	✓	✓	✓								Med	Med		Med	Med			
Catch Basins		✓	✓								Med	Med		Med	Med			
MISCELLANEOUS/OTHER																		
RCMP Detachment			✓					Med	Med								High	High
Town Hall			✓					Med	Med								Low	Low
Fire Dept			✓					Med	Med								Low	Low
Rosedale Firehall			✓					Med	Med		Low	Low					Med	Med
Health Centre			✓					Med	Med								Med	Med
Drumheller Wastewater Treatment Plant		✓									Low	Low		Low	Low			
Drumheller Water Treatment Plant		✓															Med	Med
East Coulee WWTP																		
Flood Protection Dykes (All)	✓	✓	✓														High	High

Notes
P = Probability of climate event occuring
S = Severity of the impact on the asset or infrastructure if the climate event occurs
R = Risk to the asset or infrastructure in relation to the response consieration

Table 14 Risks and Potential Impacts on the Assessed Assets

Climate Parameter	Asset	Risk Rating	Asset Performance Potentially Affected	Potential Impacts
Temperature				
Increase in extreme maximum temperature	Buildings	Medium	Functionality	• HVAC systems may not have the capacity to maintain the required air quality in the buildings due to extreme temperatures outside of specifications
Precipitation				
High intensity, short duration rainfall events	Surface transportation assets Stormwater management system	Medium	Functionality Structural	• Localized flooding • Damage to vulnerable assets • Loss of access • Localized flooding • Sewer backups resulting in basement flooding • Damage to assets
Long duration rainfalls	Stormwater management system	Medium	Functional	• Localized flooding • Sewer backups resulting in basement flooding • Damage to assets
Increase in Red Deer River flows	Surface transportation assets Buildings Flood Protection Dykes	High Medium to High High	Structural Functional Operational	• Various levels of impacts resulting from flood protection failures (functional or structural) resulting in Red Deer River water entering the protected areas.

5.0 SUMMARY AND RECOMMENDATIONS

The risk assessment conducted for the DMAF application was generally based on the principles of the PIEVC Protocol assessment to inform the Town of Drumheller on the potential climate (current and future) related risks that should be considered at the design stages of the proposed asset and associated infrastructure.

The climate analysis provides an overview of historical trends and future climate projections for meteorological events that have impacts on the infrastructure.

Future climate projections indicate potential risks to the HVAC systems of buildings due to an increase in extreme maximum temperatures. However, the increase in Red Deer River flows, due to rapid snowmelt and/or higher intensity rainfall events as projected by the climate models, are likely to produce the greatest risks to the flood protection systems and the assets in the protected areas. It is worth to emphasize here the conclusions of the 2001 Muzik report:

> A small to moderate increases in rainfall intensity may have substantial impacts on flood flows, suggesting that the existing man-made infrastructures may be insufficient to deal with future floods. These results suggested that a 25% increase in extreme rainfall could lead to 40% increase in 100-year flood, 50% increase in 10-year flood, 60% increase in 3-year flood and 90% increase in 2-year flood.

The analysis presented in this report was prepared to fulfil the requirements of the climate risk assessment of the DMAF funding application. When funding has been approved, it is recommended to perform a full PIEVC vulnerability assessment that will guide and inform the design for future climate considerations.

The Town of Drumheller

Drumheller Valley Flood Mitigation and Resiliency Strategy

Asset Management Plan

July 2018

Document Control	Asset Management Plan

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1	July 19th, 2018		Joon Choi	Darwin Durnie	
2	July 26th, 2018		JC	DD	

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1 EXECUTIVE SUMMARY

1.1 The Purpose of the Plan

Asset management planning is a comprehensive process to ensure delivery of services from infrastructure is provided in a financially sustainable manner.

This asset management plan details information about infrastructure assets including actions required to provide an agreed level of service in the most cost-effective manner while outlining associated risks. The plan defines the services to be provided, how the services are provided and what funds are required to provide the services over a 20-year planning period.

This plan is a first cut asset management plan that is to be revisited and revised periodically. The plan covers the infrastructure assets that provide protection to the residents and infrastructure of the Drumheller Valley from flood events.

1.2 Asset Description

These assets include:

The dykes network comprises:

- Earthen or concrete dykes
- Rail lines
- Bridges
- Road segments

These infrastructure assets have a replacement value of a 100 years per lifecycle if properly maintained.

1.3 Levels of Service

Our present funding levels are sufficient to continue to provide existing services at current levels in the medium term.

The main services consequences are:

- Protection of human life
- Protection of infrastructure
- Protection of Drumheller-specific treasures.

Our present funding levels are sufficient to continue to manage risks in the medium term.

The main risk consequences are:

- Death
- Loss of property (private and public)
- Loss of institutions

1.4 Future Demand

The main demands for new services are created by:

- Protection maintenance with climate change
- Prominence of the Drumheller Valley

These will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

- Climate adaptation assessment
- Dyke monitoring

1.5 Lifecycle Management Plan

What does it Cost?

Sources to provide the services covered by this Asset Management Plan (AM Plan) includes grants, taxes, and a utility model. Some operations, maintenance, renewal and upgrade costs of existing assets over the 10-year planning period is to be determined.

1.6 Financial Summary

What we will do

Estimated available funding for this period is $55 million dollars.

We plan to provide protection services for the following:

- Operation, maintenance, renewal and upgrade of dykes and dyke-structures to meet service levels set by in annual budgets.

What we cannot do

We do **not** have enough funding to provide all services at the desired service levels or provide new services. Works and services that cannot be provided under present funding levels are:

- To be determined

Managing the Risks

There are risks associated with providing the service and not being able to complete all identified activities and projects. We have identified major risks as:

- Public awareness of emergency
- Events greater than foreseen

We will endeavor to manage these risks within available funding by:

- Create educational incentives for Drumheller and other visitors from across the world
- Undergo climate adaptation assessment and foresee as accurate as possible

1.7 Asset Management Practices

Our systems to manage assets include:

- Construction and O&M cost analysis
- Design and monitor

1.8 Monitoring and Improvement Program

The next steps resulting from this asset management plan to improve asset management practices are:

- Patrol system to ensure continued resiliency
- Assess educational success to validate public awareness of regional situation.

2 INTRODUCTION

Flooding from the Red Deer River is a recurring hazard facing the communities within the Drumheller Valley. Many major, high damage, high water events, including ice jams, have been recorded since the late 1800s. In 1915, the maximum recorded river flow was 2025 cubic meters per second (m^3/s) and caused major damage. To put this into perspective, the average river elevation during summer below the Gordon E. Taylor bridge was about 678.5 m (measured in 2015). The floods of 1915 caused the river to rise to a maximum elevation of 684.2 m – nearly 6 meters in elevation difference. There were other significant events in 1923, 1928, 1929, 1948, 1952, 1954, 1990, and more recently in 2005 and 2013. With the construction of the Dickson Dam in 1984, upstream of Drumheller, the Government of Alberta built dykes in certain areas throughout the Drumheller Valley to enhance flood protection. Unfortunately, the originally planned extent of the dyke system was not completed.

The Town of Drumheller has been proactive in developing a mitigation strategy for their community and aims to achieve success through the following streams of work:

1) Develop Comprehensive Program for the Valley
2) DMAF and ICIP Grant Applications
3) Alberta Community Resiliency Program – Approved Projects
4) Land Conversion

2.1 Background

The Town of Drumheller has experienced flood events in both 2005 and 2013. The regulated flow for a 1:100 flood frequency event in the Red Deer River Basin was estimated at 1640 cubic-meters-per-second (m^3/s) in the Town of Drumheller (Golder Associates, 2013). At the present time, there are some existing berms in the region which were built by the Province of Alberta designed to protect against a flow of 1472 m^3/s based on modelling conducted in 1984. The 1:100 year revised flow is 1640 m^3/s and is represented on the existing Government of Alberta flood maps. Some of the provincial dykes have been upgraded to accommodate this flow.

Emergency protection measures including raising dykes, constructing temporary dykes, draining sewage systems, managing seepage and managing stormwater behind the dykes are planned and implemented depending on the anticipated river flow levels. Improving the permanent protection measures will significantly reduce the risk of flooding damage.

Damage from surcharged sewer systems as well as stormwater management behind dykes is a threat during flood events. These situations are well understood in Drumheller and covered under their emergency response plan.

Ice jams have occurred in the Drumheller area (e.g. 1948) and have caused extensive damage. The flow operation of the Dickson Dam (maintaining winter flow levels) have had a positive impact reducing the flood potential from ice jams. However, the threat of ice jams creates the need for mitigation strategies involving both flowing and

Other significant watercourses like the Rosebud River and Michichi Creek are flood hazards. Also, the steep valley walls and local soil conditions can result in local overland flooding.

Significant portions of Drumheller are included in the provincial Floodway and Flood fringe areas. Due to the special flooding conditions it is being proposed that the Town of Drumheller be exempt by regulation from Alberta's Bill 27, Flood Recovery and Reconstruction Act.

2.1.1 Template

This asset management plan communicates the actions required for the responsive management of assets (and services provided from assets), compliance with regulatory requirements, and funding needed to provide the required levels of service over a 20-year planning period.

The asset management plan follows the format for AM Plans recommended in Section 4 of the International Infrastructure Management Manual[1].

[1] IPWEA, 2015, Sec 4.2, Example of an Asset Management Plan Structure, pp 4|37 – 39.

The asset management plan is to be read with the other planning documents. This should include the Asset Management Policy and Asset Management Strategy where these have been developed along with the following associated planning documents:

The infrastructure assets covered by this asset management plan are shown in Table 2.1. These assets are used to provide flood mitigation services to the community.

2.2 Inventory

See attached Structural Asset Inventory for Valley Flood Mitigation. Key stakeholders in the preparation and implementation of this asset management plan are shown in Table 2.1.1.

Table 2.2.1: Key Stakeholders in the AM Plan

Key Stakeholder	Role in Asset Management Plan
Town of Drumheller	• Responsible municipality • Future owner of assets
Government of Alberta	• Owner of existing assets
Government of Canada	• Funding and guidelines
Stantec	• Engineers / Planners
Residents of the Drumheller Valley	• Integrators of the comprehensive program into the communities
Public	• Funding • Reaps the benefit of the program / project

2.3 Goals and Objectives of Asset Ownership

Drumheller Flood Mitigation system exists to provide services. Some of these services are provided by infrastructure assets. We have acquired infrastructure assets by 'purchase', by contract, construction by our staff and by donation of assets constructed by developers and others to meet increased levels of service.

Our goal in managing infrastructure assets is to meet the defined level of service (as amended from time to time) in the most cost effective manner for present and future consumers. The key elements of infrastructure asset management are:

- Providing a defined level of service and monitoring performance,
- Managing the impact of growth through demand management and infrastructure investment,
- Taking a lifecycle approach to developing cost-effective management strategies for the long-term that meet the defined level of service,
- Identifying, assessing and appropriately controlling risks, and
- Link to a long-term financial plan which identifies required, affordable expenditure and how it will be financed.[2]

Key elements of the planning framework are

- Levels of service – specifies the services and levels of service to be provided,
- Future demand – how this will impact on future service delivery and how this is to be met,
- Life cycle management – how to manage its existing and future assets to provide defined levels of service,
- Financial summary – what funds are required to provide the defined services,
- Asset management practices – how we manage provision of the services,
- Monitoring – how the plan will be monitored to ensure objectives are met,
- Asset management improvement plan – how we increase asset management maturity.

Other references to the benefits, fundamentals principles and objectives of asset management are:

- International Infrastructure Management Manual 2015[3]
- ISO 55000

[2] Based on IPWEA 2015 IIMM, Sec 1.3, p 1| 8
[3] Based on IPWEA 2015 IIMM, Sec 2.1.3, p 2| 13

3. LEVELS OF SERVICE

3.1 Customer Research and Expectations

This 'core' asset management plan is prepared to facilitate consultation initially through feedback on draft asset management plans prior to adoption by the Town of Drumheller. Future revisions of the asset management plan will incorporate community consultation on service levels and costs of providing the service. This will assist the Town of Drumheller and its Flood Mitigation Advisory Committee and stakeholders in matching the level of service required, service risks and consequences with the community's ability and willingness to pay for the service.

- In Fall 2015, the Town of Drumheller asked residents directly impacted by flooding was invited to attend an engagement event.
- In 2005, one of the largest flood events in Drumheller's recorded history, 54 km of temporary dykes were constructed with 70,000 cubic feet of dirt for the safety of the residents.
- In 2013, a flood event of similar intensity to 2005 occurred and displayed a good performance of the existing dyke system. Mayor at the time stated: "we have made our own luck – we did not get lucky."

Table 3.1: Community Satisfaction Survey Levels

Performance Measure	Satisfaction Level				
	Very Satisfied	Fairly Satisfied	Satisfied	Somewhat satisfied	Not satisfied
Dyking System Worked					
Dyking System Failed					
Dyking System Doesn't Affect Me					

Community satisfaction information is used in developing the Strategic Plan and in the allocation of resources in the budget.

3.2 Strategic and Corporate Goals

This asset management plan is prepared under the direction of the Town of Drumheller vision, mission, goals and objectives.

Our vision is:

"To be the cleanest, friendliest, most sought after community in Alberta."

Our mission is:

To provide good government and promote leadership that encourages a progressive community and positive business relationships towards a better quality of life for everyone.

The Town of Drumheller is a municipal government corporation that places service as its primary objective. Mandated by the Municipal Government Act (MGA), balanced decision making is paramount. All aspects of the management of assets will include criteria to achieve outstanding service, financial and environmental performance while considering risk.

Relevant goals and objectives and how these are addressed in this asset management plan are:

Table 3.2: Goals and how these are addressed in this Plan

Goal	Objective	How Goal and Objectives are addressed in AM Plan
Protect the Residents	Create a flood protection system by the end of 2020 that provides flood protection from the Red Deer River flow of 1640 cms.	Program development of the comprehensive system.

The Town of Drumheller will exercise its duty of care to ensure public safety in accordance with the infrastructure risk management plan prepared in conjunction with this AM Plan. Management of infrastructure risks is covered in Section 6.

3.3 Legislative Requirements

There are many legislative requirements relating to the management of assets. These include:

Table 3.3: Legislative Requirements

Legislation	Requirement
Municipal Government Act	
AEPA	
AEMA	
Water Act	
OH&S	

3.4 Customer Levels of Service

Service levels are defined service levels in two terms, customer levels of service and technical levels of service. These are supplemented by organizational measures.

Customer Levels of Service measure how the customer receives the service and whether value to the customer is provided.

Customer levels of service measures used in the asset management plan are:

Quality How good is the service … *what is the condition or quality of the service?*

Function Is it suitable for its intended purpose …. *Is it the right service?*

Capacity/Use Is the service over or under used … *do we need more or less of these assets?*

The current and expected customer service levels are detailed in Tables 3.4 and 3.5. Table 3.4 shows the expected levels of service based on resource levels in the current long-term financial plan.

Organizational measures are measures of fact related to the service delivery outcome. e.g. number of occasions when service is not available, condition %'s of Very Poor, Poor/Average/Good, Very good.

These provide a balance compared to customer perception that can be more subjective.

Table 3.4: Customer Level of Service

	Expectation	Performance Measure Used	Current Performance	Expected Position in 10 Years based on the current budget.
Service Objective: Protect residents from flood events of the present and future.				
Quality	The dyke system is of high quality and brings infrastructural value to the Town.			
	Education initiatives in place.			
	Confidence level		"[Low/medium/high]"	"[Low/medium/high]"
Function	Protect residents from flood events.			
	Contains the river in the channel.			
	Confidence level		"[Low/medium/high]"	"[Low/medium/high]"
Capacity and Use	Functional			
	Understood			
	Confidence level		"[Low/medium/high]"	"[Low/medium/high]"

3.5 Technical Levels of Service

Technical Levels of Service - Supporting the customer service levels are operational or technical measures of performance. These technical measures relate to the allocation of resources to service activities to best achieve the desired customer outcomes and demonstrate effective performance.

Technical service measures are linked to the activities and annual budgets covering:

- Operations – the regular activities to provide services (e.g. opening hours, cleansing, mowing grass, energy, inspections, etc.
- Maintenance – the activities necessary to retain an asset as near as practicable to an appropriate service condition. Maintenance activities enable an asset to provide service for its planned life (e.g. road patching, unsealed road grading, building and structure repairs),
- Renewal – the activities that return the service capability of an asset up to that which it had originally (e.g. road resurfacing and pavement reconstruction, pipeline replacement and building component replacement),
- Upgrade/New – the activities to provide a higher level of service (e.g. widening a road, sealing an unsealed road, replacing a pipeline with a larger size) or a new service that did not exist previously (e.g. a new library).

Service and asset managers plan, implement and control technical service levels to influence the customer service levels.[4]

Table 3.5 shows the technical levels of service expected to be provided under this AM Plan. The "Desired" position in the table documents the position being recommended in this AM Plan.

Table 3.5: Technical Levels of Service

Service Attribute	Service Activity Objective	Activity Measure Process	Current Performance *	Desired for Optimum Lifecycle Cost **
TECHNICAL LEVELS OF SERVICE				
Operations	"[Enter objective]" Add additional rows as required	"[Enter activity]"	"[Enter performance]"	"[Enter performance]" 100
Operational Cost			Cost should be consistent with Form 3 data of the NAMS.PLUS Expenditure Template	Forecast should be consistent with the outputs from the asset model.
Maintenance	"[Enter objective]" Add additional rows as required	"[Enter activity]"	"[Enter performance]"	"[Enter performance]"
Maintenance Cost			Cost should be consistent with Form 3 data of the NAMS.PLUS Expenditure Template	Forecast should be consistent with the outputs from the asset model.
Renewal	"[Enter objective]" Add additional rows as required	"[Enter activity]"	"[Enter performance]"	"[Enter performance]"
Renewal Cost Rip-Rap Reduced Pressure Backflow Preventer			Cost should be consistent with Form 3 data of the NAMS.PLUS Expenditure Template	Forecast should be consistent with the outputs from the asset model.
Upgrade/ New	"[Enter objective]" Add additional rows as required	"[Enter activity]"	"[Enter performance]"	"[Enter performance]"

[4] IPWEA, 2015, IIMM, p 2|28.

Service Attribute	Service Activity Objective	Activity Measure Process	Current Performance *	Desired for Optimum Lifecycle Cost **
Upgrade/New Cost			Cost should be consistent with Form 3 data of the NAMS.PLUS Expenditure Template	Forecast should be consistent with the outputs from the asset model.

Note: * Current activities and costs (currently funded). (DELETE should be consistent with the Form 3 budget shown in the Expenditure Template).

** Desired activities and costs to sustain current service levels and achieve minimum life cycle costs (not currently funded) (DELETE - should align with the Message of the AMP).

INSERT current, desired and agreed service levels – See guidelines for examples of levels of service (DELETE this sentence)

It is important to monitor the service levels provided regularly as these will change. The current performance is influences by work efficiencies and technology, and customer priorities will change over time. Review and establishment of the agreed position which achieves the best balance between service, risk and cost is essential.

4. FUTURE DEMAND

4.1 Demand Drivers

Drivers affecting demand include things such as population change, regulations, changes in demographics, seasonal factors, vehicle ownership rates, consumer preferences and expectations, technological changes, economic factors, agricultural practices, environmental awareness, etc.

4.2 Demand Forecasts

The present position and projections for demand drivers that may impact future service delivery and use of assets were identified and are documented in Table 4.3.

4.3 Demand Impact on Assets

The impact of demand drivers that may affect future service delivery and use of assets are shown in Table 4.3.

Table 4.3: Demand Drivers, Projections and Impact on Services

Demand drivers	Present position	Projection	Impact on services
Red Deer River Flow	"[Enter current position]"	"[Enter projection]"	"[Enter imact on service]"
Climate Change Adaptation	"[Enter current position]"	"[Enter projection]"	"[Enter imact on service]"
New Developments	"[Enter current position]"	"[Enter projection]"	"[Enter imact on service]"

4.4 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Non-asset solutions focus on providing the required service without the need for asset ownership and management actions including reducing demand for the service, reducing the level of service (allowing some assets to deteriorate beyond current service levels) or educating customers to accept appropriate asset failures[5]. Examples of non-asset solutions include providing services from existing infrastructure such as aquatic facilities and libraries that may be in another community area or public toilets provided in commercial premises.

Opportunities identified to date for demand management are shown in Table 4.4. Further opportunities will be developed in future revisions of this asset management plan.

Table 4.4: Demand Management Plan Summary

Demand Driver	Impact on Services	Demand Management Plan
Red Deer River	"[Enter imact on service]"	Contain the Red Deer River within its channel up to a flow of 1640 cms.
Climate Change	"[Enter imact on service]"	Ensure the containment system (dykes) allows for additional dyking to be completed which contains flows in excess of 1640 cms.
New Developments		• Do not build within the river channel

[5] IPWEA, 2015, IIMM, Table 3.4.1, p 3|89.

		• Build according to new flood regulations and building codes • Main floor to be 1m above flow level of 1640 cms

Tab to create additional rows and copy/paste rows incl. "[Enter … etc.]" macro button as required DELETE this sentence

4.5 Asset Programs to meet Demand

The new assets required to meet growth will be acquired free of cost from land developments and constructed/acquired. New assets constructed/acquired are discussed in Section 5.5. The summary of the cumulative value of new contributed and constructed asset values is shown in Figure 1.

Figure 1: Upgrade and New Assets to meet Demand – (Cumulative)

(Insert graph of new assets to meet demand– see Guidelines for details – DELETE)

In order to accommodate the demand identified in section 4.4, the Town of Drumheller needs to catch up and keep up with dynamic demand. Maintenance strategies and policies will have to be developed to meet the demands of section 4.4. Dependent upon the frequency and intensity of future events in the channel, additional maintenance may be required. This maintenance is of the highest priority and must be carried out to ensure the integrity of the system – it is not optional in the context of the financial strategy and the asset management plan.

Acquiring these new assets will commit ongoing operations, maintenance and renewal costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operations, maintenance and renewal costs in Section 5.

5. LIFECYCLE MANAGEMENT PLAN

The lifecycle management plan details how the Town plans to manage and operate the assets at the agreed levels of service (defined in Section 3) while managing life cycle costs.

5.1 Background Data

5.1.1 Physical parameters

The assets covered by this asset management plan are shown in Table 2.1.

These stable earthen dykes and concrete structures (roads, trails, etc.) are exceeding over a century in their current lifecycle (e.g. rail lines). It is expected that with proper maintenance, they will survive several more lifecycles of a 100 years or more. It must be noted however, that the changing climate may dictate permanent structures be made to the current system in order to defend against increased frequency of flooding.

The age profile of the assets included in this AM Plan are shown in Figure 2.

Figure 2: Asset Age Profile
(Insert graph of asset age profile where available – DELETE)

Add Comment about the age profile e.g. the timing of when these new assets will require renewal funding in the future DELETE.

Plans showing the "[Enter asset category]" assets are:

- "[Enter reference to overall plan of asset system]"
- "[Enter reference to overall plan of asset system]"
- "[Enter reference to overall plan of asset system]"
- "[Enter reference to overall plan of asset system]"

5.1.2 Asset capacity and performance

Assets are generally provided to meet design standards where these are available.

Locations where deficiencies in service performance are known are detailed in Table 5.1.2.

Table 5.1.2: Known Service Performance Deficiencies

Location	Service Deficiency
"[Enter location]"	"[Enter performance deficiency]"
"[Enter location]"	"[Enter performance deficiency]"
"[Enter location]"	"[Enter performance deficiency]"
"[Enter location]"	"[Enter performance deficiency]"

Tab to create additional rows and copy/paste "[Click here & type etc.]" macro button as required (DELETE this sentence)

The above service deficiencies were identified from "[Enter source of information]" .

5.1.3 Asset condition

Condition is monitored "[Enter brief desription of condition monitoring frequency and methodology]"

Or

Condition is not currently monitored in a formal way

The condition profile of our assets is shown in Figure 3.

Fig 3: Asset Condition Profile

(Insert graph of asset condition profile if available – DELETE)

This graph is available on the NAMS.PLUS3 web site where Method 1 (Asset Register) is used and condition data is entered .

Add Comment about the condition distribution DELETE.

Condition is measured using a 1 – 5 grading system[6] as detailed in Table 5.1.3.

Table 5.1.3: Simple Condition Grading Model

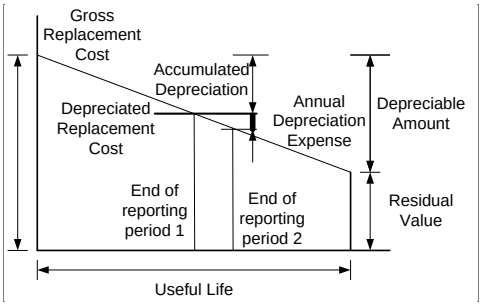
Condition Grading	Description of Condition
1	**Very Good**: only planned maintenance required
2	**Good**: minor maintenance required plus planned maintenance
3	**Fair**: significant maintenance required
4	**Poor**: significant renewal/rehabilitation required
5	**Very Poor**: physically unsound and/or beyond rehabilitation

5.1.4 Asset valuations

The value of assets recorded in the asset register as at "[Enter reporting date]" covered by this asset management plan is shown below. Assets were last revalued at "[Enter revaluation date]" . Assets are valued at "[Enter basis of valuation method, eg fair value at cost to replace service capacity, etc]"

Gross Replacement Cost	$1
Depreciable Amount	$1
Depreciated Replacement Cost[7]	$1
Annual Average Asset Consumption	$1

Useful lives were reviewed in "[Enter month and year]" by "[Enter brief description of useful life review methodology]" .



[6] IPWEA, 2015, IIMM, Sec 2.5.4, p 2|80.
[7] Also reported as Written Down Value, Carrying or Net Book Value.

Key assumptions made in preparing the valuations were:

- "[Enter key assumption]"
- "[Enter key assumption]"
- "[Enter key assumption]"

Major changes from previous valuations are due to
"[Enter brief explanation for major changes from previous valuations]"

Various ratios of asset consumption and expenditure have been prepared to help guide and gauge asset management performance and trends over time.

Rate of Annual Asset Consumption 100%

(Depreciation/Depreciable Amount)

Rate of Annual Asset Renewal 100%

(Capital renewal expenditure/Depreciable amount)

In 2018 will renew assets at "[Enter asset renewal/consumption %]" of the rate they are being consumed and will be increasing its asset stock by "[Enter asset upgrade/new + contrib %]" in the year.

5.1.5 Historical Data

Dykes were built in the 80s, 90s, and 2000s. There has not been enough history to determine a thorough a lifecycle management plan for these dykes as they are rather new in their useful life. Further analysis and time is required and relevant historical data is in creation.

5.2 Operations and Maintenance Plan

Operations include regular activities to provide services such as public health, safety and amenity, e.g. cleaning, street sweeping, grass mowing and street lighting.

Routine maintenance is the regular on-going work that is necessary to keep assets operating, including instances where portions of the asset fail and need immediate repair to make the asset operational again, e.g. road patching.

5.2.1 Operations and Maintenance Plan

Operations activities affect service levels including quality and function through the types and timing of activities, and the design of the infrastructure. Examples of these include street sweeping and grass mowing frequency, intensity and spacing of street lights and cleaning frequency and opening hours of building and other facilities.

Maintenance includes all actions necessary for retaining an asset as near as practicable to an appropriate service condition including regular ongoing day-to-day work necessary to keep assets operating. E.g. road patching but excluding rehabilitation or renewal. Maintenance may be classified into reactive, planned and specific maintenance work activities.

Reactive maintenance is unplanned repair work carried out in response to service requests and management/supervisory directions.

Planned maintenance is repair work that is identified and managed through a maintenance management system (MMS). MMS activities include inspection, assessing the condition against failure/breakdown experience, priority

of works, scheduling, actioning the work and reporting what was done to develop a maintenance history and improve maintenance and service delivery performance.

Specific maintenance is replacement of higher value components/sub-components of assets that is undertaken on a regular cycle including repainting, replacing air conditioning units, etc. This work falls below the capital/maintenance threshold but may require a specific budget allocation.

Actual past maintenance expenditure is shown in Table 5.2.1.

Table 5.2.1: Maintenance Expenditure Trends

Year	Maintenance Expenditure	
	Planned and Specific	**Unplanned**
2009-2010	$5,000 / year	$3. 3M of upgrades following 2005 floods
2011	$10,000 / year	$80,000 – Michichi Creek Erosion
2013 - 2017	$10,000 / year	$0
2018 +	$10,000 / year	None expected

Planned maintenance work is currently "[Enter planned & specific mtce exp as % of total]" of total maintenance expenditure.

Maintenance expenditure levels are considered to be adequate to meet projected service levels, which may be less than or equal to current service levels. Where maintenance expenditure levels are such that will result in a lesser level of service, the service consequences and service risks have been identified and service consequences highlighted in this AM Plan and service risks considered in the Infrastructure Risk Management Plan.

Assessment and priority of reactive maintenance is undertaken by staff using experience and judgement.

5.2.2 Operations and Maintenance Strategies

The Town of Drumheller will operate and maintain assets to provide the defined level of service to approved budgets in the most cost-efficient manner. The operation and maintenance activities include:

- Scheduling operations activities to deliver the defined level of service in the most efficient manner,
- Undertaking maintenance activities through a planned maintenance system to reduce maintenance costs and improve maintenance outcomes. Undertake cost-benefit analysis to determine the most cost-effective split between planned and unplanned maintenance activities (50 – 70% planned desirable as measured by cost),
- Maintain a current infrastructure risk register for assets and present service risks associated with providing services from infrastructure assets and reporting Very High and High risks and residual risks after treatment to management.
- Review current and required skills base and implement workforce training and development to meet required operations and maintenance needs,
- Review asset use to identify under used assets and appropriate remedies, and over used assets and customer demand management options,
- Maintain a current hierarchy of critical assets and required operations and maintenance activities,
- Develop and regularly review appropriate emergency response capability,
- Review management of operations and maintenance activities to ensure best value for the resources used.

Asset hierarchy

An asset hierarchy provides a framework for structuring data in an information system to assist in collection of data, reporting information and making decisions. The hierarchy includes the asset class and component used for asset planning and financial reporting and service level hierarchy used for service planning and delivery.

The service hierarchy is shown is Table 5.2.2.

Table 5.2.2: Asset Service Hierarchy

Service Hierarchy	Service Level Objective
Rail, highway, road, dyke	Operable, fail
Earth structures, concrete structures	Operable, fail

Critical Assets

Critical assets are those assets which have a high consequence of failure but not necessarily a high likelihood of failure. By identifying critical assets and critical failure modes, investigative activities, maintenance plans and capital expenditure plans can be targeted at the appropriate time.

Operations and maintenances activities may be targeted to mitigate critical assets failure and maintain service levels. These activities may include increased inspection frequency, higher maintenance intervention levels, etc. Critical assets failure modes and required operations and maintenance activities are detailed in Table 5.3.2.1.

Table 5.2.2.1: Critical Assets and Service Level Objectives

Critical Assets	Critical Failure Mode	Operations & Maintenance Activities
Warning system	Does not work	Test operate
Stockpiles for emergencies	Not enough stock, inaccessible	Ensure access and keep in stock
Item maintenance	Item does not work	Check incrementally

Standards and specifications

Maintenance work is carried out in accordance with the following Standards and Specifications.

- No AB standard for dykes.
- US Army Corps
- Good engineering practice

Deferred maintenance, i.e. works that are identified for maintenance and unable to be funded are to be included in the risk assessment and analysis in the infrastructure risk management plan.

Maintenance is funded from the operating budget where available.

6. RISK MANAGEMENT PLAN

The purpose of infrastructure risk management is to document the results and recommendations resulting from the periodic identification, assessment and treatment of risks associated with providing services from infrastructure, using the fundamentals of International Standard ISO 31000:2009 Risk management – Principles and guidelines.

Risk Management is defined in ISO 31000:2009 as: "coordinated activities to direct and control with regard to risk"[8].

An assessment of risks[9] associated with service delivery from infrastructure assets has identified critical risks that will result in loss or reduction in service from infrastructure assets or a 'financial shock'. The risk assessment process identifies credible risks, the likelihood of the risk event occurring, the consequences should the event occur, develops a risk rating, evaluates the risk and develops a risk treatment plan for non-acceptable risks.

6.1 Critical Assets

Critical assets are defined as those which have a high consequence of failure causing significant loss or reduction of service. Similarly, critical failure modes are those which have the highest consequences.

Research on critical assets has not yet been undertaken. This will be investigated in future updates of the asset management plan.

OR

Critical assets have been identified, their typical failure mode and the impact on service delivery are as follows:

Table 6.1 Critical Assets

Critical Asset(s)	Failure Mode	Impact
Dyke System	Mechanical problems (e.g. Flap gate)	System function is inhibited
Dyke System	Structural problems (e.g. Slump, slide, eroded rip-rap / armoring	System function is inhibited
Dyke System	Flow exceeds capacity of system	System function is inhibited

By identifying critical assets and failure modes investigative activities, condition inspection programs, maintenance and capital expenditure plans can be targeted at the critical areas.

[8] ISO 31000:2009, p 2

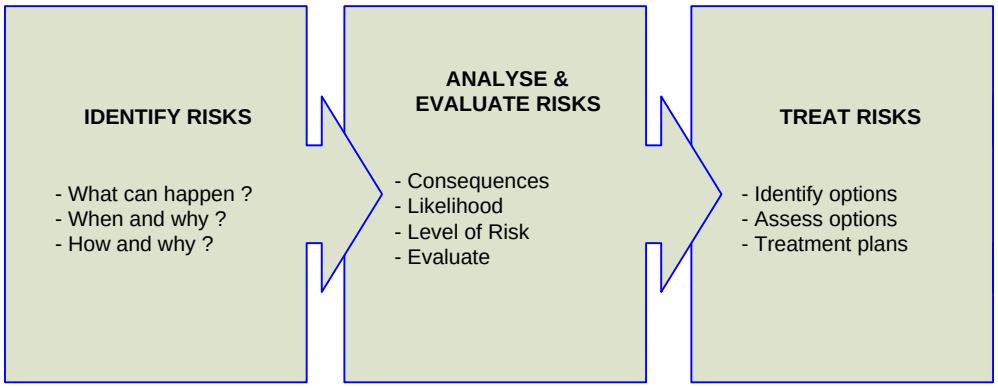
6.2 Risk Assessment

The risk management process used in this project is shown in Figure 6.2 below.

It is an analysis and problem-solving technique designed to provide a logical process for the selection of treatment plans and management actions to protect the community against unacceptable risks.

The process is based on the fundamentals of ISO risk assessment standard ISO 31000:2009.

Fig 6.2 Risk Management Process – Abridged



The risk assessment process identifies credible risks, the likelihood of the risk event occurring, the consequences should the event occur, develops a risk rating, evaluates the risk and develops a risk treatment plan for non-acceptable risks.

An assessment of risks[10] associated with service delivery from infrastructure assets has identified the critical risks that will result in significant loss, 'financial shock' or a reduction in service.

Critical risks are those assessed with 'Very High' (requiring immediate corrective action) and 'High' (requiring corrective action) rating identified in the Infrastructure Risk Management Plan. The residual risk and treatment cost after the selected treatment plan is operational is shown in Table 6.2.

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	L	L	M	M	H
Unlikely	L	L	M	M	H
Possible	L	M	H	H	H
Likely	M	M	H	H	VH
Almost Certain	M	H	H	VH	VH

[10] REPLACE with Reference to the Corporate or Infrastructure Risk Management Plan as the footnote

Ref: HB 436:2004, Risk Management Guidelines, Table 6.6, p 55.

6.3 Infrastructure Resilience Approach

The resilience of our critical infrastructure is vital to our customers and the services we provide. To adapt to changing conditions and grow over time we need to understand our capacity to respond to possible disruptions and be positioned to absorb disturbance and act effectively in a crisis to ensure continuity of service.

To enhance our capacity to manage unforeseen or unexpected risk to the continuity of operations we take an infrastructure resilience approach using an 'all hazards' methodology.

The 'all-hazards' approach involves:

- An initial assessment of critical assets;
- A resilience assessment for these assets; and
- Identification of related improvements or interventions

Resilience is built on aspects such as response and recovery planning, financial capacity and crisis leadership.

Our current measure of resilience is shown in Table 6.4 which includes the type of threats and hazards, resilience assessment and identified improvements and/or interventions.

Table 6.4: Resilience

Threat / Hazard	Resilience LMH	Improvements / Interventions
"[Enter threat / hazard]"	"[Enter Low / Medium / High]"	
"[Enter threat / hazard]"	"[Enter Low / Medium / High]"	
"[Enter threat / hazard]"	"[Enter Low / Medium / High]"	

6.4 Service and Risk Trade-Offs

The decisions made in adopting this AM Plan are based on the objective to achieve the optimum benefits from the available resources.

Options were considered based on the development of 3 scenarios.

Scenario 1 - What we would like to do based on asset register data

Scenario 2 – What we should do with existing budgets and identifying level of service and risk consequences (i.e. what are the operations and maintenance and capital projects we are unable to do, what is the service and risk consequences associated with this position). This may require several versions of the AM Plan.

Scenario 3 – What we can do and be financially sustainable with AM Plans matching long-term financial plans.

The Asset Management Plan provides the tools for discussion with the "[Enter Board / Governing Body]" and customers/community on trade-offs between what we would like to do (scenario 1) and what we should be doing with existing budgets (scenario 2) by balancing changes in services and service levels with affordability and acceptance of the service and risk consequences of the trade-off position (scenario 3).

This AM Plan has been developed using scenario 1, 2 and/or 3.

UPDATE/DELETE as appropriate.

6.4.1 What we cannot do

There are some operations and maintenance activities and capital projects that are unable to be undertaken within the next 10 years. These include:

- "[Enter relevant O&M activity / capital project]"
- "[Enter relevant O&M activity / capital project]"
- "[Enter relevant O&M activity / capital project]"
- "[Enter relevant O&M activity / capital project]"

6.4.2 Service trade-off

Operations and maintenance activities and capital projects that cannot be undertaken will maintain or create service consequences for users. These include:

- "[Enter associated service consequence]"
- "[Enter associated service consequence]"
- "[Enter associated service consequence]"
- "[Enter associated service consequence]"

6.4.3 Risk trade-off

The operations and maintenance activities and capital projects that cannot be undertaken may maintain or create risk consequences. These include:

- "[Enter associated risk consequence]"
- "[Enter associated risk consequence]"
- "[Enter associated risk consequence]"
- "[Enter associated risk consequence]"

These actions and expenditures are considered in the projected expenditures.

7. FINANCIAL SUMMARY

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

7.1 Financial Statements and Projections

The financial projections are shown in Fig 7 for projected operating (operations and maintenance) and capital expenditure (renewal and upgrade/expansion/new assets). Note that all costs are shown in real values.

Fig 7: Projected Operating and Capital Expenditure

(Insert graph of projected future operating and capital expenditure – see guidelines for details – DELETE)

Add Comment interpreting Figure DELETE.

7.1.1 Sustainability of service delivery

There are four key indicators for service delivery sustainability that have been considered in the analysis of the services provided by this asset category, these being the asset renewal funding ratio, long term life cycle costs/expenditures and medium term projected/budgeted expenditures over 5 and 10 years of the planning period.

Asset Renewal Funding Ratio

Asset Renewal Funding Ratio[11] "[Enter asset renewal funding ratio %]"

The Asset Renewal Funding Ratio is the most important indicator and reveals that over the next 10 years of the forecasting that we will have "[Enter asset renewal funding ratio %]" of the funds required for the optimal renewal and replacement of assets.

Long term - Life Cycle Cost

Life cycle costs (or whole of life costs) are the average costs that are required to sustain the service levels over the asset life cycle. Life cycle costs include operations and maintenance expenditure and asset consumption (depreciation expense). The life cycle cost for the services covered in this asset management plan is "[Enter life cycle cost]" per year (average operations and maintenance expenditure plus depreciation expense projected over 10 years).

Life cycle costs can be compared to life cycle expenditure to give an initial indicator of affordability of projected service levels when considered with age profiles. Life cycle expenditure includes operations, maintenance and capital renewal expenditure. Life cycle expenditure will vary depending on the timing of asset renewals. The life cycle expenditure over the 10 year planning period is "[Enter life cycle expenditure]" per year (average operations and maintenance plus capital renewal budgeted expenditure in LTFP over 10 years).

A shortfall between life cycle cost and life cycle expenditure is the life cycle gap. The life cycle gap for services covered by this asset management plan is "[Enter life cycle gap]" per year (-ve = gap, +ve = surplus).

[11] AIFMM, 2015, Version 1.0, Financial Sustainability Indicator 3, Sec 2.6, p 9.

Life cycle expenditure is "[Enter life cycle indicator as %age]" of life cycle costs.

The life cycle costs and life cycle expenditure comparison highlights any difference between present outlays and the average cost of providing the service over the long term. If the life cycle expenditure is less than that life cycle cost, it is most likely that outlays will need to be increased or cuts in services made in the future.

Knowing the extent and timing of any required increase in outlays and the service consequences if funding is not available will assist in providing services to their communities in a financially sustainable manner. This is the purpose of the asset management plans and long term financial plan.

Medium term – 10 year financial planning period

This asset management plan identifies the projected operations, maintenance and capital renewal expenditures required to provide an agreed level of service to the community over a 10 year period. This provides input into 10 year financial and funding plans aimed at providing the required services in a sustainable manner.

These projected expenditures may be compared to budgeted expenditures in the 10 year period to identify any funding shortfall. In a core asset management plan, a gap is generally due to increasing asset renewals for ageing assets.

The projected operations, maintenance and capital renewal expenditure required over the 10 year planning period is "[Enter 10 yr Ops, Maint & Renewal Proj Exp]" on average per year.

Estimated (budget) operations, maintenance and capital renewal funding is "[Enter 10 yr Ops, Maint & Renewal LTFP Budget Exp]" on average per year giving a 10 year funding shortfall of "[Enter 10 yr financing shortfall]" per year. This indicates "[Enter 10 yr financing indicator as % age]" of the projected expenditures needed to provide the services documented in the asset management plan.

Medium Term – 5 year financial planning period

The projected operations, maintenance and capital renewal expenditure required over the first 5 years of the planning period is "[Enter 5 yr Ops, Maint & Renewal Proj Exp]" on average per year.

Estimated (budget) operations, maintenance and capital renewal funding is "[Enter 5 yr Ops, Maint & Renewal LTFP Budget Exp]" on average per year giving a 5 year funding shortfall of "[Enter 5 yr financing shortfall]". This indicates that "[Enter 5 yr financing indicator as % age]" of projected expenditures required to provide the services shown in this asset management plan.

Asset management financial indicators

Figure 7A shows the asset management financial indicators in graphical format over the 10 year planning period and for the long term life cycle.

Figure 7A: Asset Management Financial Indicators

(Insert graph of financial indicators - see guidelines for details – DELETE)

Add Comment interpreting Figure DELETE

Providing services from infrastructure in a sustainable manner requires the matching and managing of service levels, risks, projected expenditures and financing to achieve a financial indicator of approximately 1.0 for the first years of the asset management plan and ideally over the 10-year life of the Long Term Financial Plan.

Figure 8 shows the projected asset renewal and replacement expenditure over the 20 years of the AM Plan. The projected asset renewal and replacement expenditure is compared to renewal and replacement expenditure in the capital works program, which is accommodated in the long term financial plan

Figure 8: Projected and LTFP Budgeted Renewal Expenditure

(Insert graph of projected renewal and replacement expenditure and expenditure accommodated in long term financial plan - see guidelines for details – DELETE)

Add Comment interpreting Figure DELETE

Table 7.1.1 shows the shortfall between projected renewal and replacement expenditures and expenditure in the long term financial plan. Budget expenditures accommodated in the long term financial plan or extrapolated from current budgets are shown in Appendix D.

Table 7.1.1: Projected and LTFP Budgeted Renewals and Financing Shortfall

Year	**Projected Renewals** ($000)	**LTFP Renewal Budget** ($000)	**Renewal Financing Shortfall** ($000) (-ve Gap, +ve Surplus)	**Cumulative Shortfall** ($000) (-ve Gap, +ve Surplus)

Copy and paste values from NAMS.PLUS3 Report 5 (DELETE this sentence)

Providing services in a sustainable manner will require matching of projected asset renewal and replacement expenditure to meet agreed service levels with **the corresponding** capital works program accommodated in the long term financial plan.

A gap between projected asset renewal/replacement expenditure and amounts accommodated in the LTFP indicates that further work is required on reviewing service levels in the AM Plan (including possibly revising the LTFP) before adopting the asset management plan to manage required service levels and funding to eliminate any funding gap.

We will manage the 'gap' by developing this asset management plan to provide guidance on future service levels and resources required to provide these services, and review future services, service levels and costs with the community.

DELETE above paragraphs when projected expenditure to provide the required level of service is fully accommodated in the long-term financial plan.

7.1.2 Projected expenditures for long term financial plan

Table 7.1.2 shows the projected expenditures for the 10 year long term financial plan.

Expenditure projections are in"[Enter relevant financial year]" real values.

Table 7.1.2: Projected Expenditures for Long Term Financial Plan ($000)

Year	Operations ($000)	Maintenance ($000)	Projected Capital Renewal ($000)	Capital Upgrade/ New ($000)	Disposals ($000)
2018	$50,000	$100,000	$30,000	$6.3 M	$0

Copy and paste values from NAMS.PLUS3 Report 5 (DELETE this sentence)

8 Plan Improvement and Monitoring

8.1 Improvement Plan

The asset management improvement plan generated from this asset management plan is shown in Table 8.2.

Table 8.2: Improvement Plan

Task No	Task	Responsibility	Resources Required	Timeline
1	Establish a flood mitigation system advisory committee for advice.			
2	Develop a flood mitigation emergency preparedness plan			
3	Put monitoring within the river			
4	Develop the AMP in two cycles (completion 2020)			
5				
6				
7				
8				
9				
10				

8.2 Monitoring and Review Procedures

This asset management plan will be reviewed during annual budget planning processes and amended to show any material changes in service levels and/or resources available to provide those services as a result of budget decisions.

The AM Plan will be updated annually to ensure it represents the current service level, asset values, projected operations, maintenance, capital renewal and replacement, capital upgrade/new and asset disposal expenditures and projected expenditure values incorporated into the long term financial plan.

The AM Plan has a life of 4 years ("[Enter Board / Governing Body]") and is due for complete revision and updating within "[Enter review time limit]" of each "[Enter Board / Governing Body]" election.

8.3 Performance Measures

The effectiveness of the asset management plan can be measured in the following ways:

- The degree to which the required projected expenditures identified in this asset management plan are incorporated into the long term financial plan,
- The degree to which 1-5 year detailed works programs, budgets, business plans and corporate structures take into account the 'global' works program trends provided by the asset management plan,
- The degree to which the existing and projected service levels and service consequences (what we cannot do), risks and residual risks are incorporated into the Strategic Plan and associated plans,
- The Asset Renewal Funding Ratio achieving the target of 1.0.

9. REFERENCES

- IPWEA, 2006, 'International Infrastructure Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/IIMM
- IPWEA, 2008, 'NAMS.PLUS Asset Management', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/namsplus.
- IPWEA, 2015, 2nd edn., 'Australian Infrastructure Financial Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/AIFMM.
- IPWEA, 2015, 3rd edn., 'International Infrastructure Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/IIMM

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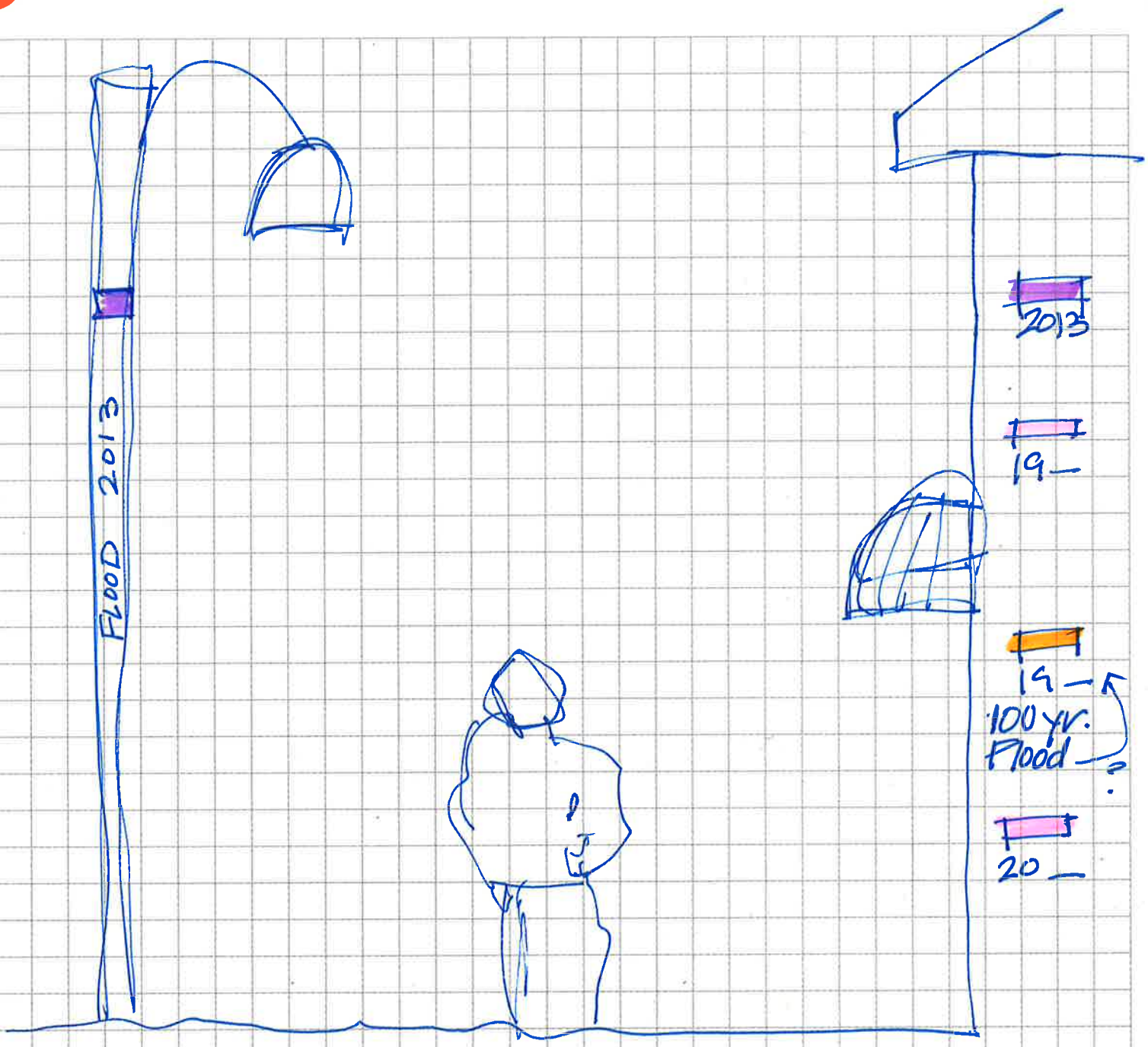
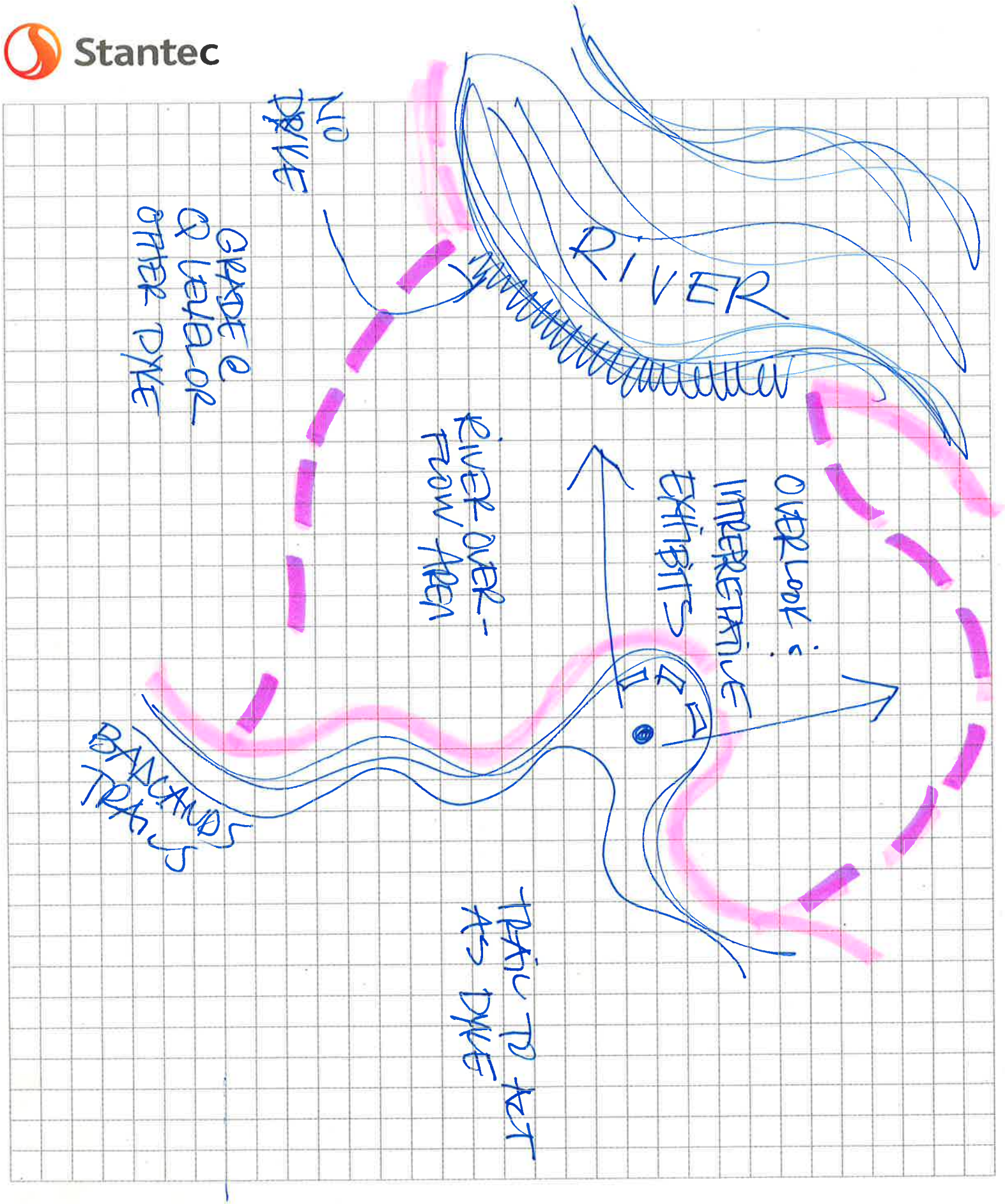


Educate flood potential through context

Designed by:

Checked by:

Stantec



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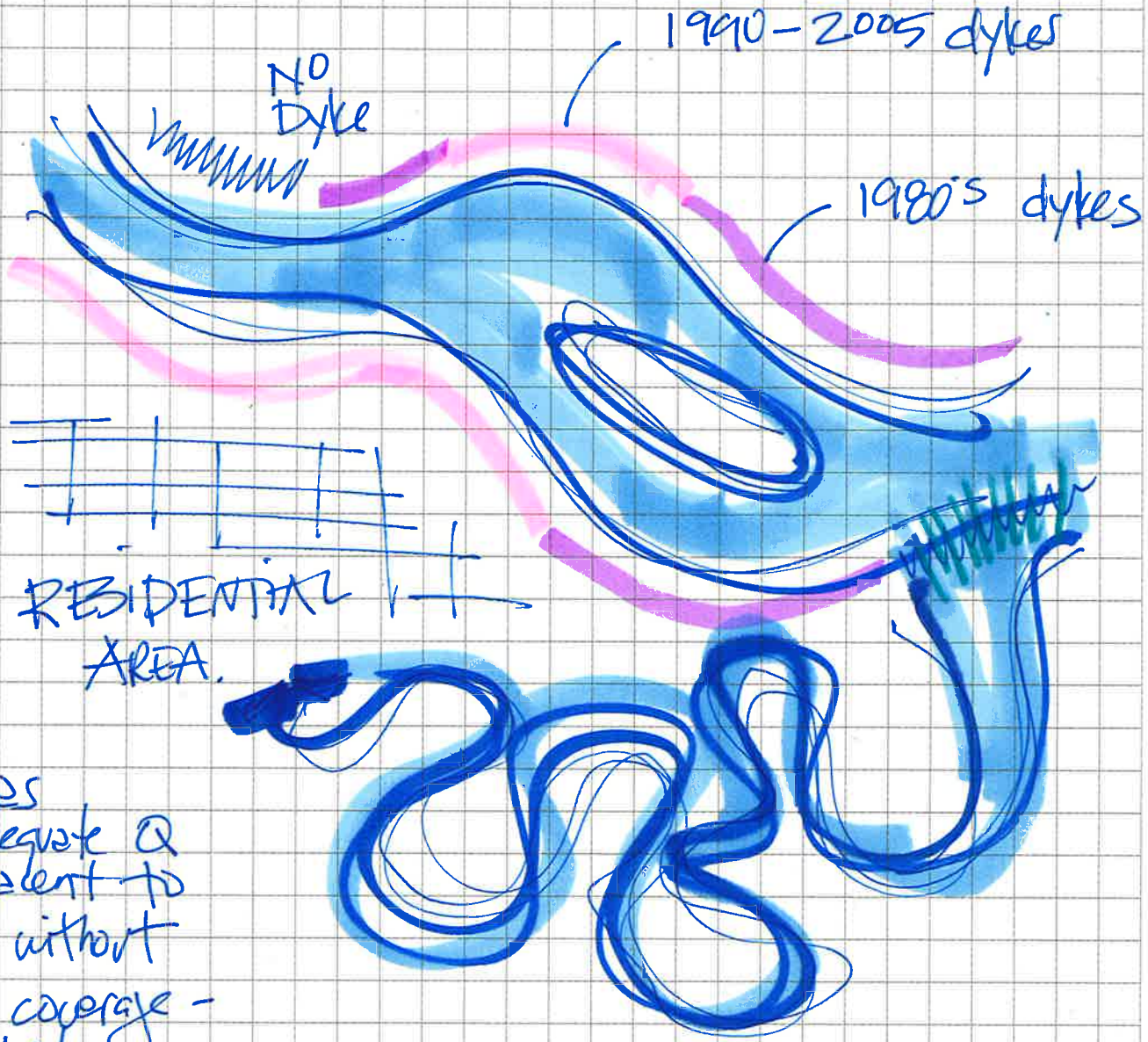

residential areas may have adequate @ protection adjacent to them - but without comprehensive coverage - water can find its way into populated areas.

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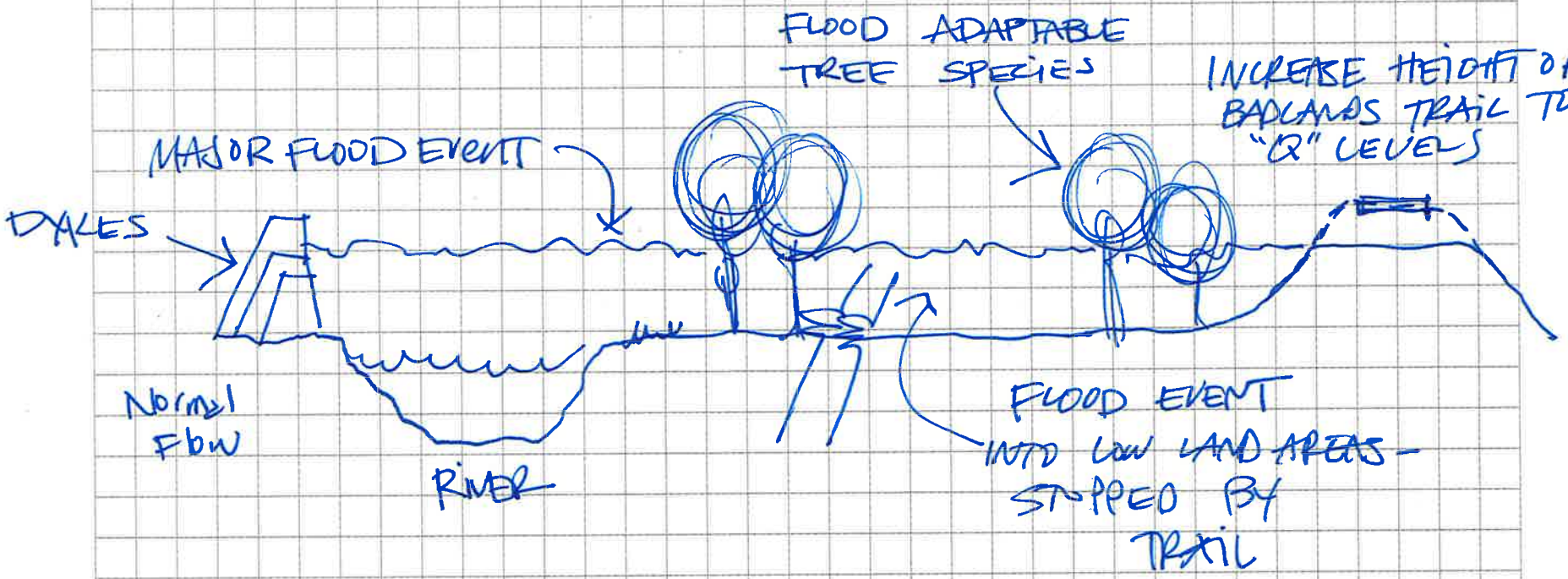


BADLANDS TRAIL SYSTEM.

Stantec

Checked by:

Designed by:

Envision Rating System
Pre-Assessment Checklist
Results Table

				Y	N	NA	
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve Community Quality of Life	2	1	0	2 of 3
2			QL1.2 Stimulate Sustainable Growth and Development	3	0	0	3 of 3
3		COMMUNITY	QL1.3 Develop Local Skills and Capabilities	3	0	0	3 of 3
4			QL2.1 Enhance Public Health and Safety	1	0	0	1 of 1
5			QL2.2 Minimize Noise and Vibration	0	1	0	0 of 1
6			QL2.3 Minimize Light Pollution	0	0	1	0 of 0
7			QL2.4 Improve Community Mobility and Access	2	1	0	2 of 3
8			QL2.5 Encourage Alternative Modes of Transportation	2	0	0	2 of 2
9			QL2.6 Improve Site Accessibility, Safety and Wayfinding	3	0	0	3 of 3
10		WELLBEING	QL3.1 Preserve Historic and Cultural Resources	2	0	0	2 of 2
11			QL3.2 Preserve Views and Local Character	2	0	0	2 of 2
12			QL3.3 Enhance Public Space	1	1	0	1 of 2
			TOTAL	21	4	1	21 of 25
13	LEADERSHIP	COLLABORATION	LD1.1 Provide Effective Leadership and Commitment	2	1	0	2 of 3
14			LD1.2 Establish a Sustainability Management System	1	0	0	1 of 1
15			LD1.3 Foster Collaboration and Teamwork	3	0	0	3 of 3
16			LD1.4 Provide for Stakeholder Involvement	3	0	0	3 of 3
17		MANAGEMENT	LD2.1 Pursue By-product Synergy Opportunities	0	1	0	0 of 1
18			LD2.2 Improve Infrastructure Integration	3	0	0	3 of 3
19		PLANNING	LD3.1 Plan for Long-term Monitoring and Maintenance	2	0	0	2 of 2
20			LD3.2 Address Conflicting Regulations and Policies	1	1	0	1 of 2
21			LD3.3 Extend Useful Life	1	0	0	1 of 1
			TOTAL	16	3	0	16 of 19
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	1	1	0	1 of 2
23			RA1.2 Support Sustainable Procurement Practices	3	0	0	3 of 3
24			RA1.3 Use Recycled Materials	2	0	0	2 of 2
25			RA1.4 Use Regional Materials	1	1	0	1 of 2
26			RA1.5 Divert Waste from Landfills	3	0	0	3 of 3
27			RA1.6 Reduce Excavated Materials Taken off Site	3	0	0	3 of 3
28			RA1.7 Provide for Deconstruction and Recycling	0	0	3	0 of 0
29		ENERGY	RA2.1 Reduce Energy Consumption	3	0	0	3 of 3
30			RA2.2 Use Renewable Energy	0	2	0	0 of 2
31			RA2.3 Commission and Monitor Energy Systems	2	0	1	2 of 2
32		WATER	RA3.1 Protect Fresh Water Availability	4	3	0	4 of 7
33			RA3.2 Reduce Potable Water Consumption	0	0	4	0 of 0
34			RA3.3 Monitor Water Systems	1	1	2	1 of 2
			TOTAL	23	8	10	23 of 31
35	NATURAL WORLD	SITING	NW1.1 Preserve Prime Habitat	1	4	0	1 of 5
36			NW1.2 Protect Wetlands and Surface Water	2	1	0	2 of 3
37			NW1.3 Preserve Prime Farmland	0	0	1	0 of 0
38			NW1.4 Avoid Adverse Geology	3	0	0	3 of 3
39			NW1.5 Preserve Floodplain Functions	5	1	0	5 of 6
40			NW1.6 Avoid Unsuitable Development on Steep Slopes	2	0	0	2 of 2
41			NW1.7 Preserve Greenfields	2	0	0	2 of 2
42		LAND & WATER	NW2.1 Manage Stormwater	0	0	2	0 of 0
43			NW2.2 Reduce Pesticide and Fertilizer Impacts	0	0	5	0 of 0
44			NW2.3 Prevent Surface and Groundwater Contamination	4	0	0	4 of 4
45		BIODIVERSITY	NW3.1 Preserve Species Biodiversity	3	1	0	3 of 4
46			NW3.2 Control Invasive Species	2	1	0	2 of 3
47			NW3.3 Restore Disturbed Soils	1	1	0	1 of 2
48			NW3.4 Maintain Wetland and Surface Water Functions	4	1	0	4 of 5
			TOTAL	29	10	8	29 of 39
49	CLIMATE	EMISSION	CR1.1 Reduce Greenhouse Gas Emissions	2	0	0	2 of 2
50			CR1.2 Reduce Air Pollutant Emissions	0	2	0	0 of 2
51		RESILIENCE	CR2.1 Assess Climate Threat	1	0	0	1 of 1
52			CR2.2 Avoid Traps and Vulnerabilities	2	0	0	2 of 2
53			CR2.3 Prepare for Long-term Adaptability	1	0	0	1 of 1
54			CR2.4 Prepare for Short-term Hazards	2	0	0	2 of 2
55			CR2.5 Manage Heat Island Effects	0	1	0	0 of 1
			TOTAL	8	3	0	8 of 11

August 15, 2013

DISASTER RECOVERY PROGRAM FLOOD MITIGATION MEASURES

PURPOSE

To outline alternative solutions for minimum flood mitigation measures when building owners apply for Disaster Recovery Program (DRP) funding to perform repairs or rebuild on their property.

DISCUSSION

The scale of damage and obstacles to recovery as a result of the 2013 flooding in Southern Alberta has resulted in the decision by the Government of Alberta to appoint an advisory panel on community flood mitigation, to provide direct input on the latest flood prevention technology from around the world. In the interim period, flood mitigation measures have been established and revised through consultation with municipalities, industry and owners to provide minimum impact to the building structure and systems. The measures include locating electrical equipment above the flood level and the selection of building materials and finishes which are less likely to be damaged by flood water or easier to restore. These measures are consistent with the recognized disaster recovery mitigation measures under the Government of Canada's Disaster Financial Assistance Arrangements (DFFA) Guidelines and the U.S. Federal Emergency Management Agency (FEMA).

All flood mitigation measures are to be included under one flood mitigation permit form (see attached form) issued by the DRP and certified by a safety codes officer employed by the municipality or an accredited agency. The municipality or accredited agency will include all measures under the flood mitigation permit form and perform necessary inspections by the appropriate safety codes officers. The flood mitigation permit form certifies compliance with flood mitigation measures when signed and dated by a safety codes officer.

GENERAL REQUIREMENTS

Homeowners and small businesses located in the flood fringe must take the minimum flood mitigation measures identified below to satisfy conditions for DRP funding in the flood fringe. The following measures are referred to as "wet flood-protection", which are intended only to minimize damage and to speed restoration in the event of a flood. This is accomplished in four primary ways:

1. Basements. The objective is to minimize moisture damage or facilitate disposal of materials and restoration.

   Alternative solutions require moisture resistant flooring and include but are not limited to:
   - The choice to leave the basement unfinished and use minimal materials;
   - The choice to use cleanable and moisture resistant materials;
   - The choice to use disposable materials allowing for easy restoration.

Issue of this STANDATA is authorized by
the Chief Administrators in Building, Electrical and
Plumbing and Gas.

Alberta Government

Safety Codes Council

Alberta Municipal Affairs – Safety Services, 16th Floor, 10155-102 Street, Edmonton, Alberta, Canada, T5J 4L4
Safety Codes Council, Suite 1000, 10665 Jasper Avenue, Edmonton, Alberta, Canada, T5J 3S9

2. Electrical equipment: The objective is to minimize the risk to life safety by providing a safe means to de-energize and re-energize the building. This allows for the de-energization of electrical equipment without having to access the basement and stand in flood water. Another consideration is being able to supply power for restoration services while being able to isolate electrical equipment damaged or made unsafe from flood waters.

   Alternative solutions include but are not limited to:
   - Re-locate the main electrical panel out of the basement and isolate circuits feeding electrical outlets and equipment in the basement so that power can be restored quickly in the event of a flood.
   - Installing a weather proof service disconnect switch on the outside of the building between the meter socket and the existing panel in the basement. This switch would have provisions for disconnection of the existing panel.
   - Installing a service panel in the garage if one exists, and feeding the house as a sub-panel. Receptacles within the garage could supply power for restoration, while the house remains de-energized.

   The Canadian Electrical Code rules regarding location and clearances for electrical panels would still apply in all cases. Other installation methods may be acceptable. Contact the Authority Having Jurisdiction (municipality or accredited agency) in your area for clarification.

3. Penetrations: The objective is to minimize water seepage into the building.

   Alternative solutions include but are not limited to:
   - Seal piping, wiring, conduit penetrations at basement walls.
   - More extensive sealing of penetrations such as windows and other exterior measures may have unintended consequences (i.e. the prevention of emergency window egress) and therefore should be undertaken on the advice of a professional.

4. The objective is to protect plumbing fixtures/equipment located in basements from backflow from the public sewers.
   - Solution: Backflow prevention devices are required under the National Plumbing Code as adopted by regulation in Alberta. All backflow prevention devices shall be installed in accordance with manufacturer's recommendations and the Plumbing Regulations.
   - Plumbing fixtures/equipment located in basements shall be protected from backflow from the public sewers. All backflow prevention devices shall be installed in accordance with manufacturer's recommendations and the Plumbing Regulations.

Questions regarding this bulletin may be directed to the Safety Services Branch.
Toll free telephone number: 1-866-421-6929.

[Original Signed]
Harry Li
Acting Chief Building Administrator

[Original Signed]
Sidney Manning
Chief Plumbing and Gas Administrator

[Original Signed]
Dan Niven
Acting Chief Electrical Administrator

APPENDIX NOTES

Acceptable materials for flood damage reduction:

Proper selection of building materials and finishes which are less likely to be damaged by flood water will reduce the extent of damage and amount of time it takes to return the facility to operation. For example, the DFAA relies on "specific repair/rebuilding projects to reduce vulnerability to future emergencies" that include but are not limited to "water resistant building materials instead of drywall"; "changing to exterior basement insulation"; and, "making structural changes to buildings to increase flood-proofing." For more information on provincial mitigation solutions recognized by DFAA and federal funding support to provinces and territories, please link to http://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/gdlns-dsstr-ssstnc/index-eng.aspx#s6

Similar measures are recognized by FEMA for structural materials and finish materials commonly used in the construction of floors, walls, and ceilings, with a level of acceptability given for each material. For example, "Flood damage-resistant material" is defined as "any building product [material, component or system] capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage." The term "prolonged contact" means at least 72 hours, and the term "significant damage" means any damage requiring more than cosmetic repair.

Following is a link to this document:

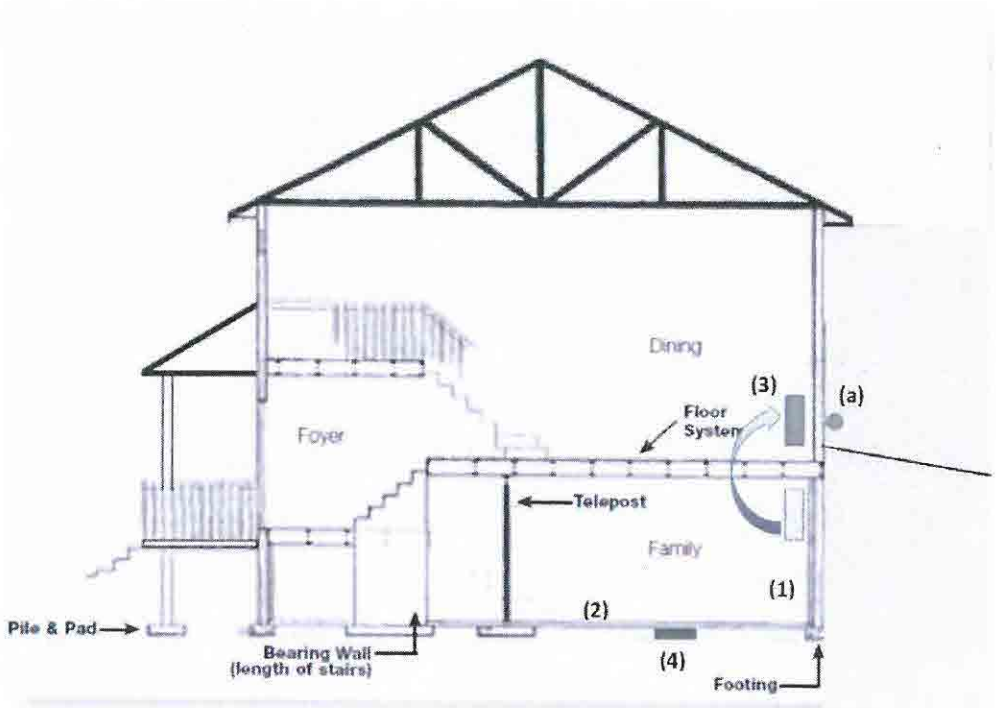
https://s3-us-gov-west-1.amazonaws.com/dam-production/uploads/20130726-1502-20490-4764/fema_tb_2_rev1.pdf

Please note that other applicable requirements of the Alberta Building Code such as flame spread rating, smoke development classification, material standards, etc., must still be complied with.

The following are examples of flood damage-resistant building materials acceptable for reconstruction work under the DRP program. This is not an exhaustive list and in no way precludes the use of other products. Materials and products that are not listed may still be used if accepted by the local building official (Building SCO). In such cases, manufacturers' literature (i.e., specifications, materials, safety data sheets, test reports etc.) may be used to determine if the product meets flood damage-resistance requirements. Acceptance should be based on sufficient evidence provided by the applicant that the materials proposed to be used will resist flood damage without requiring more than cosmetic repair and cleaning.

1. Construction Materials for Walls and Ceilings
    a. brick, metal, concrete, concrete block, porcelain, slate, glass block, stone, and ceramic and clay tile
    b. cement board, reinforced concrete
    c. polyester epoxy paint
    d. pressure treated lumber or steel studs
    e. pressure treated and marine grade plywood
    f. foam and closed-cell insulation
    g. water resistant non-paper faced gypsum exterior sheathing
    h. wall panel, steel
2. Materials for Flooring
    a. concrete, concrete tile and precast concrete
    b. latex or bituminous flooring, ceramic, clay terrazzo
    c. vinyl and rubber sheets and tiles
    d. pressure treated wood
3. Other
    a. metal doors
    b. fibreglass or vinyl doors

Flood Mitigation Sketches



Alternative solution 3- (a)

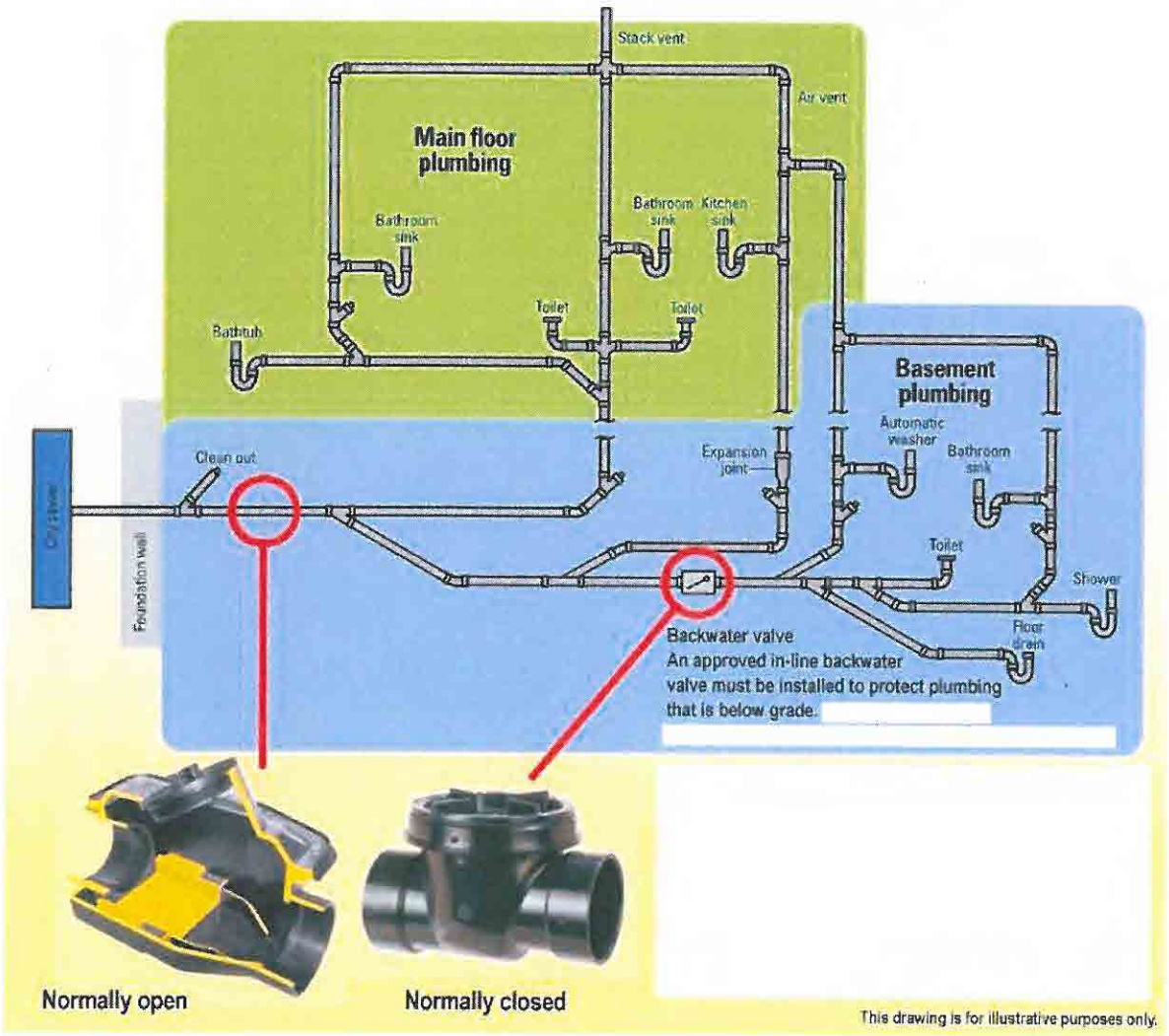
(1)- (2) Walls and Floors: Use cleanable moisture resistance material or materials easy to dispose and restore.

(3) Relocate Electric Panel or use alternative solution (a): mount a service disconnect SWITCH on the outside of the home or garage.

(4) Install a backflow prevention device.

Service Disconnect SWITCH, located outside the house or garage.

Typical household backwater valve installations



Flood Mitigation Permit Form

Disaster Recovery Program

1-866-825-4455

PLEASE PRINT

Project Location			
Project Address			Municipality
Applicant/Owner Information			
Owner Name		Contact Person	Phone
Address (if different than Project Address)			Fax
DRP Reference Number			
Permit Information			
Building	Contractor Name	Building Permit Number	
		Issuer signature (or attach permit copy)	
	Basement Penetrations Sealed	☐ Yes ☐ No ☐ NA (if NA explain)	
	Basement materials Acceptable	☐ Yes ☐ No ☐ NA (if NA explain)	
Building Certified Compliant		SCO Signature	Date
Electrical	Contractor Name	Electrical Permit Number	
		Issuer signature (or attach permit copy)	
	Disconnect or panel above grade	☐ Yes ☐ No ☐ NA (if NA explain)	
	Basement circuits isolated	☐ Yes ☐ No ☐ NA (if NA explain)	
Electrical Certified Compliant		SCO Signature	Date
Plumbing	Contractor Name	Plumbing Permit Number	
		Issuer signature (or attach permit copy)	
	Back Water protection in place	☐ Yes ☐ No ☐ NA (if NA explain)	
Plumbing Certified Compliant		SCO Signature	Date

Project Information		
Applicant's Declaration, I certify that information provided above and/or submitted with this application is true and correct.		
Please Print Name	Signature	
Address	Phone Number	Date

FINAL

TOWN OF DRUMHELLER

REPORT ON

FLOOD PROTECTION 2013

BY

A.E. PALM P ENG.

PALM ENGINEERING LTD.

SEPTEMBER 2013

PALM ENGINEERING LTD
BOX 1209 170 CENTER STREET, DRUMHELLER, ALBERTA T0J 0Y0
PH. / FAX. 403-823-7044

INTRODUCTION

Drumheller has experienced two significant floods since the 1950's which were the result of high stream flow (2005 and 2013). Ice jamming prior to 1980 was an annual concern, but since the construction of the Dickson Dam, we no longer see thick blocky ice at spring breakup.

Most of the main developed area of Drumheller has been protected by dyking. When constructed the dyking was intended to protect to the 1:100 year flood level with a 600 mm freeboard. Dyking was constructed to elevations determined by computer modelling and was paid for by Alberta Environment. The level of stream flow at multiple positions was plotted without dyking influence. It was considered that if the dyking was topped the land affected would be up to the forecast level inspite of the dyking. The main flowing stream was designated as floodway. The backwater, or area of low depth water outside of the main stream, even if protected by dyking, was designated as flood fringe.

Since the 2005 flood, various adjustments have been made to forecast levels by Alberta Environment with new mapping produced altering the forecast 1:100 year flood level.

Records were taken on high water levels in 2005 and adjustments to dykes were made, as well dyking in other areas of the Town was completed; however, some areas of the Town still remain without the provision of dyking.

Although the 2013 flood was in the order of .2 m - .4 m lower than the 2005 flood, better records of high water were obtained. From these records we are able to prove the level of dyking constructed. For the most part, dyking provided was very consistent. We note that the level of dyking provided in central Drumheller is 750 mm higher than the 2013 flood (about 500 mm above the 2005 flood). However, in some areas, particularly Newcastle, the dyke level was only 250 mm above the 2013 level. Other areas of the Town which do not have dyking protection experienced flooding.

Since most of the Town is protected to 750 mm above the 2013 flood, regardless of what return frequency it is, we feel it is a reasonable level of protection and should be extended to all areas of the Town on a consistent basis.

Only so much protection can be provided from river flow. Other factors come into play such as ground water rise and trapped water behind the dyke should a rain storm in the immediate area occur. Whatever dyke level is provided there is always a chance of over topping it.

It is felt that actual field elevations based on a flood experience of high magnitude are a more accurate determination of what protection should be provided. Actual measurements account for actual stream characteristics and present channelization of the flow.

There are however limitations to the use of a set amount above the 2013 flood level:

1) The 2013 flood occurred when there was very low flow on streams entering the Red Deer River within the Town of Drumheller (the major streams being Michichi Creek, Rosebud River and Willow Creek). Stream flows on these inlets to the main flow would certainly have an influence if they were at high flow, particularly in the vicinity, or up stream on these tributaries.
2) Ground water is an unknown factor. Those areas located on gravel bars connected to the river are subject to rapid rise in ground water level inspite of cut off cores below dykes.
3) Local drainage can cause flooding because of the inability to keep all backwater pumped out during a high intensity storm.
4) Backup of flood water in municipal storm and sanitary systems, as well as private septic fields and wells can cause flooding inspite of flood protection.
5) Cut off of wide areas of backwater storage by dyking would have an influence on the elevation of the stream.

In spite of the limitations, this report is based on augmenting the dyke system to a level of 750 mm above the 2013 flood. The preference in construction would be to construct a dyke which is wide enough to take supplemental measures to add additional protected height if, or when, over topping became evident.

Due to variations in freeboard, or variations in inflow conditions, as flood water reaches dyke level, sand bagging of low spots would occur. Pumps would be employed to de-water areas of low intensity overflow to the point that nothing else can be done.

FLOOD PROTECTION MEASURES AND DYKING UPGRADES RECOMMENDED

Nacmine General

The community of Nacmine in Drumheller has not had flood protection dyking. The area west of 7th St. is of normal urban residential density. It is slightly higher in elevation than other areas of the Red Deer River flood plain so has been of lesser priority. Even so, a large portion of the developed area is lower than the protection provided in other areas of Drumheller.

1. WestNacmine

Dyking to provide the same level of protection as central Drumheller (.75 m above 2013 flood), would involve the construction of a dyke from .5 m depth to 1.5 m depth. In some cases private dyking can be enhanced by the construction of a wall or precast barrier. In most cases a low earth dyke would be the most practical. Some clearing of trees is required. But for the most part dykes can be incorporated into existing yards and landscaped to blend in. Access should be maintained for dyke enhancement and water pumping. Numerous small drainage crossings will be necessary which can be fitted with a back flow preventer.

The cost of this section is estimated as follows:

1. Stripping and tree removal	$ 40,000.00
2. Excavation of topsoil and core	$ 60,000.00
3. Drainage piping and back flow preventers	$100,000.00
4. Earth dyke construction	$ 70,000.00
5. Landscaping	$ 30,000.00
6. Precast sections	$150,000.00
7. Engineering & Contingencies 15%	$ 75,000.00
Total	$575,000.00

2. East Central Nacmine

From 7th Street east to the east end of the Nacmine community the residential density is lower characterized by large residential parcels.
From 7th Street to Hunter Close the land is higher along the river with a valley between the river strip and the highway strip. Flood berms would not be required along this section, except at drainage ways through them which would otherwise allow backup of flood water to the lower land behind the river strip.

Estimated Cost:

Flood gates	$150,000.00

3. East Nacmine

From Hunter Close east, although development is still consisting of large residential lots, the land behind these lots drops to a low plane in close proximity to the housing. Housing is .75 m to 1.0 m below recommended flood protection. The plane is 3.3 m – 3.8 m below the target level. This area is the mouth of the previously mentioned valley which would allow back up water to enter the valley in area 2. Earth dyking in this area is recommended as an extension of the developed yards. Rising 1m to 2 m to a 4 m wide berm then dropping off 3.5 m – 4 m.

Estimated Cost:

1. Brush clearing	$ 40,000.00
2. Excavation of top soil and core	$ 38,000.00
3. Drainage piping and back flow prevention	$100,000.00
4. Earth dyke construction	$328,000.00
5. Landscaping	$ 24,000.00
6. Engineering & Contingencies 15%	$ 79,500.00
Total	$609,500.00

4. West Midland

The west end of Midland has an earth dyke constructed in 2008. It is about 1.17 m above the 2013 flood. No improvements are necessary.

5. Central Midland

The poured in place concrete wall has an elevation of about .5 m above the 2013 flood. Seepage through catch basin leads and the paved road was a problem. Faulty backflow preventers and leaky pipes may be present. Some sections of New Jersey barrier are present which do not provide the level of security, nor can they be supplemented should the need arise.

Estimated Cost:

1.Piping repairs		$200,000.00
2. Replacement of New Jersey barriers		$ 50,000.00
3. Engineering & contingencies		$ 37,500.00
	Total	$287,500.00

6. East Midland

This section has an earth berm which is barely up to the recommended grade of .75 m above the 2013 flood. The berm is narrow and is considered by the residents as providing less protection than that provided in other areas of Midland. This dyke is also protecting a high value district. We recommend widening and an increase in height to that comparable to the rest of Midland (.4 m) from 15th Street to the east end of development.

Estimated Cost: $200,000.00

7. West Newcastle

The area is influenced by the narrowing of the river at the front of an island where rapids are present. In front of the rapids the flood water level on this side of the river is higher than the other side. The present dyke is 0 to .5 m lower than the recommended level. A section of this dyke consists of .5 m high precast barriers. It is recommended that the earth berm section be raised by the addition of soil on top of the berm and the side slope on the river side. On the precast barrier section the recommended solution would be to remove the .5 m barriers and replace them with a 1m high precast concrete and gravel flood wall. This cross section will provide the advantages of higher stability as well as a surface that can be added to.

High water flow is producing a scour to the river bank which will need erosion armouring in addition to the dyke level enhancement.

A section of earth dyke and a drainage pipe with back flow preventer is required between N Railway Ave and the CNR tracks.

Estimated Cost:

1. Stripping and tree removal	$ 10,000.00
2. Excavation of topsoil and core	$ 26,000.00
3. Drainage piping and back flow preventers	$ 60,000.00
4. Earth dyke construction	$ 49,000.00
5. Landscaping	$ 10,000.00
6. Precast Concrete & Gravel Flood wall	$ 135,000.00
7. Riverbank Armour	$ 867,000.00
8. Engineering & Contingencies 15%	$ 173,550.00
Total	$1,330,550.00

7 A East Newcastle

Dyking was constructed in 2006 and is generally adequate to the recommended height. There are however, some piping leaks and grading of drainage outfalls required on the river side of the dyke.

Estimated Cost: $ 75,000.00

8. 9th Street Hospital Area

Flood elevations in 2013 were approximately .2 m below the top of the bank in this area. Not only is this a high priority area, because it is flanking the Drumheller Health Complex, it is also the upstream entrance to a large part of North Drumheller (area west of Michichi Creek). Thus if flood water breached this barrier, it would be higher than water backing up the Michichi Creek. Dyking is recommended from the east end of the island to the Michichi Creek entrance. A flood gate would be required at the drainage ditch on the south side of the health complex grounds.

Estimated Cost: (To 9th St. W)

1. Stripping	$ 19,500.00
2. Excavation of topsoil & core	$ 45,500.00
3. Drainage piping & backflow preventers	$ 100,000.00
4. Earth dyke construction	$ 123,500.00
5. Landscaping	$ 13,600.00
6. Engineering & Contingencies 15%	$ 45,315.00
Total	$ 347,415.00

9. North Drumheller Michichi Creek Area

Flood protection dyking was constructed in 2006 on the east side of Michichi Creek. On the west a dyke is required from 9th St. north until it reaches the timber protected wall of the Michichi Creek. A flood gate at the entrance of the drainage ditch at the north end will be required.

Estimated Cost:

1. Stripping and tree removal	$ 12,500.00
2. Excavation of topsoil and core	$ 35,000.00
3. Drainage piping and back flow preventers	$ 80,000.00
4. Earth dyke construction	$ 120,000.00
5. Landscaping	$ 15,000.00
6. Engineering & Contingencies 15%	$ 39,375.00
Total	$ 301,875.00

9A. Central Drumheller 2nd St. W to 5th St. E.

The area is generally protected by dyking to .75 m above 2013 flood level. A storm outfall pipe at 1st St.W and another at the spray park need either construction of flap gates, or repaired.

Estimated Cost: $ 100,000.00

The section of New Jersey barrier in the vicinity of 3rd Avenue should be replaced with a more stable structure having a width that can be added to, such as, the precast concrete and gravel flood wall recommended.

Estimated Cost:

1. Removal of NJ barrier and bed preparation	$ 57,500.00
2. Construction of flood wall	$ 154,000.00
3. Engineering & Contingencies 15%	$ 31,725.00
Total	$ 243,225.00

10. Willow Estates

A short section of dyke is required on the west side of the major drainage channel which enters the river on the east end of Willow Estates. A flood gate will be required on the channel from the west.

The roadway that follows the CNR tracks to residents east of Willow Estates has a low spot on it preventing access to housing east of this point during a flood event. The road is a narrow gravel road which can be easily raised through the low section.

Estimated Cost:

1. Stripping and tree removal	$	3,200.00
2. Excavation of topsoil and core	$	5,800.00
3. Drainage piping and back flow preventers	$	60,000.00
4. Earth dyke construction	$	19,000.00
5. Roadway construction	$	9,700.00
5. Landscaping	$	6,300.00
6. Engineering & Contingencies 15%	$	15,600.00
Total	$	119,600.00

11. Paarup Development

A development consisting of large (1 acre lots) has been constructed with the original residence and one additional residence only at the present time. Flood protection is intended to be provided by constructing residences on elevated mounds. Other (basement or foundation) flood protection can be required if deemed necessary as development permits are issued.

The outfall ditch at the east end of the development was constructed by Alberta Transportation. At the outfall it has a 1,000 mm pipe with a vertical riser and grate. A floodgate will need to be constructed to prevent backwater entry to the development and residents downstream.

Estimated Cost: $ 75,000.00

12. West Rosedale (Bertimini – Rees)

Four acreage parcels are located in the NE 29-28-19-4, north of the railway tracks. A berm is present on the east side of the Alberta Transportation ditch which is approximately 1 m lower than the recommended protection level. Supplemental height to elevation 681 m would be needed to provide the same protection as other areas of the Town. An earth dyke along the river to the east side of the Rees property then back to the railway bed would also be needed.

Estimated Cost:

1. Stripping and tree removal	$ 114,000.00
2. Excavation of topsoil and core	$ 110,850.00
3. Drainage piping and back flow preventers	$ 150,000.00
4. Earth dyke construction	$ 730,000.00
5. Roadway construction	$ 62,500.00
6. Landscaping	$ 62,500.00
7. Engineering & Contingencies 15%	$ 184,350.00
Total	$1,413,350.00

It should be noted that a berm on the river bank may have a detrimental effect to flood levels upstream of this point due to the pinching of the flow. A further setback should be considered with residents retaining the land after the dyke is constructed. A considerable cost saving could be realized due to the height of the land and a lesser distance. The cost is presented as an option.

Estimated Cost (option):

1. Stripping and tree removal	$ 81,000.00
2. Excavation of topsoil and core	$ 99,400.00
3. Drainage piping and back flow preventers	$ 150,000.00
4. Earth dyke construction	$ 444,000.00
5. Roadway construction	$ 62,500.00
6. Landscaping	$ 62,500.00
7. Engineering & Contingencies 15%	$ 134,910.00
Total	$1.034,310.00

13. Central Rosedale

An area west of the Rosebud River and south of the CNR tracks has houses in the flood fringe area. They are all protected by a flood dyke along the Rosebud. No improvements are deemed necessary. The campground is subject to flooding. No improvements are deemed necessary.

14. East Rosedale To Aerial Flats

Flood water enters the aerial district at the intersection of Railway Ave. and 1st Ave. It then flows overland exiting the developed area east of Starmine Road, where it passes into a channel taking it back to the Red Deer River.

Protection can be provided by constructing a dyke along the Rosebud River and Red Deer River from 2nd Street behind the housing to Starmine Road. The elevation begins at approximately 680.5 m and ends at about 680.0 m.

Estimated Cost:

1. Stripping and tree removal	$ 63,000.00
2. Excavation of topsoil and core	$ 66,500.00
3. Drainage piping and back flow preventers	$ 150,000.00
4. Earth dyke construction	$ 354,000.00
5. Landscaping	$ 15,000.00
6. Engineering & Contingencies 15%	$ 97,275.00
Total	$ 745,775.00

15. Southeast End of Aerial Flats

From Starmine Road east the land is higher in relation to the 2013 flood profile. A flood protection berm .5 m to .75 m high would provide the level of protection sought. A large part of this area is undeveloped, or sparsely developed. Flood protection would enhance the area for expansion of development.

Estimated Cost:

1. Stripping and tree removal	$ 55,000.00
2. Excavation of topsoil and core	$ 60,000.00
3. Drainage piping and back flow preventers	$ 200,000.00
4. Earth dyke construction	$ 337,500.00
5. Landscaping	$ 50,000.00
6. Engineering & Contingencies 15%	$ 105,375.00
Total	$ 807,875.00

16. Residents Along The Rosebud River and Residents Along The Red Deer River Up To The Community of Lehigh

Residences are scattered on acreage holdings, such as Tom Dooley's ranch, with long distances between each. Practical protection measures need to be evaluated on an individual basis. As a general guide protection measures recommended are as follows:

Flood Threats	Recommended Protection
0 - 0.5 m Above Ground at Building Grade	Landscaping features (Dykes – Mounds or Walls) Set generally about 3 m away from the structure with drainage and access gaps. To be sand bagged in the event of a flood. Wells and septic fields would need to be flood protected.
0.5 - 1.5 m Above Ground at Building Grade	Flood walls or Dykes set around the immediate developed yard. Barriers to be put in place at openings and drainways during a flood event. Portable barriers & steps could be on hand or ramps could be constructed at entryways. With this amount of flooding, basements are susceptible to flood water or ground water rise, or sewer and water backup.
1.5 m – 2.5 m Above Ground at Building Grade	With this amount of flooding, basements would fill up either by flood water or ground water rise. Foundation walls are in danger of collapse; basement floors might heave or even explode due to ground water pressure. The safest measure would be to fill the basement with compacted earth retaining only a ground level crawl space alternatives would be to reinforce the basement walls with structural columns. Holes should be cut in basement floors allowing groundwater to rise at will; Keep flood water out by keeping a pump out zone around the house not by pumping out the basement. Basements experiencing flooding should not be pumped out until ground water level has subsided
2.5 m and over	Relocate house prior to flood event

17. Lehigh

To provide protection to Lehigh would involve constructing a dyke on three sides of the community. Since a section of Highway 10 is below the recommended flood protection level, the dyke should begin approximately 400 m upstream of the community where the highway is higher. The easterly 550 m would go through heavy tree growth.

Estimated Cost:

1. Stripping and tree removal	$ 130,000.00
2. Excavation of topsoil and core	$ 126,500.00
3. Drainage piping and back flow preventers	$ 100,000.00
4. Earth dyke construction	$ 916,500.00
5. Landscaping	$ 125,000.00
6. Engineering & Contingencies 15%	$ 209,700.00
Total	$1,667,700.00

18. East Coulee

The west end of East Coulee is flood protected by a dyke with a 750 mm concrete barrier wall on top of it. The protection level is approximately the same as central Drumheller.

On the east end of the community River Drive rises to a level which is above the flood protection level at the front of houses, but the houses generally have walk out basements and the land to the river is in the range of 2 m to 2.5 m lower. Dyking in this area may have been done either privately or corporately many years ago. A low mound is present passing through many of the yards, but is not consistently present. Flooding occurred in 2005 and in 2013 to a height 0.5 m to 1.0 m. To provide protection to a level above the 2005 level may be objectionable as it would disturb landscape and cut off much use of the yard. Individual protection would take away the walk out basement feature. Consultation with land owners would be necessary.

As a compromise it is proposed to construct a bed restoring the old dyke to a consistent level of 1 m below 2005 level then placing a 1 m wide by 1 m high precast concrete and gravel flood wall on top of it bringing the protection to 0.5 m below the target level. The top of the box wall may be filled with top soil and used as a planter. Gaps would be left in the wall at walk ways, or passage ways for yard maintenance and drainage, or piped drainage ways could be incorporated below the wall. The protection provided would be about the 1 in 25 year flood.

Estimated Cost:

1. Stripping and tree removal	$ 13,000.00
2. Grading of dyke base, excavation and fill	$ 10,500.00
3. Flood wall construction	$ 118,200.00
4. Drainage piping and back flow preventers	$ 37,500.00
5. Engineering & Contingencies 15%	$ 26,880.00
Total	$ 206,080.00

19. East of East Coulee

One resident, Pearl Pugh, has a residence and out buildings east of the old timber truss bridge. Flood water in 2013 came up to the house level. Protection to the target level may not be practical. Individual protection measures as described for acreage holdings between Rosedale and Lehigh would apply.

Total Improvements Recommended Estimate **$10,229,755.00**
Plus individual protection

Conclusion

The foregoing report makes no allowance for purchase of land. It is expected that where construction occurs on private land, the land with the structure will remain the property of the present owner. Landscaping would be provided to blend into the existing landscape to a minimal extent. Further landscaping can be provided by the property owner.

It is also expected that landowners will grant easements at no cost so that access can be gained. Trees and other landscape features would not be permitted on the top of dykes. If the owners wish fences they would be at the owners' cost and incorporate gates of the full width of the berm, or access way.

DRUMHELLER FLOOD CONTROL STUDY

A RESPONSE

Prepared by:

the Public Advisory Committee

November, 1985

1. Introduction

The Drumheller Valley has a history of flooding which dates back to the late 1800's. The primary areas susceptible to flooding in the Valley are Nacmine, Midlandvale, Newcastle, North and Central Drumheller, Rosedale, Cambria, Lehigh and East Coulee. As a result of water flow control at the Dickson Dam, the hydraulics/hydrology of the Drumheller Valley and in particular the 1:100 year flood lines have been revised. In response to this change, Alberta Environment retained the consulting firms I.B.I./ E.C.O.S. to conduct a study on floodplain management along the Drumheller Valley. The primary purpose of the management program is to identify and evaluate the feasibility of alternative means of reducing flood damages in urban areas.

A Public Advisory Committee was established in the spring of 1985 to respond to the Drumheller Flood Control Study. The Committee's membership is as follows:

City of Drumheller

- 2 staff
- 1 member from Council

Improvement District No. 7

- 1 staff
- 1 member from Council

Palliser Regional Planning Commission

- 2 staff

Alberta Environment

- 1 staff Planning Division
- 1 staff Water Resource Administration Division

Alberta Environment's participation on the Committee is to provide technical and financial assistance as well as to act as a liaison between the committee and provincial agencies.

This report has been prepared by the Public Advisory Committee in response to the Drumheller Flood Control Study. The recommendations contained in this report, once ratified by the respective councils of the City of Drumheller and Improvement District No. 7, are to be forwarded to Alberta Environment.

2. Drumheller Flood Control Study

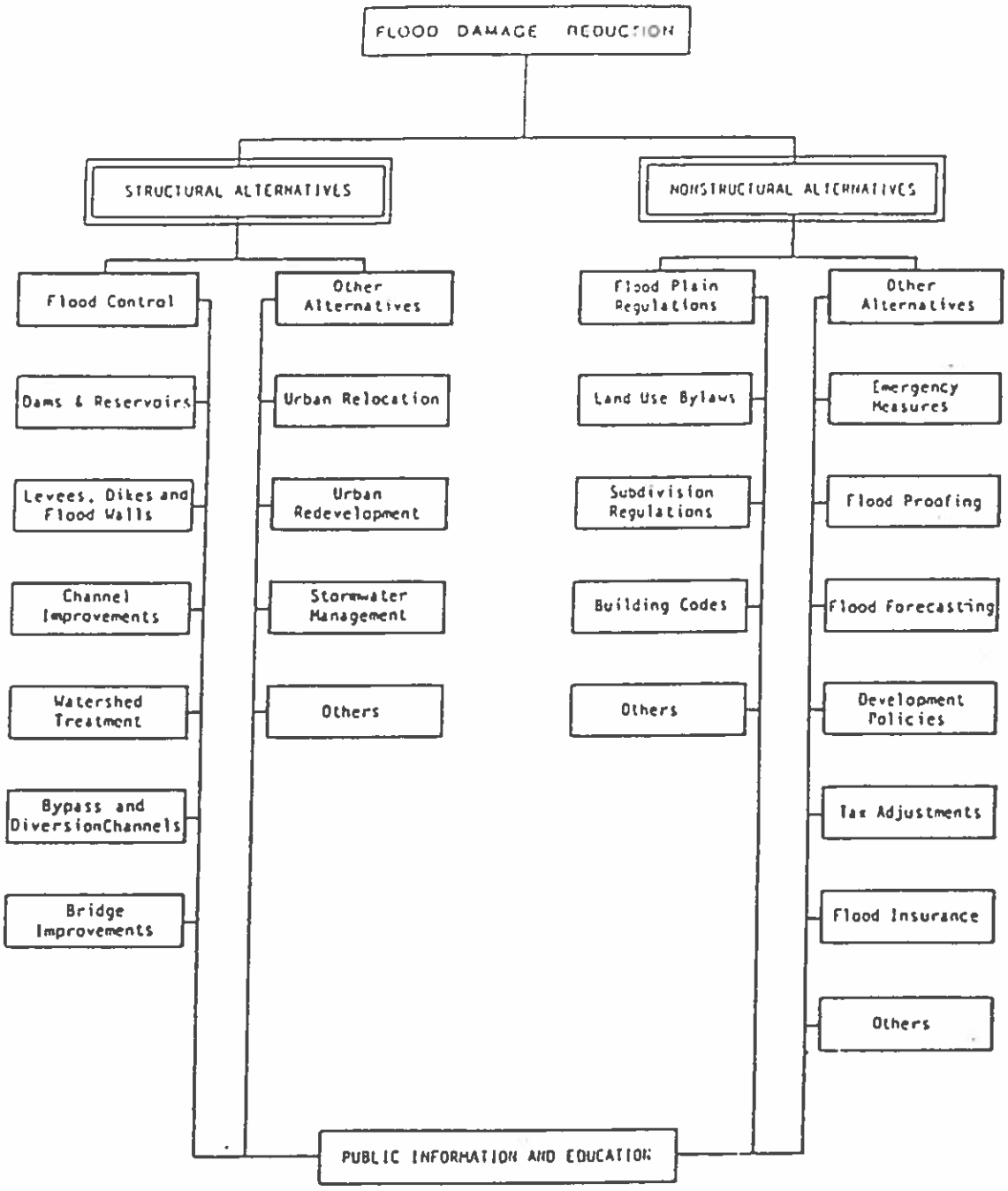
The primary objective of the study was to formulate a plan to reduce existing flood damage potential and prevent an increase in future flood damage potential. For all the urban areas in the Valley, the plan makes recommendations combining structural and non-structural alternatives (see Figure 1).

Structural alternatives consist of physical works located on or immediately adjacent to the river for the purpose of confining the flood waters or reducing the flood stages. These alternatives include dikes, dams and reservoirs, relocation, storm water management and diversion channels.

Non-structural alternatives are intended to be preventive rather than corrective. These alternatives seek to reduce flood damage by means such as: floodplain regulations in the form of land use bylaws, subdivision regulations and building codes, flood proofing, flood forecasting, development policies, evaluation and contingency measures.

For the purpose of the Drumheller Flood Control Study, the

FIGURE 1



SOURCE: From Tennessee Valley Authority 1962.

following alternatives were identified:

- diking
- relocation
- land purchase/expropriation
- flood proofing - modifications to the sewer system
  - flood proofing of individual dwellings with emphasis on new construction.
- contingency measures
- floodplain regulations

Figure 2 describes in summary, the recommendations of the consultants for each urban community in the Valley.

3. Public Participation

Since the Spring of 1985, the Public Advisory Committee has met on a regular basis to review the Drumheller Flood Control Study. As part of the review, the Committee visited each urban area in the Valley for which structural alternatives were recommended for on site inspections.

In addition to the review, the Committee prepared public information such as a pamphlet, newspaper articles and a news release. The Committee organized and attended three Open Houses which were held in October, 1985 in order to obtain public input. These Open Houses were held at the Rosedale Community Hall, Knox United Church in Drumheller and the East Coulee Community Hall. In order to provide comprehensive information to the general public, the Advisory Committee with the financial assistance of Alberta Environment had high quality display board prepared as well as an 18 minute audio-visual presentation.

While the turnout to the Open Houses was relatively low, the response received from those attending was constructive and helpful to the Advisory Committee in reviewing the recommendations (see Appendix for summary of Open House results).

FIGURE 2

DRUMHELLER FLOOD CONTROL STUDY
CONSULTANT'S RECOMMENDATIONS

LOCATION / ALTERNATIVE	DIKING	RELOCATION	LAND PURCHASE	FLOOD PROOFING	CONTINGENCY MEASURES	FLOODPLAIN REGULATION
Nacmine				X	X	X
Midlandvale	X			X	X	X
Newcastle	X	X		X	X	X
North Drumheller	X			X	X	X
Central Drumheller	X			X	X	X
Rosedale	X			X	X	X
Cambria				X	X	X
Lehigh				X	X	X
East Coulee	X			X	X	X

"X" signifies recommendation.

4. Recommendations of the Public Advisory Committee

The Advisory Committee recommends that the following three measures be instituted for all urban communities in the Drumheller Valley.

(a) Contingency Plans - the development of a comprehensive plan which would put in effect such items as early warning, stockpiling of sandbags, sand, shovels, pumps etc., flood lighting, evacuee accommodations, public education etc., in order that damages to contents and risk of life would be minimized during a flood.

(b) Floodplain Regulations - floodplain regulation would be considered to restrict the extent and types of development within flood prone areas. This could be accomplished by the City of Drumheller and Improvement District No. 7 adopting appropriate policies in their General Municipal Plans, Area Structure Plans and Land Use Bylaws/ Orders.

(c) Floodproofing - this option entails the elevation of all residential structures above the design flood level. This may be impractical for existing structures. Modifications should be considered to the existing sewer system and lift-stations.

In regard to the structural alternatives, a number of recommendations are outlined in terms of the recommendations made in the Alberta Environment Consultant's Report.

(a) Nacmine

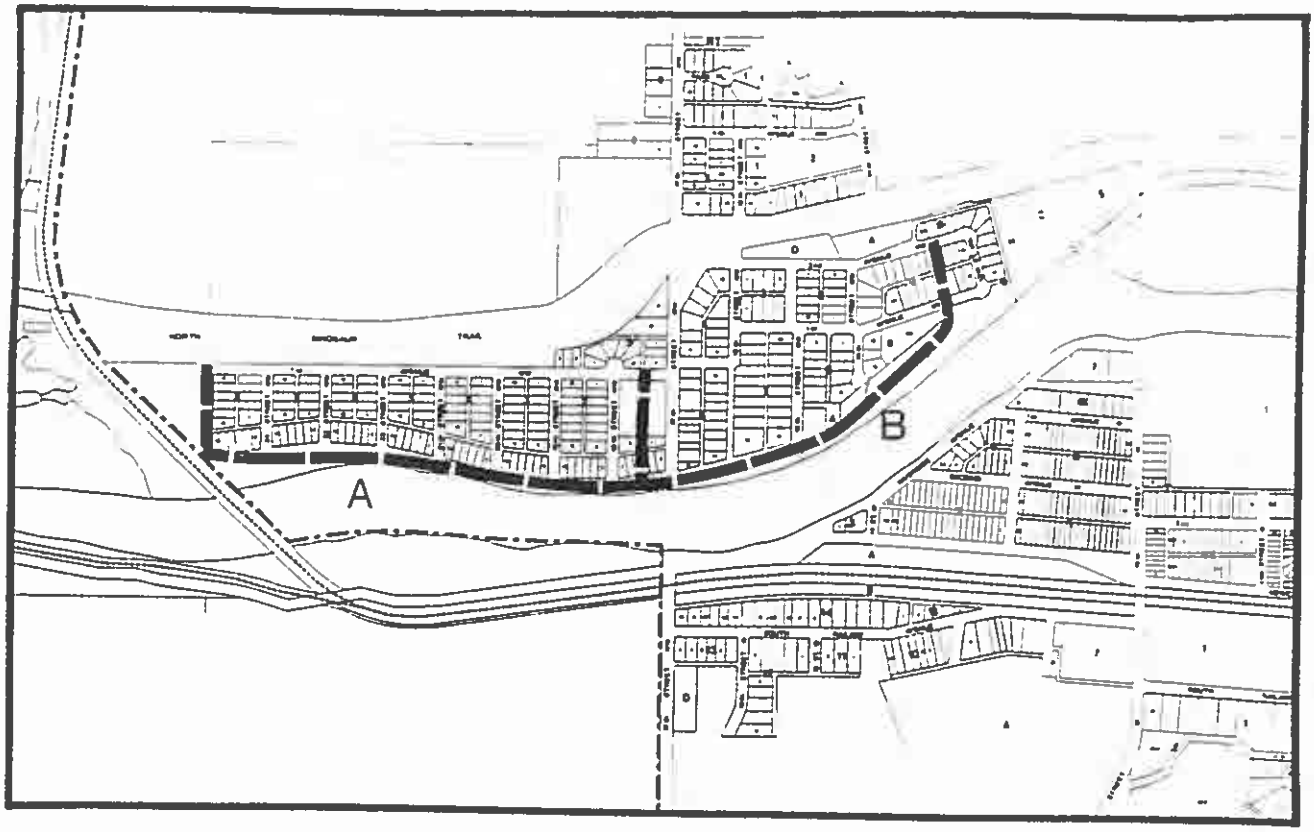
- No diking is recommended

- Contingency plans, floodplain regulations and flood proofing are recommended.

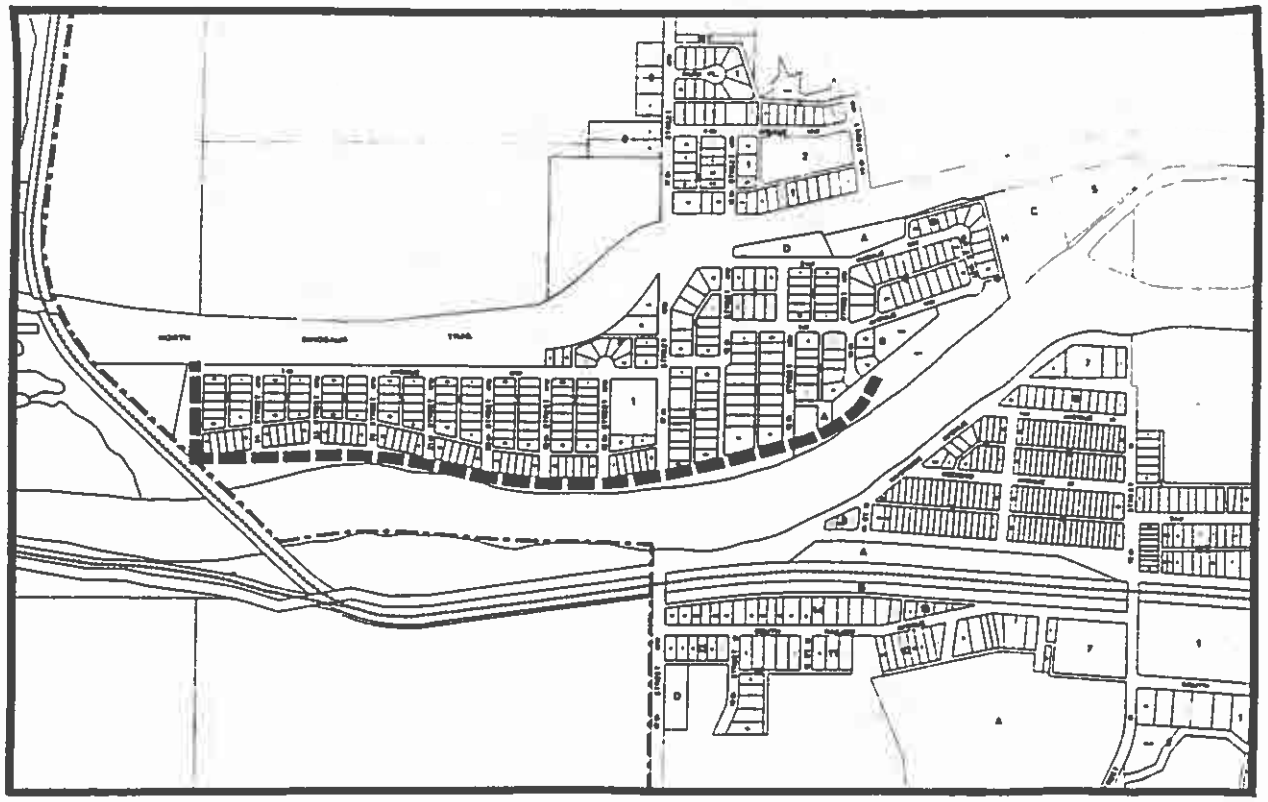
(b) Midlandvale (Figure 3)

- Dike A is recommended. However, there is concern about the well established trees along the riverbank. It is suggested that Alberta Envi-

Fig. 3: MIDLANDVALE



Dike as proposed by IBI Group and ECOS Engineering Service Ltd



Dike as proposed by the Public Advisory Committee

ronment investigate the means to incorporate the existing trees in the dike design. In addition, the eastern part of the dike through the ball park is to be eliminated.

- Dike B is recommended, however reduced in length as the eastern area incorporated behind the dike has been filled in recent years as a result of a residential subdivision. The dike should be realigned from 15th Street, N.W. towards the north. It is felt Dikes A & B must be viewed as one project.

- It is highly recommended that the sewage lift-station east of Midlandvale be flood proofed.

- Contingency plans, floodplain regulations and flood proofing are recommended.

(c) Newcastle (Figure 4)

- Dike B is recommended, however, further investigation is required regarding the dike's alignment and tie in with the existing street pattern. In addition, further assessment is required of the western extreme of 1st Avenue and Riverside due to close proximity of the 1:100 year floodplain at this location.

- Dike A is currently not economically viable with the recent passing of the Newcastle Area Redevelopment Plan as the high risk areas are to be eliminated. It is highly recommended that funds are allocated to assist the City in the relocation of the squatters in the area.

- Contingency plans, floodplain regulations and flood proofing are recommended.

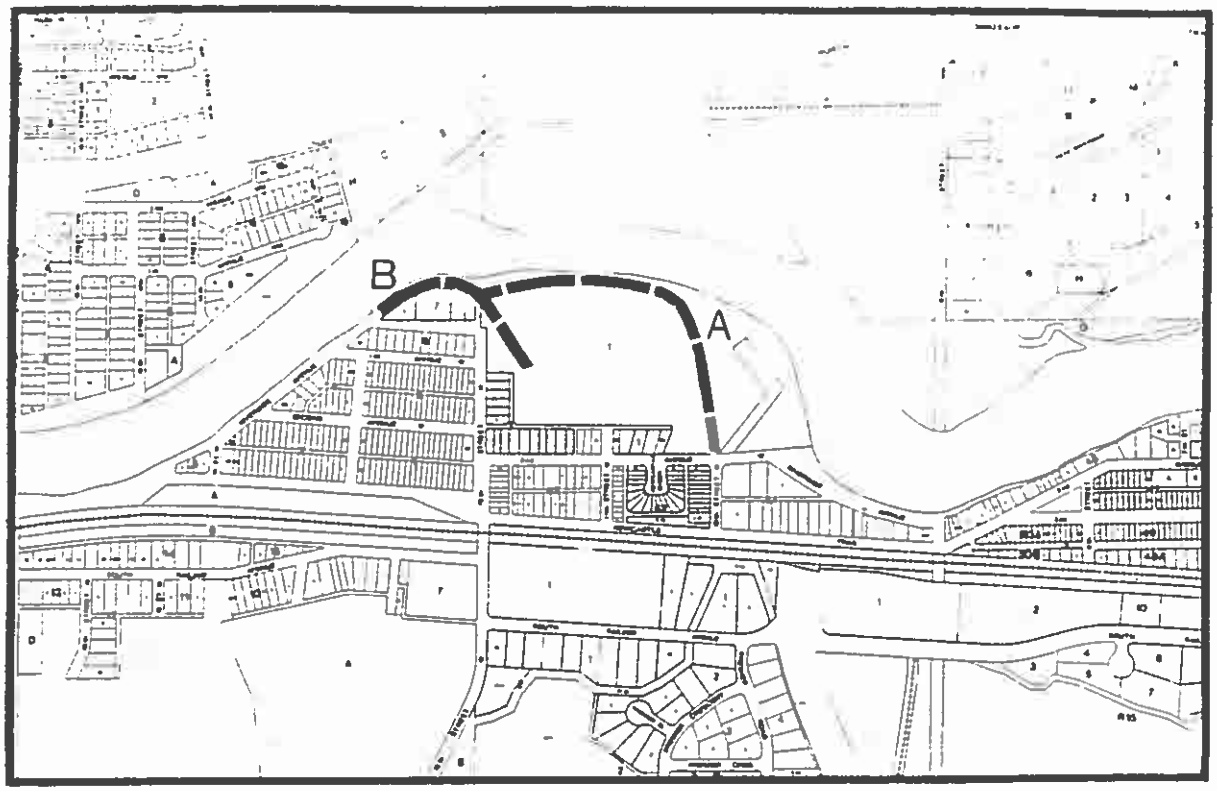
(d) Drumheller (Figure 5)

- Dikes B, C in North Drumheller and dike D in Central Drumheller are recommended.

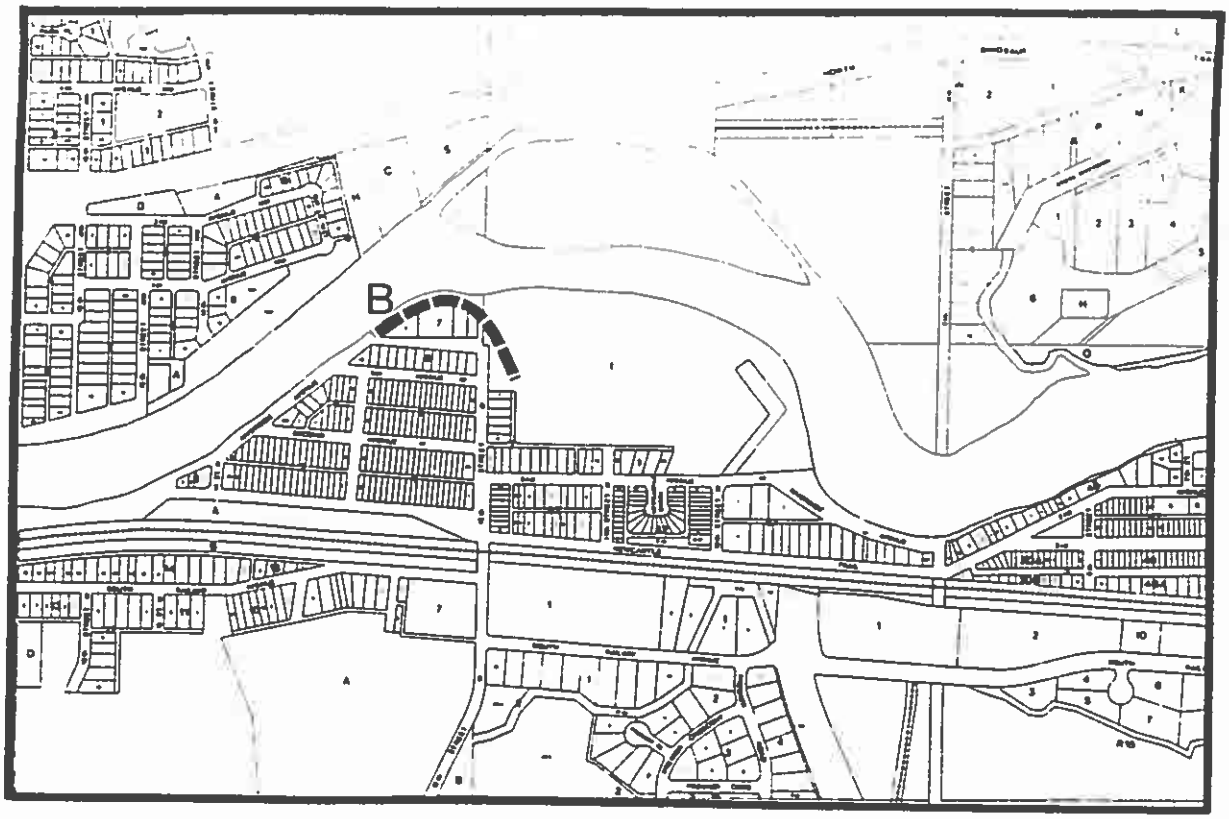
- From cost/benefit point-of-view, dike A is at this time not viable.

- Dike B & C in North Drumheller are interrelated, it is recommended that the location of these structures and the long-term proposal of Transportation Route B through this part of the City, be reinvestigated.

Fig.4 NEWCASTLE

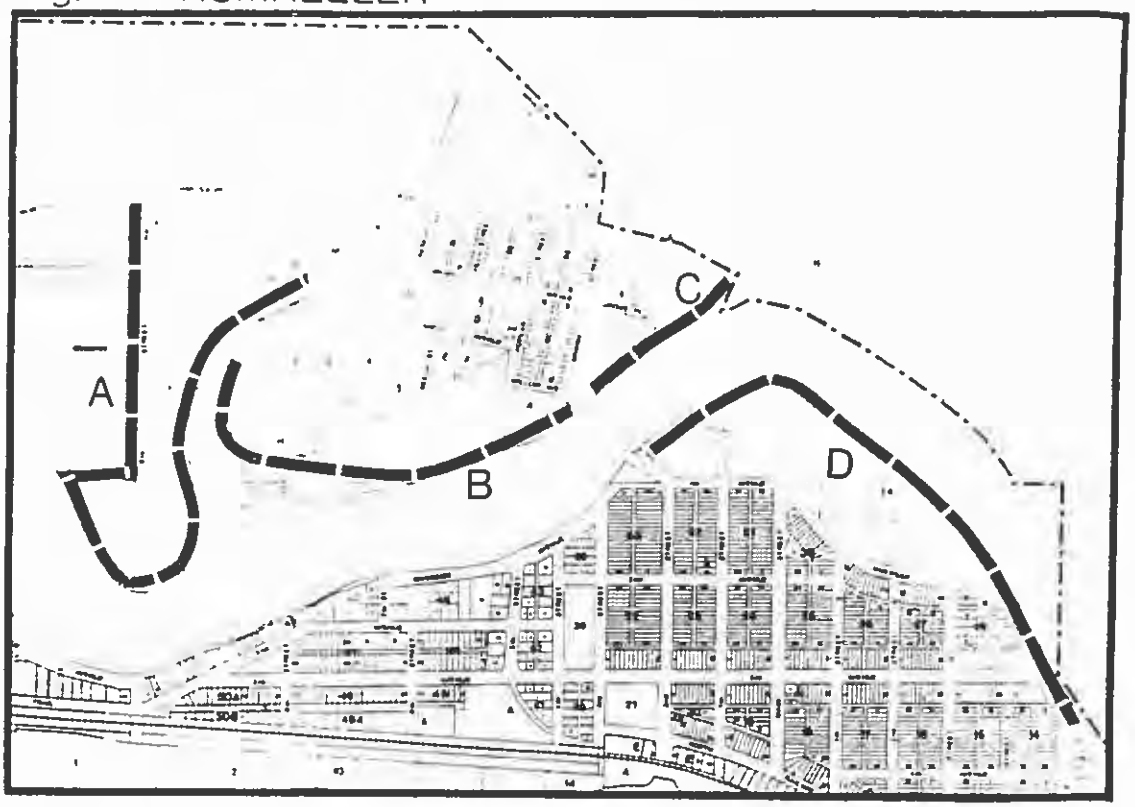


Dike as proposed by IBI Group and ECOS Engineering Service Ltd

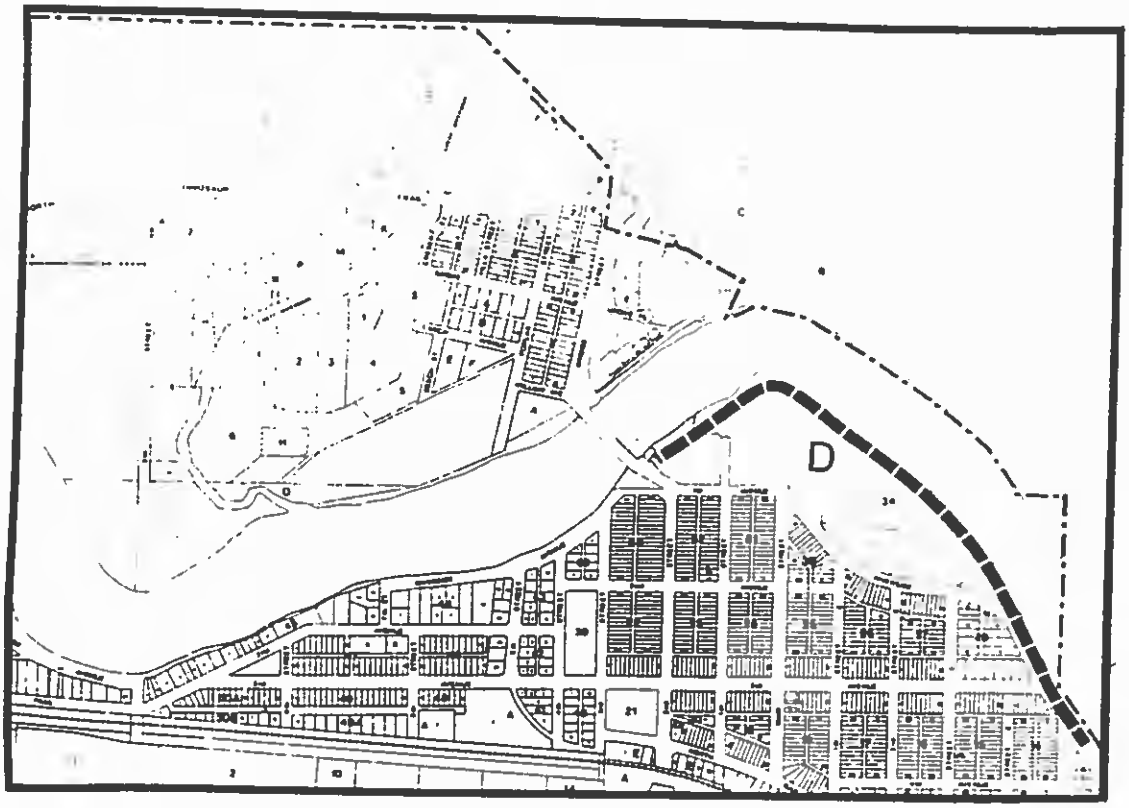


Dike as proposed by he Public Advisory Committee

Fig. 5: DRUMHELLER



Dike as proposed by IBI Group and ECOS Engineering Service Ltd



North

Dike as proposed by the Public Advisory Committee

- Dike D in Central Drumheller has a high cost/ benefit factor and land acquisition costs are minimized. Further, a dike in this location will enhance the recreational value of land.

- Additional upstream storage of Michichi Creek should be investigated.

- Contingency plan, floodplain regulations and flood proofing are recommended.

(e) Rosedale (Figure 6)

- Dikes B & C are recommended.

- Dike B is partially constructed and only requires minor modifications.

- Dike C has a high cost/benefit factor, however, a realignment should be reviewed as the proposed location of the dike may potentially create access problem for existing residential developments.

- Dikes A & D are at this time not recommended for construction due to the low cost/benefit factor, and the existing low density and unserviced developments, the dikes would protect.

- Research is required to accommodate flows from Rosebud Creek and back water effects.

- Contingency plans, floodplain regulations and flood proofing are recommended.

(f) Cambria (Figure 7)

- No diking is recommended.

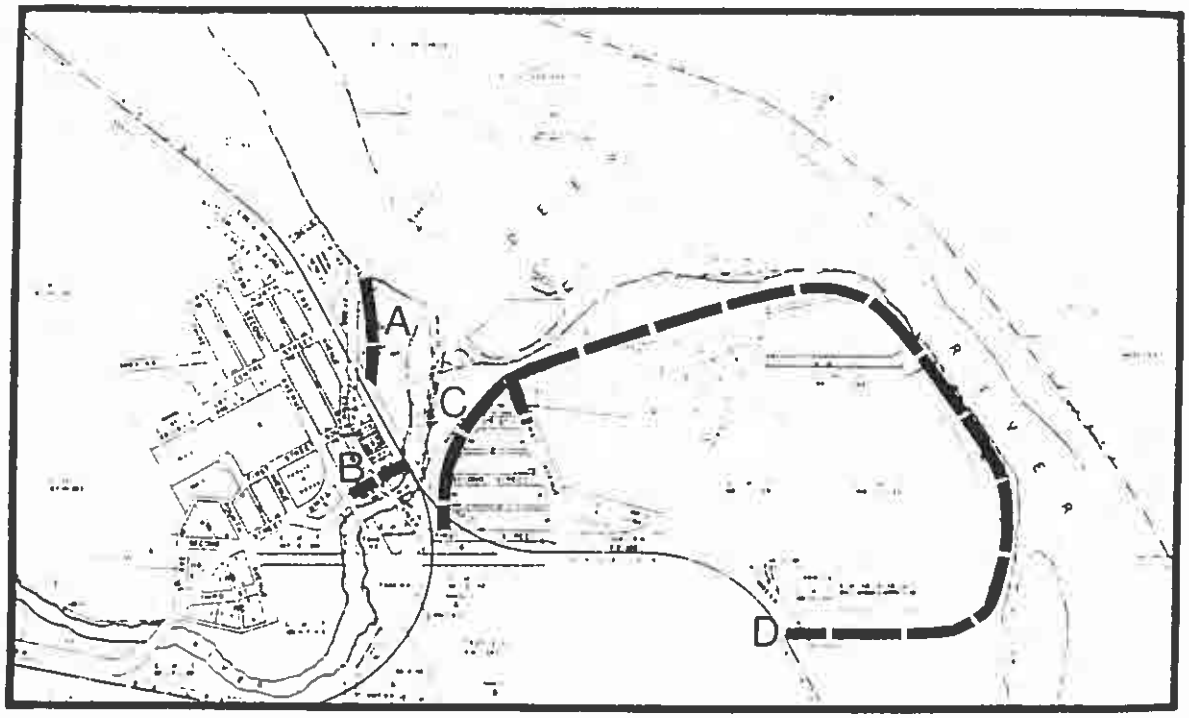
- Contingency plans, floodplain regulations and flood proofing are recommended.

(g) Lehigh (Figure 8)

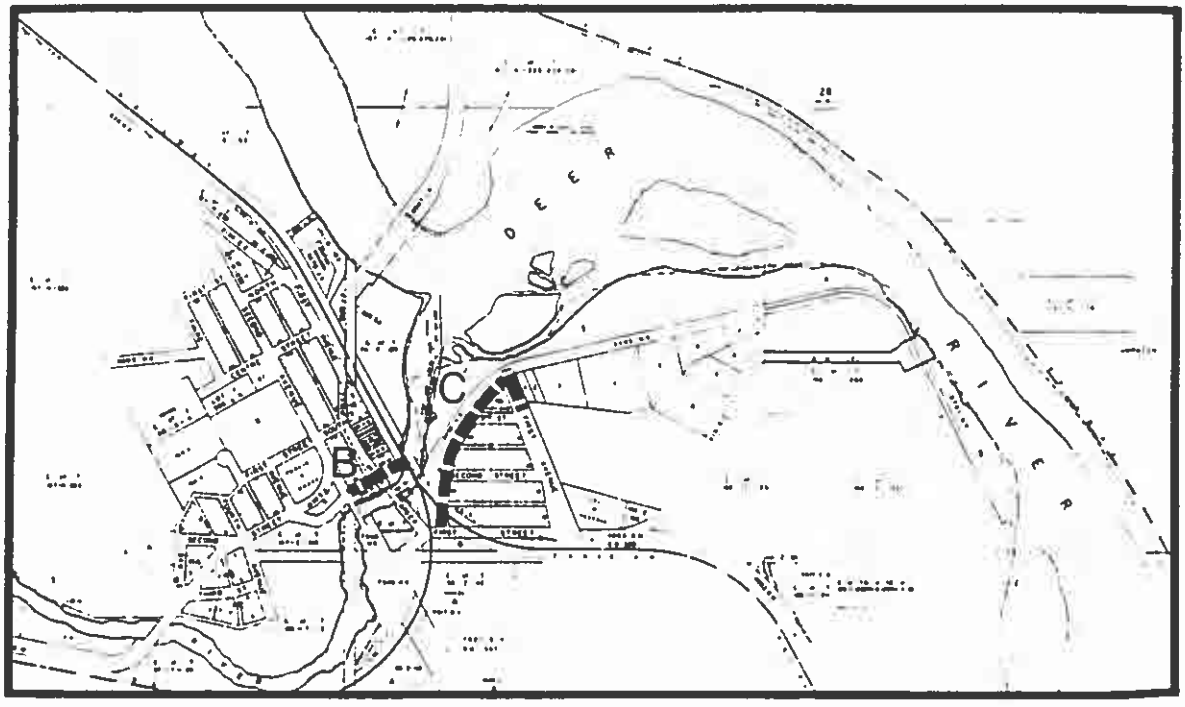
- No diking is recommended.

- Contingency plans, floodplain regulations and flood proofing are recommended.

Fig.6: ROSEDALE

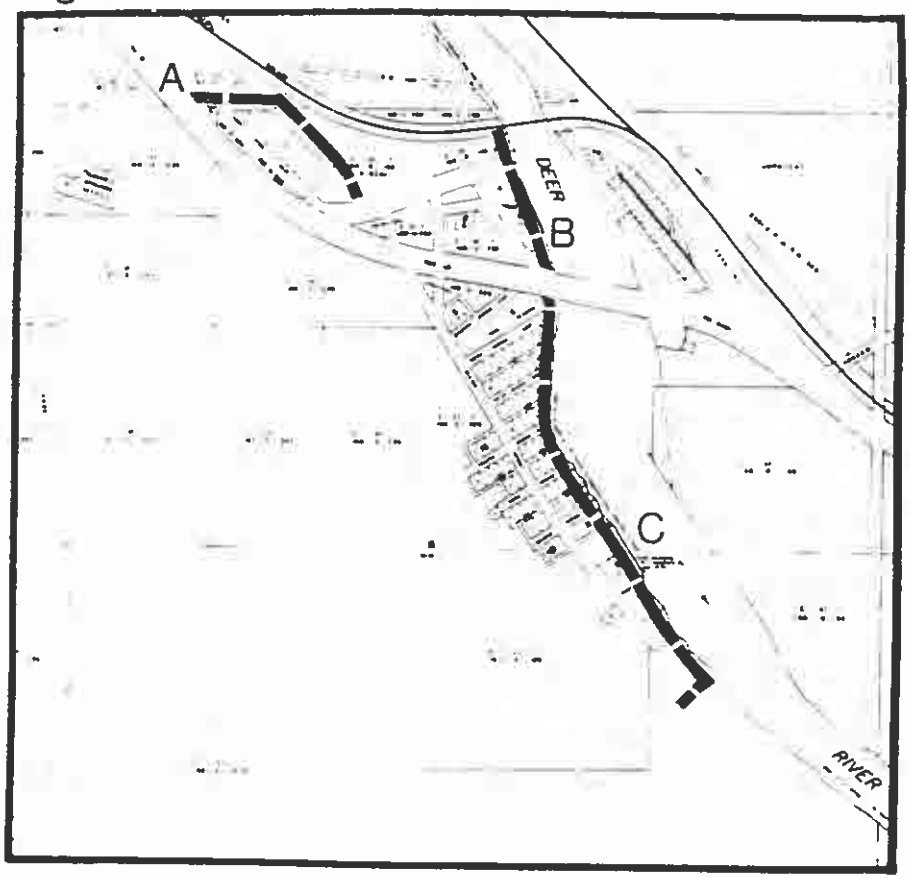


Dike as proposed by IBI Group and ECOS Engineering Service Ltd.



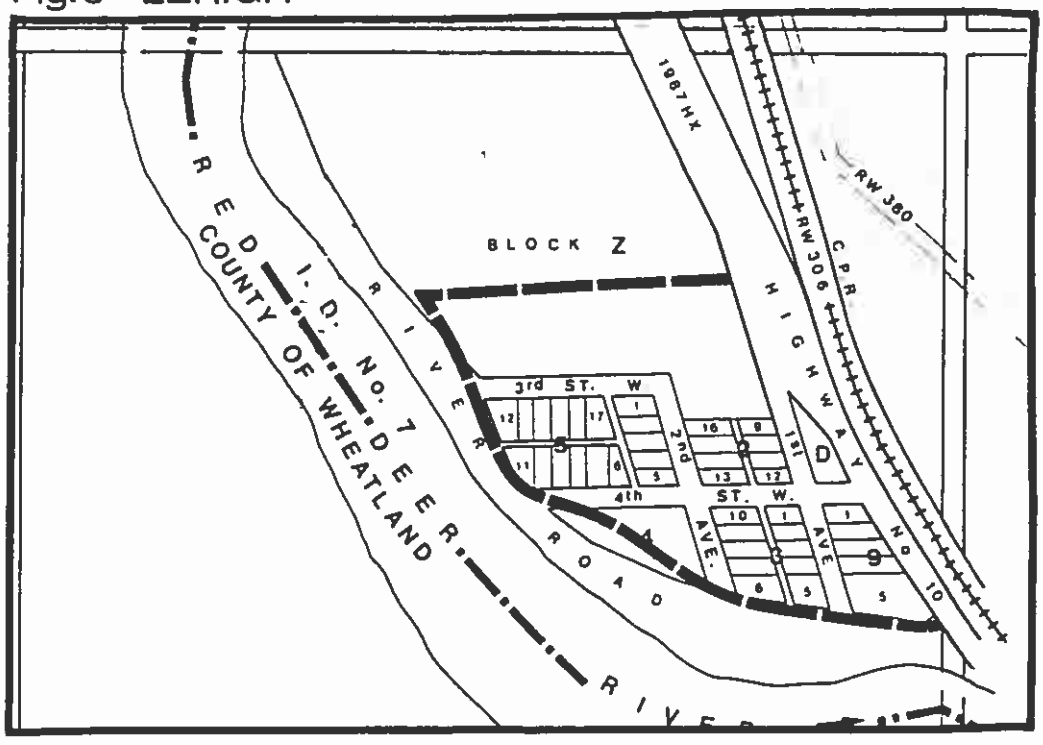
Dike as proposed by the Public Advisory Committee

Fig.7: CAMBRIA



Dike as proposed by IBI Group and ECOS Engineering Service Ltd

Fig.8: LEHIGH



Dike as proposed by IBI Group and ECOS Engineering Service Ltd

(h) East Coulee (Figure 9)

- The diking of East Coulee is highly recommended. It is suggested, however, that a possible extension of the dike be investigated to incorporate those lands to the east of the new bridge.

- Contingency plans, floodplain regulations and flood proofing are recommended.

In a number of areas where dikes are recommended, limited construction space is available due to the location of existing residential structures. The Committee recommends that no existing habitable dwellings be removed to accommodate a dike and that instead sheet piling be used to build into the river to locate the proposed dike.

Based on the above, the Committee priorized the structural alternatives by Community as follows:

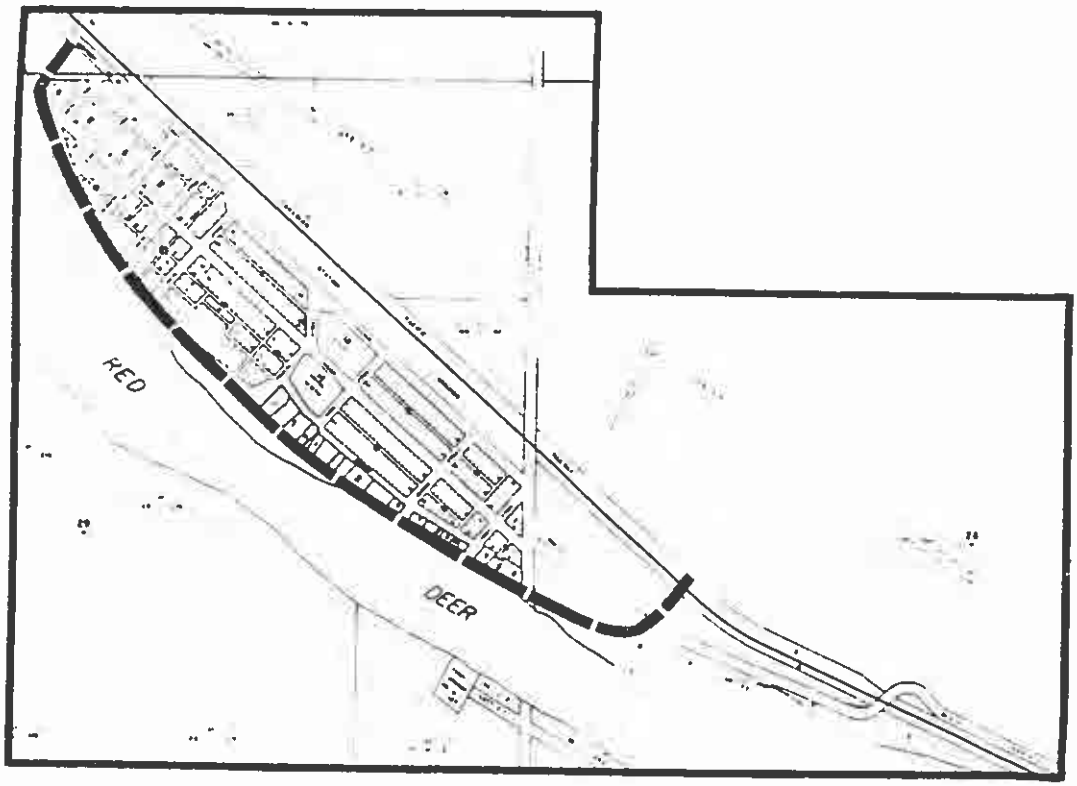
(a) Newcastle	- Relocation funding assistance Dike B*
(b) East Coulee	- Dike
(c) City of Drumheller	- Dike D
(d) Rosedale	- Dike B
(e) Midlandvale	- Dike A* & B*
(f) Rosedale	- Dike C*

* Require additional study.

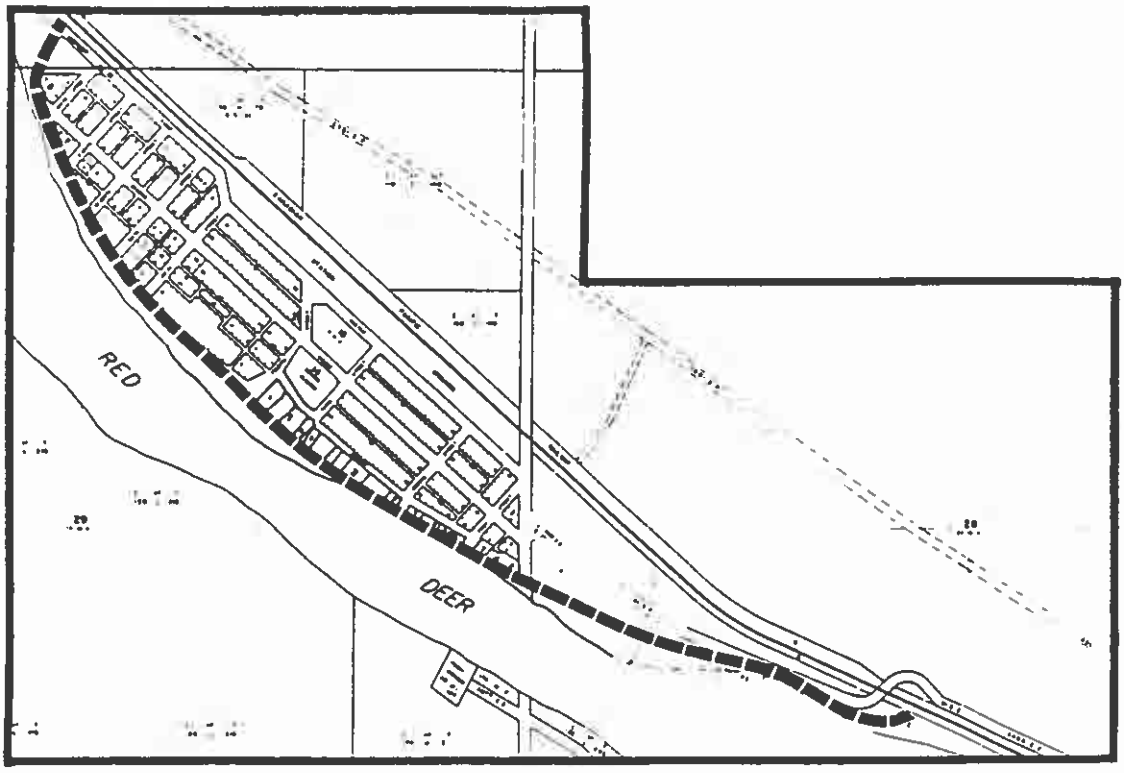
5. Conclusion

The Public Advisory Committee has extensively and carefully reviewed the Drumheller Flood Control Study as prepared by I.B.I./

Fig.9 EAST COULEE



▬▬Dike as proposed by IBI Group and ECOS Engineering Service Ltd.



▬▬Dike as proposed by the Public Advisory Committee

E.C.O.S. for Alberta Environment. The recommendations contained in this report are to be forwarded to Alberta Environment for implementation. It is understood the structural recommendations are to be phased into Alberta Environment's budget and construction program. Nevertheless, since the relevant municipalities and citizens have waited many years for something to be done in the Valley to address flooding, it is recommended solutions be worked on immediately.

It is proposed that the Public Advisory Committee remain and continue to monitor the situation and advise Alberta Environment on the projects recommended for implementation in the Drumheller Valley. In addition, it is the Committee's intention to review in detail the floodplain regulations and any contingency plans currently in effect for the Drumheller Valley. The Committee is confident the right combination of solutions can be implemented.

APPENDIX

November 1, 1985

IBI GROUP

Bob Hardie
Alberta Environment
2938 - 11th Street N.E.
Deerfoot Square
Second Floor
Calgary, Alberta
T2E 7L7

RE: Drumheller Flood Control Study
Public Open House

The following highlights the public response for the open house exercise held the week of October 21 throughout the Drumheller Valley. Open houses were held at three locations: Rosedale, Drumheller and East Coulee the week of October 21. Open house sessions ran from 6:00 to 8:00 p.m. and featured eleven display panels and an audio-slide show. Total attendance was approximately 38 with 9 survey forms completed.

DATE	COMMUNITY	LOCATION	ATTENDANCE	SURVEYS COMPLETED
October 21	Rosedale	Community Centre	20	5
October 23	Drumheller	Knox United Church	10	3
October 24	East Coulee	Community Centre	8	1

General Comments

- At all three open houses comments related to a misconception about Dickson Dam providing complete protection from flooding events. Most attendees were unaware of the real purpose of the dam and appear to have been misled by a variety of sources including heresay, real estate agents, etc.

- A large percentage of the people attending wanted to subdivide their property either to obtain title in the case of squatters or for development purposes. These people assume that with the implementation of dyking they would then be allowed to subdivide. Still others are unaware of the provisions within the various Municipal bylaws relating to flood proofing within the flood plain area and from their comments it would appear that application is somewhat discretionary rather than determined by any definitive criteria.

Questionnaire Responses

- With respect to Question 2, the majority of respondents indicated that dykes should be examined in more detail. One respondent indicated

structural measures; another to examine the use of Dickson Dam and a third cited flood proofing, land purchase and dyking.

- With regards to Question 3, the responses are as follows:
  - The more detailed study should involve all members of the community in its development.
  - Tourism promotion and recreational aspects associated with the alternatives should be examined.
  - Preserve or re-establish tree growth where dykes are constructed.
  - Dyke heights in North Drumheller should reflect flooding both on the Red Deer River and Michichi Creek.
- Concerning Question 4, specific comments about the study were as follows:
  - How were the dyking locations decided?
  - Was maximum property and people concerns taken into consideration?
  - Before any action is taken, will the people concerned have further input?
  - Excellent study.
  - Studies have been going on for some time, but no solutions have been implemented.
  - Could the dyke in East Coulee be extended further east from the railway bridge to the new bridges?
  - Could a weir for recreational purposes be allowed for, or incorporated, in any flood control scheme?
  - Dyking should be continuous around communities irrespective of cost implications.
- Concerning the usefulness of the open house to understanding the problems and measures proposed, seven people completed this question, six answering "yes" and one "no".
- The majority of people (5) became aware of the open house through the newsletter, three cited the newspaper, two word of mouth and one radio.

Bob Hardie November 1, 1985

Conclusions

From these results there appears to be within the study area a general lack of concern about the potential flood problem or the proposed construction of dykes adjacent to riverfront properties. Those who attended and did express concern were by and large looking to subdivide their properties. Although the majority of people made positive comments regarding the content and quality of the presentation there is still considerable skepticism regarding the possibility of flooding.

A subsequent public presentation, either immediately before or immediately after construction of the initial dyke is probably in order.

I trust the above is suitable for your purposes at this time. Should you have any questions please do not hesitate to contact me.

Yours truly,

IBI GROUP

Steve Shawcross
Associate

SS/mp

5. SUMMARY

The maximum recorded flood peak for the Red Deer River at Red Deer is 1930 m^3/s for the flood of June 27, 1915. This event has an estimated return period of about 1:200 years for the annual series of natural maximum instantaneous discharges.

The predicted 1:100 year return period natural annual maximum instantaneous discharge for the Red Deer River at Dickson Damsite is 1250 m^3/s. The regulated peak flow rate without flood forecasting, for this event, is the same as the natural peak flow rate. The regulated peak flow rate for this event, based on a 24 hour flood forecast warning which is updated every 12 hours, is 1060 m^3/s.

The predicted 1:100 year return period natural annual maximum instantaneous discharge for the Red Deer River at Red Deer is 1690 m^3/s. The regulated peak flow rate without flood forecasting, for this event, is the same as the natural peak flow rate. The regulated peak flow rate for this event, based on a 24 hour flood forecast warning which is updated every 12 hours, is 1440 m^3/s.

The predicted 1:100 year return period natural annual maximum instantaneous discharge for the Red Deer River at Drumheller is 1840 m^3/s. The regulated peak flow rate without flood forecasting, for this event, is the same as the natural peak flow rate. The regulated peak flow rate for this event, based on a 24 hour flood forecast warning which is updated every 12 hours, is 1640 m^3/s. The regulated 1:100 peak flow rate of 1640 m^3/s is recommended for delineating floodplain boundaries along the Red Deer River through the City of Drumheller.

DRUMHELLER

DINOSAURS • DISCOVERY • OPPORTUNITY

Dinosaur Capital of the World

Municipal Recovery Action Plan

February 2014

Table of Contents

Figure 1: Impacted Flood Region

BACKGROUND

On June 20th, 2013 River Forecasting projected 1600 m3/s and by June 21st evening it was 1000 m3/s and by June 22nd early morning flows were in the neighborhood of 1300 m3/s – 1400 m3/s plus the flows from Little Red (meaning a flood similar to 2005). Environment's Alberta River Basins: for Red Deer River recorded a peak flow at 1307.32 m3 on June 23rd at 16:00; the Town's gauge on the Gordon Taylor Bridge correlated with River Forecasting.

Provincial Minister Starke toured the area on June 24th, 2013 and Federal Minister Toews toured the area on June 26th. They were given a tour of the Town's dyking system improvements since 2005 and the temporary berms needed for protection in the 2013 flooding.

Authorities identified approximately 65 residents that were in high risk areas with possible flooding/seepage damage. Total evacuees at the time of the event were 3300.

Disaster Recovery Program administrators set up an office in Drumheller on July 7th, 2013 for impacted residents to complete the application process. The Town of Drumheller assisted with the completion of applications.

A meeting with the Provincial Recovery Program was held July 11th, 2013 to review how the community is coping, discuss any outstanding issues and what damages can be claimed by municipalities. Associate Minister of Municipal Affairs Greg Weadick was assigned to address any concerns from the flooding.

CAO Ray Romanetz met with Charlene Schmidt - Assigned Recovery Coordinator on July 11, 2013 for the completion of the Transition Assessment Worksheet.

Public comments / concerns expressed at the Provincial Flood Meeting held on August 28, 2013 at the Badlands Community Facility.

Mayor Yemen and Byron Nagazina – Director of Corporate Services attended a flood mitigation workshop sponsored by the Alberta Government in Calgary on October 4th and a draft copy of Drumheller's Report on Flood Protection 2013 was hand delivered to Andre Corbould, Chief Assistant Deputy Minister. At the workshop, Drumheller was identified as a best practice as a result of work that has been done over the years with dyking and the land use bylaw.

Administration along with Palm Engineering and Hunter Survey Systems prepared a report that identified improvements required within the existing dyking system in Nacmine, Midland, Newcastle and Drumheller Central and identified new dyking for unprotected developed areas. The final version of the report was forwarded to Andrew Wilson – Project Manager – Flood Mitigation Secretariat on October 29th, 2013.

The Town submitted their application for Disaster Recovery Assistance on November 11, 2013 in the amount of $1,166,464.88 with a breakdown as follows:

Emergency Operations: Flood prevention: $373,258.53

Flood recovery: $415,008.23

Evacuation Centre: $10,068.87

Road Damage: $368, 129.25

Estimated # of losses 54 (small business and institutional losses (5) and residential losses (49).

Elin Gwinner – Town of Drumheller's Finance Manager has been working with Kerry Yeo from the Disaster Recovery Program to reconcile the Town's flood claim submission.

A meeting was held on January 20th, 2014 in Drumheller with Provincial representatives. The Province announced that they have hired a consultant to compile a report on Red Deer River flood levels /erosion controls and community flood mitigation projects. The timeline for completion has been set at 90 days. A meeting was held with Town Administration and Stantec on February 7th, to discuss any issues regarding flooding and how it may affect our water intake systems, possible low lying areas for flooding, other infrastructure and other information they required for their reporting.

At their meeting of January 13, 2014, Council made a motion to reduce the municipal portion of taxes for Tax Roll #10002004 and Tax Roll #19041201 based on the reduction of assessment by Rod Vikse – Wildrose Assessment Services for the timeframe the properties were affected by the flood in 2013. The Town of Drumheller will request the Province to waive the educational portion of taxes for both these properties damaged by flood.

Grant application will be forwarded to the Province for erosion protection is needed for from the Hospital Drive to the end of 9th St. NW. Ed Palm to provide projected cost estimates for this work (to be added to the Action Plan Report as an addendum).

Grant application will be forwarded to the Province for reimbursement on staffing / consultants' wages.

Vision Statement – To develop advanced floodplain mapping, detail risk assessments and response plans to help our residents protect themselves from flood hazards.

INTRODUCTION

This detail includes the key milestones for this fiscal year (to March 31, 2014) and beyond. The strategic guidance is intended to enable continued alignment of efforts and provide clarity for longer-term planning, particularly for municipal departments.

VISION AND PRINCIPLES

Flood Recovery Vision

To enable the social, environmental and economic recovery of the Town of Drumheller's citizens and and businesses while providing a healthy and resilient community environment for the future.

Principles

Regional Focus, Resident Focus, Sustainability, Service Hub, Timely, Fairness, Preserve Culture, Preserve Vision, Resiliency and Model

Flood Recovery Goals

- Identifying future flood mitigation projects
- Updating flood data sets
- Updating municipal emergency plan
- Referring affected residents to proper flood recovery agencies
- Follow direction of the flood recovery task force
- Capture and document data from 2013 flood events for future reference
- Communicate economic viability of region after flood events

STAKEHOLDERS

Successful long-term recovery will depend on all stakeholders and every level of government working collaboratively. The municipality interacts with a broad range of stakeholders on a regular basis. These include the federal and provincial governments, community not-for-profit sector, businesses and industry groups, education and training providers, social service providers, children, students, their families, and individuals. This section should describe the recovery roles and responsibilities of the outlined stakeholders.

These stakeholders and the municipality perform three main functions together.
1. Encourage, support and coordinate contributions for the recovery efforts.
2. Gather, track and coordinate cross-ministry and cross-municipality issues.
3. Recommend possible responses.

Engagement needs to be collaborative and supportive; enabling ministries and communities to take ownership as they move from "emergency response" to recovery.

Golden Hills School Division #75
Christ the Redeemer Separate Regional School Division #3
Drumheller Institution (Corrections Canada)
Royal Tyrrell Museum – Alberta Culture

Retail sector
Industrial sector
Tourism and hospitality sector

Individuals and Families
The individuals and families in the region have begun the steps to recovery by returning to their homes or seeking temporary housing. They have returned to their employment, placed children back in school, begun the process of working with insurance companies and are seeking information on the process of rebuilding.

Local Governments
The Town of Drumheller is responsible for leading and planning the recovery within their respective communities. They have also committed to working together as a joint council to achieve long-term recovery for the region.

Non Government Organizations (NGO)
The Alberta NGO Council has actively participated in flood response and recovery and has been supporting affected communities since the beginning of the disaster. They continue to play a key role in supporting their communities using non-profit/volunteer agencies including but not limited to the following organizations:

Salvation Army
Samaritan's Purse
Local Churches
Local Service Clubs (Kinsmen, Rotary, Knights of Columbus, etc)
Federal Penitentiary

Government of Alberta
The Government of Alberta provides a support role to the local government recovery. The Government of Alberta appointed the Flood Recovery Task Force to coordinate department support to the affected communities and facilitate the recovery process.

Federal Government
The Government of Canada will provide financial assistance to Alberta through the Disaster Financial Assistance Arrangements (DFAA), administered by Public Safety Canada (PSC). As well, funding for First Nation recovery is available through Aboriginal Affairs and Northern Development Canada.

GOVERNANCE, ROLES AND RESPONSIBILITIES
It is important for local leadership to guide the community through recovery, back to pre-disaster conditions and, if possible, better than pre-disaster conditions. Local government primarily has this responsibility and will be supported by the Alberta Government through its departments and the Flood Recovery Task Force.

RECOVERY PLANNING FRAMEWORK

The planning framework considers four elements: people, environment, reconstruction and economy (as outlined in Figure 2). The concept of local community remains at the centre of each element and provides the lens through which all aspects of recovery are viewed. This approach embraces the regional community's cultures, values, objectives and goals.

Figure 2: Recovery Framework

PEOPLE

The highest priority is the overall physical, mental and social well-being of the residents of Town of Drumheller. This component focuses on aspects that ensure the right resources are in place to support the community's needs. Continue to assist citizens recover and repair damage to property as well as assist with insurance claims.

Safety

Safety includes the provision of fire and police services, property safety assessments/cleanup, site access and essential services such as potable water and sewage.

Health

Health care includes ensuring emergency care, acute care, long-term care and seniors' health, public health and addictions and mental health activities, which are monitored over the longer term. This may also include community health assessments and long-term health care strategies if required.

Social well-being

Considerations for social well-being include activities related to community and group support, faith-based activities, sports and education initiatives, interim housing and return-to-work support.

ENVIRONMENT

The disaster had significant impacts on the environment as a result of overland flooding and sewage back up.

Biodiversity, ecosystems and natural resources

The flooding event affected precious environmental assests on both public and private lands, including a number of nature areas. This element focuses on activities and management of parks, wildlife and pests. Monitoring of the air, water and soil quality is an essential activity during recovery.

Amenities

Amenities such as recreational facilities are an essential part of recovery operations. Projects to re-establish or enhance available amenities can assist in meeting the overall plan objective.

Waste and pollution management

Properly and effectively managing waste, particularly in landfills, is essential to the ongoing protection of human health and enhancement of the natural environment.

RECONSTRUCTION

The disaster affected approximately **[66]** properties. Damaged infrastructure
Included residential buildings and utilities as well as damage to municipal infrastructure, (streets, berms). There was also damage to municipal recreation properties including boat launches, beaches, campgrounds and ball diamonds.

Residential, commercial and public buildings

Rebuilding infrastructure lost in the flooding in a predetermined and timely manner is essential to community recovery.

Re-establish Insured Assets

A main component of the rebuild is to establish what is covered by insurance and focus on the rebuilding of those assets.

Architecture and Surveying

After the cleanup of debris, decisions regarding the establishment of architectural controls will need to be taken and property lines may need to be re-surveyed. We have identified deficiencies in levels of infrastructure in place (berms).

Prevention

Steps should be taken to reduce the risk of similar disasters in the future. Adopting flood mitigation standards is required to ensure the community is available for DRP funding.

Information for Homeowners and Business Owners

Due to the diversity of individuals, home and business owners involved in the losses, information on rebuilding will need to be proactively provided.

Planning and Permits

Before rebuilding, careful attention should be paid to the existing planning requirements and restrictions of the municipalities.

Inspections
The affected areas fall under the Alberta Safety Codes Act (chpt S-1 RSA 2000) for permitting and inspections. At this time, Alberta Municipal Affairs will monitor and assist the municipalities in their permitting and inspection programs to ensure construction is in compliance with the Act.

Utilities
It is imperative that water, sewer, gas, electricity, and private sewage systems are restored to safe operational levels.

ECONOMY
The economic recovery of the region will help ensure that people, business and industry, infrastructure and government in the region are able to return to normal. The plan will support the return of economic health in the region, and will help to enhance the economy and offset economic disadvantages experienced as a direct result of the disaster.

Individuals
Individuals require access to insurance adjusters and emergency financial services, as well as career counseling and employment assistance.

Business
Businesses have been impacted by the disruption of service resulting in loss of income, loss of goods due to spoilage and potentially the loss of clients and staff. Support could include loans, temporary office space, and advice on how to re-establish their presence within the community. Local labour supply may be impacted due to a loss of housing for employees.

Infrastructure, communications and transport planning
Restoration of affected communications, infrastructure and transportation links are vital to the recovery and enhancement of the local economy.

Government
Support of the local government in **The Town of Drumheller** is imperative to assist with the economic recovery of the region. Intermediate and long-term supports will be put in place to assist local governments with their recovery goals.

SUCCESS FACTORS
In general, community recovery is successful if it overcomes the impacts of the disaster, re-establishes an economic and social base that instills confidence in the local citizens and businesses, and rebuilds the community to be more resilient from future disasters.
A critical issue in defining recovery success is specifying when recovery is complete. Metrics (indicators) of successful recovery are based on this end point. Recovery is also considered

within the context of the trajectory of the community and not based solely on a static pre-disaster state. For example, successful recovery considers the previous population growth of the community not just the total population. Measures of success for each individual project or activity in the plan are required to monitor overall success of the recovery.

Figure 3: Indicators of Successful Recovery

Indicator	Target
PEOPLE	
Population	Overall population in 2015 is consistent with the 2010 census data plus a growth based on historical and current local and provincial rate information.
ENVIRONMENT	
Environmental parameters	Soil, air, water and biodiversity monitoring show that there have been no long-term adverse impacts to the region due to the flood.
RECONSTRUCTION	
Rebuild	All destroyed or damaged structures have been rebuilt and growth rate for the community has been re-established.
ECONOMY	
Employment rate	Regional employment in 2015 is consistent with local historical and overall provincial rates.

RECOVERY PLAN FUNDING

A plan should be supported to some extent by all levels of government, including municipal, provincial and federal; not for profit organizations; and support through donations from individuals, agencies and businesses.

The federal government will fund some aspects through the Disaster Financial Assistance Arrangements (DFAA). The provincial government will fund some aspects through the Disaster Recovery Program (DRP), and other aspects through special programs or financial approvals.

CONCLUSION

Recovery cannot be defined simply by the region's return to pre-disaster circumstances. Recovery is a success when it overcomes the impacts of disasters and re-establishes an economic and social base that will enable future growth. Continued collaboration and support from all stakeholders will be a key enabler of success in the long-term recovery of Town of Drumheller.

TOWN OF DRUMHELLER

MUNICIPAL DEVELOPMENT PLAN

VOLUME 1 BACKGROUND STUDY

Prepared by:

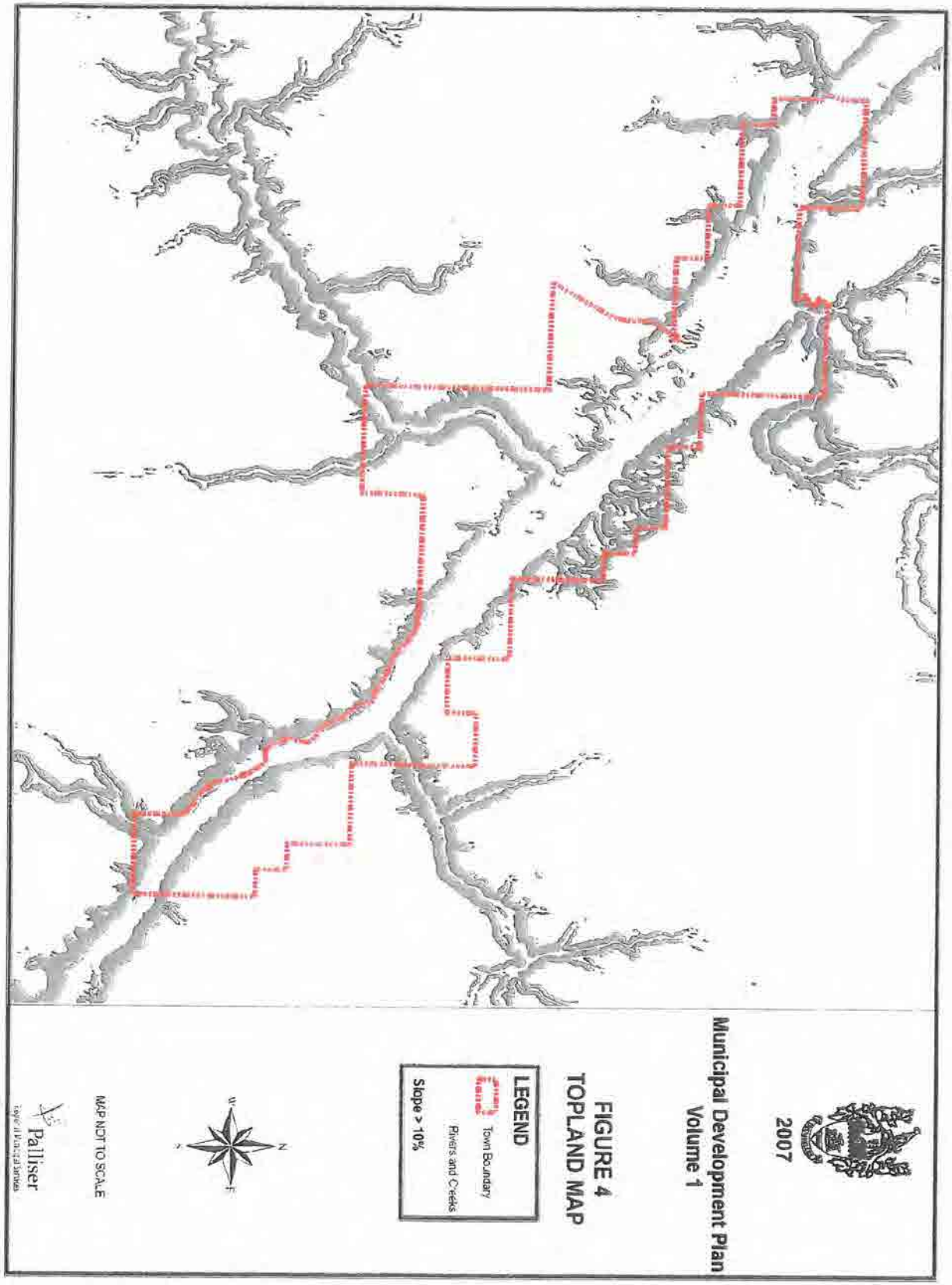
Town of Drumheller and
Palliser Regional Municipal Services

4.4.1. Topography of the Drumheller Valley

The physical features of the Drumheller Valley pose significant development constraints to future development expansion. Badlands formations, as the transition zone between the flat Valley floor and the top lands, cover a large portion of the Valley, both north and south of the Red Deer River. This topography severely constrains future large-scale development due to the significant costs associated with leveling these formations. The steep slopes of the escarpment lands that form the outer walls of the Valley also have soil conditions that limit development potential. Soil instability at the base of these escarpments lands and along the Valley sides, largely due to sparse vegetative cover, presents conditions, which are not well suited for further development. Figure 4 shows the general topography of the Drumheller Valley. A rough estimation is that a total of 3,960 ha (35.6% of the total area of Drumheller) in the Town have a slope of greater than 10% (see Figure 4)

4.4.2. Flood Risk Area

Urban development in the Town of Drumheller clearly exhibits a linear pattern. Contained within the bottomlands, development extends from the toe of the escarpment slope to the banks of the Red Deer River. Development occurred in these areas due to proximity to employment centres and the relative ease of building upon flat land as opposed to badland topography. These bottomlands, however, are subject to periodic flooding by the Red Deer and Rosebud Rivers. The flood risk area is defined as the area which would be inundated by the design flood and is identified by the Provincial and Federal governments for urban areas subject to flooding concerns. In Alberta, the design flood is a 1 in 100 year flood, or one which has one percent chance of being equaled or exceeded in any year. This flood risk area is shown in the Land Use Bylaw as lying below the design flood level as defined by Alberta Environmental Protection. Figure 5 identifies the extent of the flood risk area within the Town of Drumheller. The total area of land lying within the flood risk area is 943 ha. (8.5% of the total area of Drumheller).


2007
Municipal Development Plan
Volume 1
FIGURE 4
TOPLAND MAP
LEGEND
Town Boundary
Rivers and Creeks
Slope > 10%
MAP NOT TO SCALE
Palliser

Large floods occurred in 1901 and 1915, while less significant flooding has occurred in 1948, 1952 and 1954. In 2005 a 1:100 year flood event occurred, but significant flood damage was avoided due to extensive, temporary upgrades to the Town's network of dykes. All floods occurred primarily as a result of multiple upriver storm events, with the exception of the 1948 flood which was caused by an ice jam near East Coulee.

The impact of potential flooding within the Town of Drumheller presents a significant land use planning concern, requiring the implementation of measures to mitigate the risk. Mitigation measures may include:

- discouraging intensification of a land use through the subdivision and development approval process within the flood risk area which can be implemented through the Land Use Bylaw;
- restrict uses within the flood risk area to those least likely to result in loss of life or property damage due to a flood, such as agricultural, recreational or transportation land uses;
- implementing specific flood proofing measures, such as the use of elevated pads or earth fill in locations which it could be utilized economically to raise buildings above the design flood level, thereby facilitating development in areas susceptible to flooding; or
- utilize other flood proofing measures which may include certain safeguards such as locating electrical panels and shut off valves for gas and water lines above the design flood level, the waterproofing of basement walls and restricting the use of rooms below the flood level and/or the provision of sumps and pumps.

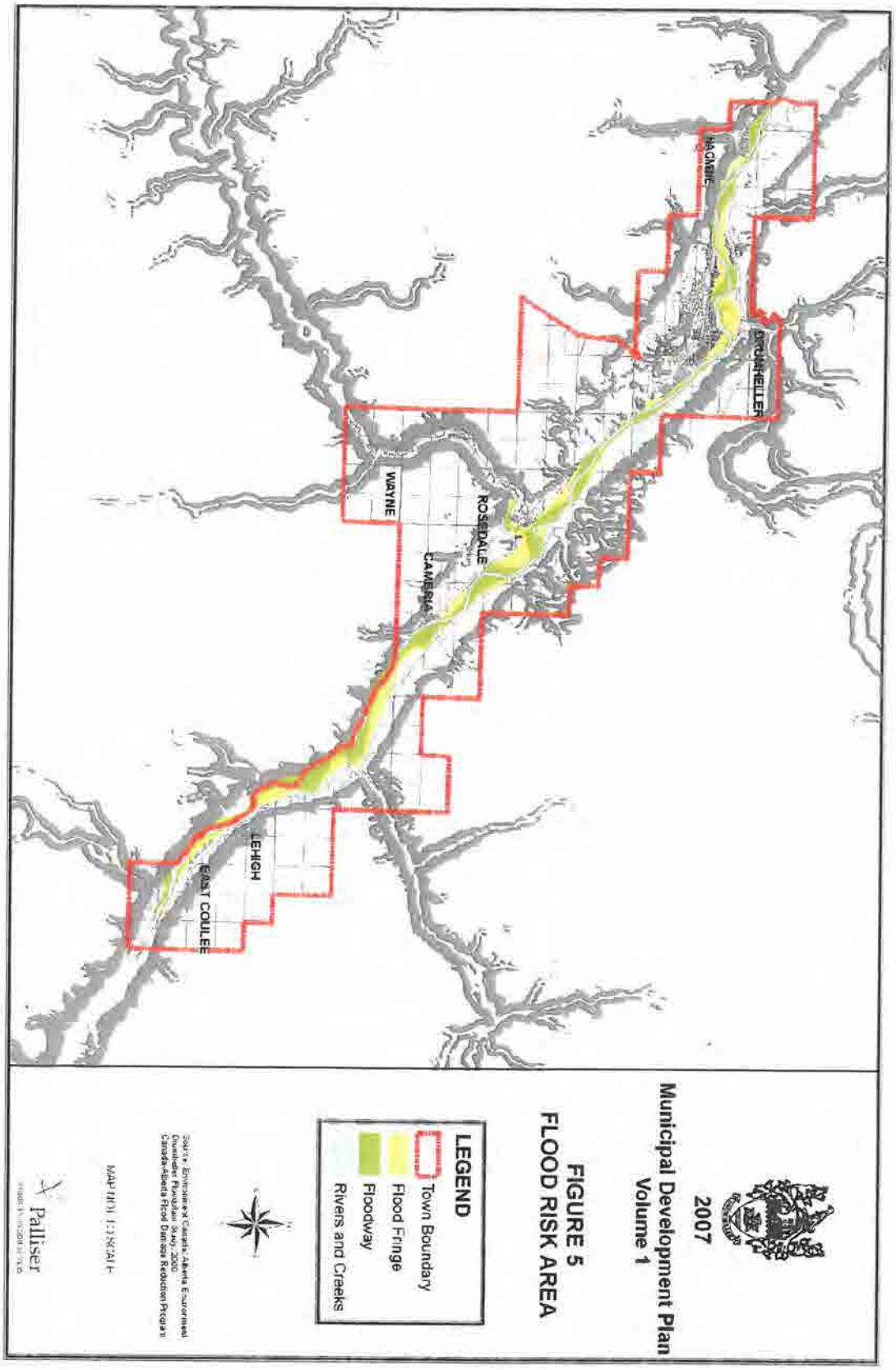
The Federal Government and the Province of Alberta signed "An Agreement Respecting Flood Damage Reduction and Flood Risk Mapping in Alberta" in April 1989. This agreement initiated the Canada-Alberta Flood Damage Reduction Program, which is based on the premise, that the best way to reduce the financial toll of flood damage is to discourage inappropriate development in the flood risk area.

The program requires that flood risk areas be mapped in all urban areas across the province. The flood risk area is defined as the area that would be inundated by the 1:100 year flood event. In Drumheller, a distinction has been made between the floodway and the flood fringe areas of the flood risk zone. The floodway has the greatest risk: floodway waters are the deepest, fastest, and most destructive and new development in these areas is discouraged. In a flood fringe area, water is shallower and moves more slowly. Development in the flood fringe may be permitted provided that it is adequately flood proofed.

Once flood risk maps are completed, the provincial minister responsible for the program will designate the floodway and flood fringe as areas where certain government policies will apply:

In a floodway:

1. No new federal or provincial buildings or structures that are vulnerable to flood damage will be placed in a flood risk area;
2. Financial assistance from federal and provincial sources will no longer be available for new buildings or structures placed in a flood risk area and subject to flooding;
3. Any buildings or structures vulnerable to flood damage placed in a flood risk area after designation will not be eligible for flood disaster assistance; and
4. The federal and provincial governments will encourage local municipalities to adopt land use restrictions to prohibit further development in flood risk areas.


HANNA
DRUMHELLER
WAYNE
ROSEDALE
CAMBRIA
LEHIGH
EAST COULEE
Municipal Development Plan
Volume 1
2007
FIGURE 5
FLOOD RISK AREA
LEGEND
Town Boundary
Flood Fringe
Floodway
Rivers and Creeks
Source: Environment Canada - Alberta Environment
Drumheller Floodplain Study, 2000
Canada-Alberta Flood Damage Reduction Program
MAP NOT TO SCALE
Palliser

In a flood fringe:

1. Development will be allowed, provided it is adequately protected from flood damage. Also, any additions or enlargements made to existing buildings in a flood fringe after designation will require flood proofing to be eligible for future disaster assistance.

Any existing development already in place at the time of designation will continue to be eligible for government flood disaster assistance. Normal maintenance and repair of existing structures will continue as before.

4.4.3. Undermining and Subsidence Conditions

Coal mining has occurred under extensive areas of land in the Drumheller Valley. The approximate locations of mined areas are outlined in Figure 6. Since the extent and depth of mining activity is largely unknown due to insufficient reporting in the past, many potential development sites may be subject to subsidence risk.

It is therefore necessary to assess the degree of risk existing at any site expected to have subsidence conditions caused by undermining. Providing proper verification to relevant authorities, through engineering tests to ensure satisfactory subsurface conditions for urban development are present can accomplish this. Through sound planning and design, sites can be developed with an acceptable degree of risk.

4.4.4. Oil and Gas Wells

The Drumheller region is surrounded by extensive reserves of oil and gas. The surge in the price of gas over the past decade has resulted in a significant amount of seismic activity in the region, followed by significant pipeline and facility construction. There are over 23,000 oil and gas wells licensed within 50 km of the Town boundaries; 12,100 of which have been licensed since 1998. This activity provides a variety of employment opportunities, including well servicing, oil field construction, transportation, and other related activities. Figure 7 shows the location of oil and gas wells within the Town of Drumheller.

Although these resources can be a significant benefit to the area, they can also be perceived as a serious impediment if not managed properly. Oil and gas extractive resource operations may cause land use conflicts depending on the type of resource, the scale and method of extraction and the location of operations and facilities. Conversely, the location of land uses adjacent to these areas may preclude their use. For this reason it is necessary to provide a land use strategy, identifying future growth areas to minimize conflicts and achieve an orderly and efficient land use pattern. Developments of wells and batteries within the meaning of the Oil and Gas Conservation Act are exempt from the provisions under Part 17 (Planning and Development) of the Municipal Government Act (Sec 618.01). Despite the fact that the responsibility for their management lies primarily with the Provincial Government, the municipality should be aware of these resources when planning decisions are made. The expansion of the oil and gas industry must be considered with regards to its impact on existing and future growth within the Town of Drumheller.

4.4.5. Pipelines

An associated land use consideration of oil and gas resource development is the location and alignment of pipeline right-of-ways. Figure 8 shows the pipeline locations in the Town of Drumheller and surrounding area. Pipeline rights-of-way may present an obstacle to various land uses through the fragmentation of land, rendering land unsuitable for many types of development. This can result in increased costs for servicing land, disturb environmentally sensitive and historical resource areas and create complications for the orderly and economical subdivision of land. Although the Alberta Energy and Utilities Board (AEUB) holds approval authority over pipeline projects, it is important for the municipality to understand the implications and impact that pipelines can have on future land use. With this understanding, advance provisions for integration of pipelines with future developments can be made in cooperation with the AEUB and the oil and gas companies.

Town of Drumheller

Strategic Business Plan

Facilitator: Dr. Gordon McIntosh

2018

Approved by Council: January 8, 2018 as amended.

Quarterly Update to Council:

Quarterly Update to Council:

Quarterly Update to Council:

Final Review by Council:

WORKSHOP HELD ON NOVEMBER 29TH, 2017

OUR VISION

To be the cleanest, friendliest, most sought after community in Alberta.

OUR MISSION

To provide good government and promote leadership that encourages a progressive community and positive business relationships towards a better quality of life for everyone.

OUR VALUES

We value:

The people who live here. Every contribution matters.

Honest, open communication. Decisions are made transparently. Citizen's questions and concerns are answered. Collaborative problem solving, every reasonable avenue to say yes is explored.

Fiscal responsibility. All public funds are spent wisely.

Innovation and creativity.

CORPORATE PRIORITIES WORK PROGRAM

FLOOD MITIGATION (TOWN ROLE) (CAO) **When do we decide to move forward with mitigation?** On February 26th, 2016 Drumheller was approved under the Alberta Community Resilience Program in the amount of $6.4M for two flood mitigation priorities - East Midland & Newcastle and Central Drumheller. Agreement with Province remains unsigned. **What are the significant issues?** Provincial Funding Formula is 90/10% cost sharing for the first $3M and 70/30% cost sharing thereafter. Where does the Town come up with their portion of the costs?	The remaining priorities have been re-submitted under the 2016 and 2017 grant program which includes: Berms for Nacmine, Willow Estates, Rosedale / Aerial Flats and 9th Street NW (Hospital Area); Repairs to Midland's Existing Dyking Structure; and Relocations. Annual Application Submission under Advocacy	1. Agreement Dyke Ownership 2. Funding Formula 3. RFP – Engineering Services 4. Public Consultation 5. RFP - Construction

Action Steps – Flood Mitigation (Town Role)

What specific activities or actions will we perform to complete the strategy?

Step No.	Action Step	Assigned To (Who)	Start Date	Due Date
	Background: On June 26th, 2017 Council gave first reading to two borrowing bylaws as follows: Central Drumheller in the amount of $497,400; and East Midland & Newcastle in the amount of $516,000. If Council passes all three readings it does not commit Council to borrowing the money; it does however ensure that the borrowing option is in place and the dollars can be accessed immediately. On August 21st, Council debated the consequences of borrowing versus using reserves to fund the projects and Bylaw 04.17 for borrowing in the amount of $497,400 (Central Drumheller) was defeated at second reading. Bylaw 05.17 in the amount of $516,000 (East Midland & Newcastle) was tabled to a future Council meeting. The Province's funding agreement is not signed for the East Midland & Newcastle and Central Drumheller flood mitigation projects and until such the Town cannot move forward for tendering of the design phase. The funding agreement is not signed because the Province wants the Town to take ownership of the dykes and a mutually agreeable agreement has not been reached as of yet. The Town will be seeking funding through the **Public Safety Canada's National Disaster Mitigation Program (NDMP)**, which is a federal-provincial grant program intended to enhance local and provincial capacity to effectively mitigate, prepare for, respond to, and recover from flood-related events. The program operates on a federal, provincial and municipal costs-share model. This grant program requires AEMA to nominate the Town for this funding. Past CAO and current CAO have had ongoing discussions with Andy Lamb for an agreement as well as the moving forward with buyouts.	CAO		
1.	Agreement Dyke Ownership Town of Drumheller's Position (as of September 27, 2017): Town will take ownership of the dykes once the improvements have been completed to our satisfaction. Province will continue to be responsible for major repairs (repairs over $50,000 – Town suggests $25,000) through the DRP Grant Program based on an event that has a frequency of occurring of approximately 1:10 and includes damage resulting from ice jams on the Red Deer River. The Town recommends three (3) changes to the LOI: 1) 1:10 storm to be a guideline (not a firm frequency);			

	2) Damage from ice flows / jams to be included in definition; 3) Major repairs to be reduced from $50,000 to $25,000.			
2.	Funding Formula			Jan-Feb., 2018
3.	RFP – Engineering Services			
4.	Public Consultation			
5.	RFP – Construction			

NOTE FOR FILE -- FLOOD PLAIN -- Pt. N.E. 10-29-2D-W.4

1. The following people convened in a meeting in the council chamber of the Drumheller City Hall on Thursday morning, September 2, 1976. The meeting started about 10:45 a.m.

Mr. Francis Porter -- Mayor of City of Drumheller

Mr. R. Deeprose -- Director of Technical Services, Department of the Environment

Mr. Rhys Smith -- Director, Calgary Regional Planning Commission

Mr. Ralph Southwell -- Calgary Regional Planning Commission

Mr. Ray Romanetz -- City Engineer, Drumheller

Gordon E. Taylor, M.L.A.

2. Gordon Taylor acted as chairman, and welcomed the others to the meeting and expressed the hope that a solution to the problem could be found, as Drumheller was short of land and the cost of moving into the hills was exorbitant. He also mentioned the fact that the area in question -- the old Hy-Grade Mine site -- is much higher than many areas already subdivided.

In short opening statements, the following points were made:

(a) Mayor Porter said that he wants to arrive at a solution, and he expressed appreciation for the co-operation of the others in coming to the meeting. Mr. Porter also dealt with the varlous stages of the floods throughout the years and referred to statements from some who were there in 1915 who stated that the Hy-Grade plain was not flooded. He knew personally that the area in question was not under water in 1948, 1952 or 1954, as he was in charge of civil defence in Drumheller at that time.

(b) Mr. Deeprose outlined the methods used in establishing the flood plain and stated that if there was something wrong with the material upon which

the decision was based he and the Department would be glad to review it. He also mentioned that if the risk is too high, that is, if the possibility of flooding is too evident, then development is not wise. Mr. Deeprose dealt in some detail with the methods used in getting the information about the flood plain and did say that the early information (1911, 1915) was based on a number of assumptions. He emphasized that the Department of the Environment does not have any veto authority and that other jurisdictions outside of the Province use different criteria in establishing flood plains and in permitting development.

(c) Mr. Rhys Smith pointed out that not every flood acts the same way. He referred to contours in relation to the drop in rivers. He emphasized that the City Council is the real authority and that the Calgary Regional Planning Commission is responsible for giving all facts and information due consideration. He did point out that water and sewer must be approved by the Department of the Environment after the subdivision is approved. Mr. Smith mentioned three particular areas: Area 1 is where residential development, with water and sewer, is already in place and an extension is desired; 2 -- the land outside of an area that is subdivided; 3 -- subdivision within the flood plain, where there is no development, and queried whether such lands should not be used for racetracks and other "non-people" purposes.

Mr. Smith emphasized the importance of getting a permanent or long-term solution to the problems, that is, guidelines which the Calgary Regional Planning Commission can use; for example, what kind of development should take place in a 1% flood area, in a 2% flood area, etc.

3. The question of responsibility then was discussed, and Mr. Smith agreed that the City Council, as the local authority, has the authority to make decisions, insofar as many things are concerned, and if the City wanted to develop the said area, or have it developed, then it could apply for it. He

pointed out that water and sewer would have to be approved by the Department of the Environment, and guessed that the C. R. P. C. would approve, with some qualifications.

Mr. Porter indicated that the City Council is really trapped. On the one hand, it appears to have the authority to make a decision that the area should be developed; the Calgary Regional Planning Commission would probably then say, "O. K., if Environment approves." Environment would say, "It's not our place to approve." So the City is back to Square One, and this is most frustrating for the mayor and the city councillors.

Mr. Romanetz pointed out one inequity: namely, if an area had been subdivided before the flood plain was declared, even if it was lower than the flood plain, development could take place, and had, indeed, taken place.

The following points were made:

(a) Mayor Porter wants the said area taken out of the flood plain.

(b) Mr. Deeprose indicated that he did not hear anything that would make him change his mind regarding the correctness of the report by the Department of the Environment, and emphasized that he appreciated the fact that the area in question was higher than many areas already subdivided. He advised that he was going to make a full report to his Deputy.

(c) Mr. Rhys Smith suggested that guidelines be prepared by, possibly, the Department of the Environment and the City.

In conclusion, it was suggested that possibly (1) the City would make application for the subdivision; (2) that the Calgary Regional Planning Commission would likely approve; (3) that the Department of the Environment would then deal with water and sewer. Mr. Rhys Smith pointed out that where the Calgary Regional Planning Commission does not approve, an appeal could be made to the Provincial Planning Board. He did advise that the Calgary Regional Planning Commission had

been appointed the approving authority for subdivision.

One of the main difficulties appears to hinge on the fact that an appointed board may approve or veto a decision of the elected representatives of the local area; the locally elected officials are most concerned, as they must continue to live in the area.

In conclusion, the Chairman pointed out that progress had been made and many issues clarified, and that some of the things that could be done to have the area approved for subdivision included (1) putting the houses on higher land, as has been done in some areas to the east of the area in question; (2) building a dike along the south bank of the area -- along the bank of the Red Deer River; (3) raising the whole general area with some of the slack that is already piled there; (4) building waterproof basements; and (5) requiring all buildings to be above a certain level.

Before adjourning, the Chairman thanked everyone for their contributions towards a solution.

Following the meeting, everyone except Mr. Smith and Mr. Romanetz went to the site and saw the area in question and the very nice houses to the east, where the level had been raised, before building, to the height of the site in question, with some a little higher and some lower than the area being studied.

It was suggested at the close of the meeting that the Mayor should set out in a memo to the Department his feelings about the whole matter.

The matter is to be pursued.

Gordon Taylor

GORDON E. TAYLOR M.L.A.

Town of Drumheller

Municipal Sustainability Plan Implementation

REVIEWED BY COUNCIL: **December 12, 2011**

REVIEWED BY COUNCIL: **2012 Updates in Blue (November 29, 2012)**

REVIEWED BY COUNCIL:

REVIEWED BY COUNCIL:

The Municipal Sustainability Plan was adopted by Council on September 27, 2010 and it is the document that will guide the community into the future.

ENVIRONMENT PILLAR

SUSTAINABILITY VISION: Natural Area Protection	Current Reality	Ongoing Initiatives
The community values the natural environment. The public has considered strategies to protect natural landscapes and watersheds. A regional plan to protect natural areas is in place and provides an appropriate level of protection to environmentally sensitive areas. Residents feel that a balance has been struck between intensive land use and the preservation of the environment. Group Responsible for Implementation: Municipal Planning Commission / Planning Department	• The province has recently introduced a Provincial Land Use Framework. Municipalities are familiar with the preliminary concepts that will form the basis for the implementation of these provincially-driven policies. • The Town actively monitors the use of natural areas, with input from residents. Enforcement activities use a combination of active area patrols and follow-up on complaints received from residents. • The development of a provincial land use framework will require future changes to be made to Drumheller's Municipal Development Plan and Land Use Bylaw.	• The Town administers the Land Use Bylaw and Municipal Development Plans. Statutory plans are followed through the regular course of business. • The municipality is participating in regional land use planning discussions. • The province administers the Environmental Protection Act, which concerns natural areas that are in proximity to watersheds and or crown properties. Enforcement of environmental issues can come from various agencies.

Action Steps – NATURAL AREA PROTECTION

What specific activities or actions will we perform to complete the vision?

Step No.	Action Step	Timeline (Short, Medium or Long Term)	Lead Department Head	Link to Multi-Year Capital Infrastructure Plan/ Other Municipal Plans	Start Date	Completion Date
1.	Evaluation and development of plans / policies for natural area protection (i.e river valley / floodplain protection, significant unique hills / valley walls, etc.).	Short Term	PRMS / MPC/Dev Off		2012	2013
2. Year 2 - 5	*MSP Committee recommendations:* • *Retain existing natural areas, naturalize and / or restore disturbed natural areas to replace traditional landscaping.* Public promotion of the xeriscaping policy as published in the Land Use Bylaw and the Municipal Development Plan. Further review and development of xeriscaping policy options / best practices is in process. • *Natural Area Protection Focus Strategy.* Continue to educate and inform developers and residents on the allowable scope of landscape alternatives. Refer to natural protection sections of the Municipal Development Plan. • *Plans and policies in place preserve and enhance the natural environment.* MDP contains natural areas protection policies to be utilized as considerations when subdivision or development is proposed.					

Town of Drumheller

Infrastructure Financing Strategy

Draft 3.1
August 31, 2017

Based on Policy Adopted by Council
July 18, 2011

EXECUTIVE SUMMARY

Table Contents

1. Introduction

1.1. Definitions

For the purposes of this document certain terms need to be identified and defined.

a. Capital Asset – An asset that provides a long-term benefit to the town and its historical cost is a material amount. Examples: Buildings, heavy equipment, and water and wastewater infrastructure.

b. Capital Asset Value – As defined in the Infrastructure Plan. Value is based on the estimated cost to replace that asset with a similar although not identical asset.

c. Capital Addition or Upgrade Expense – The acquisition of a capital asset that is new, or expands the capacity of an existing capital asset or is a new technology of a significant scale and cost.

d. Capital Reinvestment Expense – The acquisition of a capital asset that replaces an existing asset that is already identified in the Infrastructure Plan. The capital asset acquired may have greater capacity or involve new technology but the increases would be marginal.

e. Infrastructure Plan – Town of Drumheller Multi-year Infrastructure Plan as revised and adopted from time to time by Council.

f. Restricted Surplus (*Type/Function*)– An amount of money set aside to assist in funding the renewal, upgrading and replacement of infrastructure of a specified type or function in the present or future years. Also referred to as a reserve.

g. Restricted Surplus – Overall Contingency – An amount of money set aside to cover operating costs in the future in case the Town's source of revenue is unexpectedly interrupted.

h. Strategy – Town of Drumheller Infrastructure Financing Strategy as revised and adopted from time to time.

i. Operating Expense – An expense that is required to carry on the daily or routine operations of a facility or service. It does not include major renewal, upgrading or replacement of existing infrastructure nor the purchase or construction of new infrastructure.

j. Tangible Capital Asset – are non-financial assets having physical substance that:
   (i) are held for use in the production or supply of goods and services, for rental to others, for administrative purposes or for the development, construction, maintenance or repair of other tangible capital assets;
   (ii) have useful economic lives extending beyond an accounting period;
   (iii) are to be used on a continuing basis; and
   (iv) are not for sale in the ordinary course of operations.

1.2. Objective of the Strategy

This Strategy sets out the approach for funding the expenses identified in the Infrastructure Plan. This strategy identifies how the funding needed to renew, upgrade and replace the Town's infrastructure will be provided.

The Strategy will set out the contributions to the Overall Contingency necessary to build up sufficient funds to cover operating expenses for a certain time period should the Town ever lose its operating revenue for some unforeseen reason.

This Strategy will also identify target levels for contributions to restricted surpluses for:

- facilities,
- vehicles and equipment
- streets and roads
- storm drainage
- water, and
- wastewater

to allow for continuing renewal, upgrading and replacement necessary to maintain the Town's assets at an acceptable service level.

This Strategy and the Infrastructure Plan will be reviewed and updated on a regular basis to ensure that these continue to reflect current financial, political, environmental and community priorities.

This Strategy is used to set up the funding approach for the 2017 – 2026 Infrastructure Plan, most recently updated to August 31, 2017 and which reflects the adopted 2017 Capital Budget.

1.3. Previous Capital Financing Strategies

Over the past 20 years the capital financing strategies of Council have continued to evolve. The first strategy was put in place in 1998 (Policy C-02-98). That strategy was replaced by a more detailed policy in 2004 which was further refined in 2006. A new strategy was adopted in 2011 and the present strategy is patterned on that policy with additional detail and analysis included.

1.4. Tangible Capital Asset Value

At the end of 2016, the original cost of the Town's tangible capital assets totalled $230,808,008 with net book value after amortization of $143,112,340 (2015 - $144,402,277). This balance reflects the book value of tangible capital assets as detailed in the Town's general ledger. For 2017 the budgeted annual amortization (depreciation) is projected to total $3.74 Million:

- general revenue supported functions - $1.65 Million
- water utility - $1.25 Million
- wastewater utility – $840,000

1.5. Assumptions

The following assumptions are used in the preparation of this strategy.

1. The annual expense for renewal, upgrading and replacement of each element of the Town's Infrastructure is set out in the Infrastructure Plan

2. Water and Wastewater utilities are self-funded from the monthly revenue they generate. Restricted surpluses for water and wastewater utilities are independent of the general restricted surpluses for facilities, equipment, transportation and storm related infrastructure. Capital contributions paid by the Kneehill Regional Water Services Commission and the Starland Water Authority are held in a deferred revenue account and amortized to restricted surpluses with the interest earned used for capital.

3. Annual earned interest income on the investment of restricted surplus funds will accrue to respective restricted surplus. However, because of the very low rates of return on investments, interest earned on restricted surplus funds is not considered as a revenue in the Infrastructure Plan

4. The revenue and expense set out in the Infrastructure Plan are expressed in 2017 dollars and inflation is not considered. Debt servicing costs are shown with the actual amount in the year of payment.

5. Operating Funds will be made available to assist in funding the expenses identified in the Infrastructure Plan

6. The annual amount diverted from general revenue toward replacement and renewal of existing non-utility infrastructure will not exceed an amount equal to the amortization expense of that year.

7. Long-term borrowing is used to fund a portion of major new infrastructure but is to remain below the maximum levels identified in the borrowing policy.

8. The amount available for infrastructure spending in each year is identified in the Infrastructure Plan. Annual variations may result due to saving for large scale projects, which exceed the annual average developed in the Infrastructure Plan.

2. Funds Available for Infrastructure Expenses

There are three primary sources of funds for infrastructure purposes:

- Grants, Donations, Development Contributions and other External Contributions
- Town's own property taxation revenue, revenue from sales of service and other general revenues
- Borrowing

This Strategy will blend funds from each of these sources in the most advantageous way to fund particular infrastructure expenses.

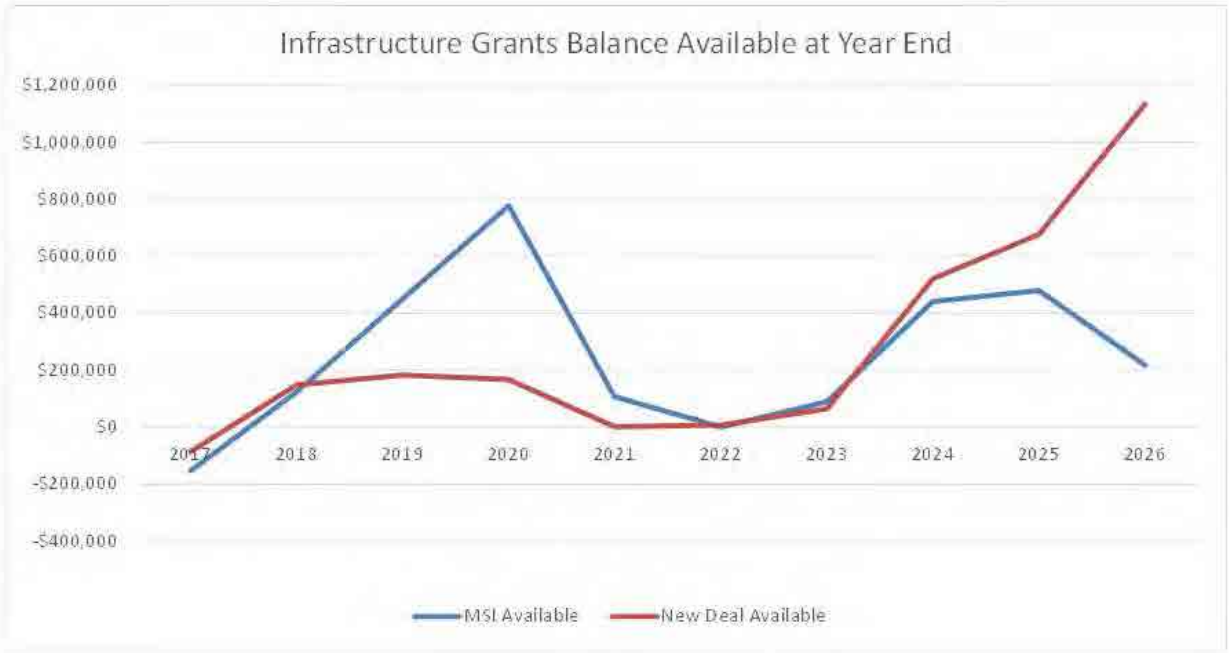
2.1. General Conditional Infrastructure Grant Funds

In common with other Alberta Municipalities, the Town is eligible each year for funds under the Alberta Municipal Affairs Municipal Sustainability Initiative (MSI) Program (including MSI Capital and BMTG Components) and the New Deal for Cities (Federal Gas Tax Fund or GTF Program) for infrastructure purposes. In 2017, the Town will be eligible for $1.81 Million under both components of the MSI program and $435,000 under GTF Program.

In the Infrastructure Plan, it is assumed that the Town will continue to be eligible for similar levels of per capita funding from a continuation of these current programs or any successor programs. With the carry forward of $1.19 Million from 2016 and assuming an average annual population increase of 1%, it is assumed that a total of $22.98 Million will be available under these grants over the 10 years of the Infrastructure Plan.

The Infrastructure Plan at this point identifies uses of $22.82 Million leaving $1.35 Million available for other projects near the end of the 10 year planning time frame. For every 10% drop in these grants from 2017 expected levels, the Town would lose $225,000 annually in funding.

	Available Beginning 2017	2017 - 2026 Received	2017 - 2026 Used	Remaining End 2026
Municipal Sustainability Reserve	$1,185,372	$18,530,609	$19,497,246	$218,735
Federal Gas Tax Fund	$0	$4,453,573	$3,320,000	$1,133,573
	$1,185,372	**$22,984,183**	**$22,817,246**	**$1,352,308**



Administration of the FGT Program shifted to Alberta Municipal Affairs in 2016. The program's description on the AMA website, identifies that FGTF funding is "intended to cover capital costs only. How this criteria is administered and to what extent its use for

funding the renewal and replacement of existing infrastructure is allowed may have implications for the ability to use this grant for expenses identified in the Multi Year Infrastructure Plan.

Beginning in 2018, funds under the MSI and FGT programs are not planned to be used for water and wastewater infrastructure.

2.2. Defined Purpose Conditional Infrastructure Grants

Additionally there are conditional grants under Federal and Provincial programs that may be available for funding Town infrastructure expenses. The Multi Year Infrastructure Plan contemplates funding over the 10 year planning time frame from the:

- Alberta Municipal Water/Wastewater Partnership Program, both the
  - regular program - $230,000, and
  - Water for Life Strategy - $2.4 Million
- Alberta Community Resiliency Program – $29.4 Million
- Strategic Transportation Infrastructure Program – $1.6 Million
- Federal Clean Water / Wastewater Fund (FCW/WWF) - $685,000

Beyond the FCW/WWP Funding other potential funding from Government of Canada federal infrastructure programs has not been contemplated in the Multi-Year Infrastructure Plan.

The Town will continue to monitor infrastructure grant availability and make applications for funding as the opportunity arises. Funding received from defined purpose conditional grants may allow the reallocation of general conditional infrastructure grants (Section 2.1) or Taxation and General Revenue funds (Section 2.4) to other infrastructure expense but is not intended to result in a reduction of the Taxation and General Revenue made available for infrastructure purposes.

2.3. Off-site Levies and Development Contributions

The Town, where able, will require land development to contribute toward major street, water, wastewater and storm drainage infrastructure through the payment of offsite levies. In 2017 the Town has a balance of $396,000 in collected offsite levies. The Infrastructure Plan at this point does not contemplate drawing any of those funds as revenue for infrastructure projects.

2.4. Donations and Other Contributions

The Town will not seek donations and fundraising contributions from others for the renewal and replacement of infrastructure but rather for the major upgrading of existing and the development of new recreation and parks infrastructure and for specialty emergency services equipment. Apart from one small project in 2017, the Infrastructure Plan does not include in its funding sources any further donations, fundraising and other contributions.

2.5. Taxation and General Revenue Available for Non-Utility Infrastructure

A portion of the annual taxation and general revenue of the Town is made available for non-utility infrastructure purposes – expenses in that year and infrastructure borrowing

costs with funds unneeded in the present year, placed in reserves for future years. As part of the financing strategy, it is necessary to forecast how much funding will be available from the Town's own annual revenues for infrastructure purposes.

The 2017 Town Budget anticipates sufficient revenues to cover operating expense and about 2/3 of tangible capital asset amortization (depreciation). In that amortization is a non-cash transaction, the revenue remaining after operating expense is cash that can be used for infrastructure. In previous years funds actually available neared 100% of amortization. In 2016, it was 90%.

In 2017 it is expected that about $1.9 Million in cash would be available after regular operating expenses. After deducting debt principal payments, about $1.4 Million is expected to be available. Assuming a similar magnitude is available in future years and adjusting for changes in debenture principal payments, a net amount of about $1.7 Million per year is available for 2018 – 2023 and $1.5 Million per year thereafter. These funds would be allocated as follows:

- 5% for unanticipated operating expense or to operating reserves
- 10% for diversion to Contingency Reserves
- 85% for infrastructure expense

The total taxation and general revenue available for non-utility infrastructure expenses for the 10 year period of the Infrastructure Plan would total about $14 Million. Each 1% of increase in the municipal tax rate would add about $100,000 annually in available revenue.

2.6. Utility Revenue Available for Water and Wastewater Infrastructure

The water and wastewater utilities are financially self-supporting and do not utilize taxation or other general revenues of the Town. The Town prepares utility rate models annually for the water and wastewater utilities which forecast the rates and revenue for the next three years.

For water, the rates and expected revenue for 2017, 2018 and 2019 will generate funds for water infrastructure of $865,000; $980,000 and $985,000 respectively. This amount would decline in the future by the amount of annual payments for debt. Total estimated funds that would be available for water infrastructure for the period 2017 – 2026 would be about $9.4 Million.

Similarly the wastewater utility is projected to generate surplus funds for wastewater infrastructure of $4.78 Million over the next 10 years rising beginning at $450,000 in 2017 and averaging about $480,000 over the decade.

2.7. Restricted Surplus

With the changes in financial reporting requirements, the term "reserve" has been replaced with the phrase "restricted surplus." In this policy the terms restricted surplus and reserve are used interchangeably.

The total restricted surplus for the Town for all purposes at the beginning of 2017 was $14.5 Million. (see table in Section 2.9 below) This is about $1,820 per capita based on a 2016 federal census population of 7,982. This compares to a median value of $1,339 for

the group of municipalities to which the Town compares itself in a review of 2015 reported values.

By 2026 it is estimated that the total of all reserves would be about $18.1 Million, a gain of about $3.6 Million over the 10 years of the Plan. The objective would be to continue to increase the sum of total reserves by an average of about $300,000 per year.

It has been and remains a goal to ultimately have in place reserves totalling 10% of the original cost of the Town's tangible capital assets. As identified in Section 1.4, the Town's original cost of tangible capital assets totals nearly $231 million. The long term goal of the Town would be reserves totalling about $23 Million.

2.8. Restricted Surplus – Contingency

A restriction in surplus for contingencies would be used to cover unexpected expense or interruptions revenue receipts. There are two contingency reserves maintained.

Contingency Reserve – Infrastructure

Funds from the Infrastructure Contingency Reserve would be available to fund unexpected but necessary infrastructure spending that has not been anticipated in the 10 Year Infrastructure Plan.

Contingency Reserve – Overall

Funds from the overall contingency reserve would be available to cover operating expenses in the event of an interruption in the revenue or cash flow or for emergency operating costs caused by a natural disaster, emergencies, or by extremely high inflation.

The question would be how many months' coverage should be kept in the overall contingency fund to keep the Town operating if an unexpected problem arises. Private business usually keeps no less than three months operating costs as cash on hand. Municipally various objectives are identified. A 3 month benchmark for the Town would provide enough funding and time to take action should an interruption occur.

The Town's 2016 (audited) cash Operating Expenses, (net of amortization but including debt principal payments) was $15.7 Million, an average of $ 1.3 Million per month. At a target of 3 months minimum, the Town's Restricted Surplus – Contingency should be about $ 3.95 Million.

Target for Accumulated Surplus - Contingency

At the beginning of 2017, the Town had just over $3 Million in both contingency accounts.

- Contingency – Long Term $905,000
- Contingency – Overall $2,175.000

A diversion to Restricted Surplus – Contingency of 10% of available taxation and general revenue funds as identified in Section 2.5 above – about $170,000 annually, the Town would accumulate about $4.7 Million. The Overall Contingency Reserve would be capped

at 3 months of operating expenses or $4 million in 2022. The remaining funds would be diverted to the Infrastructure Contingency and be available for unanticipated, premature failure or loss of infrastructure.

2.9. Restricted Surplus for Specific Functions and Types of Infrastructure

The Town to this point has had restricted surpluses established for each of the five major areas of infrastructure: transportation, facilities, equipment, water and wastewater. A sixth is added for storm drainage infrastructure.

The amount of cash held in these funds or the target level should represent at least the annual reinvestment required to keep a particular asset at its present level of service. Establishing the level of restricted surpluses for capital reinvestment has no hard and fast rules. Some jurisdictions are able to fund their entire annual capital programs from the interest earned from restricted surpluses, while others do not hold anything in reserve and borrow money to pay for their programs.

In this Strategy, the funds available annually for infrastructure expense from the Town's annual revenue are allocated to the six infrastructure restricted surplus funds. Funds needed for Infrastructure Projects are drawn out of the respective restricted surplus funds in the present or in future years as the case may be.

Funds available for non-utility infrastructure over the period 2017 – 2026 have been allocated as follows:

Equipment	30%	$4,483,764
Facilties	25%	$4,047,558
32 Streets and Roads	35%	$5,231,058
37 Storm Drainage	10%	$1,183,500
		$14,945,880

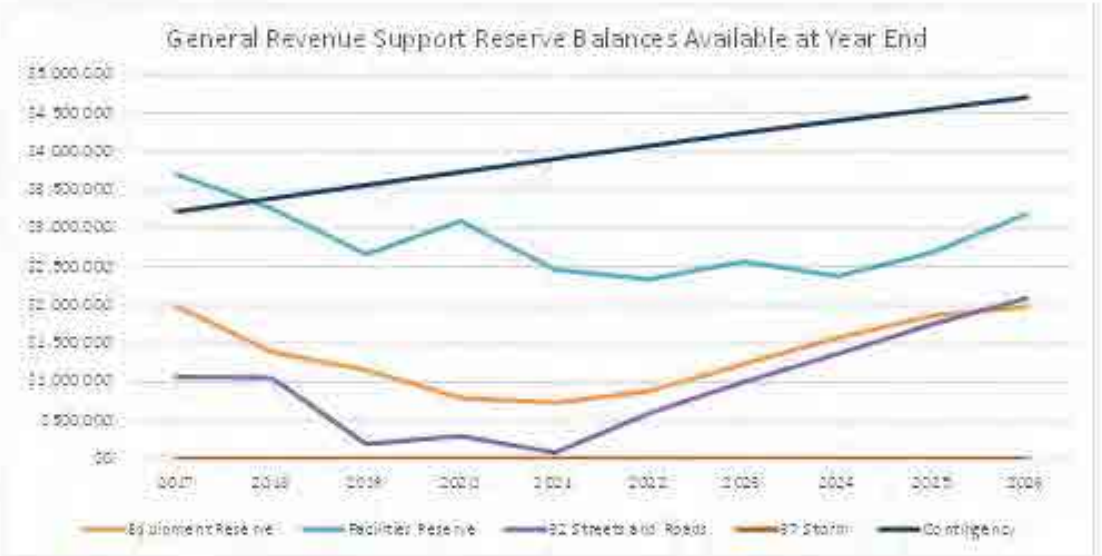
A total of $9.38 Million has been added to water restricted surplus and $4.78 Million added to wastewater restricted surplus.

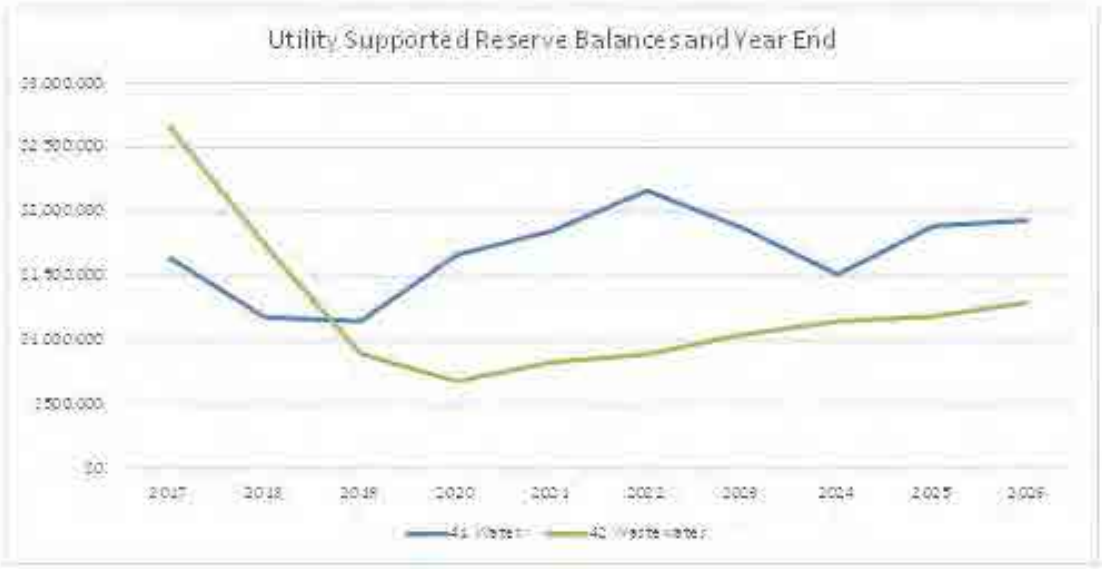
The balance of the various restricted surplus funds for the 10 year planning timeframe is as set out below.

	Reserve Balances	
	Beginning 2017	Ending 2026
Infrastructure Reserves		
Equipment	$1,813,450	$2,177,522
Facilities	$4,200,500	$3,696,308
Transportation	$1,318,450	$2,591,878
Storm	$0	$0
Water	$988,355	$2,734,920
Wastewater	$2,704,900	$1,801,098
	$11,025,655	$13,001,726
Contingency Reserves		
Contingency - Infrastructure	$905,000	$702,288
Contingency - Overall	$2,175,000	$4,000,000
	$3,080,000	$4,702,288
Other Reserves		
General Capital	$51,520	$55,000
Offsite Levies	$393,000	$395,882
Land	($342,500)	($342,500)
Municipal (Parks) Reserves	$12,236	$12,236
Sandstone	$41,000	$66,000
Various Operating Reserves	$265,100	$265,100
	$420,356	$451,718
	$14,526,011	**$18,155,732**

To fund the funding requirements of the Infrastructure Plan, some of the specific restricted surplus funds have been drawn down in the years 2017 to 2021. There is recovery in the years 2022 to 2026 such that the restricted surplus available for infrastructure is nearly $2 Million higher in 2026.

Total restricted surplus for all purposes including contingency rises to over $18 Million by 2026.





2.10. Debt Financing

The third major source of infrastructure financing is debt financing. Historical practice of some municipalities is to keep borrowing to a minimum and only allow borrowing on major projects having life expectancy of 40 years or more. However, a number of larger communities with significant water systems or suppliers of regional water have adopted the less restrictive debt practices advocated by the Alberta Utilities Commission (AUC). Those practices are more in line with other utility systems such as electrical and natural gas.

The total debt principal owing at December 31, 2016 is $10.5 Million. For non-utility infrastructure, new debt taken on includes:

- $1 Million in 2017 as part of funding for the $7.3 Million Flood Protection Project and
- $2.5 Million in 2021 – 2022 for the development of a replacement Public Works shop facility (Shop A)
- $1.4 Million as funding towards $2.4 Million of unspecified investment in the years 2024 - 2026

For water, new debt taken includes:

- $800,000 in 2022 for the Penitentiary Booster Station Replacement,
- $1.6 Million in 2025 for the Water Treatment Plant upgrade to handle treatment process residual wastewater

For water, the long term debt principal balance begins at just under $2.7 million at the beginning of 2017, drops to $1.7 million in 2021 and rises to $2.8 Million by 2026. Debt as a proportion of the total capitalization of the water system remains very low at about 10%. The notional capital structure upon which the utility rates are calculation is 70% debt and 30% equity.

For wastewater, new debt taken on includes:

- $485,000 in 2017 as a portion of the $1.3 Million for the East Coulee Lift Station Replacement
- $219,450 in 2020 as the balance of funding needed after grant to finance upgrading of the River Outfall
- $650,000 in 2023 for the construction of the 11th Street to 19th Street Forcemain

Wastewater debt principal peaks at $3.2 Million at the end of 2017 and declines to $2.2 Million by 2026. Debt as a proportion of the total capitalization of the wastewater system remains very low at about 10%

New debt is contemplated by way of debentures issued by Alberta Capital Finance Authority for 25 year amortization period at 4% interest for debenture taken in 2017 and 5% for debentures thereafter. The current (Aug 2017) 25 year rate from ACFA is 3.227%. The estimated total debt principal owing at the end of the 10 year planning timeframe is $10.4 Million.

	Taxation and General Revenue Supported	Water Utility Supported	Wastewater Utility Supported	Total
Principal Owing - Beginning 2017	$4,927,734	$2,672,310	$2,908,314	$10,508,357
Annual Payments at Highest	$752,865	$461,963	$366,843	$1,581,672
Annual Payments at Lowest	$513,110	$291,893	$285,192	$1,090,196
Interest Paid - 2017- 2026	$2,486,727	$1,015,551	$1,232,237	$4,734,515
Principal Owing - Ending 2026	$5,364,973	$2,829,617	$2,204,566	$10,399,157

2.11. Compliance with Debt Management Policy

The Town's Debt Management Policy provides for the following debt related limits:

- Total debt will not exceed 60% of the debt limit established in the *Municipal Government Act* and regulations
- Total debt service costs will not exceed 60% of the debt service limit established in the *Municipal Government Act* and regulations
- Debt service costs for tax-supported debt will not exceed 20% of the taxes available for municipal purposes.

As set below, the debt financing contemplated in the Infrastructure Plan is well within the limits established in the Debt Management Policy. In 2017, the debt owing is 38% of the statutory debt limit and 63% of the Debt Management Policy limit. By 2026, slightly less of policy limit is used - 35% of statutory and 58% of debt policy limits.

The annual debt servicing cost (payments of interest and principal) in 2017 is only 28% of the statutory limit and 47% of Debt Management Policy limit. By 2025 this remains low at 32% of statutory and 53% of debt policy limits. There is room for an additional borrowing of $7.6 Million under the debt management policy.

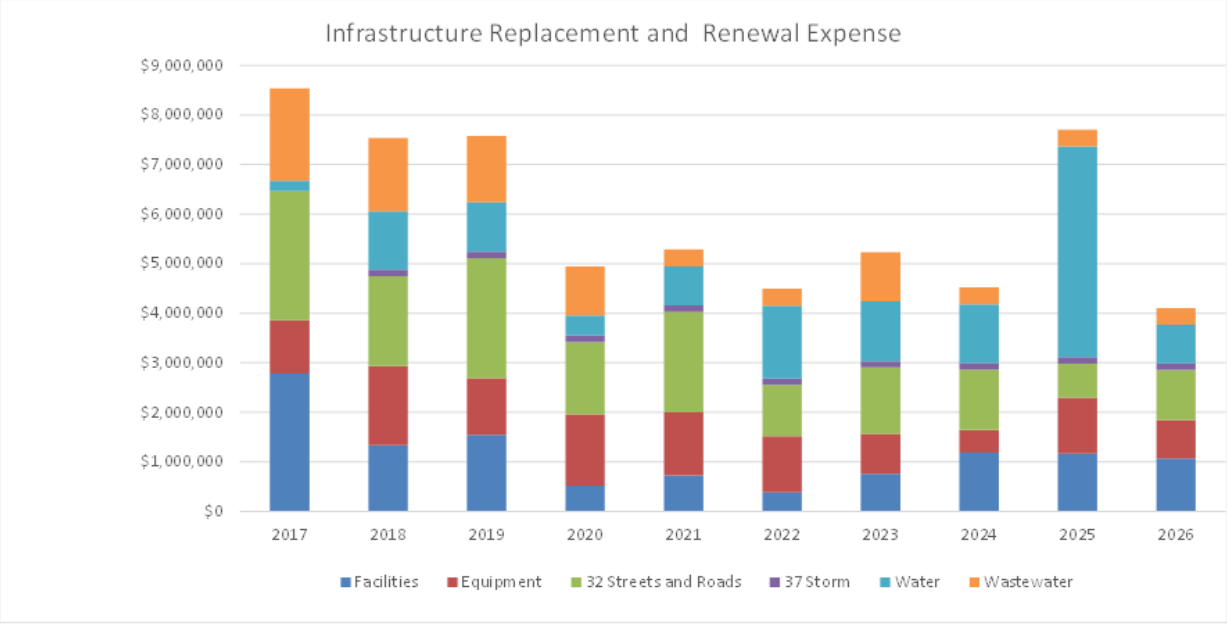
	2017	2026
Debt Limit		
Prior Year Annual Revenue	$18,611,114	$20,000,000
Debt Limit as Factor of Annual Revenue	1.5	1.5
Legislated Debt Limit	$27,916,671	$30,000,000
Debt Management Policy		
As % of Legislated Debt Limit	60%	60%
Debt Management Policy Limit	$16,750,003	$18,000,000
Total Debt Principal Owing at Dec 31	$10,508,357	$10,399,157
% of Legislated Debt Limit	38%	35%
% of Debt Management Policy Limit	63%	58%
Debt Servicing Limit		
Debt Servicing Limit as % of Annual Revenue	25%	25%
Legislated Debt Servicing Limit	$4,652,779	$5,000,000
Debt Management Policy		
As % of Legislated Debt Service Limit	60%	60%
Debt Management Policy Service Limit	$2,791,667	$3,000,000
Annual Debt Servicing Expense	$1,317,925	$1,581,672
% of Legislated Debt Servicing Limit	28%	32%
% of Debt Management Policy Limit	47%	53%

3. Infrastructure Expense

3.1. Infrastructure Renewal, Upgrading and Replacement

The total expense set out in the Infrastructure Plan for renewal, upgrading and replacement of existing infrastructure is estimated at $60.5 million over the period 2017 – 2026.

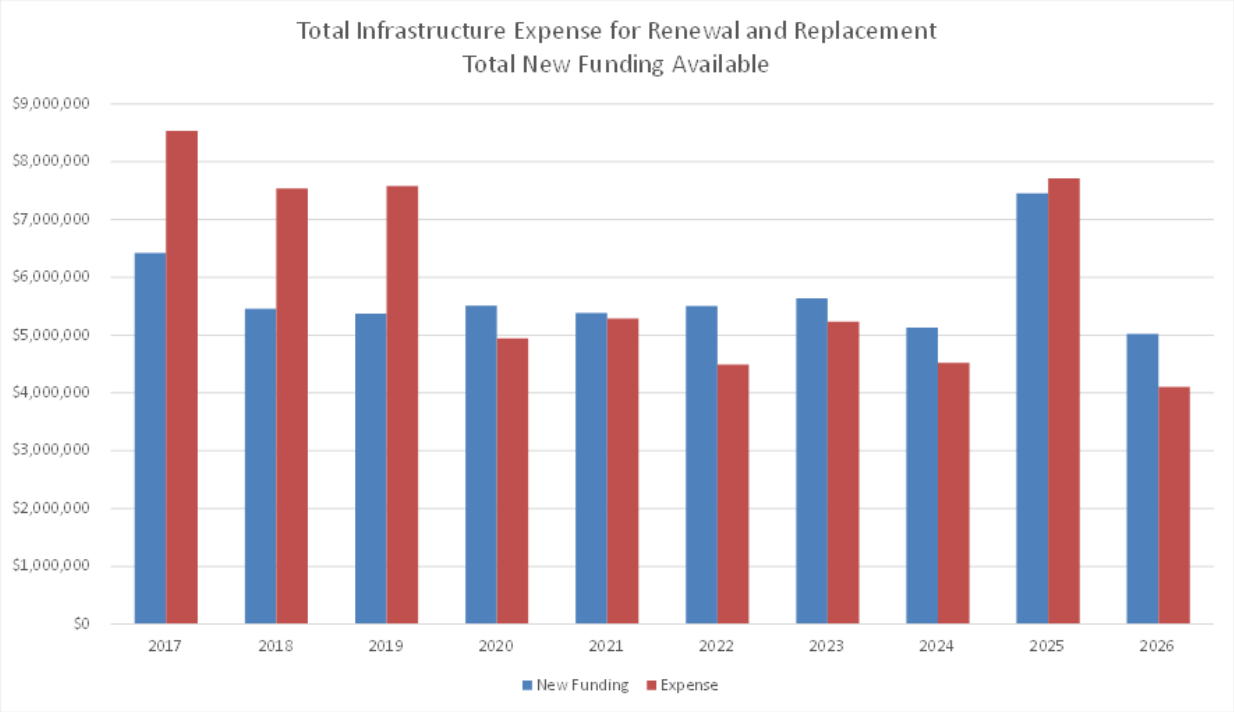
	2017 - 2026	
	Amount	**Proportion**
Reinvestment and Renewal		
Common		
Facilities	$11,479,726	19%
Equipment	$10,833,784	18%
Functions		
32 Streets and Roads	$15,616,000	26%
37 Storm	$1,183,500	2%
41 Water	$12,478,600	21%
42 Wastewater	$8,365,000	14%
Total Expense	**$59,956,610**	

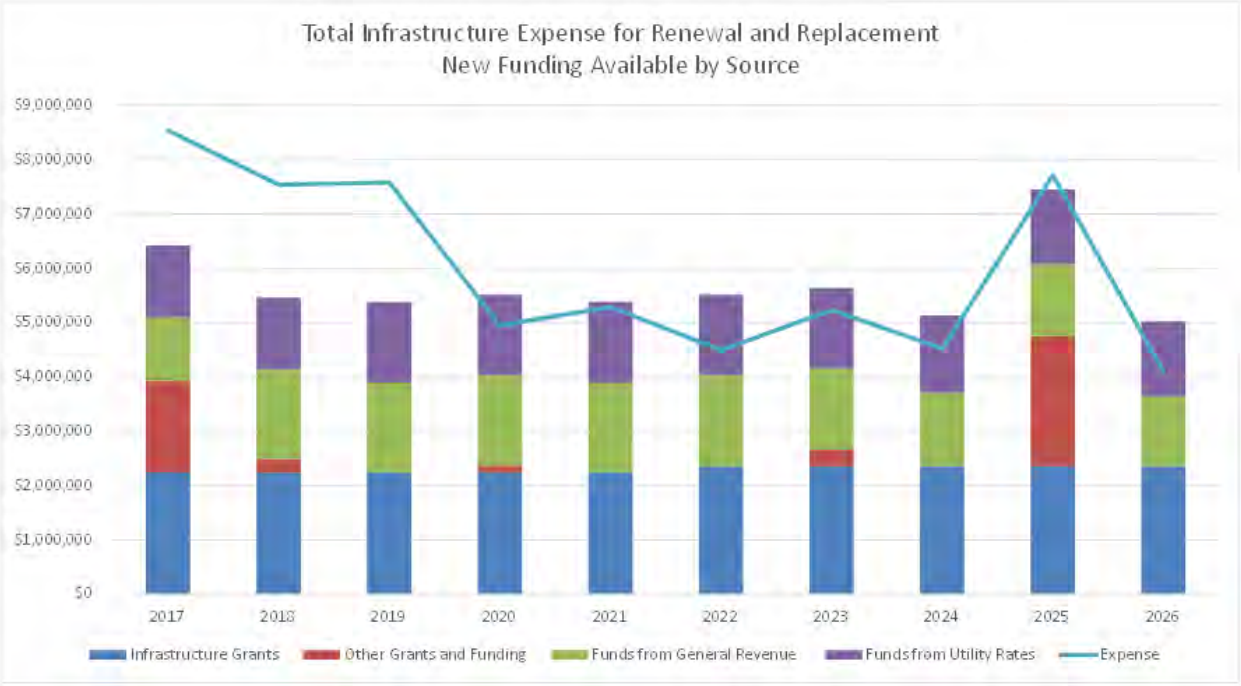


The average annual level of renewal and replacement contemplated under the Infrastructure Plan exceeds the identified policy targets in earlier financing strategies and exceeds the annual long term life cycle replacement costs set out in the Infrastructure Plan.

	Policy 2-98	Policy 1-04	Long Term Life Cycle	Plan Yearly Avg 2017 - 2026
Common				
Facilities	$203,571	$490,345	$589,137	$1,147,973
Equipment	$308,779	$470,060	$631,661	$1,083,378
Functions				
32 Streets and Roads	$1,282,182	$928,089	$1,453,779	$1,561,600
37 Storm		$0	$82,183	$118,350
41 Water	$202,460	$365,320	$568,749	$1,247,860
42 Wastewater	$269,961	$449,860	$725,462	$836,500
Average Annual Infrastructure Expense	**$2,266,953**	**$2,703,674**	**$4,050,970**	**$5,995,661**

The timing of the projects and expenses in the Infrastructure Plan are concentrated toward the beginning of the 10 year planning timeframe. Only after 2020 does the amount new funding available exceed infrastructure expense.





3.2. New Infrastructure / Major Projects

Set out following are the new infrastructure and major projects included in the Infrastructure Plan.

Index	Time Frame	Total Cost	Funded By			
			Grant	Debt	Reserves	Undetermined
Facilities						
Shop A Replacement	2021/2022	$5,000,000	$500,000	$2,500,000	$2,000,000	
72 BCF Phase 2 - Arena	2022	$10,000,000				$10,000,000
72 BCF Phase 2 - Curling Rink	2022	$7,500,000				$7,500,000
37 Storm Drainage						
Flood Protection - Berm Enhncmnt	2017	$7,430,000	$6,413,600	$1,016,400		$0
Flood Mitigation (5 Year Program)	2018 - 2022	$18,400,000	$18,400,000	$0		$0
Total New Infrastructure / Major Projects		**$48,330,000**	**$25,313,600**	**$3,516,400**	**$2,000,000**	**$17,500,000**

Phase 2 of the Badlands Community Facility which includes $10 Million of a second ice surface and $7.5 Million for a replacement of the curling rink is included in the Infrastructure Plan in the year 2022 but remains unfunded at this time.

4. Tables

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Summary of Replacement and Renewal of Existing Infrastructure

Index

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total 2017- 2026
General Revenue Supported Functions											
Expense											
Facilities	$2,787,726	$1,332,000	$1,545,000	$515,000	$730,000	$380,000	$765,000	$1,185,000	$1,170,000	$1,070,000	$11,479,726
Equipment	$1,072,450	$1,599,880	$1,145,600	$1,446,080	$1,268,148	$1,140,000	$804,356	$459,772	$1,127,498	$770,000	$10,833,784
32 Streets and Roads	$2,601,770	$1,818,750	$2,423,000	$1,456,500	$2,027,000	$1,032,500	$1,331,000	$1,218,480	$687,000	$1,020,000	$15,616,000
37 Storm	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$1,183,500
Total Expense	**$6,461,946**	**$4,882,130**	**$5,245,100**	**$3,549,080**	**$4,156,648**	**$2,684,000**	**$3,031,856**	**$2,994,752**	**$3,115,998**	**$2,991,500**	**$39,113,010**
Funding											
Grants											
General Infrastructure	$3,467,746	$1,730,000	$1,880,000	$1,930,000	$2,577,000	$1,955,000	$2,210,000	$1,547,500	$2,010,000	$2,160,000	$21,467,246
Special	$1,000,000	$142,000	$0	$0	$0	$0	$300,000	$0	$0	$0	$1,442,000
Restricted Surplus	$1,707,600	$2,701,814	$3,346,796	$1,482,820	$1,569,310	$639,000	$514,760	$838,057	$340,915	$331,500	$13,472,572
Other Functions	$0	$308,316	$18,304	$136,260	$10,338	$90,000	$7,096	$109,195	$365,083	$0	$1,044,592
Debt	$0	$0	$0	$0	$0	$0	$0	$500,000	$400,000	$500,000	$1,400,000
Trade In, Disposition Proceeds	$30,000										
Outside Contributions	$9,600										
To be Determined	$247,000										
	$6,461,946	**$4,882,130**	**$5,245,100**	**$3,549,080**	**$4,156,648**	**$2,684,000**	**$3,031,856**	**$2,994,752**	**$3,115,998**	**$2,991,500**	**$38,826,410**
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Water Utility											
Expense											
Water Infrastructure	$213,600	$1,172,000	$995,000	$407,000	$792,000	$1,471,000	$1,212,000	$1,188,000	$4,255,000	$773,000	$12,478,600
Vehicles and Equipment	$0	$267,440	$18,304	$62,510	$6,698	$0	$3,396	$104,195	$294,699	$0	$757,242
Total Expense	**$213,600**	**$1,439,440**	**$1,013,304**	**$469,510**	**$798,698**	**$1,471,000**	**$1,215,396**	**$1,292,195**	**$4,549,699**	**$773,000**	**$13,235,842**
Funding											
Restricted Surplus	$213,600	$1,439,440	$1,013,304	$469,510	$798,698	$671,000	$1,215,396	$1,292,195	$549,699	$773,000	$8,435,842
Special Grants											
AMW/WWP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Water for Life	$0	$0	$0	$0	$0	$0	$0	$0	$2,400,000	$0	$2,400,000
Federal Infrastructure	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Debt	$0	$0	$0	$0	$0	$800,000	$0	$0	$1,600,000	$0	$2,400,000
Total Funding	**$213,600**	**$1,439,440**	**$1,013,304**	**$469,510**	**$798,698**	**$1,471,000**	**$1,215,396**	**$1,292,195**	**$4,549,699**	**$773,000**	**$13,235,842**
Wastewater Utility											

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Summary of Replacement and Renewal of Existing Infrastructure

Index

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total 2017- 2026
Expense											
Wastewater Infrastructure	$1,860,000	$1,485,000	$1,340,000	$990,000	$340,000	$340,000	$990,000	$340,000	$340,000	$340,000	$8,365,000
Vehicles and Equipment	$0	$40,876	$0	$73,750	$3,640	$90,000	$3,700	$5,000	$70,384	$0	$287,350
Total Expense	**$1,860,000**	**$1,525,876**	**$1,340,000**	**$1,063,750**	**$343,640**	**$430,000**	**$993,700**	**$345,000**	**$410,384**	**$340,000**	**$8,652,350**
Funding											
Restricted Surplus	$490,000	$1,423,301	$1,340,000	$713,750	$343,640	$430,000	$343,700	$345,000	$410,384	$340,000	$6,179,775
General Infrastructure Grants	$200,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200,000
Special Grants											
AMW/WWP	$0	$102,575	$0	$130,550	$0	$0	$0	$0	$0	$0	$233,125
Federal Infrastructure	$685,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$685,000
Debt	$485,000	$0	$0	$219,450	$0	$0	$650,000	$0	$0	$0	$1,354,450
	$1,860,000	**$1,525,876**	**$1,340,000**	**$1,063,750**	**$343,640**	**$430,000**	**$993,700**	**$345,000**	**$410,384**	**$340,000**	**$8,652,350**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Overall Summary of Infrastructure Expense and Funding

Index	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future	Total 2017- 2026
Infrastructure Expense												
Reinvestment and Renewal												
Facilities	$2,787,726	$1,332,000	$1,545,000	$515,000	$730,000	$380,000	$765,000	$1,185,000	$1,170,000	$1,070,000	$0	$11,479,726
Equipment	$1,072,450	$1,599,880	$1,145,600	$1,446,080	$1,268,148	$1,140,000	$804,356	$459,772	$1,127,498	$770,000	$1,238,021	$10,833,784
32 Streets and Roads	$2,601,770	$1,818,750	$2,423,000	$1,456,500	$2,027,000	$1,032,500	$1,331,000	$1,218,480	$687,000	$1,020,000	$0	$15,616,000
37 Storm	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$0	$1,183,500
41 Water	$213,600	$1,172,000	$995,000	$407,000	$792,000	$1,471,000	$1,212,000	$1,188,000	$4,255,000	$773,000	$17,058,000	$12,478,600
42 Wastewater	$1,860,000	$1,485,000	$1,340,000	$990,000	$340,000	$340,000	$990,000	$340,000	$340,000	$340,000	$0	$8,365,000
Total Reinvest/Renewal	$8,535,546	$7,539,130	$7,580,100	$4,946,080	$5,288,648	$4,495,000	$5,233,856	$4,522,752	$7,710,998	$4,104,500	$18,296,021	$59,956,610
New Infrastructure / Major Projects												
Facilities - Shop A	$50,000	$0	$0	$0	$3,000,000	$2,000,000	$0	$0	$0	$0		$5,050,000
Provincial Highway	$650,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$650,000
37 Storm Drainage	$7,430,000	$4,600,000	$4,600,000	$4,600,000	$4,600,000	$4,582,400	$0	$0	$0	$0	$0	$30,412,400
66 Subdivision	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
72 BCF Phase 2 - Arena	$0	$0	$0	$0	$0	$10,000,000	$0	$0	$0	$0		$10,000,000
72 BCF Phase 2 - Curling Rink	$0	$0	$0	$0	$0	$7,500,000	$0	$0	$0	$0		$7,500,000
Sub-Total Major Projects	$8,130,000	$4,600,000	$4,600,000	$4,600,000	$7,600,000	$24,082,400	$0	$0	$0	$0	$0	$53,612,400
Total Infrastructure Expense	$16,665,546	$12,139,130	$12,180,100	$9,546,080	$12,888,648	$28,577,400	$5,233,856	$4,522,752	$7,710,998	$4,104,500	$18,296,021	$113,569,010
												$113,569,010
Capital Revenue												
General Fund												
Grants												
MSI - Capital	$2,667,746	$1,050,000	$1,000,000	$1,000,000	$1,997,000	$1,545,000	$1,350,000	$1,087,500	$1,400,000	$1,700,000	$500,000	$14,797,246
MSI - BMTG	$480,000	$480,000	$480,000	$480,000	$480,000	$460,000	$460,000	$460,000	$460,000	$460,000	$0	$4,700,000
FGT	$320,000	$200,000	$400,000	$450,000	$600,000	$450,000	$400,000	$0	$150,000	$0	$0	$2,970,000
Federal Infrastructure	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Special	$8,063,600	$4,742,000	$4,600,000	$4,600,000	$4,600,000	$4,582,400	$300,000	$0	$0	$0	$0	$31,488,000

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Overall Summary of Infrastructure Expense and Funding

Index	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future	Total 2017- 2026
Restricted Surplus												
Facility	$911,750	$890,000	$1,045,000	$15,000	$1,080,000	$580,000	$165,000	$535,000	$20,000	($180,000)	$0	$5,061,750
Equipment	$182,450	$1,091,564	$727,296	$859,820	$560,810	$355,000	$97,260	$63,077	$112,415	$270,000	$735,507	$4,319,692
32 Transportation	$663,400	$588,750	$1,443,000	$476,500	$797,000	$72,500	$121,000	$108,480	$77,000	$110,000	$0	$4,457,630
37 Storm	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$0	$1,183,500
Solid Waste Management	$0							$0	$0	$0		$0
Debt	$1,016,400	$0	$0	$0	$1,500,000	$1,000,000	$0	$500,000	$400,000	$500,000	$0	$4,916,400
Development Levies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Trade in, Disposition	$30,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000
Outside Contributions	$9,600	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$9,600
To be Determined	$247,000	$0	$0	$0	$0	$17,500,000	$0	$0	$0	$0	$0	$17,747,000
	$14,591,946	$9,173,814	$9,826,796	$8,012,820	$11,746,310	$26,676,400	$3,024,760	$2,885,557	$2,750,915	$2,991,500	$1,235,507	$91,680,818
Water												
Grants												
MSI - Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MSI - BMTG	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
FGT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
AMW/WWP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Water for Life	$0	$0	$0	$0	$0	$0	$0	$0	$2,400,000	$0	$0	$2,400,000
Federal Infrastructure	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Special	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Restricted Surplus	$213,600	$1,439,440	$1,013,304	$469,510	$798,698	$671,000	$1,215,396	$1,292,195	$549,699	$773,000	$58,000	$8,435,842
Operating Revenue												
Debt	$0	$0	$0	$0	$0	$800,000	$0	$0	$1,600,000	$0	$0	$2,400,000
Development Levies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Contributions											$17,000,000	
To be Determined	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$213,600	$1,439,440	$1,013,304	$469,510	$798,698	$1,471,000	$1,215,396	$1,292,195	$4,549,699	$773,000	$17,058,000	$13,235,842

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Overall Summary of Infrastructure Expense and Funding

Index

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future	Total 2017- 2026
Wastewater												
Grants												
MSI - Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MSI - BMTG	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
FGT	$200,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200,000
AMW/WWP	$0	$102,575	$0	$130,550	$0	$0	$0	$0	$0	$0	$0	$233,125
Federal Infrastructure	$685,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$685,000
Special	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
From Facilities												
Restricted Surplus	$490,000	$1,423,301	$1,340,000	$713,750	$343,640	$430,000	$343,700	$345,000	$410,384	$340,000	$0	$6,179,775
Debt	$485,000	$0	$0	$219,450	$0	$0	$650,000	$0	$0	$0	$0	$1,354,450
Development Levies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
To be Determined	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$1,860,000	$1,525,876	$1,340,000	$1,063,750	$343,640	$430,000	$993,700	$345,000	$410,384	$340,000	$0	$8,652,350
Total Capital Revenue	$16,665,546	$12,139,130	$12,180,100	$9,546,080	$12,888,648	$28,577,400	$5,233,856	$4,522,752	$7,710,998	$4,104,500	$18,293,507	$113,569,010

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Facilities Infrastructure Expense and Funding Summary

Index
Facilities Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Infrastructure Expense											
12 Administration / Fire Hall											
1 Building Upgrades	$0	$150,000	$0	$0	$0	$30,000	$30,000	$430,000	$300,000	$0	$0
2 Land for Government Use (Frontage)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
	$0	$150,000	$0	$0	$0	$30,000	$30,000	$430,000	$300,000	$0	$0
21 Police											
1 RCMP Building	$0	$40,000	$0	$0	$120,000	$0	$0	$0	$0	$0	$0
23 Fire											
1 Drumheller Fire Hall	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0	$0
2 Rosedale Fire Hall	$0	$30,000	$0	$30,000	$0	$0	$0	$0	$0	$0	$0
3 East Coulee File Hall	$0	$0	$0	$30,000	$0	$0	$0	$40,000	$0	$0	$0
	$0	$30,000	$0	$110,000	$0	$0	$0	$40,000	$0	$0	$0
24 Emergency Services											
1 Floodway	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
31 Common Services											
1 Shop A	$0	$150,000	$0	$35,000	$0	$35,000	$0	$0	$0	$0	$0
2 Shop B	$0	$35,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
3 New Shop Facility	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$185,000	$0	$35,000	$0	$35,000	$0	$0	$0	$0	$0
33 Airport											
1 Terminal Building	$0	$10,000	$0	$65,000	$0	$0	$0	$0	$0	$0	$0
2 Runway	$0	$0	$0	$0	$0	$0	$600,000	$0	$0	$0	$0
3 Lights and Equipment	$0	$142,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
4 Fuel Facilities	$35,000										
	$35,000	$152,000	$0	$65,000	$0	$0	$600,000	$0	$0	$0	$0
56 Cemetery											
1 Paving	$25,000	$25,000	$25,000	$25,000	$25,000	$0	$0	$0	$0	$0	$0
2 Cemetery Phase 2 Concrete Paving	$0	$0	$0	$45,000	$0	$0	$0	$0	$0	$0	$0
3 Phase 3 - Expansion	$150,000	$0	$0	$0	$150,000	$0	$0	$0	$0	$0	$0
	$175,000	$25,000	$25,000	$70,000	$175,000	$0	$0	$0	$0	$0	$0
68 Housing											
1 Community Housing	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Facilities Infrastructure Expense and Funding Summary

Index
Facilities Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
42 Wastewater											
Transfer to Wastewater Function											
72 Recreation Facilities											
1 Arena	$225,000	$655,000	$1,080,000	$100,000	$50,000	$0	$50,000	$0	$0	$0	$0
2 Aqualplex	$1,803,976	$50,000	$270,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$0
3 Curling Rink	$0	$25,000	$150,000	$0	$0	$0	$0	$0	$0	$0	$0
4 Community Center	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5 BCF	$50,000	$20,000	$20,000	$70,000	$20,000	$120,000	$20,000	$20,000	$20,000	$20,000	$0
6 All Facilities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$2,078,976	$750,000	$1,520,000	$220,000	$120,000	$170,000	$120,000	$70,000	$70,000	$70,000	$0
74 Parks											
1 Parks	$47,000	$0	$0	$0	$0	$0	$0	$30,000	$0	$0	$0
2 Trails	$0	$0	$0	$0	$100,000	$100,000	$0	$0	$0	$0	$0
3 Entrance Signage	$0	$0	$0	$0	$15,000	$15,000	$15,000	$15,000	$0	$0	$0
4 Dinosaurs	$100,000	$0	$0	$0	$0	$30,000	$0	$0	$0	$0	$0
5 Suspension Bridge Facilities	$100,000	$0	$0	$0	$200,000	$0	$0	$0	$0	$0	$0
6 Hoodoo Facilities	$100,000	$0	$0	$15,000	$0	$0	$0	$0	$0	$0	$0
7 Downtown/Corridor Beautification	$151,750	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8 Skateboad Park	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$498,750	$0	$0	$15,000	$315,000	$145,000	$15,000	$45,000	$0	$0	$0
Unspecified Investment								$600,000	$800,000	$1,000,000	
Total Facility Renewal / Replacement	**$2,787,726**	**$1,332,000**	**$1,545,000**	**$515,000**	**$730,000**	**$380,000**	**$765,000**	**$1,185,000**	**$1,170,000**	**$1,070,000**	**$0**
New Facilities											
Shop A Facility	$50,000	$0	$0	$0	$3,000,000	$2,000,000	$0	$0	$0	$0	$0
BCF Phase 2 - Arena	$0	$0	$0	$0	$0	$10,000,000	$0	$0	$0	$0	$0
BCF Phase 2 - Curling Rink	$0	$0	$0	$0	$0	$7,500,000	$0	$0	$0	$0	$0
Total New Facilities	**$50,000**	**$0**	**$0**	**$0**	**$3,000,000**	**$19,500,000**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Facilities Infrastructure Expense	**$2,837,726**	**$1,332,000**	**$1,545,000**	**$515,000**	**$3,730,000**	**$19,880,000**	**$765,000**	**$1,185,000**	**$1,170,000**	**$1,070,000**	**$0**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Facilities Infrastructure Expense and Funding Summary

Index
Facilities Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Infrastructure Funding											
General Revenue Supported											
Funding Required	$2,837,726	$1,332,000	$1,545,000	$515,000	$3,730,000	$19,880,000	$765,000	$1,185,000	$1,170,000	$1,070,000	$0
Provided From											
MSI Capital	$1,653,976	$300,000	$500,000	$500,000	$1,150,000	$700,000	$300,000	$150,000	$750,000	$750,000	
MSI BMTG											
FGT						$100,000					
Federal Infrastructure											
Special	$25,000	$142,000					$300,000				
Surplus Restricted for Facilities	$911,750	$890,000	$1,045,000	$15,000	$1,080,000	$580,000	$165,000	$535,000	$20,000	-$180,000	
Surplus Restricted for Transportation											
Surplus Restricted for Land Development											
Debt					$1,500,000	$1,000,000		$500,000	$400,000	$500,000	
Outside Contributions											
To be Determined	$247,000					$17,500,000					
Total General Revenue Funding	**$2,837,726**	**$1,332,000**	**$1,545,000**	**$515,000**	**$3,730,000**	**$19,880,000**	**$765,000**	**$1,185,000**	**$1,170,000**	**$1,070,000**	**$0**
Total Funding	**$2,837,726**	**$1,332,000**	**$1,545,000**	**$515,000**	**$3,730,000**	**$19,880,000**	**$765,000**	**$1,185,000**	**$1,170,000**	**$1,070,000**	**$0**
Sustainable Funding Levels											
Life Cycle Re-investment											
Replacement	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954	$1,572,954
Renewal	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137	$589,137
Planned Average Annual Investment	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	$1,335,261	
Average Annual Restricted Surplus	$414,180	$414,180	$414,180	$414,180	$414,180	$414,180	$414,180	$414,180	$414,180	$414,180	
% of Total Average Annual Investment	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	
Surplus Restricted for Facilities Infrastructure (Facilities Capital Reserve)											
Opening Balance	$4,200,500	$3,699,534	$3,258,026	$2,661,518	$3,095,009	$2,463,501	$2,339,802	$2,569,402	$2,376,555	$2,686,368	
Additional Restricted Surplus	$410,784	$448,492	$448,492	$448,492	$448,492	$456,301	$394,599	$342,153	$329,813	$319,941	
Withdrawn	-$911,750	-$890,000	-$1,045,000	-$15,000	-$1,080,000	-$580,000	-$165,000	-$535,000	-$20,000	$180,000	
Closing Balance	**$3,699,534**	**$3,258,026**	**$2,661,518**	**$3,095,009**	**$2,463,501**	**$2,339,802**	**$2,569,402**	**$2,376,555**	**$2,686,368**	**$3,186,308**	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Vehicles and Equipment Infrastructure Expense and Funding Summary

Index
Equipment Details

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Infrastructure Expense											
By Type of Equipment											
Information systems, Administrative Equipmer	$92,000	$50,500	$51,000	$199,500	$52,000	$62,500	$52,500	$62,500	$52,500	$35,000	$52,000
100 Series Light Duty Trucks	$0	$60,000	$60,000	$103,000	$60,000	$60,000	$60,000	$60,000	$70,000	$60,000	$0
200 Series Passenger Vehicles	$45,000	$0	$0	$35,000	$0	$0	$35,000	$0	$0	$0	$0
300 Series Heavy Duty Trucks	$173,000	$270,000	$50,000	$265,000	$335,000	$345,000	$120,000	$225,000	$105,729	$150,000	$0
400 Series - Heavy Duty Equipment	$240,000	$421,000	$414,600	$203,000	$197,000	$180,000	$185,000	$7,500	$186,826	$200,000	$645,630
500 Series Parks	$0	$236,000	$100,000	$105,000	$110,000	$115,000	$0	$55,000	$150,613	$100,000	$0
600 Series Emergency Services	$500,000	$500,000	$455,000	$500,000	$500,000	$370,000	$330,000	$5,500	$41,783	$150,000	$531,555
700 Series Trailers	$0	$14,000	$0	$2,080	$0	$0	$10,240	$44,272	$132,583	$50,000	$8,836
800 Series Hand Tools	$0	$7,000	$15,000	$33,500	$7,200	$7,500	$7,500	$0	$41,943	$25,000	$0
900 Series Pumps & Power	$0	$41,380	$0	$0	$6,948	$0	$4,116	$0	$345,521	$0	$0
Communications	$10,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Solid Waste Management	$12,450	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total by Type	**$1,072,450**	**$1,599,880**	**$1,145,600**	**$1,446,080**	**$1,268,148**	**$1,140,000**	**$804,356**	**$459,772**	**$1,127,498**	**$770,000**	**$1,238,021**
By Function											
General Revenue Supported											
12 Administration	$15,000	$10,000	$0	$18,000	$0	$10,000	$35,000	$10,000	$0	$10,000	$0
15 Information Services	$77,000	$40,500	$51,000	$181,500	$52,000	$52,500	$52,500	$52,500	$52,500	$25,000	$52,000
16 Communications	$10,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
21 Police	$0	$0	$40,000	$0	$0	$0	$0	$0	$0	$0	$0
23 Fire	$500,000	$500,000	$415,000	$500,000	$503,000	$330,000	$330,000	$5,500	$1,783	$150,000	$504,436
24 Emergency Services											
26 Enforcement	$45,000	$19,003	$0	$0	$0	$40,000	$0	$0	$50,700	$0	$27,119
31 Common Services	$0	-$31,669	$69,478	$30,066	$89,720	$176,970	$76,760	$17,694	$215,353	$285,000	$213,642
32 Streets and Roads	$413,000	$514,494	$451,818	$465,250	$501,881	$325,530	-$9,900	$165,611	$196,686	$200,000	$438,310
43 Solid Waste	$12,450	$0	$0	$0	$0	$0	$0	$31,056	$87,593	$0	$0
56 Cemetery	$0	$0	$0	$0	$0	$0	$14,965	$0	$0	$0	$0
72 Recreation and Parks	$0	$239,236	$100,000	$115,004	$111,209	$115,000	$297,935	$68,216	$157,800	$100,000	$0
Utility Supported											
41 Water	$0	$267,440	$18,304	$62,510	$6,698	$0	$3,396	$104,195	$294,699	$0	$2,514
42 Wastewater	$0	$40,876	$0	$73,750	$3,640	$90,000	$3,700	$5,000	$70,384	$0	$0
43 Solid Waste	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total by Function	**$1,072,450**	**$1,599,880**	**$1,145,600**	**$1,446,080**	**$1,268,148**	**$1,140,000**	**$804,356**	**$459,772**	**$1,127,498**	**$770,000**	**$1,238,021**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Vehicles and Equipment Infrastructure Expense and Funding Summary

Index
Equipment Details

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Infrastructure Funding											
General Revenue Supported											
Funding Required	$1,072,450	$1,291,564	$1,127,296	$1,309,820	$1,257,810	$1,050,000	$797,260	$350,577	$762,415	$770,000	$1,235,507
Provided From											
MSI Capital	$860,000	$0			$197,000	$345,000	$300,000	$287,500	$500,000	$500,000	$500,000
MSI BMTG											
FGT		$200,000	$400,000	$450,000	$500,000	$350,000	$400,000		$150,000		
Federal Infrastructure											
Special											
Surplus Restricted for Equipment Capital	$182,450	$1,091,564	$727,296	$859,820	$560,810	$355,000	$97,260	$63,077	$112,415	$270,000	$735,507
Debt											
Outside Contributions											
Trade in, Salvage, Private Disposition	$30,000										
To be Determined											
Total General Revenue Funding	**$1,072,450**	**$1,291,564**	**$1,127,296**	**$1,309,820**	**$1,257,810**	**$1,050,000**	**$797,260**	**$350,577**	**$762,415**	**$770,000**	**$1,235,507**
Utility Supported											
41 Water	$0	$267,440	$18,304	$62,510	$6,698	$0	$3,396	$104,195	$294,699	$0	$2,514
42 Wastewater	$0	$40,876	$0	$73,750	$3,640	$90,000	$3,700	$5,000	$70,384	$0	$0
43 Solid Waste Management	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Funding	**$1,072,450**	**$1,599,880**	**$1,145,600**	**$1,446,080**	**$1,268,148**	**$1,140,000**	**$804,356**	**$459,772**	**$1,127,498**	**$770,000**	**$1,238,021**
Sustainable Funding Levels											
Life Cycle Re-investment											
Replacement	$631,661	$631,661	$631,661	$631,661	$631,661	$631,661	$631,661	$631,661	$631,661	$631,661	
Planned Average Annual Investment	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	$1,083,378	
Average Annual Restricted Surplus	$474,494	$474,494	$474,494	$474,494	$474,494	$474,494	$474,494	$474,494	$474,494	$474,494	
% of Total Average Investment	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	
Surplus Restricted for Equipment Infrastructure (Equipment Reserve)											
Opening Balance	$1,813,450	$1,983,101	$1,388,672	$1,158,512	$795,828	$732,154	$880,983	$1,234,666	$1,577,577	$1,860,573	
Additional Restricted Surplus	$352,101	$497,136	$497,136	$497,136	$497,136	$503,829	$450,942	$405,988	$395,411	$386,949	
Capital Uses	-$182,450	-$1,091,564	-$727,296	-$859,820	-$560,810	-$355,000	-$97,260	-$63,077	-$112,415	-$270,000	
Closing Balance	**$1,983,101**	**$1,388,672**	**$1,158,512**	**$795,828**	**$732,154**	**$880,983**	**$1,234,666**	**$1,577,577**	**$1,860,573**	**$1,977,522**	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
32 Streets and Roads Infrastructure Expense and Funding Summary

Index
Streeets and Roads Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Infrastructure Expense											
Reinvestment and Renewal											
By Community Area											
Nacmine	$0	$0	$0	$0	$0	$345,000	$300,000	$0	$0	$0	$0
Midland	$0	$0	$200,000	$315,000	$240,000	$0	$0	$0	$0	$0	$0
Newcastle	$50,000	$0	$255,000	$0	$0	$0	$216,000	$1,008,480	$0	$0	$0
North Drumheller	$0	$0	$420,000	$0	$0	$0	$0	$0	$0	$0	$0
Drumheller	$500,000	$1,255,000	$510,000	$855,000	$1,500,000	$0	$408,500	$0	$477,000	$0	$0
Wayne	$0	$150,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rosedale	$0	$0	$712,500	$0	$0	$0	$0	$0	$0	$0	$0
Cambria	$0	$0	$0	$0	$0	$0	$120,000	$0	$0	$0	$0
East Coulee	$0	$100,000	$0	$0	$0	$400,000	$0	$0	$0	$0	$0
Unspecified	$2,701,770	$313,750	$325,500	$286,500	$287,000	$287,500	$286,500	$210,000	$210,000	$1,020,000	$0
Total Reinvestment and Renewal	**$3,251,770**	**$1,818,750**	**$2,423,000**	**$1,456,500**	**$2,027,000**	**$1,032,500**	**$1,331,000**	**$1,218,480**	**$687,000**	**$1,020,000**	**$0**
By Type of Work *											
New Pavement Surface	$0	$40,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Overlay Pavement	$100,000	$1,005,000	$1,357,500	$1,020,000	$1,500,000	$745,000	$701,000	$972,000	$477,000	$0	$0
Mill and Overlay Pavement	$0	$0	$500,000	$150,000	$240,000	$0	$0	$0	$0	$0	$0
Chip Seal Surface	$30,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$51,480	$15,000	$15,000	$0
Road Reconstruction	$485,000	$485,000	$85,000	$85,000	$85,000	$85,000	$428,500	$85,000	$85,000	$85,000	$0
Lane Reconstruction	$0	$0	$240,000	$0	$0	$0	$0	$0	$0	$0	$0
Bridges	$1,335,000	$30,750	$42,500	$43,500	$44,000	$44,500	$43,500	$0	$0	$0	$0
Parking Lot	$0	$60,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sidewalk and Patching Program	$357,000	$107,000	$107,000	$107,000	$107,000	$107,000	$107,000	$107,000	$107,000	$107,000	$0
Flood Mitigation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Lighting	$50,000	$50,000	$50,000	$10,000	$10,000	$10,000	$10,000	$0	$0	$10,000	$0
Drainage	$50,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Infrastructure Master Plan	$153,770	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Trailways	$26,000	$26,000	$26,000	$26,000	$26,000	$26,000	$26,000	$3,000	$3,000	$3,000	$0
Electric Charging Station	$15,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Unspecified										$800,000	
Total Reinvestment and Renewal	**$2,601,770**	**$1,818,750**	**$2,423,000**	**$1,456,500**	**$2,027,000**	**$1,032,500**	**$1,331,000**	**$1,218,480**	**$687,000**	**$1,020,000**	**$0**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
32 Streets and Roads Infrastructure Expense and Funding Summary

Index
Streeets and Roads Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Major Transportation Projects											
Provincial Highway	$650,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$650,000	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Transportation Infrastructure	**$3,251,770**	**$1,818,750**	**$2,423,000**	**$1,456,500**	**$2,027,000**	**$1,032,500**	**$1,331,000**	**$1,218,480**	**$687,000**	**$1,020,000**	**$0**
Infrastructure Funding											
General Revenue Supported											
Funding Required	$3,251,770	$1,818,750	$2,423,000	$1,456,500	$2,027,000	$1,032,500	$1,331,000	$1,218,480	$687,000	$1,020,000	$0
Provided From											
MSI Capital	$153,770	$750,000	$500,000	$500,000	$650,000	$500,000	$750,000	$650,000	$150,000	$450,000	
MSI BMTG	$480,000	$480,000	$480,000	$480,000	$480,000	$460,000	$460,000	$460,000	$460,000	$460,000	
FGT	$320,000				$100,000						
Federal Infrastructure											
Special	$1,625,000										
Operating Revenue											
Surplus Restricted for Transportation Capital	$663,400	$588,750	$1,443,000	$476,500	$797,000	$72,500	$121,000	$108,480	$77,000	$110,000	
Debt											
Development Levies Storm											
Outside Contributions	$9,600										
To be Determined											
Total Funding	**$3,251,770**	**$1,818,750**	**$2,423,000**	**$1,456,500**	**$2,027,000**	**$1,032,500**	**$1,331,000**	**$1,218,480**	**$687,000**	**$1,020,000**	**$0**
Measures for Sustainable Funding Levels											
Streets and Roads											
Life Cycle Re-investment											
Replacement	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	$1,453,779	
Planned Average Annual Investment	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	$1,626,600	
Average Annual Restricted Surplus	$523,106	$523,106	$523,106	$523,106	$523,106	$523,106	$523,106	$523,106	$523,106	$523,106	
% of Total Average Investment	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
32 Streets and Roads Infrastructure Expense and Funding Summary

Index
Streeets and Roads Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Future
Surplus Restricted for Transportation Infrastructure (Transportation Infrastructure Reserve)											
Opening Balance	$1,318,450	$1,065,834	$1,057,076	$194,068	$297,559	$80,551	$595,852	$1,000,952	$1,366,125	$1,750,438	
Additional Restricted Surplus	$410,784	$579,992	$579,992	$579,992	$579,992	$587,801	$526,099	$473,653	$461,313	$451,441	
Withdrawn for Transportation	-$663,400	-$588,750	-$1,443,000	-$476,500	-$797,000	-$72,500	-$121,000	-$108,480	-$77,000	-$110,000	
Closing Balance	**$1,065,834**	**$1,057,076**	**$194,068**	**$297,559**	**$80,551**	**$595,852**	**$1,000,952**	**$1,366,125**	**$1,750,438**	**$2,091,878**	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
37 Storm Drainage Infrastructure Expense and Funding Summary

Index
Storm Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Infrastructure Expense										
Major Flood Protection Projects										
Flood Protection - Berm Enhancement - East	$7,430,000									
Midland, Newcastle, Central Drumheller										
Flood Mitigation	$0	$4,600,000	$4,600,000	$4,600,000	$4,600,000	$4,582,400				
Total Major Projects	**$7,430,000**	**$4,600,000**	**$4,600,000**	**$4,600,000**	**$4,600,000**	**$4,582,400**	**$0**	**$0**	**$0**	**$0**
Annual Reinvestment, Renewal										
Storm Drainage Work and Culvert Replacmnt	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500
Total Reinvenstment, Renewal	**$0**	**$131,500**	**$131,500**	**$131,500**	**$131,500**	**$131,500**	**$131,500**	**$131,500**	**$131,500**	**$131,500**
Total Storm Drainage	**$7,430,000**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,713,900**	**$131,500**	**$131,500**	**$131,500**	**$131,500**
Infrastructure Funding										
General Revenue Supported										
Funding Required	**$7,430,000**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,713,900**	**$131,500**	**$131,500**	**$131,500**	**$131,500**
Provided From										
MSI Capital										
MSI BMTG										
FGT										
Federal Infrastructure										
Alberta Community Resilience Program	$6,413,600	$4,600,000	$4,600,000	$4,600,000	$4,600,000	$4,582,400				
Surplus Restricted for Storm Infrastructure	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500
Debt	$1,016,400									
Development Levies Storm										
Outside Contributions										
To be Determined										
Total Funding	**$7,430,000**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,731,500**	**$4,713,900**	**$131,500**	**$131,500**	**$131,500**	**$131,500**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
37 Storm Drainage Infrastructure Expense and Funding Summary

Index
Storm Detail

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Measures for Sustainable Funding Levels										
Storm Drainage										
Life Cycle Re-investment										
Replacement	$82,183	$82,183	$82,183	$82,183	$82,183	$82,183	$82,183	$82,183	$82,183	$82,183
Planned Average Annual Investment	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500
Surplus Restricted for Storm Drainage Infrastructure (Storm Capital Reserve)										
Opening Balance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Additional Restricted Surplus	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500
Withdrawn	$0	-$131,500	-$131,500	-$131,500	-$131,500	-$131,500	-$131,500	-$131,500	-$131,500	-$131,500
Closing Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
41 Water Infrastructure Expense and Funding Summary

Index
Water Details

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Date Unspecific	
											Development	Other
Infrastructure Expense												
Supply												
Raw Water Facilities	$25,000	$97,000	$53,000	$25,000	$0	$0	$0	$0	$0	$0	$0	
Low Lift Pump Renewal	$0	$0	$120,000	$0	$0	$120,000	$0	$0	$120,000	$0	$0	
Planning, Assessment, Evaluation	$25,000	$227,000	$25,000	$33,000	$0	$0	$15,000	$0	$2,000	$0	$10,000	
WTP Annual Renewal/Upgrade Program	$148,600	$82,000	$141,000	$86,000	$169,000	$387,000	$70,000	$60,000	$60,000	$60,000	$10,000	
High Lift Pump Renewal	$0	$65,000	$33,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$0	
Chlorine Room - Code Upgrade	$0	$0	$0	$45,000	$105,000	$36,000	$84,000	$0	$0	$0	$0	
Install Deep Aeration System	$0	$0	$0	$90,000	$360,000	$0	$0	$0	$0	$0	$0	
WTP Wastewater Handling and Treatment	$0	$0	$0	$0	$0	$0	$0	$0	$4,000,000	$0	$0	
Transmission												
Allowance for Network Upgrading	$0	$46,000	$23,000	$23,000	$23,000	$23,000	$23,000	$23,000	$23,000	$23,000	$23,000	
Transmission Lines	$0	$0	$0	$0	$0	$0	$885,000	$0	$0	$0	$0	
Water Tower / Reservoir Renewals	$0	$140,000	$85,000	$55,000	$85,000	$55,000	$85,000	$55,000	$0	$140,000	$0	
Midland River Crossing	$0	$0	$0	$0	$0	$0	$0	$1,000,000	$0	$0	$0	
Storage Facilities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
South Hill Development Areas 1,3											$17,000,000	
Penetentiary Booster Station Upgrade	$0	$0	$0	$0	$0	$800,000	$0	$0	$0	$0		
Total Supply and Transmission	$198,600	$657,000	$480,000	$392,000	$777,000	$1,456,000	$1,197,000	$1,173,000	$4,240,000	$258,000	$17,043,000	$0
Distribution												
Main Replacement	$0	$500,000	$500,000	$0	$0	$0	$0	$0	$0	$500,000	$0	
Meter Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Allowance for Network Upgrading	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	
Total Distribution	$15,000	$515,000	$515,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$515,000	$15,000	$0
Total Fixed Infrastructure	**$213,600**	**$1,172,000**	**$995,000**	**$407,000**	**$792,000**	**$1,471,000**	**$1,212,000**	**$1,188,000**	**$4,255,000**	**$773,000**	**$17,058,000**	
Vehicles and Mobile Equipment	$0	$267,440	$18,304	$62,510	$6,698	$0	$3,396	$104,195	$294,699	$0	$0	
Total Infrastructure Expense	**$213,600**	**$1,439,440**	**$1,013,304**	**$469,510**	**$798,698**	**$1,471,000**	**$1,215,396**	**$1,292,195**	**$4,549,699**	**$773,000**	**$17,058,000**	**$0**
	$213,600	*$1,439,440*	*$1,013,304*	*$469,510*	*$798,698*	*$1,471,000*	*$1,215,396*	*$1,292,195*	*$4,549,699*	*$773,000*	*$17,058,000*	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
41 Water Infrastructure Expense and Funding Summary

Index
Water Details

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Date Unspecific	
												Development	Other
Infrastructure Funding													
Grants													
MSI - Capital													
MSI - BMTG													
FGT													
AMW/WWP - General (Local)	37.3%												
AMW/WWP - Water 4 Life (Regional)	60.0%		$0		$0					$2,400,000			
Federal Infrastructure													
Special													
Total Grants		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$2,400,000**	**$0**	**$0**	
Borrowing													
Debentures			$0		$0		$800,000	$0		$1,600,000		$0	
Short Term								$0					
Total Borrowing		**$0**	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$0**	**$0**	**$1,600,000**	**$0**	**$0**	
Other Funding													
Developer Contributions												$17,000,000	
To be Determined													
Total Other Funding		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$17,000,000**	
From Own Sources													
Offsite Levies													
Operating Funds													
Surplus Restricted for Water Capital		$213,600	$1,439,440	$1,013,304	$469,510	$798,698	$671,000	$1,215,396	$1,292,195	$549,699	$773,000	$58,000	$0
Total Own Sources		**$213,600**	**$1,439,440**	**$1,013,304**	**$469,510**	**$798,698**	**$671,000**	**$1,215,396**	**$1,292,195**	**$549,699**	**$773,000**	**$58,000**	**$0**
Total Funding		**$213,600**	**$1,439,440**	**$1,013,304**	**$469,510**	**$798,698**	**$1,471,000**	**$1,215,396**	**$1,292,195**	**$4,549,699**	**$773,000**	**$17,058,000**	**$0**
Unfunded		*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*		

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
41 Water Infrastructure Expense and Funding Summary

Index
Water Details

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Date Unspecific	
											Development	Other
Measures for Sustainable Funding Levels												
Restricted Surplus - Water Rate Model	$864,107	$977,462	$984,462	$984,462	$984,462	$984,462	$928,049	$928,049	$928,049	$815,223		
Life Cycle Re-investment												
Replacement	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756	$1,420,756		
Renewal	$568,749	$568,749	$568,749	$568,749	$568,749	$568,749	$568,749	$568,749	$568,749	$568,749		
Amortization of Tangible Capital Assets	$1,227,063	$1,230,630	$1,254,669	$1,271,591	$1,279,432	$1,292,770	$1,317,336	$1,337,633	$1,359,212	$1,435,192		
Resticted Surplus Balances												
Water General Restricted Surplus												
Opening Balance	$988,355	$1,638,862	$1,176,884	$1,148,042	$1,662,994	$1,848,758	$2,162,220	$1,874,873	$1,510,727	$1,889,077		
Added from Operating (From Water Rate Model)	$864,107	$977,462	$984,462	$984,462	$984,462	$984,462	$928,049	$928,049	$928,049	$815,223		
Used for Capital Expense	-$213,600	-$1,439,440	-$1,013,304	-$469,510	-$798,698	-$671,000	-$1,215,396	-$1,292,195	-$549,699	-$773,000		
Closing Balance	**$1,638,862**	**$1,176,884**	**$1,148,042**	**$1,662,994**	**$1,848,758**	**$2,162,220**	**$1,874,873**	**$1,510,727**	**$1,889,077**	**$1,931,301**		
									$2,692,696	*$2,734,920*		
Debt Balances												
Debenture Debt												
Existing	$2,499,164	$2,317,880	$2,128,066	$1,929,313	$1,721,193	$1,503,254	$1,275,025	$1,036,012	$785,694	$785,694	$785,694	
New Debenture 41-1		$800,000	$783,382	$765,923	$747,579	$728,308	$708,060	$686,787	$664,438	$664,438	$664,438	
New Debenture 41-2				$1,600,000	$1,566,764	$1,531,845	$1,495,159	$1,456,615	$1,416,120	$1,373,575	$1,416,120	
Total Debt	**$2,499,164**	**$3,117,880**	**$2,911,448**	**$4,295,236**	**$4,035,536**	**$3,763,407**	**$3,478,244**	**$3,179,414**	**$2,866,252**	**$2,823,707**	**$2,866,252**	
Short Term Borrowing												
Total Debt	**$2,499,164**	**$3,117,880**	**$2,911,448**	**$4,295,236**	**$4,035,536**	**$3,763,407**	**$3,478,244**	**$3,179,414**	**$2,866,252**	**$2,823,707**	**$2,866,252**	

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
42 Wastewater Infrastructure Expense and Funding Summary

Index
Wastewater Details

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Infrastructure Expense										
Collection and Transmission										
3 Ave Sanitary Line Replacement prior to 3rd Ave Overlay	$0			$250,000						
Lift Station communication/ SCADA upgrades	$0	$150,000	$100,000							
Lift Station Upgrades	$0	$80,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Main/ Forcemain replacement & Liners	$0	$200,000	$850,000	$200,000	$200,000	$200,000	$850,000	$200,000	$200,000	$200,000
Forcemain Assessment Study	$75,000									
Manhole Replacements	$0	$80,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Service Replacements/Liners	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Odour Management	$60,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Lift Station Renewal		$0	$200,000							
Penitentiary inline sewer power generator	$0	$40,000	$0	$0	$0	$0	$0	$0	$0	$0
East Coulee Lift Station Replacement	$1,370,000									
Total Collection and Transmission	$1,565,000	$610,000	$1,290,000	$590,000	$340,000	$340,000	$990,000	$340,000	$340,000	$340,000
Treatment and Disposal										
Septage Receiving Station	$45,000	$0								
Aeration System Renewal	$0	$450,000								
WWTP Optimization	$200,000	$150,000								
WWTP Improvements (SCADA Upgrades)	$50,000	$275,000	$50,000	$50,000	$0	$0	$0	$0	$0	$0
River Outfall	$0	$0	$0	$350,000	$0	$0	$0	$0	$0	$0
Total Treatment and Disposal	$295,000	$875,000	$50,000	$400,000	$0	$0	$0	$0	$0	$0
Total Fixed Infrastructure	$1,860,000	$1,485,000	$1,340,000	$990,000	$340,000	$340,000	$990,000	$340,000	$340,000	$340,000
Vehicles and Mobile Equipment	$0	$40,876	$0	$73,750	$3,640	$90,000	$3,700	$5,000	$70,384	$0
Total Capital Expense	**$1,860,000**	**$1,525,876**	**$1,340,000**	**$1,063,750**	**$343,640**	**$430,000**	**$993,700**	**$345,000**	**$410,384**	**$340,000**
	$1,860,000	*$1,525,876*	*$1,340,000*	*$1,063,750*	*$343,640*	*$430,000*	*$993,700*	*$345,000*	*$410,384*	*$340,000*

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
42 Wastewater Infrastructure Expense and Funding Summary

Index
Wastewater Details

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Infrastructure Funding											
Grants											
MSI - Capital											
MSI - BMTG											
FGT		$200,000									
AMW/WWP - Local	37.3%		$102,575		$130,550						
AMW/WWP - Regional	60.0%										
Federal Infrastructure - CWWF		$685,000									
Special		$0									
Total Grants		**$885,000**	**$102,575**	**$0**	**$130,550**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Borrowing											
Debentures		$485,000			$219,450			$650,000			
Short Term								$0			
Total Borrowing		**$485,000**	**$0**	**$0**	**$219,450**	**$0**	**$0**	**$650,000**	**$0**	**$0**	**$0**
Other Funding											
Developer Contributions											
Facility Reserve											
To be Determined											
Total Other Funding		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
From Own Sources											
Offsite Levies Restricted Surplus											
Wastewater Restricted Surplus		$490,000	$1,423,301	$1,340,000	$713,750	$343,640	$430,000	$343,700	$345,000	$410,384	$340,000
Total Own Sources		**$490,000**	**$1,423,301**	**$1,340,000**	**$713,750**	**$343,640**	**$430,000**	**$343,700**	**$345,000**	**$410,384**	**$340,000**
Total Funding		**$1,860,000**	**$1,525,876**	**$1,340,000**	**$1,063,750**	**$343,640**	**$430,000**	**$993,700**	**$345,000**	**$410,384**	**$340,000**
Measures for Sustainable Funding Levels											
Restricted Surplus - Wastewater Rate Model		$452,954	$499,210	$499,210	$499,210	$489,316	$494,636	$494,636	$448,800	$448,800	$448,800
Life Cycle Re-investment											
Replacement		$847,199	$847,199	$847,199	$847,199	$847,199	$847,199	$847,199	$847,199	$847,199	$847,199
Renewal		$725,462	$725,462	$725,462	$725,462	$725,462	$725,462	$725,462	$725,462	$725,462	$725,462
Amortization of Tangible Capital Assets		$937,682	$968,744	$994,226	$1,016,604	$1,034,369	$1,040,108	$1,047,289	$1,063,883	$1,069,645	$1,076,498

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
42 Wastewater Infrastructure Expense and Funding Summary

Index
Wastewater Details

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Resticted Surplus Balances											
Wastewater General Restricted Surplus											
Opening Balance		$2,697,031	$2,659,985	$1,735,894	$895,105	$680,565	$826,241	$890,877	$1,041,813	$1,145,613	$1,184,029
Added From Wastewater Operations		$452,954	$499,210	$499,210	$499,210	$489,316	$494,636	$494,636	$448,800	$448,800	$448,800
Used for Capital Expense		-$490,000	-$1,423,301	-$1,340,000	-$713,750	-$343,640	-$430,000	-$343,700	-$345,000	-$410,384	-$340,000
Closing Balance		**$2,659,985**	**$1,735,894**	**$895,105**	**$680,565**	**$826,241**	**$890,877**	**$1,041,813**	**$1,145,613**	**$1,184,029**	**$1,292,829**
Target Additions		$1,127,759	$1,150,314	$1,173,320	$1,196,787	$1,220,722	$1,245,137	$1,270,040	$1,295,440	$1,321,349	$1,347,776
Maximum Balance - % of Original Cost	10.0%	$5,369,934	$5,382,522	$5,503,934	$5,488,897	$5,538,298	$5,531,897	$5,637,668	$5,566,397	$5,678,706	$5,600,397
Balances											
Debenture Debt											
Existing		$2,749,170	$2,582,960	$2,409,370	$2,228,069	$2,049,748	$1,863,560	$1,669,156	$1,466,174	$1,254,233	$1,035,233
New Debenture 42-1		$485,000	$473,417	$461,366	$448,828	$435,783	$422,211	$408,092	$393,401	$378,117	$362,216
New Debenture 42-2					$219,450	$214,891	$210,102	$205,070	$199,784	$194,230	$188,394
New Debenture 42-3								$650,000	$636,498	$622,312	$607,408
Total Debt		**$3,234,170**	**$3,056,377**	**$2,870,735**	**$2,896,347**	**$2,700,423**	**$2,495,873**	**$2,932,318**	**$2,695,857**	**$2,448,892**	**$2,193,252**
Short Term Borrowing					$0	$0	$0	$0			
Total Debt		**$3,234,170**	**$3,056,377**	**$2,870,735**	**$2,896,347**	**$2,700,423**	**$2,495,873**	**$2,932,318**	**$2,695,857**	**$2,448,892**	**$2,193,252**

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
General Infrastructure Grant Funding

Index

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Population										
Official										
Projected	7,982	7,982	7,982	7,982	7,982	8,389	8,389	8,389	8,389	8,389
@ Growth Rate										
MSI Capital - Municipal Sustainability Initia										
Carried Forward	$1,185,372	($152,855)	$123,844	$450,543	$777,242	$106,941	$800	$89,659	$441,017	$479,876
Funding - MSI Component										
Per Capita Rate	$166.35	$166.35	$166.35	$166.35	$166.35	$166.35	$166.35	$166.35	$166.35	$166.35
MSI Grant	$1,327,779	$1,327,779	$1,327,779	$1,327,779	$1,327,779	$1,395,509	$1,395,509	$1,395,509	$1,395,509	$1,395,509
March 2015 Supplement										
Total MSI Component	$1,327,779	$1,327,779	$1,327,779	$1,327,779	$1,327,779	$1,395,509	$1,395,509	$1,395,509	$1,395,509	$1,395,509
Funding - BMTG Component										
Per Capita Rate	$60.35	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
BMTG Grant	$481,740	$478,920	$478,920	$478,920	$478,920	$503,350	$503,350	$503,350	$503,350	$503,350
Total Grant Funds	$1,809,519	$1,806,699	$1,806,699	$1,806,699	$1,806,699	$1,898,859	$1,898,859	$1,898,859	$1,898,859	$1,898,859
Projects										
MSI Component Projects										
Facilities	$1,653,976	$300,000	$500,000	$500,000	$1,150,000	$700,000	$300,000	$150,000	$750,000	$750,000
Equipment	$860,000	$0	$0	$0	$197,000	$345,000	$300,000	$287,500	$500,000	$500,000
Streets	$153,770	$750,000	$500,000	$500,000	$650,000	$500,000	$750,000	$650,000	$150,000	$450,000
BMTG Component										
Facilities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Streets	$480,000	$480,000	$480,000	$480,000	$480,000	$460,000	$460,000	$460,000	$460,000	$460,000
Total Projects	$3,147,746	$1,530,000	$1,480,000	$1,480,000	$2,477,000	$2,005,000	$1,810,000	$1,547,500	$1,860,000	$2,160,000
Remaining and Carried Forward	($152,855)	$123,844	$450,543	$777,242	$106,941	$800	$89,659	$441,017	$479,876	$218,735
New Deal for Cities (FGT - Federal Gas Tax Fund)										
Carried Forward	$0	($85,719)	$148,562	$182,843	$167,124	$1,405	$7,839	$64,272	$520,706	$677,140
Funding										
Per Capita Rate	$54.41	$54.41	$54.41	$54.41	$54.41	$54.41	$54.41	$54.41	$54.41	$54.41
Grant	$434,281	$434,281	$434,281	$434,281	$434,281	$456,434	$456,434	$456,434	$456,434	$456,434
Projects										
Street Rehab										

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
General Infrastructure Grant Funding

Index	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
East Coulee Lift Station	$200,000									
Sanitary Sewage										
Water Treatment and Transmission										
Town Hall										
Future Projects								$0	$150,000	$0
Facilities	$0	$0	$0	$0	$0	$100,000	$0	$0	$0	$0
Equipment	$0	$200,000	$400,000	$450,000	$500,000	$350,000	$400,000	$0	$150,000	$0
Streets	$320,000	$0	$0	$0	$100,000	$0	$0	$0	$0	$0
Total Projects	$520,000	$200,000	$400,000	$450,000	$600,000	$450,000	$400,000	$0	$300,000	$0
Remaining and Carried Forward	($85,719)	$148,562	$182,843	$167,124	$1,405	$7,839	$64,272	$520,706	$677,140	$1,133,573

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Capital Debt Summary

Index

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
General Revenue Support Debt													
Community Housing													
Interest	i	$9,319	$8,275	$7,148	$5,930	$4,615	$3,194	$1,659					
Principal	p	$12,994	$14,037	$15,164	$16,382	$17,698	$19,119	$20,653					
Total Annual Payments		$22,312	$22,312	$22,312	$22,312	$22,312	$22,312	$22,312	$0	$0	$0	$0	$0
Balance Owing at Year End	b	$103,054	$89,016	$73,852	$57,470	$39,772	$20,653	$0	$0	$0	$0	$0	$0
Badlands Community Facility - Phase 1													
Interest	i	$212,344	$202,200	$191,619	$180,584	$169,075	$157,070	$144,551	$131,493	$117,874	$103,669	$88,855	$88,855
Principal	p	$236,076	$246,220	$256,801	$267,836	$279,346	$291,350	$303,870	$316,927	$330,546	$344,751	$359,565	$359,565
Total Annual Payments		$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420	$448,420
Balance Owing at Year End	b	$4,816,312	$4,570,092	$4,313,291	$4,045,455	$3,766,109	$3,474,759	$3,170,890	$2,853,962	$2,523,416	$2,178,665	$1,819,100	$1,459,534
Hillsview Subdision Phase 3													
Interest	i	$5,394	$3,445	$1,482									
Principal	p	$264,713	$266,662	$268,625									
Total Annual Payments		$270,107	$270,107	$270,107	$0	$0	$0	$0	$0	$0	$0	$0	$0
Balance Owing at Year End	b	$535,287	$268,625	$0									
Flood Protection													
Interest	i	$0	$40,416	$39,435	$38,415	$37,353	$36,249	$35,100	$33,904	$32,660	$31,366		
Principal	p	$0	$24,275	$25,255	$26,276	$27,337	$28,442	$29,591	$30,786	$32,030	$33,324		
Total Annual Payments		$0	$64,690	$64,690	$64,690	$64,690	$64,690	$64,690	$64,690	$64,690	$64,690		
Balance Owing at Year End	b	$1,016,400	$992,125	$966,870	$940,595	$913,257	$884,816	$855,225	$824,439	$792,409	$759,086		
Shop A													
Interest	i	$0	$0	$0	$0	$0	$0	$124,359	$121,730	$118,968	$116,066		
Principal	p	$0	$0	$0	$0	$0	$0	$51,931	$54,560	$57,323	$60,225		
Total Annual Payments		$0	$0	$0	$0	$0	$0	$176,290	$176,290	$176,290	$176,290		
Balance Owing at Year End	b				$2,500,000	$2,500,000	$2,500,000	$2,448,069	$2,393,508	$2,336,186	$2,275,961		
Unspecified Facilities Expense - 2024													
Interest	i										$24,872	$24,346	
Principal	p										$10,386	$10,912	
Total Annual Payments											$35,258	$35,258	
Balance Owing at Year End	b										$489,614	$478,702	
Unspecified Facilities Expense - 2025													
Interest	i											$19,897	
Principal	p											$8,309	
Total Annual Payments												$28,206	
Balance Owing at Year End	b											$391,691	
Unspecified Facilities Expense - 2026													

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Capital Debt Summary

Index

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Interest	i												
Principal	p												
Total Annual Payments	b												
Balance Owing at Year End													
Total General Revenue Supported Debt													
Interest	i	$227,058	$213,920	$200,249	$226,930	$213,124	$198,679	$183,563	$167,741	$277,332	$259,304	$265,355	$280,530
Principal	p	$513,782	$526,920	$540,591	$308,493	$322,299	$336,744	$351,860	$345,369	$412,069	$430,097	$459,304	$472,335
Total Annual Payments		$740,840	$740,840	$740,840	$535,423	$535,423	$535,423	$535,423	$513,110	$689,401	$689,401	$724,659	$752,865
Balance Owing at Year End	**b**	$5,454,653	$4,927,734	$5,403,543	$5,095,050	$4,772,751	$6,936,007	$6,584,147	$6,238,778	$5,826,709	$5,396,612	$5,437,308	$5,364,973
Utility Supported Debt													
Water (Total from Water Financial Model)													
Interest		$127,789	$126,515	$118,748	$110,609	$102,080	$93,141	$83,773	$73,955	$63,665	$52,880	$41,576	$41,576
Principal		$149,847	$165,379	$173,145	$181,284	$189,814	$198,753	$208,121	$217,939	$228,229	$239,014	$250,318	$250,318
Total Annual Payments		$277,637	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$291,893
Penitentiary Booster Station Upgrade													
Interest				$0	$0	$0	$0	$0	$0	$39,795	$38,954	$38,070	$37,141
Principal				$0	$0	$0	$0	$0	$0	$16,618	$17,459	$18,343	$19,272
Total Annual Payments				$0	$0	$0	$0	$0	$0	$56,413	$56,413	$56,413	$56,413
WTP Wastewater Handling and Treatment													
Interest				$0	$0	$0	$0	$0	$0	$0	$0	$0	$79,590
Principal				$0	$0	$0	$0	$0	$0	$0	$0	$0	$34,067
Total Annual Payments				$0	$0	$0	$0	$0	$0	$0	$0	$0	$113,657
Total Water													
Interest				$118,748	$110,609	$102,080	$93,141	$83,773	$73,955	$103,460	$91,833	$79,646	$158,307
Principal				$173,145	$181,284	$189,814	$198,753	$208,121	$217,939	$244,847	$256,473	$268,661	$303,656
Total Water Payments				$291,893	$291,893	$291,893	$291,893	$291,893	$291,893	$348,306	$348,306	$348,306	$461,963
Total Water Principal Owing at Year End		$2,837,688	$2,672,310	$2,499,164	$2,317,880	$2,128,066	$1,929,313	$1,721,193	$2,303,254	$2,058,407	$1,801,934	$3,133,274	$2,829,617
Existing Wastewater Debt (Total from Wastewater Financial Model)													
Interest		$139,289	$132,813	$126,048	$118,982	$111,601	$103,891	$95,971	$88,104	$79,888	$71,309	$62,351	$62,351
Principal		$145,902	$152,379	$159,144	$166,210	$173,591	$175,980	$178,321	$186,188	$194,404	$202,982	$211,941	$211,941
Total Annual Payments		$285,192	$285,192	$285,192	$285,192	$285,192	$279,872	$274,292	$274,292	$274,292	$274,292	$274,292	$274,292
East Coulee Lift Station													
Interest					$19,285	$18,817	$18,330	$17,824	$17,297	$16,749	$16,178	$15,585	$14,967
Principal					$11,583	$12,051	$12,538	$13,045	$13,572	$14,120	$14,690	$15,284	$15,901
Total Annual Payments					$30,869	$30,869	$30,869	$30,869	$30,869	$30,869	$30,869	$30,869	$30,869

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Capital Debt Summary

Index

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
11th Street to 19th Street Forcemain												
Interest					$0	$0	$0	$0	$0	$32,333	$31,650	$30,932
Principal					$0	$0	$0	$0	$0	$13,840	$14,540	$15,276
Total Annual Payments					$0	$0	$0	$0	$0	$46,173	$46,190	$46,208
River Outfall												
Interest					$0	$0	$10,916	$10,685	$10,443	$10,188	$9,921	$9,639
Principal					$0	$0	$4,559	$4,789	$5,032	$5,287	$5,554	$5,835
Total Annual Payments					$0	$0	$15,475	$15,475	$15,475	$15,475	$15,475	$15,475
Total Wastewater												
Interest			$126,048	$138,267	$130,418	$122,222	$124,711	$116,086	$107,080	$130,009	$119,506	$117,889
Principal			$159,144	$177,793	$185,642	$188,518	$195,924	$204,549	$213,555	$236,799	$247,319	$248,954
Total Wastewater			$285,192	$316,060	$316,060	$310,740	$320,635	$320,635	$320,635	$366,808	$366,825	$366,843
Total Wastewater Principal Owing at Year End	$3,060,693	$2,908,314	$3,234,170	$3,056,377	$2,870,735	$2,901,667	$2,705,743	$2,501,193	$2,937,638	$2,700,839	$2,453,520	$2,204,566
Total Debt												
Interest	$494,136	$473,248	$445,045	$475,806	$445,622	$414,041	$392,047	$357,782	$487,872	$481,146	$464,507	$556,727
Principal	$809,532	$844,677	$872,880	$667,571	$697,754	$724,015	$755,905	$767,857	$870,470	$923,369	$975,284	$1,024,945
Total Annual Payments	$1,303,668	$1,317,925	$1,317,925	$1,143,376	$1,143,376	$1,138,056	$1,147,952	$1,125,639	$1,358,342	$1,404,515	$1,439,791	$1,581,672
Total Principal Owing at Year End	$11,353,034	$10,508,357	$11,136,877	$10,469,307	$9,771,552	$11,766,987	$11,011,082	$11,043,225	$10,822,755	$9,899,386	$11,024,102	$10,399,157

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Operating Revenues Available for Ongoing Infrastructure Projects

Index

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
General Revenue										
Amortization										
12 Administration	$175,000	$175,000								
21 Police	$42,385	$42,385								
23 Fire	$81,300	$81,300								
26 Safety	$3,400	$3,400								
31 Engineering Administration	$125,700	$125,700								
32 Roads and Streets	$458,228	$553,228								
33 Airport	$63,065	$63,065								
56 Cemetery	$1,000	$1,000								
66 Subdivision	$12,700	$12,700								
67 Public Housing	$90,400	$90,400								
72 Recreation Administration	$274,100	$274,100								
74 Community Facility	$359,100	$359,100								
Total Amortization	$1,686,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378	$1,781,378
Operating Funds										
Funds Available After Operating, Maintenance, Debt Interest	$1,921,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378	$2,016,378
Less: Debenture Principal on Current Debt	-$540,591	-$308,493	-$308,493	-$308,493	-$308,493	-$308,493	-$308,493	-$484,783	-$484,783	-$484,783
Net Funds Available	$1,380,787	$1,707,885	$1,707,885	$1,707,885	$1,707,885	$1,707,885	$1,707,885	$1,531,595	$1,531,595	$1,531,595
Funds Retained for Operating Contingency	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	$69,039	$85,394	$85,394	$85,394	$85,394	$85,394	$85,394	$76,580	$76,580	$76,580
Funds Diverted to Restricted Surplus - Contingency	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
	$138,079	$170,789	$170,789	$170,789	$170,789	$170,789	$170,789	$153,159	$153,159	$153,159
Funds Reserved for Infrastructure Purposes	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
	$1,173,669	$1,451,702	$1,451,702	$1,451,702	$1,451,702	$1,451,702	$1,451,702	$1,301,856	$1,301,856	$1,301,856
Add: Debenture Payments on Matured Debt		$270,107	$270,107	$270,107	$270,107	$292,420	$292,420	$292,420	$292,420	$292,420
Less: Debenture Payments for New Borrowing	$0	-$64,690	-$64,690	-$64,690	-$64,690	-$64,690	-$240,981	-$240,981	-$276,239	-$304,445
Surplus Available for Infrastructure Purposes	$1,173,669	$1,657,119	$1,657,119	$1,657,119	$1,657,119	$1,679,432	$1,503,141	$1,353,295	$1,318,037	$1,289,830

Town of Drumheller
Multi Year Infrastructure Plan 2017 - 2026
Operating Revenues Available for Ongoing Infrastructure Projects

Index

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Restrictions in Surplus											
Equipment	30%	$352,101	$497,136	$497,136	$497,136	$497,136	$503,829	$450,942	$405,988	$395,411	$386,949
Facilities (remaining funds)	25%	$410,784	$448,492	$448,492	$448,492	$448,492	$456,301	$394,599	$342,153	$329,813	$319,941
32 Transportation	35%	$410,784	$579,992	$579,992	$579,992	$579,992	$587,801	$526,099	$473,653	$461,313	$451,441
37 Storm (= annual reinvestment)	10%	$0	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500	$131,500
Total Restricted General Surplus		$1,173,669	$1,657,119	$1,657,119	$1,657,119	$1,657,119	$1,679,432	$1,503,141	$1,353,295	$1,318,037	$1,289,830
Utilities											
Water											
Amortization		$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010	$1,257,010
Funds Available After Operating, Maintenance, Debt Interest		$1,037,252	$1,158,746	$1,165,746	$1,165,746	$1,165,746	$1,165,746	$1,165,746	$1,165,746	$1,165,746	$1,165,746
Less: Debenture Principal on Current Debt		-$173,145	-$181,284	-$181,284	-$181,284	-$181,284	-$181,284	-$181,284	-$181,284	-$181,284	-$181,284
Add: Debenture Payments on Matured Debt											
Less: Debenture Payments for New Borrowing		$0	$0	$0	$0	$0	$0	-$56,413	-$56,413	-$56,413	-$169,239
Surplus Available for Infrastructure Purposes		$864,107	$977,462	$984,462	$984,462	$984,462	$984,462	$928,049	$928,049	$928,049	$815,223
Wastewater											
Amortization		$840,330	$840,330	$840,330	$840,330	$840,330	$840,330	$840,330	$840,330	$840,330	$840,330
Funds Available After Operating, Maintenance, Debt Interest		$612,098	$696,289	$696,289	$696,289	$696,289	$696,289	$696,289	$696,289	$696,289	$696,289
Less: Debenture Principal on Current Debt		-$159,144	-$166,210	-$166,210	-$166,210	-$166,210	-$166,210	-$166,210	-$166,210	-$166,210	-$166,210
Add: Debenture Payments on Matured Debt						$5,580	$10,900	$10,900	$10,900	$10,900	$10,900
Less: Debenture Payments for New Borrowing			-$30,869	-$30,869	-$30,869	-$46,343	-$46,343	-$46,343	-$92,179	-$92,179	-$92,179
Surplus Available for Infrastructure Purposes		$452,954	$499,210	$499,210	$499,210	$489,316	$494,636	$494,636	$448,800	$448,800	$448,800
Total Surplus Restricted for Infrastructure Purposes		$2,490,730	$3,133,792	$3,140,792	$3,140,792	$3,130,897	$3,158,529	$2,925,826	$2,730,144	$2,694,886	$2,553,854
Total Amortization		**$3,783,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**	**$3,878,718**

Town of Drumheller
Infrastructure Plan 2017 - 2026
Restricted Surplus (Reserves)

Index

	2016	2017						
	Closing Balance	Added					Withdrawn	Closing Balance
		General Rev	Utilities	Adjustment	2016 Surplus	Other		
Infrastructure Related Reserves								
General Capital	$51,520			$3,480				$55,000
Equipment	$1,813,450	$352,101			$200,000		-$182,450	$2,183,101
Facilities	$4,200,500	$410,784			$500,000	$10,000	-$911,750	$4,209,534
Offsite Levies	$393,000					$2,882		$395,882
Land	-$342,500							-$342,500
Storm	$0	$0					$0	$0
Municipal (Parks) Reserves	$12,236							$12,236
Transportation	$1,318,450	$410,784			$500,000		-$663,400	$1,565,834
Equipment	$0							$0
Building	$0							$0
Sandstone	$41,000					$25,000		$66,000
Total	$7,487,656	$1,173,669		$3,480	$1,200,000	$37,882	-$1,757,600	$8,145,087
Utilities								
Water	$988,355		$864,107		$803,619		-$213,600	$2,442,481
Wastewater	$2,704,900		$452,954		$500,400		-$490,000	$3,168,254
Total Utilities	$3,693,255	$0	$1,317,061	$0	$1,304,019	$0	-$703,600	$5,610,735
Contingency								
Contingency - Overall	$2,175,000	$138,079				$905,000		$3,218,079
Contingency - Infrastructure	$905,000					-$905,000		$0
	$3,080,000	$138,079		$0	$0	$0	$0	$3,218,079
Other Reserves								
Management Incentive	$35,000							$35,000
Scholarship	$36,600							$36,600
Utility Energy Savings	$193,500							$193,500
	$265,100	$0		$0	$0	$0	$0	$265,100
Total Restricted Surplus	**$14,526,011**	**$1,311,748**	**$1,317,061**	**$3,480**	**$2,504,019**	**$37,882**	**-$2,461,200**	**$17,239,001**
Total Available for Infrastructure	$11,025,655							$13,569,204

Town of Drumheller
Infrastructure Plan 2017 - 2026
Restricted Surplus (Reserves)

Index

	2018				2019				2020			
	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance
	General Rev	Utilities			General Rev	Utilities			General Rev	Utilities		
Infrastructure Related Reserves												
General Capital				$55,000				$55,000				$55,000
Equipment	$497,136		-$1,091,564	$1,588,672	$497,136		-$727,296	$1,358,512	$497,136		-$859,820	$995,828
Facilities	$448,492		-$890,000	$3,768,026	$448,492		-$1,045,000	$3,171,518	$448,492		-$15,000	$3,605,009
Offsite Levies				$395,882				$395,882				$395,882
Land				-$342,500				-$342,500				-$342,500
Storm	$131,500		-$131,500	$0	$131,500		-$131,500	$0	$131,500		-$131,500	$0
Municipal (Parks) Reserves				$12,236				$12,236				$12,236
Transportation	$579,992		-$588,750	$1,557,076	$579,992		-$1,443,000	$694,068	$579,992		-$476,500	$797,559
Equipment				$0				$0				$0
Building				$0				$0				$0
Sandstone				$66,000				$66,000				$66,000
Total	$1,657,119	$0	-$2,701,814	$7,100,392	$1,657,119	$0	-$3,346,796	$5,410,716	$1,657,119	$0	-$1,482,820	$5,585,015
Utilities												
Water		$977,462	-$1,439,440	$1,980,503		$984,462	-$1,013,304	$1,951,661		$984,462	-$469,510	$2,466,613
Wastewater		$499,210	-$1,423,301	$2,244,163		$499,210	-$1,340,000	$1,403,374		$499,210	-$713,750	$1,188,834
Total Utilities	$0	$1,476,672	-$2,862,741	$4,224,666	$0	$1,483,672	-$2,353,304	$3,355,035	$0	$1,483,672	-$1,183,260	$3,655,447
Contingency												
Contingency - Overall	$170,789			$3,388,867	$170,789			$3,559,656	$170,789			$3,730,444
Contingency - Infrastructure				$0				$0				$0
	$170,789	$0	$0	$3,388,867	$170,789	$0	$0	$3,559,656	$170,789	$0	$0	$3,730,444
Other Reserves												
Management Incentive				$35,000				$35,000				$35,000
Scholarship				$36,600				$36,600				$36,600
Utility Energy Savings				$193,500				$193,500				$193,500
	$0	$0	$0	$265,100	$0	$0	$0	$265,100	$0	$0	$0	$265,100
Total Restricted Surplus	**$1,827,908**	**$1,476,672**	**-$5,564,555**	**$14,979,026**	**$1,827,908**	**$1,483,672**	**-$5,700,100**	**$12,590,506**	**$1,827,908**	**$1,483,672**	**-$2,666,080**	**$13,236,006**
Total Available for Infrastructure				$11,138,441				$8,579,132				$9,053,844

Town of Drumheller
Infrastructure Plan 2017 - 2026
Restricted Surplus (Reserves)

Index

	2021				2022				2023			
	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance
	General Rev	Utilities			General Rev	Utilities			General Rev	Utilities		
Infrastructure Related Reserves												
General Capital				$55,000				$55,000				$55,000
Equipment	$497,136		-$560,810	$932,154	$503,829		-$355,000	$1,080,983	$450,942		-$97,260	$1,434,666
Facilities	$448,492		-$1,080,000	$2,973,501	$456,301		-$580,000	$2,849,802	$394,599		-$165,000	$3,079,402
Offsite Levies				$395,882				$395,882				$395,882
Land				-$342,500				-$342,500				-$342,500
Storm	$131,500		-$131,500	$0	$131,500		-$131,500	$0	$131,500		-$131,500	$0
Municipal (Parks) Reserves				$12,236				$12,236				$12,236
Transportation	$579,992		-$797,000	$580,551	$587,801		-$72,500	$1,095,852	$526,099		-$121,000	$1,500,952
Equipment				$0				$0				$0
Building				$0				$0				$0
Sandstone				$66,000				$66,000				$66,000
Total	$1,657,119	$0	-$2,569,310	$4,672,824	$1,679,432	$0	-$1,139,000	$5,213,256	$1,503,141	$0	-$514,760	$6,201,637
Utilities												
Water		$984,462	-$798,698	$2,652,377		$984,462	-$671,000	$2,965,839		$928,049	-$1,215,396	$2,678,492
Wastewater		$489,316	-$343,640	$1,334,510		$494,636	-$430,000	$1,399,146		$494,636	-$343,700	$1,550,082
Total Utilities	$0	$1,473,778	-$1,142,338	$3,986,887	$0	$1,479,098	-$1,101,000	$4,364,985	$0	$1,422,685	-$1,559,096	$4,228,574
Contingency												
Contingency - Overall	$170,789			$3,901,233	$170,789	-$72,021		$4,000,000	$170,789	-$170,789		$4,000,000
Contingency - Infrastructure				$0		$72,021		$72,021		$170,789		$242,810
	$170,789	$0	$0	$3,901,233	$170,789	$0	$0	$4,072,021	$170,789	$0	$0	$4,242,810
Other Reserves												
Management Incentive				$35,000				$35,000				$35,000
Scholarship				$36,600				$36,600				$36,600
Utility Energy Savings				$193,500				$193,500				$193,500
	$0	$0	$0	$265,100	$0	$0	$0	$265,100	$0	$0	$0	$265,100
Total Restricted Surplus	**$1,827,908**	**$1,473,778**	**-$3,711,648**	**$12,826,044**	**$1,850,220**	**$1,479,098**	**-$2,240,000**	**$13,915,362**	**$1,673,930**	**$1,422,685**	**-$2,073,856**	**$14,938,120**
Total Available for Infrastructure				$8,473,093				$9,463,644				$10,486,402

Town of Drumheller
Infrastructure Plan 2017 - 2026
Restricted Surplus (Reserves)

Index

	2024				2025				2026			
	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance	Added		Withdrawn	Closing Balance
	General Rev	Utilities			General Rev	Utilities			General Rev	Utilities		
Infrastructure Related Reserves												
General Capital				$55,000				$55,000				$55,000
Equipment	$405,988		-$63,077	$1,777,577	$395,411		-$112,415	$2,060,573	$386,949		-$270,000	$2,177,522
Facilities	$342,153		-$535,000	$2,886,555	$329,813		-$20,000	$3,196,368	$319,941		$180,000	$3,696,308
Offsite Levies				$395,882				$395,882				$395,882
Land				-$342,500				-$342,500				-$342,500
Storm	$131,500		-$131,500	$0	$131,500		-$131,500	$0	$131,500		-$131,500	$0
Municipal (Parks) Reserves				$12,236				$12,236				$12,236
Transportation	$473,653		-$108,480	$1,866,125	$461,313		-$77,000	$2,250,438	$451,441		-$110,000	$2,591,878
Equipment				$0				$0				$0
Building				$0				$0				$0
Sandstone				$66,000				$66,000				$66,000
Total	$1,353,295	$0	-$838,057	$6,716,875	$1,318,037	$0	-$340,915	$7,693,996	$1,289,830	$0	-$331,500	$8,652,326
Utilities												
Water		$928,049	-$1,292,195	$2,314,346		$928,049	-$549,699	$2,692,696		$815,223	-$773,000	$2,734,920
Wastewater		$448,800	-$345,000	$1,653,882		$448,800	-$410,384	$1,692,298		$448,800	-$340,000	$1,801,098
Total Utilities	$0	$1,376,849	-$1,637,195	$3,968,228	$0	$1,376,849	-$960,083	$4,384,994	$0	$1,264,024	-$1,113,000	$4,536,018
Contingency												
Contingency - Overall	$153,159	-$153,159		$4,000,000	$153,159	-$153,159		$4,000,000	$153,159	-$153,159		$4,000,000
Contingency - Infrastructure		$153,159		$395,969		$153,159		$549,129		$153,159		$702,288
	$153,159	$0	$0	$4,395,969	$153,159	$0	$0	$4,549,129	$153,159	$0	$0	$4,702,288
Other Reserves												
Management Incentive				$35,000				$35,000				$35,000
Scholarship				$36,600				$36,600				$36,600
Utility Energy Savings				$193,500				$193,500				$193,500
	$0	$0	$0	$265,100	$0	$0	$0	$265,100	$0	$0	$0	$265,100
Total Restricted Surplus	**$1,506,454**	**$1,376,849**	**-$2,475,252**	**$15,346,172**	**$1,471,196**	**$1,376,849**	**-$1,300,998**	**$16,893,219**	**$1,442,990**	**$1,264,024**	**-$1,444,500**	**$18,155,732**
Total Available for Infrastructure				$10,894,454				$12,441,501				$13,704,014

Alberta's Watershed Management Symposium: Flood and Drought Mitigation Basin Map

Presentation - Red Deer River Basin

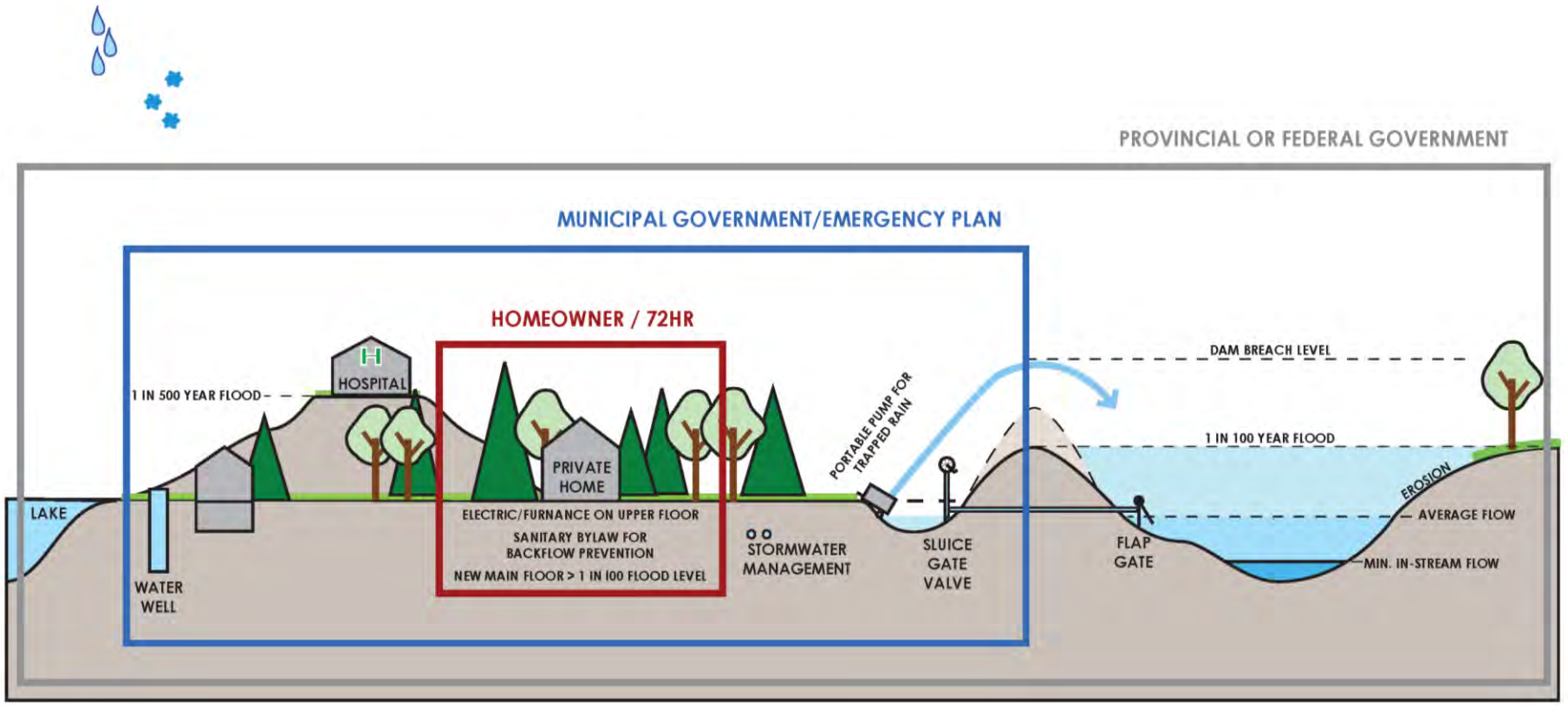
April 29, 2014

Government of Alberta

Key Elements of Mitigation

- Overall Watershed Management
- Flood Modelling, Prediction, and Warning Systems
- Flood Risk Management Policies
- Water Management and Mitigation Infrastructure
- Erosion Control
- Local Mitigation Initiatives – by municipality
- Individual Mitigation Measures for Homes

Multi-Barrier Approach



Overall Mitigation Plan

- Based on the FRTF'S Three Elements:

  - Emergency Preparedness (0 to 1 year)
  - Mitigation (0 to 3 years)
  - Adaptation & Policies (0 to 10 years)

Utilize Concepts & Theories

- Concepts
  - Flood detention sites
    - *Maintain natural flow in non-flood conditions*
  - River by-passes
    - *Move large volumes downstream beyond areas at high risk*
  - Channel Conveyance Improvement
- Theories – Past Flood Events (Including 2005 & 2013)
  - Meteorological Systems
    - *Weather patterns*
  - Hydrological
    - *River flows*

Water Management Strategy

- Address both Augmentation and Drought
- Basin-wide Water Management
  - Including Special Areas / Dry Dams
- There is no Single Solution
  - Dickson Dam

Identified Stakeholders

- First Nations
  - Stoney Nakoda Nation
  - Siksika First Nation
- Municipalities
  - Clearwater County*
  - Mountain View County
  - Town of Sundre
  - Red Deer County
  - City of Red Deer
  - Lacombe County
  - Kneehill County
  - Town of Drumheller
  - Starland County*
  - Stettler County*
  - Special Areas Board*
- Regional Water Commissions

Identified Stakeholders (continued)

- Utility Companies
  - Alberta Common Ground Alliance
  - Alberta Electrical System Operator
- Government of Alberta
  - Dickson Dam
  - Alberta Transportation
  - Alberta Environment and Sustainable Resource Development
  - Alberta Parks, Recreation, and Tourism
- Other
  - CP Rail & CN Rail
  - Red Deer River Watershed Alliance
  - Red Deer River Municipal Users Group
  - Palliser Regional Municipal Services
  - Flood Recovery Task Force

Engagement Schedule

- Jan 17 – Town of Drumheller
- Jan 21 - Special Areas Board, Town of Three Hills, Town of Sundre
- Jan 22 - Lacombe County, AB Common Ground Alliance
- Jan 23 – Red Deer County
- Jan 24 – Stoney Nakoda Nation
- Jan 31 – Task Force Communication Meeting
- Feb 3 – Municipal Data/GIS Collection Meeting

Engagement Outcomes

- Recognized areas of specific concern
  - Town of Sundre
  - Dickson Dam
  - Red Deer County
  - City of Red Deer
  - Town Of Drumheller
- Identify existing and proposed projects
- Gain general feedback regarding potential projects

Flood Recovery Task Force Communication

- Weekly updates to Task Force's Stakeholder Engagement Team identifying:
  - Who / When / When stakeholders were engaged
  - Issues or items that arose
  - Any follow up that was required / desired

- Weekly meeting with the Task Force Project Director
  - Who / When / Where stakeholder were engaged
  - What items were being discovered
  - Issues or items that arose
  - Any follow up that was required / desired

DICKSON DAM

Dickson Dam

- Economic Development
  - Attract industries to the Red Deer River Basin
    - *Petro Chemical*
    - *Irrigation*
- Operation
  - Provide minimum of 16 cms flow year round to the Saskatchewan border
  - Stage pre-release to offset peak flows from downstream areas
- Challenges
  - Balance between drought storage and flood control
  - Maximum pre-release flow is 200 cms, due to location of properties downstream

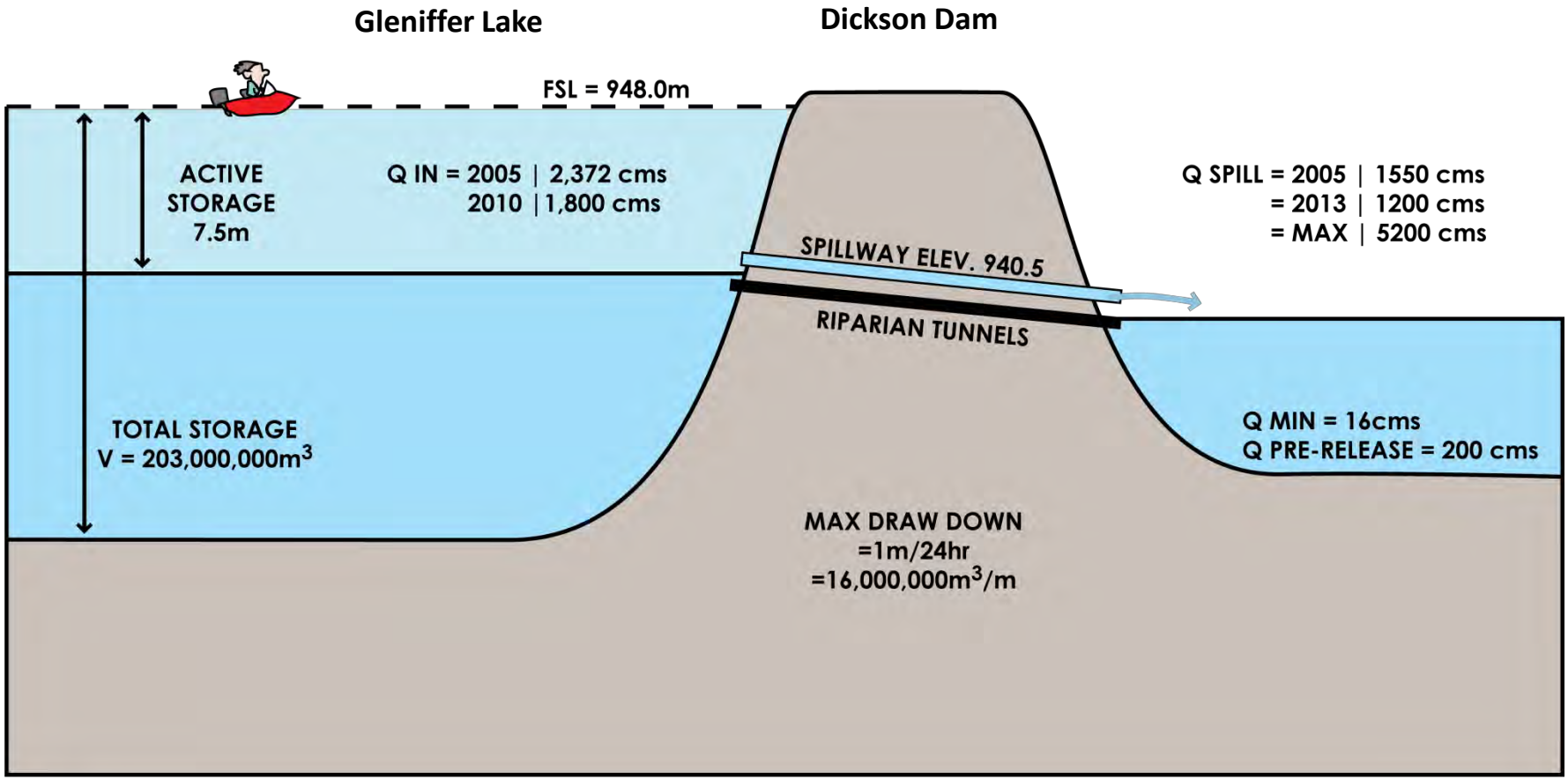
Interesting Operational Facts

- Minimum discharge requirement – 16cms
- Maximum discharge capacity of the Dickson Dam – 5,200cms
- Highest inflow into the reservoir – 2372 m3/s in June 2005 with a 1550cms discharge
- 2nd highest inflow into the reservoir was June 2013 – 1800cms with an outflow of 1200cms
- Largest recorded flood in the Red Deer River Basin prior to 2005 – 1,650cms (1915)

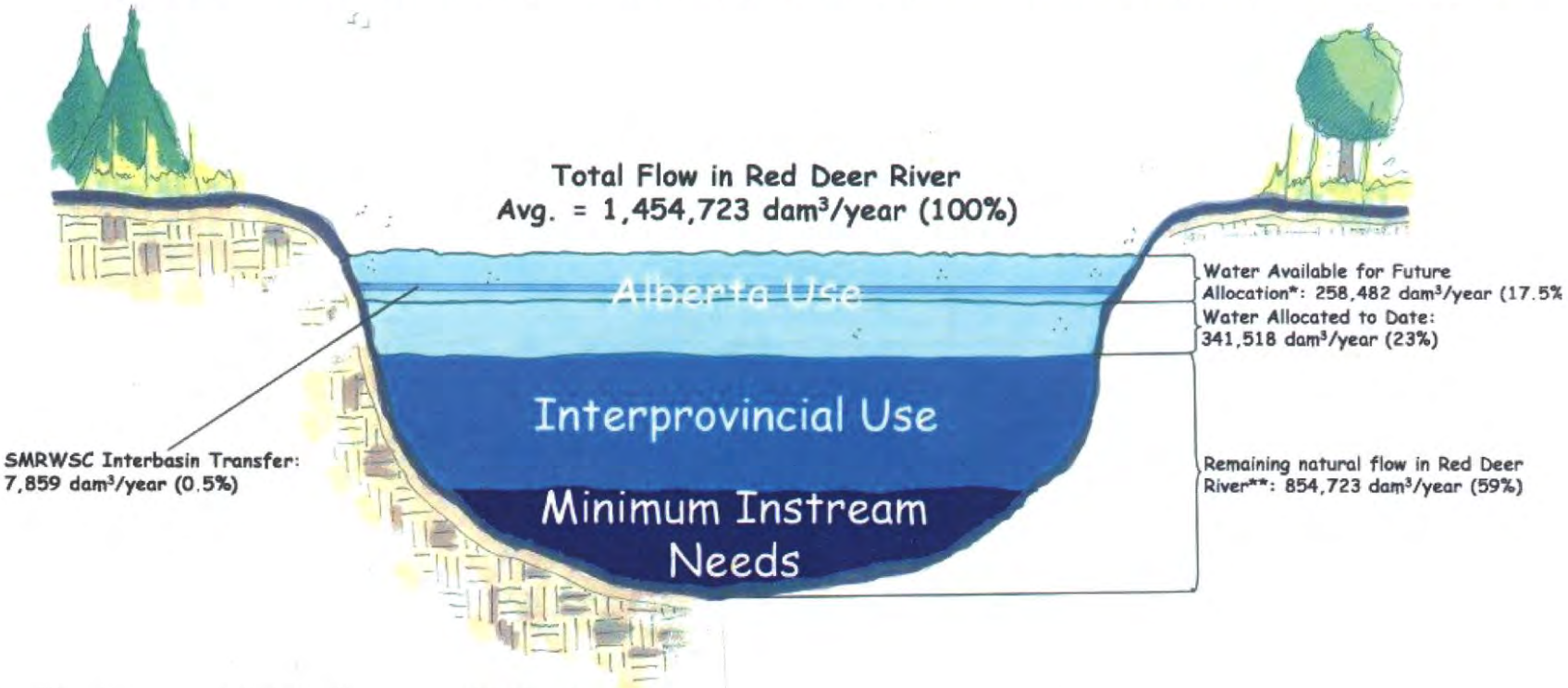
Interesting Operational Facts (continued)

- Historical low flows – less than 2 cubic meters per second

Dickson Dam Schematic



Shirley McClellan Regional Water Services Commission
Interbasin Water Transfer
Public Consultation Process - August, 2007
Proposed Transfer Volume from the Red Deer River to Battle River Basin



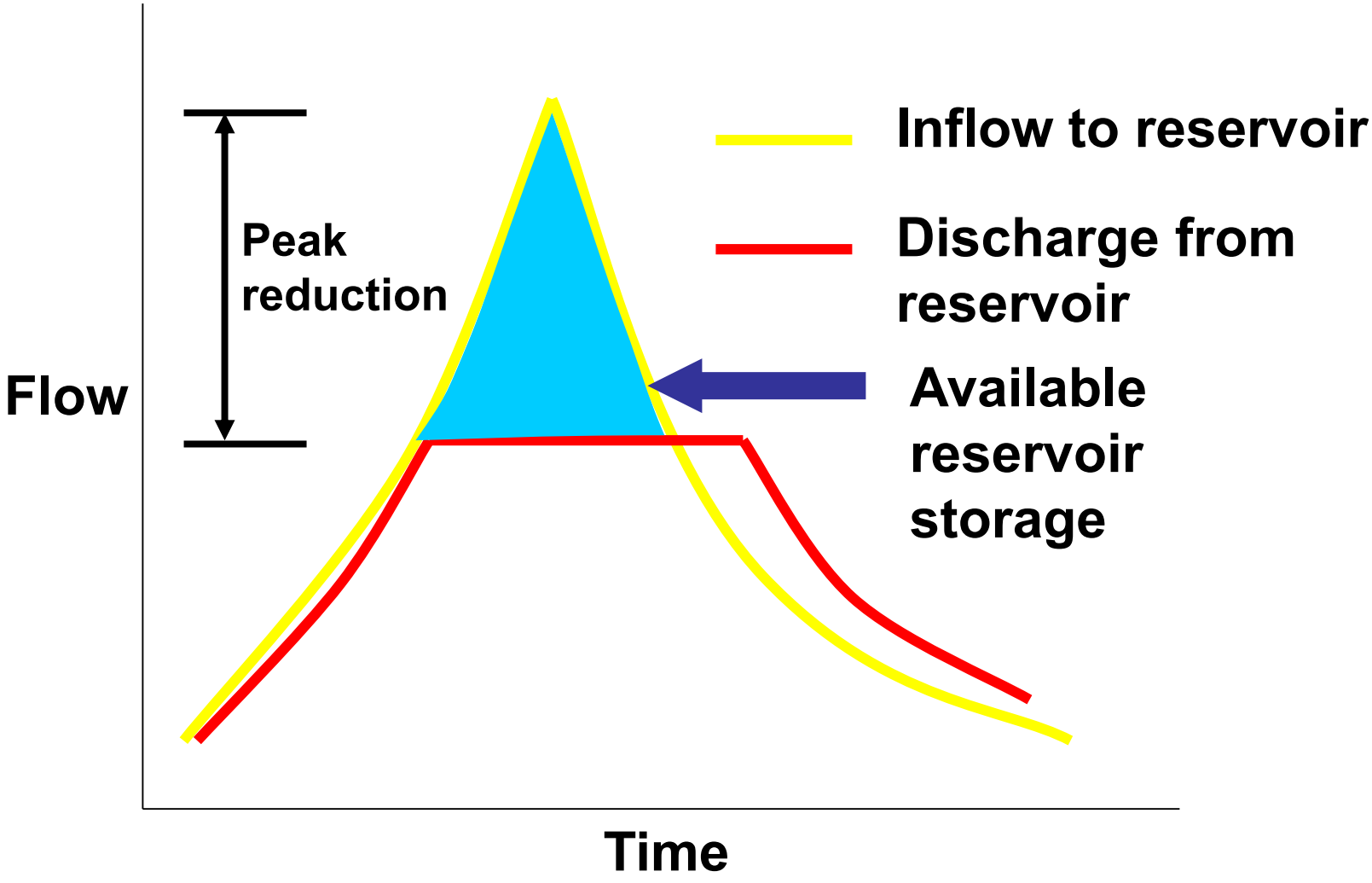
* Alberta Environment (2006) - Initial allocation target 600,000 dam³/year, aquatic environmental review at 550,000 dam³/year. Allocation available is calculated from the initial target.

** Interprovincial flow equals the total flow minus the Alberta use. Minimum instream need: the greater flow of 45% of the natural flow or 16 m³/s from November to March and the greater flow of 45% of the natural flow or 10 m³/s from April to October from the confluence with the Blindman River to the Saskatchewan border (approximately 394,200 dam³/year using defined minimum flow rates).

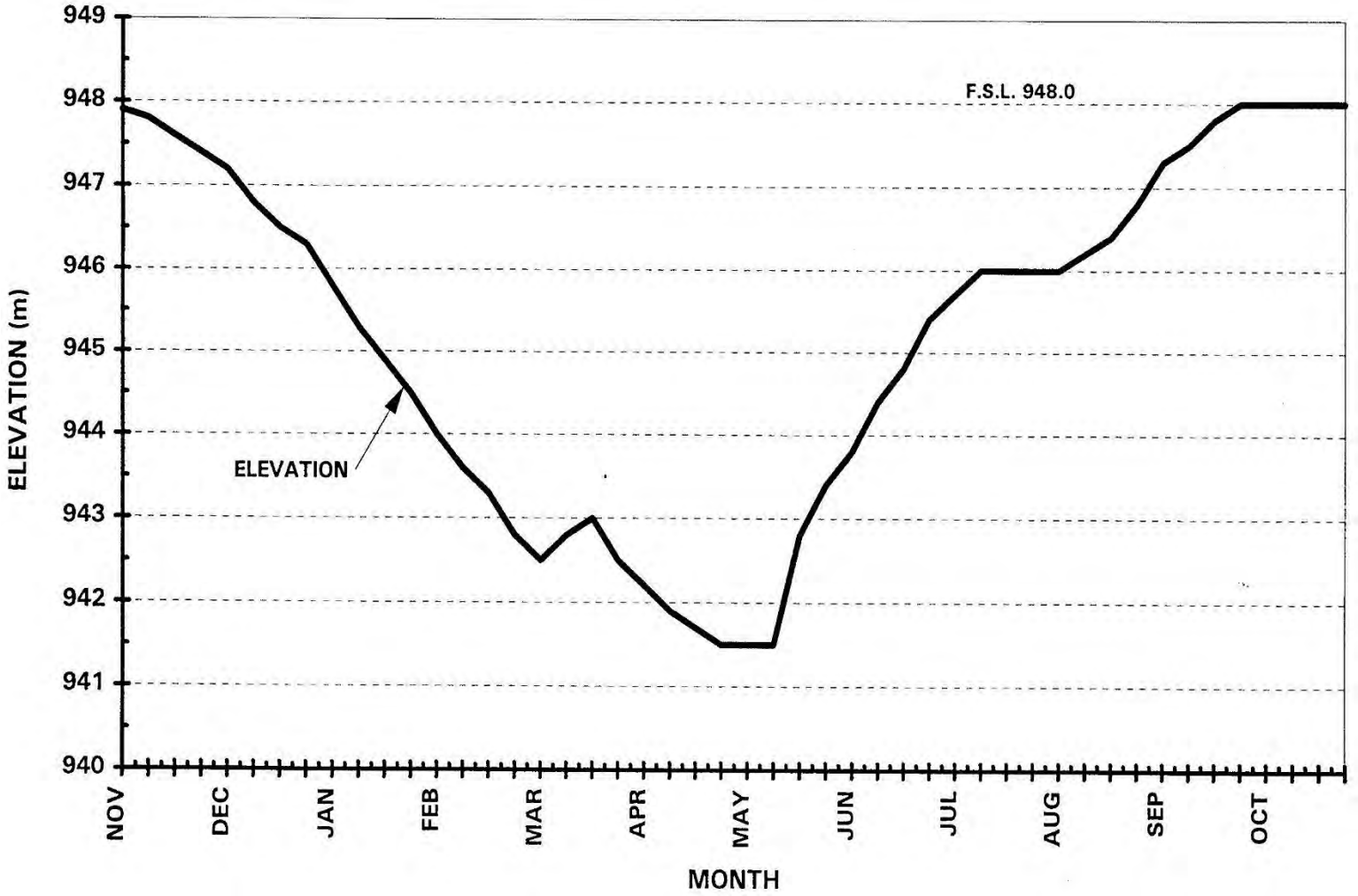
Sources:

Alberta Environment, 2006, Approved Water Management Plan for the South Saskatchewan River Basin (Alberta), Edmonton.
Alberta Environment, 2003 (revised 2005), South Saskatchewan River Basin Water Allocation, Southern Region.

Flood Operation Procedures



Typical Reservoir Regulation



- Downstream of Dickson Dam

- Dickson Dam

RED DEER RIVER BASIN PROJECTS

Downstream of Dickson Dam

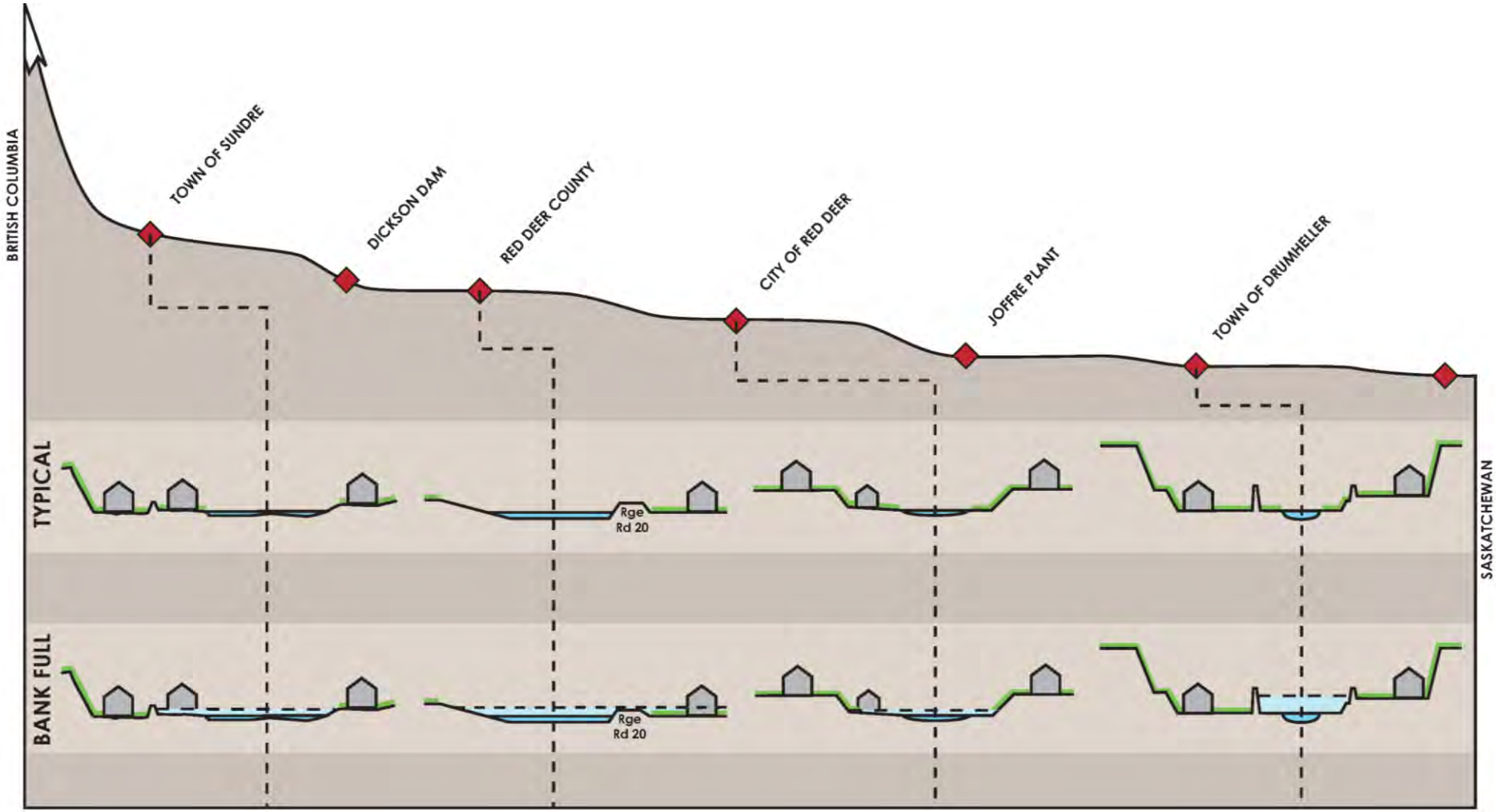
- Key Locations
  - Dickson Dam
  - Red Deer County
  - City of Red Deer
  - Drumheller
  - Regional Water Systems

- Key Issues
  - Un-regulated flows on tributaries including Little Red Deer River, Medicine River, Michichi Creek, Rosebud River, Blindman River and Kneehills Creek
  - Drumheller bank-full capacity of 1390 cms
  - Regional Water Treatment Plants

Downstream of Dickson Dam

- Operational Flow (Regulated)
- Tributaries
- Dyking

Bank Full Conditions

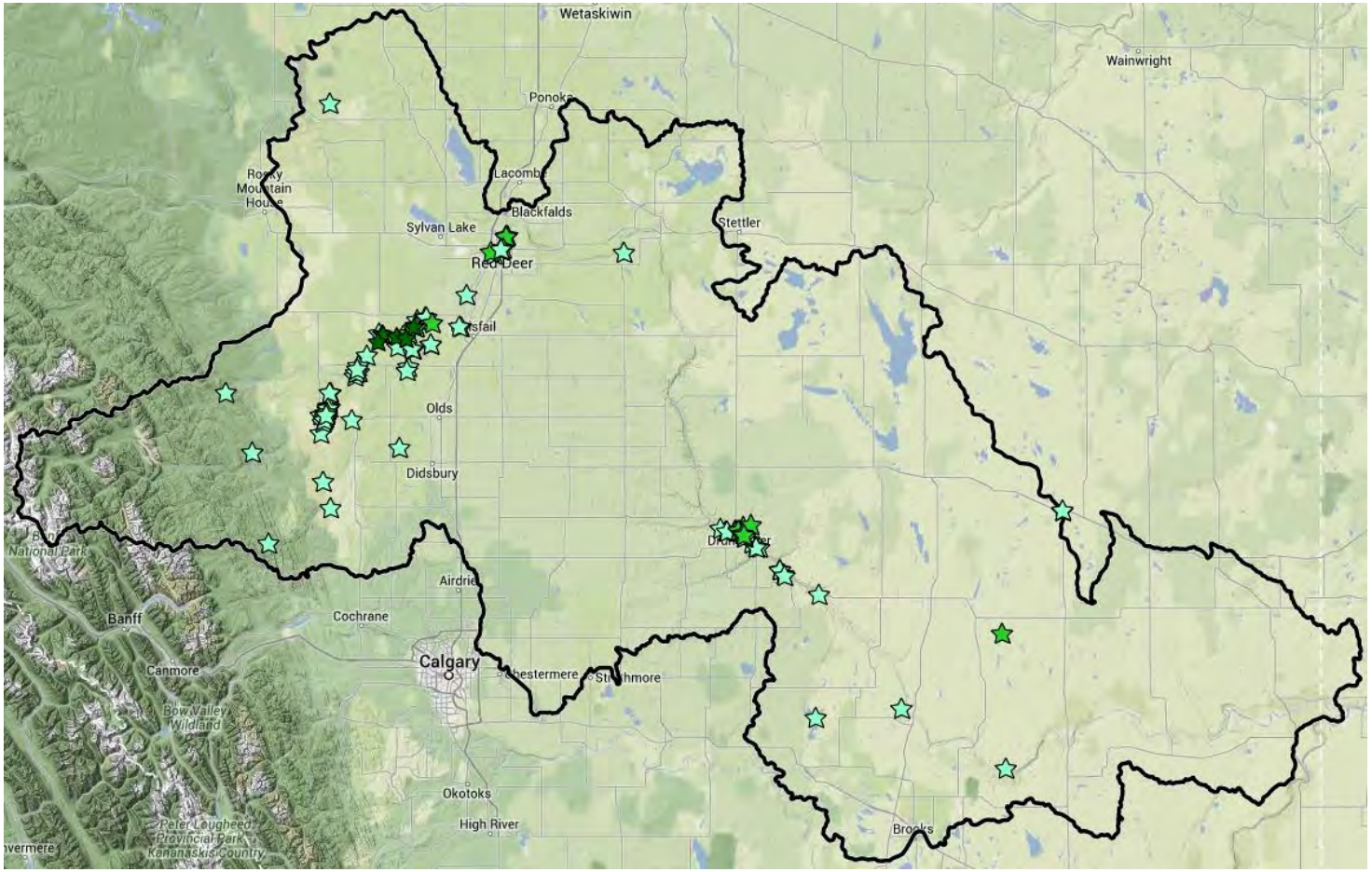


Considerations & Priorities

- Human Life
- Property
- Environment

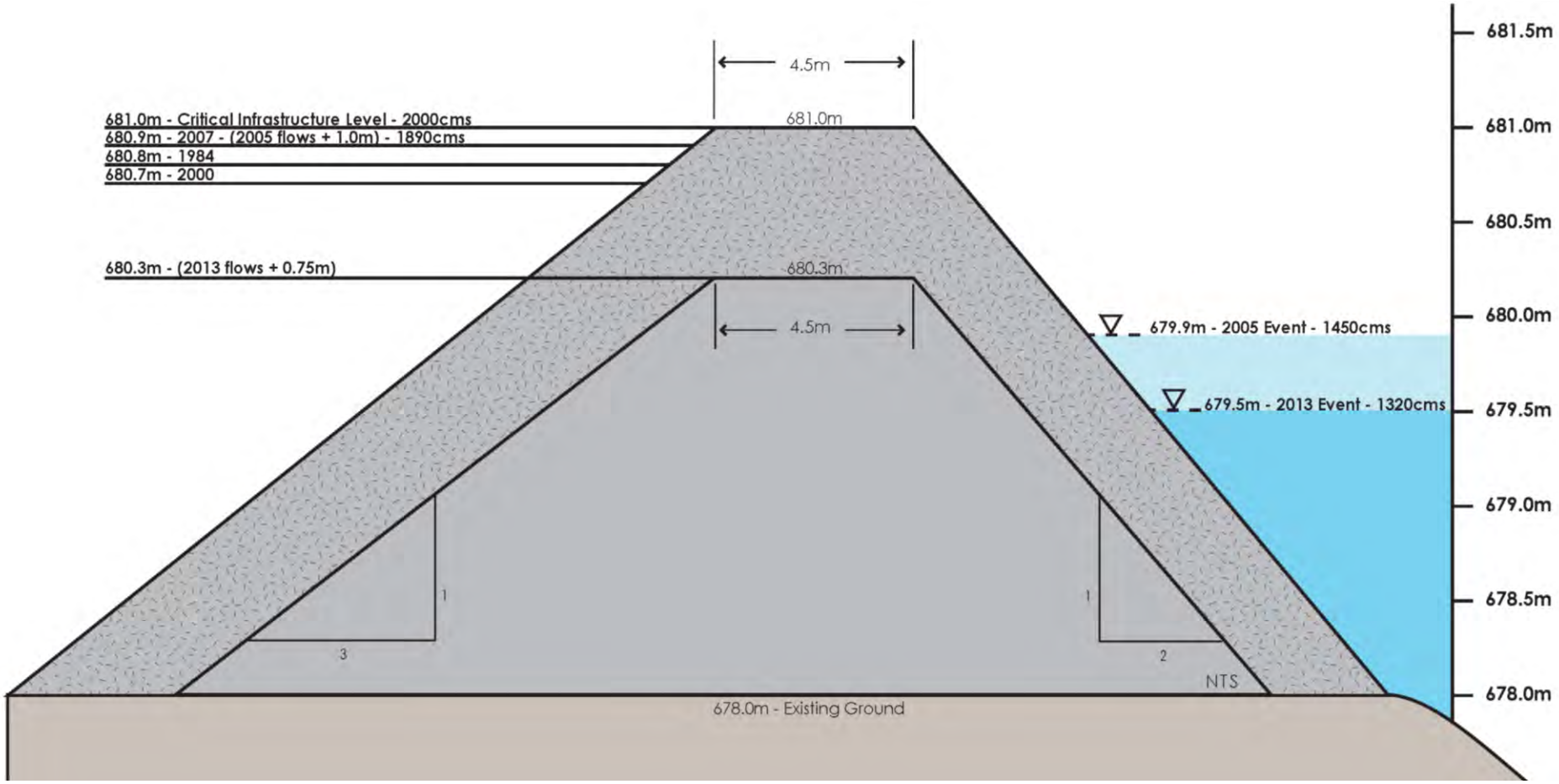
- Critical Infrastructure
  - Major Roads
  - Railroads
  - Bridges
  - Water Treatment Plants
  - Hospitals
  - Dangerous Goods
    - *Pipelines*
  - Public utilities

Identified Projects

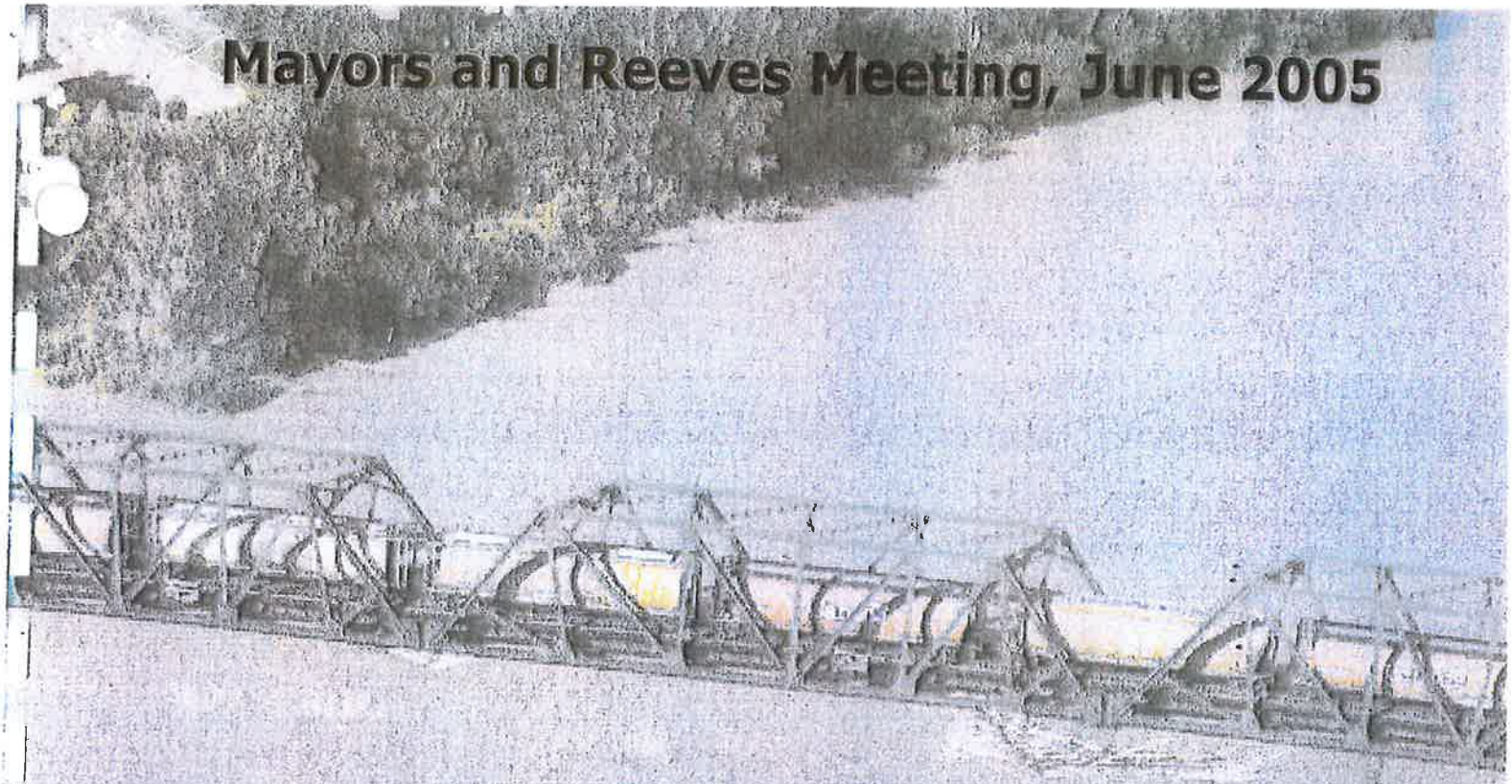


Flood Events at (Rosedale) Aerial Flats

Cross-Section Location 52, Drumheller



Mayors and Reeves Meeting, June 2005



PRELIMINARY BRIEFING REPORT

DRUMHELLER 2005 FLOOD

Prepared for:

Prime Minster Paul Martin

and

Premier Ralph Klein

Presented at High River, Alberta

DRUMHELLER

DINOSAURS • DISCOVERY • OPPORTUNITY

Dinosaur Capital of the World

Table of Contents

Event Summary

The Town of Drumheller experienced a flood of the Red Deer River which peaked on June 21 2005 beyond the 1:100 year flood event. Through extreme effort and the assistance of neighbouring communities, contractors and other resources, Drumheller was able to mitigate the effect of the potential damage through the construction of emergency berms and the evacuation of 3000 residents over a 3 day period. Some 85 homes were flooded or received water or waste water damage. These homes were beyond the protection of existing or emergency berms. No loss of human life was experienced.

The entire protection effort, evacuation, resultant infrastructure damage, damage to private homes and businesses and other related expenses is estimated in the millions of dollars.

Initial Flood Forecast required that an immense amount of temporary dyking would be required to protect the community and that 1/3 to ½ of the community would need to be evacuated.

Ultimately an estimated 3000 population was evacuated and 7.1 km of berms were constructed or fortified with over 85,000 cubic meters of earth fill.

Four neighbouring rural Counties, namely Starland, Wheatland and Kneehills Counties and Special Areas, provided aid ranging from heavy equipment and construction through to personnel for the EOC. Ten neighbouring urban municipalities, including Olds, Didsbury, Innisfail, Three Hills, Morrin, Munson, Stettler, Hanna, Strathmore and Calgary provided personnel operators, reception to evacuees and equipment.

The total personnel from responding agencies numbered approximately 600 with an estimated 800 – 1000 volunteers providing services ranging from sandbag filling to phone answering and reception center and security duties.

Actual Flood Levels Experienced

On June 21 2005 at 0100 hours the Red Deer River at Drumheller peaked at a flow of 1396 cubic meters per second (m^3/s) which is 10 times its normal flow. The actual high flow experienced is 682.78 m ASL (above sea level) and was beyond the height of the predicted 1:100 year flood event established under the **Canada- Alberta Flood Protection Program undertaken in the 1980's**. Figure 1 is a graph of the flow experienced and prepared by the Town of Drumheller and Figure 2 is a table showing the annual flow experienced to date in the Red Deer River at Drumheller as supplied by Alberta Environment.

Figure 1 Flood Volume Graph

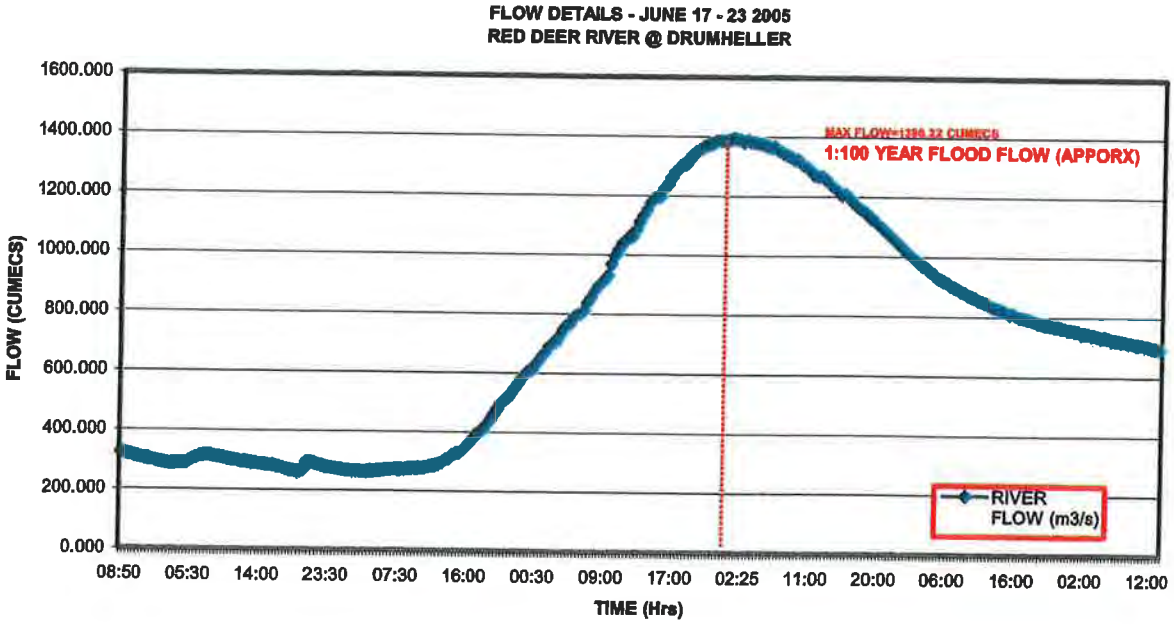
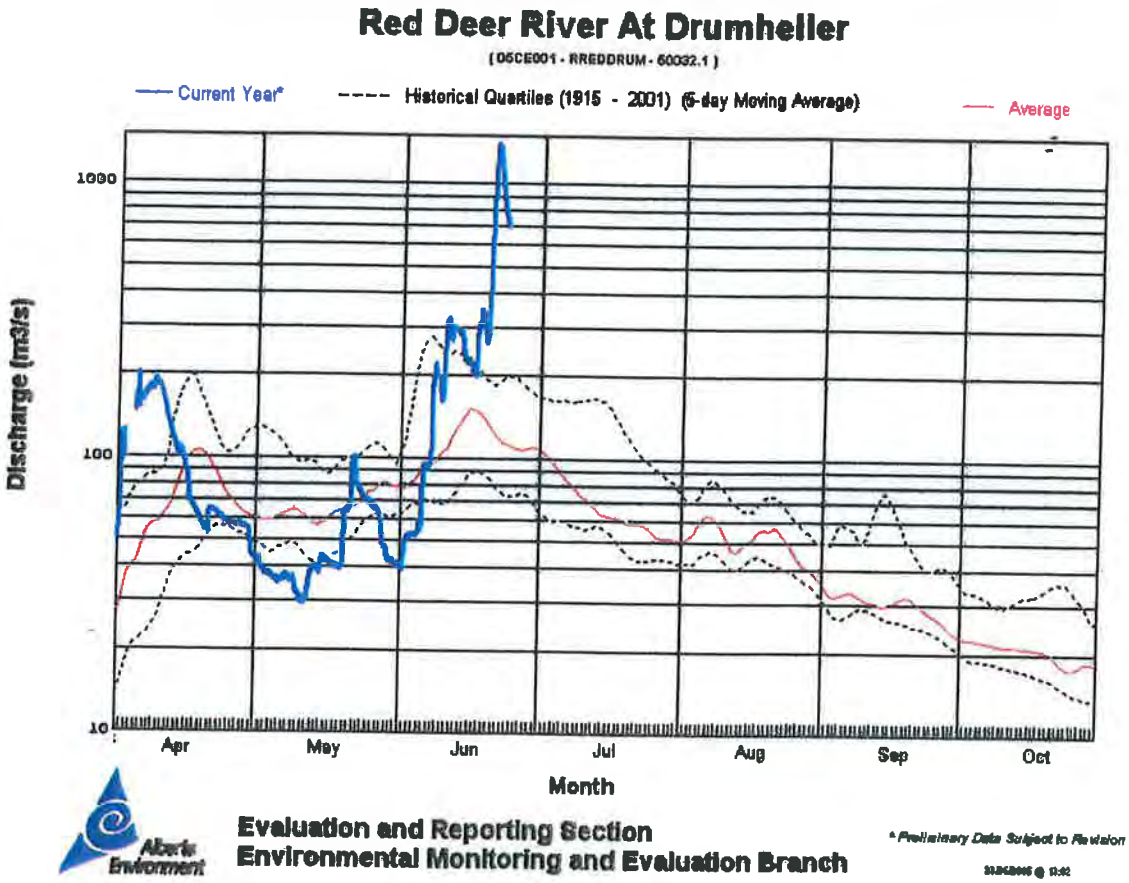


Figure 2 – Alberta Environment Annual Flow Summary



Flood Prediction & Warning

Initial information provided by the Alberta Environment River Forecast Centre at 1245 hrs on Saturday June 18, 2005 predicted a flow of 1400 m3/s which would have resulted in a flood height beyond the 1:100 event. River forecasters provided updates to the Town throughout the event and based on information received at 0500 hours on June 19 the expected flow was expected to be 2000 m3/s.

Location

Drumheller is located in east Central Alberta approximately 120 kilometres NE of Calgary. It is Located within the Red Deer River Valley and has a disproportionately large geographical areas compared to its population when viewed with other Alberta Communities.

The Town Limits of Drumheller cover an area approximately 30 km long and 5 km wide as it follows several communities along the banks of the Red Deer River which comprise of a total population of some 7785 people and shown below in Table 1.

Table 1 – Drumheller Population by Communities

•Nacmine	497
•Midland	668
•Newcastle	787
•North Drumheller	334
•Drumheller Proper	4844
•Rosedale / Aerial	139
•Cambria	50
•Lehigh	20
•East Coulee	146
•Wayne	40
•Rural	260

Valley of Communities

The total length of river within the Community is shown in Appendix 2. This length includes 36 km of Red Deer River and 10 km of the Rosebud River. The entire length of River Bank (both sides) is summarized in Table 2 as well and is 72 km for the Red Deer River in Drumheller alone. Of this amount approximately 20 km are immediately adjacent to the urban communities developed areas identified in the Table 1. Interspersed are rural acreages and farms adjacent the river.

Table 2 further compares the length of river in Drumheller with other Alberta Communities. This comparison shows that Drumheller had to manage in the overall sense a very significantly larger exposure to flooding in proportion to other communities of its population.

Table 2 – River Lengths in Alberta Communities

#	CITY	RIVER	LENGTH	BANKS	POPULATION 2004
1	**DRUMHELLER**	RED DEER	36 KM	72 KM	7 785
		ROSEBUD	10 KM	20 KM	
				92 KM	
2	RED DEER	RED DEER	15KM	30 KM	75 923
3	CALGARY	BOW RIVER	48KM		933 495
		ELBOW RIVER	22KM	140 KM	
4	EDMONTON	SASKATCHEWAN	81 KM	162 KM	666 104

The Response

State of Local Emergency Declared

Based on the initial predictions received from Alberta Environment's River Forecast Centre the Town of Drumheller declared a State of Local Emergency at 4:30 pm on Saturday June 18, 2005. The Emergency Operations Centre (EOC) was established at Town Hall and planning commenced to deal with the imminent flood situation.

Through its advanced GIS capabilities, flood inundation maps were prepared based upon a flow of 1900 m3/s , additional maps were prepared for the larger 2100 m3/s when the River forecast centre provided additional predictions.

The preservation of Life, Property and municipal infrastructure was identified as the order in which response priority would be undertaken.

Through the evening of the 18th and the early morning hours of the 19th resources were mustered to provide:

- Temporary Berms
- Evacuation and Security for Evacuation Areas
- Victim Relocation / Reception Centres
- Media Centres
- Surveying

The EOC focused on the assessment of flood risk and the prioritization of what areas would be saved for a level of effort commensurate with the resources available. This was a continuous process of re-evaluation throughout the event as more resources became available and the expected peak high water level diminished. Through this continuous process the area protected was constantly expanded. The result being that the final berms being constructed or fortified immediately were in place prior to and during the peak flow encountered. The high water level exceeded the level of most of the existing flood protection dykes constructed under the **Canada – Alberta Flood Protection Program on the 1980's**.

Following the declaration of a State of Local Emergency, Mayor Ainscough received advice from the following with the general theme being that he had their support to do what is necessary to save as much of the town as possible.

Deputy Premier McClellan	Phone Call	June 18, 2005
	In person	June 19, 2005
	In Person	June 20, 2005
Prime Minister Martin	Phone Call	June 19, 2005
Minister of the Environment Boutlier – In Person		June 20, 2005
Minister of Municipal Affairs Rob Renner – In Person		June 21, 2005

Temporary Berms and Fortification

The identification of location and the prioritization of the order of construction of temporary berms or fortification of existing berms was based upon an expected flow of 1900 m3/s.

Appendix 3 identifies the location of existing berms and the fortification or temporary structures built in Drumheller and Appendix 4 identifies these structures for Rosedale.

Table 3 identifies the length and material volume required for these facilities

Table 3 Temporary Berms Constructed

#	Location	Top Width	Bottom Width	Height	Length	Volume
1	Rosedale - Railway Ave	3.50	6.00	2.50	1130.1264	13420.25
2	Rosedale - 1 Ave S on West side of Rosebud	3.50	6.00	2.50	205.4770	2440.039
3	Drumheller - Riverside Drive East	3.50	6.00	3.50	776.1439	12903.39
4	Drumheller - 1 Ave West & Behind Arena	3.50	5.00	2.00	482.1093	4097.929
5	Drumheller - Riverside Drive East	2.50	4.00	1.00	793.5318	2578.978
6	Drumheller - Riverside Drive East	3.50	6.00	2.50	1105.9900	13133.63
7	Drumheller - Newcastle West	3.50	6.00	3.00	774.1057	11031.01
8	Drumheller - Newcastle East	3.50	6.00	1.00	168.0791	798.3757
9	Drumheller - Midland - North River Drive	3.50	6.00	3.00	1693.5948	24133.73
					7129.1580	84537.33

A considerable amount of equipment was required to construct this temporary berm system in a timely manner and came from such sources as neighbouring municipalities including Special Areas, Wheatland County, Kneehill County and Starland County. In addition a large number of local contractors and outside contractors from all over Alberta from Edson to Brooks and Rocky Mountain House to Calgary were used to construct this berm.

Evacuation

Evacuation of some 3000 residents was order as mandatory on June 19th at 7:00 pm. The initial advisory to voluntarily evacuate was given at 0900 hrs on June 19th .The areas evacuated are shown on the following Appendix 2 and the detailed in Table 4.

Table 4 - Evacuated Parcels

DRUMHELLER		
1)	RIVERVIEW	231
2)	DRUMHELLER CENTRAL	228
3)	NORTH DRUMHELLER	187
4)	NEWCASTLE	163
5)	MIDLAND	170
NACMINE		70
ROSEDALE		113
CAMBRIA		44
LEHIGH		45
EAST COULEE		348
TOTAL=		1599

An evacuation registration centre was established at the Drumheller Stampede and Ag Barn. Greentree School in the Drumheller core was established as an alternate evacuation centre. The evacuation of the acute care centre of the Drumheller Hospital was deemed necessary by the David Thompson Regional Health Authority.

The identification of location and the prioritization of the order of evacuation was based upon an expected flow of 1900 m^3/s as identified by the flood inundation maps produced by the Town's Geographic Information System Operator. Other considerations included potential effect of sewer back up, and the available access to areas by Fire and EMS.

Return to Evacuation Areas

A staged removal of the evacuation order for the various communities affected was completed based upon a decision checklist which generally followed the resumption of services (i.e. Electricity, Natural Gas, Roads, Sanitary Sewer, Storm Sewer) for a given area. The evacuation order was rescinded entirely and access was allowed to all homes and business by 6:00 pm June 21, 2005 and was completed by 7:00 pm on the 22nd of June.

The Clean –Up

With residents and business returning to the evacuation zones, damage of varying levels of severity was discovered. In total it appears that approximately 85 homes were affected by either overland flooding, sewer backup and/or seepage. Additional damage to homes is also being assessed as a result of temporary berm construction.

While few businesses appear at this time to be physically impacted by the flooding business loss was experienced due to:

- business interruption since staff were evacuated
- business located in the evacuation zone (closure)
- businesses conducting flood response efforts (opportunity loss – current contracts interrupted).

Relief agencies such as the Red Cross and Samaritans Purse have implemented plans to assist with the physical clean up efforts. This work is ongoing and is being identified.

Public Health is assessing the impact of flooding on water wells in those areas of the community which are not served by the municipal potable water system.

Disaster Recovery Plan

The following are the next steps in the Flood clean up and follow up:

Big Picture

- Open Claims Centre for affected property owners.
- Tabulate Costs for municipality.
- Assess Condition of Infrastructure.
- Extend Thank you to all members.
- Upcoming Events
    - July 1 Celebrations.
    - Wayne Rally.
    - Passion Play.

Clean up

- Develop Strategy.
- Leave Fill in Place where possible – Design and construct higher berms.
- Provide assistance to flooded homes.
- MAP the location of homes – GIS – Start intense records and dB.

Cost

Preliminary estimates have identified that the following expenditures have been or will be required:

- Mobilization of berm construction and fortification and clean up - $2.0 million.
- Private property damage and clean up - $2.0 million.
- Road and underground infrastructure - $2.0 million.
- Improvements to existing dykes and construction of new - $4.0 million.
- Total cost to $10 million.

The Town of Drumheller requires an immediate cash infusion of at least $2.0 million to cover the direct costs incurred and requires that the remaining funds be allocated as special by the senior levels of government. This will ensure that the upgrades will take place outside of the normal budget cycle in a very timely manner.

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The following are the next steps in the Flood clean up and follow up:

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Appendix

Appendix 1 – Red Deer River Flow Data at Drumheller
Appendix 2 – Map of Drumheller (Overview)
Appendix 3 – Temporary Berms in Drumheller Map
Appendix 4 – Temporary Berms in Rosedale Map

DRUMHELLER
OFFICE OF THE MAYOR

Dinosaur Capital of the World

Speaking Notes
Presentation to Prime Minister Paul Martin
and Premier Ralph Klein
June 24, 2005
High River Alberta

Messages

- This flood was well beyond anything predicted.
- Topped the flood dykes made in the eighties under the Canada – Alberta flood program.
- Drumheller is a small community - 8000 people.
- Large geographically – Drumheller – 125 km^2
  - Edmonton has 80 km of River Bank to Defend
  - Calgary has 140 km
  - Red Deer has 15km
  - Drumheller has 162 km of Bank
  - Even taking into account the rural areas – there are 19 km of bank directly adjacent to urban areas
- Had to Build over 7.0 km of Dyke with over 85,000 cubic metres of earth – that's about 7,000 tandem dump trucks
- We did this in 54 hours.
- No loss of life and evacuated about 3000 people.

DRUMHELLER
OFFICE OF THE MAYOR

Dinosaur Capital of the World

- Clean up is underway. Need Federal (DFO) and Provincial (AENV) regulators and compliance officers to use maximum discretion.

- The cost is estimated in the millions.

  - Mobilization of berm construction and fortification and clean up - $2.0 million.
  - Private property damage and clean up - $2.0 million.
  - Road and underground infrastructure - $2.0 million.
  - Improvements to existing dykes and construction of new - $4.0 million.
  - Total cost to $10 million.

  - The Town of Drumheller requires an immediate cash infusion of at least $2.0 million to cover the direct costs incurred

  - Requires that the remaining funds be allocated as special by the senior levels of government.

  - This will ensure that the upgrades will take place outside of the normal budget cycle in a very timely manner.

We wish to thank the following for their phone calls and telling us to do what it takes to minimize the threat to Drumheller:

Deputy Premier McClellan	**Phone Call**	**June 18, 2005**
	In person	**June 19, 2005**
	In Person	**June 20, 2005**
	In Person	**June 21, 2005**
Prime Minister Martin	**Phone Call**	**June 19, 2005**

Minister of the Environment Boutlier – In Person June 20, 2005

Minister of Municipal Affairs Rob Renner – In Person June 21, 2005

APPENDIX - 1

#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
1	17/06/2005	08:50	324.460	2.548	679.268
2	17/06/2005	21:00	323.360	2.543	679.263
3	17/06/2005	21:30	320.280	2.529	679.249
4	17/06/2005	22:00	318.080	2.519	679.239
5	17/06/2005	22:30	314.560	2.503	679.223
6	17/06/2005	23:00	310.820	2.486	679.206
7	17/06/2005	23:30	307.080	2.469	679.189
8	17/06/2005	23:50	304.880	2.459	679.179
9	18/06/2005	00:05	305.100	2.460	679.180
10	18/06/2005	00:30	300.920	2.441	679.161
11	18/06/2005	01:00	297.840	2.427	679.147
12	18/06/2005	01:30	295.200	2.415	679.135
13	18/06/2005	02:00	293.000	2.405	679.125
14	18/06/2005	02:30	290.480	2.393	679.113
15	18/06/2005	02:55	288.800	2.385	679.105
16	18/06/2005	03:00	289.220	2.387	679.107
17	18/06/2005	03:30	289.220	2.387	679.107
18	18/06/2005	04:00	289.640	2.389	679.109
19	18/06/2005	04:30	290.480	2.393	679.113
20	18/06/2005	05:00	289.430	2.388	679.108
21	18/06/2005	05:30	296.300	2.420	679.140
22	18/06/2005	05:55	302.900	2.450	679.170
23	18/06/2005	06:00	308.400	2.475	679.195
24	18/06/2005	06:30	313.020	2.496	679.216
25	18/06/2005	07:00	315.880	2.509	679.229
26	18/06/2005	07:30	316.540	2.512	679.232
27	18/06/2005	07:35	316.540	2.512	679.232
28	18/06/2005	08:00	314.120	2.501	679.221
29	18/06/2005	08:30	312.580	2.494	679.214
30	18/06/2005	09:00	310.600	2.485	679.205
31	18/06/2005	09:30	308.620	2.476	679.196
32	18/06/2005	10:00	305.320	2.461	679.181
33	18/06/2005	10:30	303.120	2.451	679.171
34	18/06/2005	11:00	300.480	2.439	679.159
35	18/06/2005	11:30	298.720	2.431	679.151
36	18/06/2005	11:50	296.740	2.422	679.142
37	18/06/2005	12:00	296.960	2.423	679.143
38	18/06/2005	12:30	294.980	2.414	679.134
39	18/06/2005	13:00	293.000	2.405	679.125
40	18/06/2005	13:30	291.950	2.400	679.120
41	18/06/2005	14:00	289.010	2.386	679.106
42	18/06/2005	14:30	287.540	2.379	679.099
43	18/06/2005	14:55	286.700	2.375	679.095
44	18/06/2005	15:00	285.440	2.369	679.089
45	18/06/2005	15:30	285.230	2.368	679.088
46	18/06/2005	16:00	282.080	2.353	679.073
47	18/06/2005	16:30	279.770	2.342	679.062
48	18/06/2005	17:00	276.200	2.325	679.045
49	18/06/2005	17:30	272.630	2.308	679.028
50	18/06/2005	17:55	270.200	2.296	679.016
51	18/06/2005	18:00	268.400	2.287	679.007

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#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
52	18/06/2005	18:30	265.400	2.272	678.992
53	18/06/2005	19:00	264.800	2.269	678.989
54	18/06/2005	19:30	267.400	2.282	679.002
55	18/06/2005	20:30	295.860	2.342	679.062
56	18/06/2005	21:00	295.050	2.338	679.058
57	18/06/2005	21:30	292.290	2.325	679.045
58	18/06/2005	22:00	287.950	2.304	679.024
59	18/06/2005	22:30	284.860	2.289	679.009
60	18/06/2005	23:00	281.150	2.271	678.991
61	18/06/2005	23:30	278.490	2.258	678.978
62	18/06/2005	23:55	276.860	2.250	678.970
63	19/06/2005	00:05	275.210	2.242	678.962
64	19/06/2005	00:30	273.370	2.233	678.953
65	19/06/2005	01:00	270.770	2.221	678.941
66	19/06/2005	01:30	268.640	2.210	678.930
67	19/06/2005	02:00	268.500	2.209	678.929
68	19/06/2005	02:30	266.960	2.201	678.921
69	19/06/2005	02:45	266.400	2.198	678.918
70	19/06/2005	03:00	266.630	2.199	678.919
71	19/06/2005	03:25	264.680	2.189	678.909
72	19/06/2005	03:30	266.690	2.199	678.919
73	19/06/2005	04:00	267.750	2.204	678.924
74	19/06/2005	04:30	267.620	2.203	678.923
75	19/06/2005	05:00	269.480	2.212	678.932
76	19/06/2005	05:30	270.350	2.217	678.937
77	19/06/2005	05:55	272.000	2.225	678.945
78	19/06/2005	06:00	272.430	2.227	678.947
79	19/06/2005	06:30	273.550	2.232	678.952
80	19/06/2005	07:00	274.670	2.237	678.957
81	19/06/2005	07:30	274.730	2.237	678.957
82	19/06/2005	08:00	275.640	2.241	678.961
83	19/06/2005	08:30	275.500	2.240	678.960
84	19/06/2005	08:55	277.440	2.249	678.969
85	19/06/2005	09:00	276.820	2.246	678.966
86	19/06/2005	09:30	277.730	2.250	678.970
87	19/06/2005	10:00	279.270	2.257	678.977
88	19/06/2005	10:30	279.120	2.257	678.977
89	19/06/2005	11:00	281.920	2.270	678.990
90	19/06/2005	11:30	284.090	2.280	679.000
91	19/06/2005	11:55	287.080	2.294	679.014
92	19/06/2005	12:00	289.200	2.304	679.024
93	19/06/2005	12:30	293.040	2.322	679.042
94	19/06/2005	13:00	298.180	2.345	679.065
95	19/06/2005	13:30	307.050	2.385	679.105
96	19/06/2005	14:00	311.960	2.407	679.127
97	19/06/2005	14:30	322.150	2.453	679.173
98	19/06/2005	14:55	329.460	2.487	679.207
99	19/06/2005	15:00	330.580	2.492	679.212
100	19/06/2005	15:30	340.940	2.538	679.258
101	19/06/2005	16:00	352.280	2.587	679.307
102	19/06/2005	16:30	363.540	2.635	679.355

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#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
103	19/06/2005	17:00	377.540	2.693	679.413
104	19/06/2005	17:30	392.260	2.754	679.474
105	19/06/2005	17:55	401.920	2.794	679.514
106	19/06/2005	18:00	409.130	2.824	679.544
107	19/06/2005	18:30	425.530	2.892	679.612
108	19/06/2005	19:00	441.840	2.958	679.678
109	19/06/2005	19:30	460.420	3.033	679.753
110	19/06/2005	20:00	478.750	3.106	679.826
111	19/06/2005	20:30	497.830	3.182	679.902
112	19/06/2005	20:55	508.450	3.224	679.944
113	19/06/2005	21:00	516.260	3.254	679.974
114	19/06/2005	21:30	531.430	3.312	680.032
115	19/06/2005	22:00	548.930	3.379	680.099
116	19/06/2005	22:30	565.910	3.443	680.163
117	19/06/2005	23:00	583.550	3.508	680.228
118	19/06/2005	23:30	596.320	3.555	680.275
119	19/06/2005	23:55	608.810	3.601	680.321
120	20/06/2005	00:05	611.000	3.610	680.330
121	20/06/2005	00:30	628.890	3.676	680.396
122	20/06/2005	01:00	642.290	3.725	680.445
123	20/06/2005	01:30	659.180	3.785	680.505
124	20/06/2005	02:00	672.430	3.832	680.552
125	20/06/2005	02:30	690.160	3.895	680.615
126	20/06/2005	02:55	701.630	3.935	680.655
127	20/06/2005	03:00	706.290	3.951	680.671
128	20/06/2005	03:30	724.650	4.014	680.734
129	20/06/2005	04:00	745.430	4.083	680.803
130	20/06/2005	04:30	760.830	4.134	680.854
131	20/06/2005	05:00	769.020	4.162	680.882
132	20/06/2005	05:30	788.620	4.227	680.947
133	20/06/2005	05:55	798.300	4.259	680.979
134	20/06/2005	06:00	801.920	4.271	680.991
135	20/06/2005	06:30	813.710	4.310	681.030
136	20/06/2005	07:00	838.410	4.392	681.112
137	20/06/2005	07:30	857.100	4.454	681.174
138	20/06/2005	08:00	879.100	4.527	681.247
139	20/06/2005	08:30	895.390	4.581	681.301
140	20/06/2005	08:55	905.700	4.616	681.336
141	20/06/2005	09:00	913.530	4.641	681.361
142	20/06/2005	09:30	930.820	4.697	681.417
143	20/06/2005	10:00	970.290	4.823	681.543
144	20/06/2005	10:30	996.960	4.908	681.628
145	20/06/2005	11:00	1019.090	4.974	681.694
146	20/06/2005	11:30	1040.460	5.037	681.757
147	20/06/2005	11:50	1049.000	5.062	681.782
148	20/06/2005	12:00	1063.440	5.105	681.825
149	20/06/2005	12:05	1063.440	5.105	681.825
150	20/06/2005	12:30	1087.740	5.177	681.897
151	20/06/2005	13:00	1113.050	5.252	681.972
152	20/06/2005	13:30	1134.650	5.316	682.036
153	20/06/2005	14:00	1155.910	5.379	682.099

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#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
154	20/06/2005	14:30	1178.180	5.445	682.165
155	20/06/2005	14:50	1193.030	5.489	682.209
156	20/06/2005	15:00	1197.410	5.502	682.222
157	20/06/2005	15:05	1197.410	5.502	682.222
158	20/06/2005	15:30	1225.420	5.585	682.305
159	20/06/2005	16:00	1240.610	5.630	682.350
160	20/06/2005	16:30	1263.220	5.697	682.417
161	20/06/2005	17:00	1281.780	5.752	682.472
162	20/06/2005	17:30	1293.250	5.786	682.506
163	20/06/2005	17:50	1306.950	5.810	682.530
164	20/06/2005	18:00	1307.320	5.826	682.546
165	20/06/2005	18:30	1323.050	5.869	682.589
166	20/06/2005	19:00	1339.150	5.913	682.633
167	20/06/2005	19:30	1349.760	5.942	682.662
168	20/06/2005	20:00	1356.710	5.961	682.681
169	20/06/2005	20:30	1363.660	5.994	682.714
170	20/06/2005	20:50	1371.710	6.002	682.722
171	20/06/2005	21:00	1373.170	6.006	682.726
172	20/06/2005	21:30	1376.830	6.016	682.736
173	20/06/2005	22:00	1386.710	6.043	682.763
174	20/06/2005	22:30	1388.170	6.030	682.750
175	20/06/2005	23:00	1388.170	6.047	682.767
176	20/06/2005	23:30	1388.900	6.049	682.769
178	21/06/2005	00:30	1391.830	6.057	682.777
179	21/06/2005	00:50	1396.220	6.069	682.789
181	21/06/2005	01:30	1392.930	6.060	682.780
182	21/06/2005	02:00	1391.460	6.056	682.776
183	21/06/2005	02:25	1383.410	6.034	682.754
184	21/06/2005	02:30	1389.630	6.051	682.771
185	21/06/2005	03:00	1383.410	6.034	682.754
186	21/06/2005	03:30	1383.780	6.035	682.755
187	21/06/2005	04:00	1380.120	6.025	682.745
188	21/06/2005	04:30	1377.930	6.019	682.739
189	21/06/2005	05:00	1373.900	6.008	682.728
190	21/06/2005	05:30	1370.240	5.986	682.706
191	21/06/2005	05:55	1366.220	5.987	682.707
192	21/06/2005	06:00	1369.510	5.996	682.716
193	21/06/2005	06:30	1357.070	5.962	682.682
194	21/06/2005	07:00	1354.150	5.950	682.670
195	21/06/2005	07:30	1343.900	5.926	682.646
196	21/06/2005	08:00	1339.150	5.913	682.633
197	21/06/2005	08:30	1334.760	5.901	682.621
198	21/06/2005	08:55	1325.980	5.877	682.597
199	21/06/2005	09:00	1324.510	5.873	682.593
200	21/06/2005	09:30	1314.630	5.846	682.566
201	21/06/2005	10:00	1304.390	5.818	682.538
202	21/06/2005	10:30	1298.310	5.801	682.521
203	21/06/2005	11:00	1286.160	5.765	682.485
204	21/06/2005	11:30	1273.340	5.727	682.447
205	21/06/2005	11:55	1269.970	5.717	682.437
206	21/06/2005	12:00	1269.290	5.715	682.435

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#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
207	21/06/2005	12:30	1260.850	5.690	682.410
208	21/06/2005	13:00	1251.070	5.661	682.381
209	21/06/2005	13:30	1239.600	5.627	682.347
210	21/06/2005	14:00	1230.820	5.601	682.321
211	21/06/2005	14:30	1219.690	5.568	682.288
212	21/06/2005	14:55	1208.210	5.534	682.254
213	21/06/2005	15:00	1210.240	5.540	682.260
214	21/06/2005	15:30	1200.790	5.512	682.232
215	21/06/2005	16:00	1189.650	5.479	682.199
216	21/06/2005	16:30	1177.170	5.442	682.162
217	21/06/2005	17:00	1166.030	5.409	682.129
218	21/06/2005	17:30	1158.270	5.386	682.106
219	21/06/2005	18:00	1149.160	5.359	682.079
220	21/06/2005	18:30	1138.700	5.328	682.048
221	21/06/2005	19:00	1126.880	5.293	682.013
222	21/06/2005	19:30	1119.800	5.272	681.992
223	21/06/2005	20:00	1107.310	5.235	681.955
224	21/06/2005	20:30	1097.860	5.207	681.927
225	21/06/2005	21:00	1085.710	5.171	681.891
226	21/06/2005	21:30	1075.590	5.141	681.861
227	21/06/2005	22:00	1063.440	5.105	681.825
228	21/06/2005	22:30	1053.660	5.076	681.796
229	21/06/2005	23:00	1042.860	5.044	681.764
230	21/06/2005	23:30	1031.720	5.011	681.731
231	21/06/2005	00:00	1017.890	4.970	681.690
232	22/06/2005	00:30	1009.790	4.946	681.666
233	22/06/2005	01:00	1000.670	4.919	681.639
234	22/06/2005	01:30	989.690	4.884	681.604
235	22/06/2005	02:00	981.880	4.859	681.579
236	22/06/2005	02:30	970.310	4.822	681.542
237	22/06/2005	03:00	964.060	4.802	681.522
238	22/06/2005	03:30	952.810	4.766	681.486
239	22/06/2005	04:00	945.000	4.741	681.461
240	22/06/2005	04:30	934.060	4.706	681.426
241	22/06/2005	05:00	926.250	4.681	681.401
242	22/06/2005	05:30	919.690	4.660	681.380
243	22/06/2005	06:00	914.380	4.643	681.363
244	22/06/2005	06:30	904.100	4.609	681.329
245	22/06/2005	07:00	899.600	4.594	681.314
246	22/06/2005	07:30	893.900	4.575	681.295
247	22/06/2005	08:00	885.200	4.546	681.266
248	22/06/2005	08:30	881.000	4.532	681.252
249	22/06/2005	09:00	873.800	4.508	681.228
250	22/06/2005	09:30	869.000	4.492	681.212
251	22/06/2005	10:00	863.600	4.474	681.194
252	22/06/2005	10:30	856.400	4.450	681.170
253	22/06/2005	11:00	853.400	4.440	681.160
254	22/06/2005	11:30	848.000	4.422	681.142
255	22/06/2005	12:00	843.800	4.408	681.128
256	22/06/2005	12:30	836.000	4.382	681.102
257	22/06/2005	13:00	831.500	4.367	681.087

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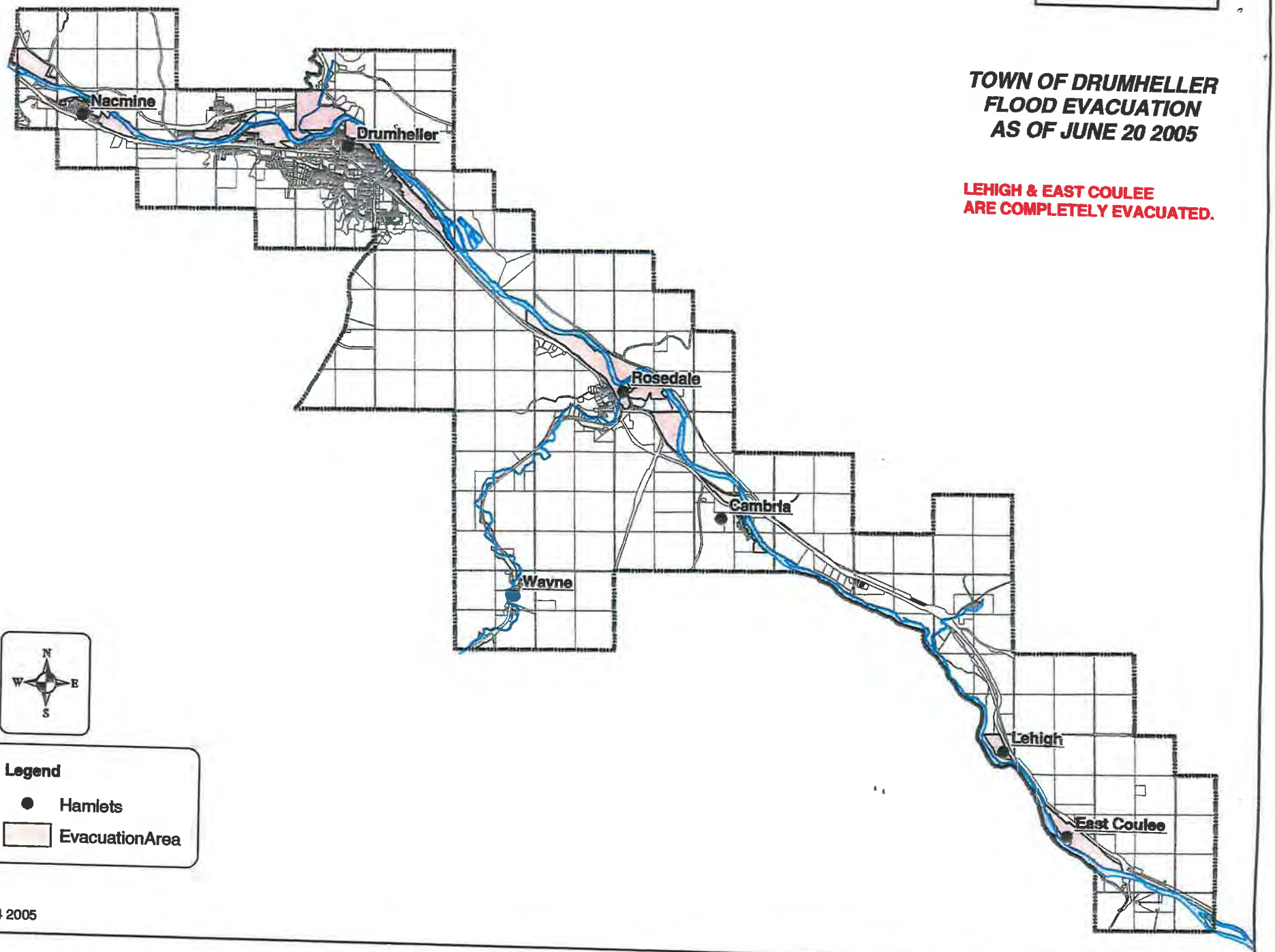
#	DATE	TIME	RIVER FLOW	DEPTH (m)	WATER LEVEL (m)
258	22/06/2005	13:30	829.100	4.359	681.079
259	22/06/2005	14:00	824.000	4.342	681.062
260	22/06/2005	14:30	819.500	4.327	681.047
261	22/06/2005	15:00	813.500	4.307	681.027
262	22/06/2005	15:30	813.200	4.306	681.026
263	22/06/2005	16:00	806.900	4.285	681.005
264	22/06/2005	16:30	800.600	4.264	680.984
265	22/06/2005	17:00	800.000	4.262	680.982
266	22/06/2005	17:30	795.500	4.247	680.967
267	22/06/2005	18:00	794.000	4.242	680.962
268	22/06/2005	18:30	788.300	4.223	680.943
269	22/06/2005	19:00	784.400	4.210	680.930
270	22/06/2005	19:30	782.900	4.205	680.925
271	22/06/2005	20:00	776.600	4.184	680.904
272	22/06/2005	20:30	776.600	4.184	680.904
273	22/06/2005	21:00	772.700	4.171	680.891
274	22/06/2005	21:30	770.300	4.163	680.883
275	22/06/2005	22:00	769.700	4.161	680.881
276	22/06/2005	22:30	767.300	4.153	680.873
277	22/06/2005	23:00	764.900	4.145	680.865
278	22/06/2005	23:30	758.900	4.125	680.845
279	22/06/2005	00:00	759.500	4.127	680.847
280	23/06/2005	00:30	757.100	4.119	680.839
281	23/06/2005	01:00	754.700	4.111	680.831
282	23/06/2005	01:30	749.000	4.092	680.812
283	23/06/2005	02:00	749.600	4.094	680.814
284	23/06/2005	02:30	747.200	4.086	680.806
285	23/06/2005	03:00	742.100	4.069	680.789
286	23/06/2005	03:30	742.700	4.071	680.791
287	23/06/2005	04:00	739.100	4.059	680.779
288	23/06/2005	04:30	735.800	4.048	680.768
289	23/06/2005	05:00	737.600	4.054	680.774
290	23/06/2005	05:30	733.700	4.041	680.761
291	23/06/2005	06:00	727.700	4.021	680.741
292	23/06/2005	06:30	726.200	4.016	680.736
293	23/06/2005	07:00	725.300	4.013	680.733
294	23/06/2005	07:30	722.680	4.004	680.724
295	23/06/2005	08:00	721.810	4.001	680.721
296	23/06/2005	08:30	717.170	3.985	680.705
297	23/06/2005	09:00	718.040	3.988	680.708
298	23/06/2005	09:30	713.110	3.971	680.691
299	23/06/2005	10:00	712.240	3.968	680.688
300	23/06/2005	10:30	712.530	3.969	680.689
301	23/06/2005	11:00	708.180	3.954	680.674
302	23/06/2005	11:30	706.150	3.947	680.667
303	23/06/2005	12:00	702.380	3.934	680.654
304	23/06/2005	12:30	701.220	3.930	680.650
305	23/06/2005	13:00	698.900	3.922	680.642
306	23/06/2005	13:30	696.580	3.914	680.634

APPENDIX - 2



TOWN OF DRUMHELLER
FLOOD EVACUATION
AS OF JUNE 20 2005

LEHIGH & EAST COULEE
ARE COMPLETELY EVACUATED.

JUNE 24 2005

TOWN OF DRUMHELLER

LAND USE BYLAW 10-08

Prepared by:

Town of Drumheller and

Palliser Regional Municipal Services

"Easement" means a right to use land generally for access to other property or as a right-of-way for a public utility;

Amended: Bylaw # 06-09 March 16, 2009

"Education Facility - unconventional" means a use that does not comply with the definitions of a 'School – Public' or 'School – Private':

(a) where education curriculum is taught and may include Kindergarten to Grade 12 pursuant to the School Act, post secondary education and/ or skills training:
(b) that may or may not have conventional hours of operation similar to a school;
(c) that may include any buildings and related playing fields and park spaces;
(d) that may provide food service to the students and staff; and
(e) that may provide programs for parental and community involvement.

"Escarpment Land" means the land which forms the outer walls of a valley where a large drop in elevation exists;

"Existing" means existing at the effective date of this Bylaw;

"Extensive Agriculture" means systems of tillage and grazing on large areas of land by the raising of crops or the rearing of livestock either separately or in conjunction with one another and includes buildings and other structures incidental to the operation;

"Fabric Covered Building" means a steel-framed, fabric-membrane pre-engineered building for temporary & permanent industrial, commercial & agricultural applications including warehouses, equipment storage, manufacturing facilities, barns, stables, arenas & event centers. All fabric covered buildings shall require the appropriate building permits to ensure all aspects of the development is in accordance with the Alberta Safety Codes including appropriate foundation construction and building anchoring;

"Farm Residence" means a dwelling or manufactured home occupied by a person engaged in an agricultural pursuit for at least six (6) months of a year;

"Fence" means a physical barrier constructed out of typical building material for the purpose of providing privacy or preventing unauthorized access or both;

"Flankage" means the side lot line of a corner lot that abuts the street;

"Flood Fringe" means that portion of the flood risk area where the water is shallower and moves more slowly. Development in the flood fringe may be permitted provided that it is adequately flood proofed;

"Flood Risk Area" means land calculated or determined by the Province as the area which would be inundated by the design flood. In Alberta, the design flood is a 1 in 100 year flood, or one which has a one percent chance of being equaled or exceeded in any year;

"Floodway" means the portion of the flood risk area with the greatest risk of flooding. Floodway waters are the deepest, fastest, and most destructive and new development in these areas is discouraged;

"Frontage" means the side of a lot abutting the street, however, in the case of a corner lot the shorter side shall be the frontage;

61. Land within the 1:100 Year Flood Risk Area

(a) Development shall be discouraged on land within the flood risk area as determined by Alberta Environmental Protection;

(b) Development activities in the flood risk area shall be carefully controlled. Low intensive uses such as open space, recreation and agricultural activities shall be preferred.

(c) Subdivision and development of permanent structures shall not be permitted within the flood way;

(d) Notwithstanding the above and at the discretion of the Development Authority, development defined as infill development may be allowed on land within the flood risk area. In all cases, as a condition of development approval, the Developer shall hold the Municipality harmless from any damage to or loss of the development caused by flooding by way of an agreement registered as a caveat or restrictive covenant against the titles of the property being developed; and

(e) At the discretion of the Development Authority and where development does not constitute an infill situation as defined in this bylaw, development may be allowed on land within the flood fringe area if sufficient landfill can be provided to raise the building or development site above the elevation of the 1:100 year flood probability contour or other suitable flood proofing techniques can be employed. The Town may require professional certification to ensure this requirement.

62. Undermining or Subsidence Conditions

Where development is proposed for land which has potential undermining or subsidence conditions, no development permit shall be granted unless the Development Authority is satisfied that hazards and other problems will not adversely affect the development as proposed. Valid engineering tests may be required.

63. Bed and Breakfast Establishments

(a) Bed and Breakfast establishments shall conform to the following or such standards as the Provincial Building Code may have, whichever is greater:

- no cooking facilities in guest rooms;
- minimum room size of 7 m^2 (75 sq. ft.) per single occupant and 4.6 m^2 (50 sq. ft.) per person for multiple occupants;
- window compulsory for guest room;
- sanitation and potable water as required by Health Unit;

Council Briefing – Mitigation Strategy – Strong Protective Measures

September 22, 2014

Stantec

1. Channel Conveyance Preservation

- Floodway
- New residential will not be considered
- Land used for environmental reserves, recreation and agriculture
- Existing houses will be considered for buy-outs or other flood mitigation measures

Stantec

2. Critical Infrastructure

- Protected to 2000 cms plus freeboard
- Includes:
  - —Water and Wastewater Treatment Plants
  - —Sanitary Sewer Lift Stations
  - —Fire
  - —Police
  - —Government Buildings
  - —Hospital
  - —Bridges

Stantec

3. Existing Development Area

- Exemption Zone to be protected to 1640 cms plus 0.75 meter freeboard
- Existing buildings to be grandfathered
- Minor upgrading (less than 10% increase in building footprint) will not be subjected to complete house modifications for STANDATA (Safety Code) flood protection

Stantec

4. Redevelopment / Subdivision in the Existing Development Area

- New developments will be required to meet STANDATA (Safety Code)
- Development to be protected to 1640 cms plus 0.75 meter freeboard
- Main floor and critical building services to be above flood elevations
- Basements to be used for storage only
- No opening below flood elevations

Stantec

5. Future Development Areas

- New development on undeveloped lands / zones
- Homes to be protected to natural flow of 1840 cms plus 0.75 meters of freeboard

Stantec

Date	From	To	Indigenous Group Contact Details	Medium (e.g.., email, letter, phone call)[2]	Communication Description	Nature of Concern(s)	Follow-up required? (yes/no)
20/07/2018	Town of Drumheller Darryl Drohomerski	Siksika Nation	Stacy Doore Director Emergency Management stacyd@siksikanation.com	Phone Call	Discussed merits of Town of Drumheller submission. CAO Drohomerski requested if Stacy Doore would participate in the proposed Flood Mitigation Advisory committee. Stacy agreed to idea and also recommended a follow up call to discuss importance of traditional lands in the area	Is there traditional land use in Drumheller that could impact proposed flood mitigation dyking?	Yes
23/07/2018	Town of Drumheller	Glenda Spotted Eagle	Siksika Nation Consultation Office 403-734-4350	Phone Call	Left message to discuss a meeting to review traditional lands in Drumheller Valley that may impact Drumheller Mitigation and Resiliency System	No	Yes
24/07/2018	Town of Drumheller CAO Darryl Drohomerski	Siksika Nation	Stacy Doore Director Emergency Management stacyd@siksikan	Phone call	Follow up call to confirm if Glenda Spotted Eagle consultation manager is appropriate contact to discuss traditional lands in Drumheller. Stacy confirmed she is correct contact and will be contacting us tomorrow	Is there traditional land use in Drumheller that could impact proposed flood mitigation dyking?	Yes

			ation.com				
26/07/2018	Town of Drumheller	Siksika Nation	Stacy Doore Director Emergency Management stacyd@siksikanation.com	Phone Call	Follow up call to confirm when Glenda may be available to meet. Stacy informed that staff are at AFN in Vancouver but should be available week of July 30	Is there traditional land use in Drumheller that could impact proposed flood mitigation dyking?	Yes
27/07/2018	Town of Drumheller	Siksika Nation	Stacy Doore Director Emergency Management (DEM)	email	Email sent to Stacy Doore, (DEM) inviting him to participate on Town of Drumheller advisory committee		Yes

DRUMHELLER
CHIEF ADMINISTRATIVE OFFICER

Dinosaur Capital of the World

July 26, 2018

Stacy Doore
Director Emergency Management
Box 1437
Siksika Nation, AB
T0J 3W0

Dear Stacy:

It was a pleasure meeting you at the Provincial Flood Orientation session in High River. It was a great opportunity to meet fellow Directors' of Emergency Management and I found the conversations extremely beneficial. I'm writing this letter to invite you to participate on an Advisory Committee the Town of Drumheller is implementing.

As you are aware, we have experienced significant flooding in both 2005 and 2013 that resulted in declaring States of Local Emergency. And, our recent ice jam flood this Spring, also resulted in the declaration of a State of Local Emergency.

We are developing a mitigation and resiliency strategy to formulate a permanent plan to reduce the flood damage potential. We hope to receive funding for the construction and improvement of dykes that will provide greater protection to our community and improve public safety.

We are inviting key stakeholders to participate on an advisory committee that can provide input to our strategy. As per our conversations at the flood orientation session in High River, collaboration and regional response with neighbouring communities is an area we wish to pursue. We hope you will consider this offer as your awareness of our traditional lands, plus your proactive emergency planning will assist us as we develop our mitigation and resiliency strategy.

I look forward to working with you.

Yours truly,

Darryl E. Drohomerski, C.E.T.
Chief Administrative Officer

Town of Drumheller
224 Centre Street
Drumheller, AB T0J 0Y4

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Telephone: (403) 823-1339
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E-mail: rmroman@dinosaurvalley.com

TOWN OF DRUMHELLER
MITIGATION AND RESILIENCY STRATEGY ENGAGEMENT PLAN

PROJECT OVERVIEW

The Town of Drumheller consists of several unique communities along the Red Deer River and they have experienced significant flooding in both 2005 and 2013 that resulted in declaring States of Local Emergency. An ice jam flood in Spring of 2018 also resulted in the declaration of a State of Local Emergency.

This community is home to the Tyrell Museum, Canada's only Museum dedicated exclusively to the science of paleontology. Every time this area is faced with potential flooding this archeological landscape is at risk.

The objective of the Drumheller Mitigation and Resiliency Strategy is to formulate a permanent plan to reduce existing flood damage potential. Funding for the construction and improvement of dykes will provide greater protection to this community and improve public safety. This proactive investment will reduce recovery costs and minimize the requirements for Federal Disaster Financial Assistance and the Provincial Disaster Recovery Program.

GOALS/OBJECTIVES

- Educate stakeholder on options presented for the Drumheller Flood Mitigation and Resiliency Strategy
- Understand stakeholders views (benefits and concerns) for each option presented
- Create a shared ownership on vision and mandate of the DFMRS between Town of Drumheller and its citizens
- Respond to the barriers and concerns raised by the citizens
- To become a more resilient community with respect to emergency preparedness

WHAT IS NOT NEGOTIABLE?

The specific locations and heights of the dykes to be constructed

RISKS

TIME – there is a condensed timeline to engage stakeholders prior to DMAF application due in December 2018 so some activities may be shortened

STAKEHOLDER PARTICIPATION - Not identifying all impacted stakeholders and therefore excluding some from participating

MITIGATION – There may be limited mitigation options other than those presented by the consultant due to budget constraints or conditions of the grant process

STAKEHOLDERS

STAKEHOLDER	DIRECT/INDIRECT IMPACT	WHAT ARE THEY BEING ENGAGED ABOUT?	LEVEL OF ENGAGEMENT
EXTERNAL			
Residents living in impacted areas	Direct	Preliminary Design options. What alternative options are available?	Collaborate
Businesses located in impacted areas	Direct	Preliminary Design options. What alternative options are available?	Collaborate
Town of Drumheller residents at large	Indirect	Preliminary Design options Is community supportive of the process	Consult and Inform
Siksika Nation	Indirect	Preliminary Design options. What considerations need to be given to traditional lands	Collaborate
Government of Alberta - Department	Direct	Preliminary Design options. Do the options adhere to GoA Flood Mitigation strategies	Collaborate
Government of Alberta – MLA's/Ministers	Indirect	Preliminary Design – are they supportive of project	Consult and Inform
Government of Canada – MP's/Cabinet	Indirect	Preliminary Design – are they supportive of project	Consult and Inform
Fisheries and Wildlife		Preliminary Design options	
INTERNAL		Preliminary Design options	
Public Works Staff	Direct	From operations perspective do the options fit into strategic direction of department	Collaborate
Finance	Direct	From operations perspective is there a revenue model that should be explored	Collaborate
Town of Drumheller Staff	Indirect	Are staff supportive of the process	Inform
Mayor and elected officials	Direct	Preliminary Design options	Collaborate

ENGAGEMENT TACTICS/TIMELINES

PHASE	ENGAGEMENT OBJECTIVE	TIMELINE	AUDIENCE	TACTIC
Normal Operations	Community awareness on Dickson Dam operations	2015 May 2018	Town of Drumheller residents	Open houses/website updates
Conceptual Design	Better understanding of past flood events and impacts on residents	September 2015	Flooded landowners	Individual Face to Face meetings
Preliminary Design	Educate Provincial cabinet and Federal cabinet on DMAF Application details	August – October 2018	Provincial cabinet targeted: Premier Infrastructure Environment Transportation Municipal Affairs Federal cabinet targeted: Prime Minister Natural Resources (Alberta Minister) Public Safety Innovation Science Economic Development	
Preliminary Design	Receive feedback on community flood preparedness awareness	September – October 2018	Residents/business owners	On-line/phone survey
Preliminary Design	Opportunity for stakeholders to provide input on options	October 2018 - February 2019	All	Open Houses
Preliminary Design	Opportunity for stakeholders to provide input on options	October 2018 - February 2019	All	On-line survey

Preliminary Design	Establishment of Advisory Council to provide consultation on design elements of project	October 2018 – February 2019	Mayor CAO Public at large Community Associations Siksika Nation Red Deer River Watershed Drumheller Fish and Wildlife Alberta Environment Parks Operations AEP Programs and grants AEP Regulatory and approvals Stantec Scott Land and Lease	Committee Meetings
Preliminary Design	Provide community updated information on proposed project details	January 2019	All	Dedicated website page
Preliminary Design	Confirm regional emergency response roles and responsibilities	January-March 2019	Starland County Kneehill County Siksika Nation	Committee Meetings Workshops Table top exercise
Preliminary Design	Educate community on town flood response plan	April 2019	Town of Drumheller residents	Open houses Newsletter Dedicated Website page Social media presence
Preliminary Design	Inform staff on town flood response plan	April 2019	Town of Drumheller staff	Lunch and learn