A Preliminary Economic Review of Proposed Calgary Elbow River Flood Mitigation Projects Outlined in the IBI Group Reports

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Executive Summary

Power Consulting Incorporated was asked to review the information that supported the Benefit/Cost studies commissioned by the Government of Alberta and carried out by the IBI Group of alternative flood mitigation measures intended to reduce flood damage associated with high water flows in the Elbow River through Calgary, Alberta.

The review requested was to be a “desk review” of those benefit/cost studies and the supporting documentation to determine what additional information was required and what questions still needed to be answered in order to have reliable economic analysis to evaluate these alternative structural flood mitigation proposals. We were also asked to identify any flaws, inconsistencies, or ambiguities contained in the IBI Reports. For the purpose of this report the McLean Creek proposal will be identified as MC1 and the Springbank proposal will be defined as SR1.

Power Consulting Incorporated came to the following conclusions that are supported by the analysis that is contained in the following report:

1. Basic information on the costs and benefits associated with alternative flood mitigation method to protect Calgary from future floods is still in flux. Information released in 2014 and 2015 provided conflicting information on the size of both the benefits and costs. That suggests that the information available on the alternative flood mitigation measures costing hundreds of millions of dollars is not yet reliable enough to support rational decision-making. The estimated benefits in the form of reduced flood damage in the Calgary area have produced dramatically different results and major costs in the $40 to $100 million range are still being introduced. Even the land foot-print of some of the proposed projects has been change by a factor of two to four.

2. An integrated analysis of all of the flood mitigation proposals that have been made has yet to be carried out. How the various proposals interact with each other to enhance, detract, or duplicate benefits and costs is not known. Non-structural alternatives such as regulating, prohibiting, or removing development from floodways in order to reduce future damage have not been coordinated with the estimates of benefits and costs associated with the structural upstream dams and reservoirs that have been proposed.

3. The benefits of the proposed structural upstream dams and reservoirs are measured by the expected reduction in flood damage downstream, especially in the City of Calgary. There is considerable confusion and uncertainty as to exactly what the size of these projected benefits will be. The initial estimates of those flood mitigation benefits resulted in values that were much higher than other flood analyses in North America supported. That led to “alternative” estimates of those benefits that were significantly and, in some cases, dramatically lower than the initial analysis of the Calgary floods suggested. The handling and labeling of these conflicting benefit

estimates does not lend confidence to decision-making based on these estimated benefits at this time.

4. The estimated costs associated with the MC1 flood mitigation project were increased by $45 million to cover the cost of "replicating" the existing complex of facilities at the Elbow Ranger Station. This cost was included even though the analysts did not know to what extent, if any, these facilities were still being actively used. The value of infrastructure is not determined by its replacement costs but by the value of the services it is expected to provide into the future. If that is low, the cost of losing access to it is low too. One does not "replicate" a high cost facility that is surplus or outmoded.

5. One of the major costs that distinguishes the proposed MC1 and SR1 upstream dams and reservoirs, is the cost of purchasing privately held land at the SR1 site as opposed to using Crown land at the MC1 site. The land acquisition costs associated with the SR1 site was based on a land footprint of 1,760 acres. The current estimate of the acres of land the SR1 project would affect is 6,884 acres, almost four times higher. Just the land within the project perimeter is now estimated at 3,900 acres, over twice as high as the original estimate of land that would have to be purchased. Because the SR1 project is located in an area adjacent to ongoing Calgary urban sprawl, the cost of purchasing this land could be quite high. For the previous 1,760 acre footprint the cost was estimated to be as high as $40 million. At the higher level of affected private land, the cost may be several times that. The economic viability of the SR1 proposed flood mitigation project cannot be evaluated until this major cost question is settled.

A Preliminary Economic Review of Proposed Elbow River Calgary Flood Mitigation Projects

1. Changes in the Estimated Costs and Benefits of the MC1 and SR1 Flood Mitigation Proposals: June 2014 to February 2015

The costs and benefits associated with the MC1 and SR1 flood mitigation proposals appear to be in significant flux. There are substantial differences between estimates that were just eight months apart, June 2014 and February 2015.[1]

Since both proposed flood control projects were designed to provide the same level of protection for the City of Calgary, both analyses estimated the same level of benefits in the form of avoided damage to structures, infrastructure, and economic activity in Calgary. The calculated present value of the benefits (avoided flood damage) in the 2014 and 2015 studies, however, were dramatically different. In the June 2014 study, the present value of the benefits of both proposed projects was $174 million for the 1:100 year flood. In the February 2015 analysis, the estimated present value of the benefits of both proposals was $ 337 to $477 million for the 1:100 year flood, two to three times higher.[2]

This change in the estimated benefits of these two flood control projects, of course, has a significant impact on the calculated net benefits and the benefit-cost ratio. However, because the benefits were calculated to be identical for both projects, it was only the *costs* associated with each of these projects that varied and impacted the *relative* net benefits of the two projects.

The costs associated with the two alternative projects also varies between the 2014 and 2015 estimates, but not by as great a margin. The present value of costs associated with the SR1 proposal increased by about a third between 2014 and 2015, from about $194 million to $255 million. For the MC1 proposal the present value of costs rose about 14 percent from $291 to $333 million. Interestingly, the “project construction costs” did not appear to change from the 2014 to the 2015 study. What changed were other capital costs that apparently had not been included in the earlier estimates. For instance, for the MC1 proposal, $45 million in “infrastructure relocation” costs, primarily

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[1] “Flow Mitigation Measures for Bow River, Elbow River and Oldman River Basins,” AMEC Environment & Infrastructure, prepared for the Southern Alberta Flood Recovery Task Force, CW2174, June 2014. Volume 1, Summary, and Appendices G and F. “Benefit/Cost Analysis of Flood Mitigation Projects for the City of Calgary,” IBI Group for the Government of Alberta, RSRD-Resilience and Mitigation, February 18, 2015.

[2] “Provincial Flood Damage Assessment Study City of Calgary: Assessment of Flood Damages, IBI Group, prepared for Government of Alberta, ESRD-Resilience and Mitigation, February 2015. The February 2015 studies calculated two different levels of estimated benefits. These two alternatives were labeled differently throughout the report. The executive summary presented them as apparently the best estimate and then an “alternative” estimate that was lower. At other times, the two estimates were presented as “high” and “low” estimates or as “worst case” and “anticipated case” scenarios. We discuss these different estimates later in this report.

for “replicating” the Elbow Ranger Station facilities that are located in the MC1 project area, were added in the 2015 analysis along with the cost of environmental impact studies.[3] At the same time, the total capital costs of the SR1 proposal was increased by $40 million over the “project construction” costs to cover “land acquisition” and the estimated cost of “upstream mitigation” ($8.9 million), neither of which, apparently, had been included in the earlier estimate. A modest $7 million was also added to the SR1 construction costs for the relocation of Springbank Road.[4]

The net results of these significant changes in the projected capital costs of the MC1 and SR1 projects over an eight month period were to leave the MC1 project significantly more costly. The 2014 cost estimates had MC1’s construction costs about $80 million more than SR1’s construction costs. Under the new estimates, the total capital costs of MC1 remains $80 million higher despite the present value of the costs of MC1 rising almost $300 million and of SR1 rising almost $200 million.

It is not clear that a final, accurate, full estimate of the costs associated with each of these projects has been determined yet.

2. Measuring the Benefits of Flood Mitigation Projects: The Need to Take into Account Non-Structural Mitigation and the Interaction among Flood Mitigation Actions

In the aftermath of the 2013 Calgary flood, considerable attention was paid to the actions property owners and governments could take to reduce the damage that would be caused by future floods. One initial focus was on reducing the amount and type of development in flood hazard areas so that that property and infrastructure were not repeatedly flooded, damaged, and rebuilt only to be flooded again. In late 2013, after the damaging floods of that June, the Alberta Legislative Assembly gave the Government of Alberta the authority to control, regulate or prohibit development of land in a floodway.[5] The economic and fiscal logic of limiting human activity, structures and equipment, and infrastructure in flood hazard areas is widely recognized and accepted:

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[3] The earlier cost estimate appears to have included $15.6 million for infrastructure replacement. The 2015 analysis also included $15.6 million specifically for Highway 66 relocation (Exhibit 4.1). With the markups for contingencies (25 percent) and engineering/ environmental (20%), the relocation of the highway added $23.4 million to the total construction cost of $239.6 million. (Exhibit 4.1) Adding another $45 million for infrastructure relocation to the project costs (p.1) would suggest that the cost of relocating infrastructure for the MC1 proposal would be $68.4 million, almost a quarter of the total $288.6 million cost of the MC1 proposal. The $45 million of additional costs for infrastructure relocation for the MC1 proposal appears to be the “costs of replicating” the administrative and recreation facilities within the general area” which was “conservatively estimated at between $40 and $50 million” by the Government of Alberta, Environmental and Sustainable Resource Development, Resilience & Mitigation Branch (p. 5 and footnote 3). This cost was not included in the listing of MC1 costs in Exhibit 4.1 and so had to be added in as an additional cost in summarizing the “total” costs on p. 1.

[4] This is a somewhat confusing adjustment since that $7 million was already included in the project construction cost in the 2014 analysis. This would appear to increase the highway relocation costs from $7 to $14 million.

[5] “Flood Recovery and Reconstruction Act”, as discussed in the “Report of the Auditor General of Alberta, March 2015,” p. 81.

> Allowing development in floodways unnecessarily risks public safety and the public purse. Keeping people and infrastructure away from floodways is the most cost effective approach to managing flood risk in areas where experts can predict water flows will be deepest, fastest and most destructive.[6]

This echoes a widely circulated paper written in 1976 by the former Mayor of Rapid City, South Dakota, and representative of the Inland Water Directorate of Environment Canada: "Keep Them Out of the Floodways."[7] The Government of Alberta announced its intention of creating incentives for property owners who suffered flood damage in 2013 to rebuild outside of the floodway and invest in "flood-proofing" measures for structures in the flood fringe that would reduce flood damage in the future.

Unfortunately, many vulnerable structures and the goods and equipment they contain as well as public infrastructure have already been placed in known flood hazard areas despite the known risks of future flooding. In addition those who own undeveloped land in flood hazard areas often oppose government prohibitions or regulation of development in those areas for fear this will substantially reduce the value of those land assets. As a result, despite experts repeatedly stating that moving people, structures, equipment and public infrastructure out of flood hazard areas is the most cost-effective way of protecting the safety of those people and their developments, there is often considerable opposition to converting those flood hazard zones to parks, natural areas, and other urban amenities that are less likely to be damaged by flooding and can help absorb and slow flood waters.

This may explain the failure to adopt many of the recommendations of the Groeneveld Report on the 2005 Alberta floods before the 2013 floods struck.[8] Those recommendations primarily focused on *non-structural* flood mitigation strategies including the identification, mapping, and regular updating of flood hazard zones, conveying the information on these flood hazards to governments, government agencies, and the potential investors in the development of those lands. The recommendations also urged the removal of government incentives for inappropriate developments in flood hazard areas. These recommendations to more carefully identify areas of significant flood hazard and manage development in them to reduce the level of flood damage were repeated in "A Report on Recovery and Rebuilding in Southern Alberta" published by the Canadian Institute for Catastrophic Loss Reduction in 2013.[9]

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[6] Ibid.

[7] Don Barnett, September 1976. Posted on the Canadian Water Resources Association website on November 19, 2013, to encourage discussion of how to mitigate floods in the future in Southern Alberta after the damaging floods of June 2013. http://www.cwra.org/en/events-news/national-news/226-keep-them-out-of-the-floodways-by-don-barnett

[8] "Provincial Flood Mitigation Report: Consultation and Recommendations," submitted by George Groeneveld, November 10, 2006.

[9] "Best Practices for Reducing the Risk of Future Damage to Homes from Riverine and Urban Flooding: A Report on Recovery and Rebuilding in Southern Alberta," Paul Kovacs and Dan Sandink, Institute for Catastrophic Loss Reduction, ICLR research paper series, No. 53, September 2013, Toronto, Canada.

The 2013 Alberta Auditor General's review of flood mitigation efforts following the 2013 floods emphasized the need to coordinate province-wide flood mitigation efforts so that limited flood mitigation resources are not wastefully used in duplicative efforts. Without coordination among the whole set of mitigation efforts, one set of efforts to reduce future flood damage may be carried out without the realization that other efforts are also underway to reduce the risk of that same flood damage. That Auditor General's report found that: "The [ESRD] does not have adequate processes to assess what will be the cumulative effect of flood mitigation programs and initiatives within communities when it approves new projects."[10]

> We found that flood mitigation actions were implemented independently through various flood programs without a full consideration of whether a community was already adequately protected by existing programs and initiatives. For example, the Department of Infrastructure purchased homes in High River under the floodway relocation program. At the same time, ESRD approved funding for a new dike system. High River has now asked the government to make those properties available for sale to the public again because it believes the new dike system has reduced the risk for those properties.
>
> ……
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> If the department does not assess the cumulative effect of flood mitigation programs and initiatives prior to approving new ones, some communities may be over protected and other under protected from future floods.[11]

The IBI Group's benefit-cost analyses of proposed structural flood mitigation projects on the Elbow River (the MC1, SR1, and Glenmore Diversion projects) warned that IBI's estimates of the benefits of those projects (the flood damage costs avoided) did not consider any adjustments for non-structural or local structural measures that might also be put in place.[12] That is, the large structural flood mitigation projects assume that no other structural or non-structural measures will be adopted. Meanwhile, other measures *are* being considered or even implemented. This lack of coordination almost assures that the benefits associated with the large flood mitigation projects will be over-estimated. Similarly, if local flood mitigation efforts in Calgary assume no up-stream flood control projects, too much cost is likely to be incurred on them if, in fact, the Government of Alberta plans to proceed with one of those large structural upstream projects.

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[10] Ibid. p. 82.
[11] Ibid.
[12] "Provincial Flood Damage Assessment Study City of Calgary: Assessment of Flood Damages," IBI Group, prepared for Government of Alberta ESRD- Resilience and Mitigation, February 2010, p. 10, Section 3.6 "Flood Damage Assessment."

3. Measuring the Benefits of the MC1 and SR1 Flood Mitigation Projects

A. Introduction

Both the MC1 and SR1 flood mitigation proposals were designed to provide approximately the same degree of reduction of flood damage in the Calgary area.[13] The flood water storage provided by either of these projects, when combined with the storage that can be made available in the Glenmore Reservoir in anticipation of a flooding threat, would provide storage that would avoid damage in the City of Calgary from a 100-year flood. The combined storage of Glenmore and MC1 would be 73,400 dam^3 while the combined storage of Glenmore and SR1 would be 73,400 dam^3. See Section 4.2 "Flood Protection Design Basis" in Appendices F and G of the AMEC "Flood Mitigation Measures for the Bow, Elbow and Oldman River Basins" prepared for the Southern Alberta Flood Recovery Task Force.[14]

Because the basis for the design of the capacity of both of these alternative flood mitigation projects was identical, the estimated economic benefits of each of these proposals in the form of reduced flood damage in the City of Calgary was also identical in both the AMEC 2014 analysis and the IBI Group analysis in 2015. That is not to say that the size of the estimated benefits were the same in each of these years. The benefits were the same for each of the large alternative structural flood mitigation projects. The common value of the flood control benefits that each of the projects are assumed to provide were about $174 million while the common value of the benefits for those two projects in 2015 was $337 to $477 million, depending on which of the two different benefit estimates is used. That is, the 2015 estimated benefits were two to three times the benefits estimated in 2014.[15] These are the benefits reported for protecting the City of Calgary from a 100-year flood.[16]

B. Measuring Flood Damages in Calgary

The 2015 estimates of the benefits of protecting Calgary from flood damage by building flood mitigation dams and reservoirs on the Elbow River upstream from Calgary were

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[13] Because the MC1 proposal is further upstream on the Elbow River than the SR1 proposal, it would provide flood reduction benefits to the Bragg Creek area. To make these two projects "equivalent" in the flood mitigation they provide, the 2015 analyses added the cost of separately providing flood protection to the Bragg Creek area to the SR1 proposal costs. Those Bragg Creek flood mitigation measures were estimated to cost $6.2 million. Appendix D to "Benefit/Cost Analysis of Flood Mitigation Projects for the City of Calgary: SR1 Off-Stream Flood Storage, IBI Group, February 18, 2015, p. D-3. The amount entered into the statement of "Project Costs" for "Upstream Mitigation," however, was $8.9 million (p. 1)

[14] Volume 4-Flood Mitigation Measures, Final, June 2014.

[15] "Flow Mitigation Measures for Bow River, Elbow River and Oldman River Basins," AMEC Environment & Infrastructure, prepared for the Southern Alberta Flood Recovery Task Force, CW2174, June 2014. Volume 1, Summary, and Appendices G and F. "Benefit/Cost Analysis of Flood Mitigation Projects for the City of Calgary," IBI Group for the Government of Alberta, RSRD-Resilience and Mitigation, February 18, 2015, Executive Summary, p.1.

[16] Estimated benefits were also provided for protection from 200-year floods.

developed by the IBI Group for the Government of Alberta.[17] The emphasis was on measuring the tangible financial costs associated with floods of various intensities. These were divided into two groups, direct and indirect flood damage costs. The direct damages were the physical damage to structures, contents of structures, and external items such as vehicles. The indirect costs were primarily the loss of production or revenues at businesses, reduced wages, and increased business expenditures due to the flooding.

The direct flood damage to structures, equipment, contents, and infrastructure can be established by the reports to insurance companies or claims to government agencies for assistance. Structures and infrastructure damage can be grouped by type of structure and related to the depth/intensity of the flood.

The indirect damages, especially those related to interrupted economic activity, is more difficult to measure. Conceptually it is economic value that would have been created that was not and, as a result, was permanently lost. Surveys of businesses, government agencies, and households can provide some of this information but that can be a costly, time consuming process that may produce data of questionable accuracy.

Because of this, such indirect damages are often calculated using an informed "rule of thumb" that assumes that the indirect damages are a fixed percentage of the more easily measured direct damages. That indirect cost factor is likely to vary with the type of structure or infrastructure that has been damaged. For instance, for residential housing, the indirect impacts may be a smaller percentage of the direct damage since households typically are not engaged in commercial businesses from their homes. They may lose the services of their homes for a period, but that loss by itself does not necessarily mean that the income earned by residents has also been lost. A commercial business, on the other hand, may not be able to operate at all until some of the damage has been repaired or a new business site has been developed. The indirect losses to such a flooded business might be a significantly higher percentage of the direct damage.

Because of the greater uncertainty in measuring the indirect flood damages, more attention has to be paid to the accuracy of those damages in estimating the benefits associated with particular flood mitigation measures. IBI Group, in its "Assessment of Flood Damages" in the City of Calgary, recognized this and focused its attention on the indirect damages rather than the direct damages.

C. Measuring Indirect Flood Damage in Calgary

IBI Group looked at the 100-year flood hazard zone in Calgary *plus* a 75-meter buffer. It found approximately 7,200 structures including 5,600 single family homes, 700 semi-

[17] "Provincial Flood Damage Assessment Study City of Calgary: Assessment of Flood Damages," IBI Group, prepared for Government of Alberta ESRD- Resilience and Mitigation, February 2015. Appendix A of that report was "Flood Damage Assessment in Alberta: Best Practices Principles and Guidelines," also prepared by IBI Group, dated December 2014.

detached dwelling units, and 300 multi-family apartment buildings. There were also 600 commercial/industrial/institutional buildings. It analyzed the flood damages to the Stampede Park as a separate commercial/infrastructure site.[18]

IBI calculated the direct flood damage associated with each level of flooding to these structures from both the Bow and Elbow Rivers separately and together. For the 100-year frequency flood, flood damage to residential property from the Elbow River was responsible for almost 60 percent of the direct flood damage. Infrastructure damage contributed 26 percent of the direct damage. The damage to the Stampede Park complex represented 14 percent of the total direct damage associated with a 100-year flood of the Elbow River. Commercial business structure damage contributed only 2 percent of the total Calgary Elbow river flood damage.[19]

The IBI Group estimated the indirect damages, the lost economic activity, by using a Statistics Canada special Labour Force Survey to estimate the impact of the 2013 flood hours of work in various types of economic activity in the Calgary area. Estimates of labor productivity by industry were used to convert these lost hours of work to lost Gross Domestic Product. This estimate of the economic loss to commercial businesses due to the flood totaled $359 million. That was over three times the direct damage done to commercial buildings. One might expect a relatively large indirect percentage multiplier in situations where a contemporary high-rise business center is flooded, damaging the ground and lower floors but leaving the bulk of the building undamaged but also unusable until the lower floors are repaired. Significant economic activity gets displaced even when the flood damage is relatively minor.

However, previous estimates of indirect damage percentage multipliers from across Canada and the United States have not come near a multiplier of over 300 percent for flooded commercial structures. The typical range is 10 to 45 percent of direct damages.[20] The reported lost economic activity associated with the flooding of the Stampede Park, that is, the indirect flood damage to the Stampede Park, was 185 percent of the direct flood damage to those facilities. That too, fell significantly out of line compared to other North American indirect percentage multipliers.

The other indirect flood damage percentage multipliers, those for residential property and public infrastructure were similar to those used elsewhere in North America: 15 percent or direct residential property damage and 20 percent of direct infrastructure damage.

D. Over-Estimating Indirect Damages and the Benefits of Flood Mitigation

There are many problems associated with estimating the lost economic activity due to a flood by looking at the value of the business activities that did not take place at the

[18] Ibid. p. 2
[19] Ibid. Exhibit 3.15.
[20] Ibid. pp. 7-8

flooded locations until the flood damage was repaired. Economic activity can shift in location and over time rather than simply being lost. Businesses can shift office work to employees' homes or other branch offices or rented temporary office space. Customers who did not make purchases at a particular business location at a particular time because of the flood, are unlikely to simply go without whatever they were going to buy or simply reduce their level of consumption. The customers can shop elsewhere in a non-flooded area or put off the purchase until businesses are able to re-open at particular locations. Customers who cannot go to a particular entertainment site are unlikely to simply forego that entertainment and spending. It will simply shift in time and/or place.

Some business activity varies over time and that pattern of variation has to be taken into account in the estimation of economic activity "lost" due to a flooding event. The Calgary Stampede, for instance, is scheduled for a certain time period, bringing a lot more economic activity to that location and the surrounding retail businesses. During other times there is much less economic activity "scheduled" at the Stampede Park. There are brief peak levels of business, shoulder periods, and low periods. What the "lost" economic activity will be will depend on when a flood takes place. That uncertainty has to be taken into account to estimate a probability weighted "expected" loss. The initial estimates of the economic losses at the Stampede Park were based on a 100-year flood always coinciding with the 10-day annual Calgary Exhibition and Stampede. Clearly this is not a "typical" or "expected" occurrence.

The relationship between the frequency of a flood of a particular magnitude and the damage does is not proportional. Households, businesses, and public infrastructure managers are likely to adopt flood mitigation measures over time that reduce the damage cause by the more frequent but less intense flooding events. For that reason, the direct and indirect damage done by such more frequent flood events may be close to zero.

IBI Group recognized these problems with their initial estimate of the flood damages associated with a 100-year flood in Calgary, which are also the projected benefits associated with upstream flood mitigation projects such as the MC1 and SR1 dams and reservoirs.[21] IBI Group recognized that its initial estimates of flood damages were over-estimates that needed to be reduced to reflect the actual benefits that were likely to result from one or the other of the proposed upstream flood mitigation projects being built. Exhibits 3.19 through 3.24 described the reduced total damage and average annual damage estimates. These "alternative" estimates of the flood damages associated with 100-year floods on the Elbow River in Calgary dramatically reduced the projected indirect flood damages in Calgary. Commercial indirect damages were reduced by 86 percent, Stampede Park indirect damages were reduce 79 percent, and infrastructure indirect damage estimates were cut in half. Residential indirect damage estimates were not changed in IBI's more realistic estimates of the indirect damages.

[21] Ibid, Section 3.6.8 "Alternative Damage Scenario," p 20.

The impact of these adjustments in indirect flood damage estimates on the overall damages and, therefore, the benefits of flood mitigation upstream on the Elbow River was about a 30 percent reduction.[22] The overall adjustment was much smaller than the adjustments in some of the indirect damages for two reasons. First of all, the estimated *direct* damages were largely left unchanged. It was primarily the indirect damage estimates that were adjusted downward. Second, the residential damages, which represented about half of the original estimated flood damages, were not adjusted downward. A 30 percent reduction in estimated benefits of projects costing hundreds of millions of dollars, however, is certainly not a trivial adjustment. See the table below.

Changes in the Estimated Elbow River 100-Year Flood Damages in Calgary

"Original" Indirect Estimates			"Alternative" Indirect Estimates			Percentage Change
Categories of Damage		100-Year Flood	Categories of Damage		100-Year Flood	"Original" to "Alternative"
Residential	Direct	$ 299,716,000	Residential	Direct	$ 299,716,000	0.0%
	Indirect 15%	$ 44,957,000		Indirect 15%	$ 44,957,000	0.0%
	Total	$ 344,673,000		Total	$ 344,673,000	0.0%
Commercial	Direct	$ 10,205,000	Commercial	Direct	$ 10,205,000	0.0%
	Indirect 323%	$ 32,962,000		Indirect 45%	$ 4,592,000	86.1%
	Total	$ 43,167,000		Total	$ 14,797,000	65.7%
Infrastructure	Direct	$ 130,721,000	Infrastructure	Direct	$ 69,666,000	46.7%
	Indirect 20%	$ 26,144,000		Indirect 20%	$ 13,933,000	46.7%
	Total	$ 156,865,000		Total	$ 83,599,000	46.7%
Stampede	Direct	$ 68,900,000	Stampede	Direct	$ 68,900,000	0.0%
	Indirect 185%	$ 127,400,000		Indirect 38%	$ 26,400,000	79.3%
	Total	$ 196,300,000		Total	$ 95,300,000	51.5%
Total	Direct	$ 509,542,000	Total	Direct	$ 448,487,000	12.0%
	Indirect 52%	$ 231,463,000		Indirect 21%	$ 89,882,000	61.2%
	Total	$ 741,005,000		Total	$ 538,369,000	27.3%

Sources: Exhibits 3.15 and 3.21: Provincial Flood Damage Assessment Study City of Calgary: Assessment of Flood Damages, IBI Group, Feb 2015

The IBI Group presents these “adjustments” in the estimated benefits of the proposed upstream flood mitigation project on the Elbow River in a variety of ambiguous terms. The initial high estimates of the benefits were presented simply as factually what the data indicated about the damages associated with a 100-year Elbow River flood in Calgary. After pointing out that these “indirect” “lost business multipliers (e.g. 323 and 185 percent) were significantly above similar indirect multipliers when judged by other North American estimates, IBI offered an “alternative” estimate that was significantly lower.

The first estimate is simply presented as “Damages to Commercial and Residential Buildings” or “Total Damages” (Exhibits 3.4, 3.5, 3.13, 3.14, 3.15). The “Annual Average Damages (AAD)” and the “Flood Damages Probability Distribution” are also presented without any indication that these estimates are known over-estimates (Exhibits 3.16

[22] 27.3 percent.

through 3.18). Then an “Alternative Damage Scenario” is presented with the accompanying exhibits simply labeled “Alternative” (Exhibits 3.19 through 3.24).

The text of the IBI report on Calgary flood damages provides a dramatically different description of the initial and the alternative estimates of the 100-year Elbow River flood damages in Calgary. It says: “The previous damage assessment is reflective of worst case conditions, in particular as it related to commercial indirect damages.” Waiting until the end of the report to indicate that the estimated damages were “worst case” estimates, not accurate estimates, and labeling the tables and figures in an ambiguous manner (no mention of “worst case” and the more accurate estimates labeled an “alternative” estimates) is simply misleading. The Executive Summary presents the estimated flood damages in the same manner.

The IBI Group also prepared the “Benefit/Cost Analysis of Flood Mitigation Projects for the City of Calgary.” In particular, for the Elbow River flood mitigation projects such benefit/cost analyses were prepared for the MC1 Flood Storage project, the SR1 Off-Stream Flood Storage project, and the Glenmore Reservoir Diversion project.[23] In those documents IBI was somewhat more careful in how it labeled its tables presenting the estimated benefits of Elbow River flood mitigation projects. It labeled the two estimates as the “High Damage Scenario” and the “Low Damage Scenario.”[24] Later in the text of the benefit/cost reports more accurate language was used: The higher estimated damage was labeled a “’worst case’ condition” and the lower estimate was labeled the “’anticipated case’ condition.”[25] This more accurate language was used only once in each report. Labeling the “lower” “alternative” estimate the “anticipated case” makes clear that that estimate is the preferred estimate in terms of accuracy and the “high” original estimate that was presented is a less accurate indication of likely damage given that it is a worst case possibility. It is unclear why ambiguous and confusing language was chosen over what the analysts recognized as the more accurate language.[26]

E. The Economic Implications of the Over-Estimation of Flood Damages/Flood Mitigation Benefits

Placing the emphasis on the “worst case” flood damages rather than on the “anticipated” or expected flood damages increases the apparent benefits associated with large structural mitigation projects. If the “worst case” numbers are used, the MC1 project appears to provide significant net benefits with a Benefit/Cost ratio of 1.43 and a present value of net benefits of $144.2 million. But if the “anticipated” values of flood reduction impacts are used, Spring Bank moves to being economically questionable with a Benefit/Cost ratio of 1.01 and a present value of net benefits of only $4.1 million

[23] All three were dated February18, 2015, and prepared for the Government of Alberta, ESRD-Resilience and Mitigation.
[24] “Key Metrics” tables in the Executive Summaries.
[25] P. 5 in the MC1 and SR1 benefit/cost studies and p. 4 in the Glenmore Reservoir Diversion study.
[26] It should be noted that Environment and Sustainable Resource Development’s “Elbow River Flood Mitigation Project Decisions Fact Sheet” (February 23, 2015) does use the “worst-case” and “anticipated” language and presents the “Anticipated Damage Scenario” version of the total expected flood damage that could be avoided by either the MC1 or SR1 upstream flood mitigation alternatives. Page 2.

just because of this one change in the economic analysis. There are similar substantial impacts on the apparent economic viability of the other two proposed Elbow River flood mitigation projects during a 100-year interval flood. See the table below. If other corrections are made to the assumptions that guided the economic analysis of these alternative flood mitigation projects, the projects would appear even less attractive from an economic point of view.

The Economic Implications of Over-Estimated Flood Damages
Alternative Elbow River Projects, 100-Year Flood

Elbow River Project	Flood Damages/Project Benefits Present Value ($ millions)		Benefit-Cost Ratio		Net Benefits Present Value ($millions)	
	"Anticipated"	"Worst Case"	"Anticipated"	"Worst Case"	"Anticipated"	"Worst Case"
MC1	$336.80	$476.90	1.01	1.43	$4.10	$144.20
SR1	$336.80	$476.90	1.32	1.87	$81.70	$221.80
Glenmore Diversion	$416.30	$621.70	0.81	1.21	-$96.20	$25.40

Source: Benefit-Cost Analyses of Flood Mitigation Projects for the City of Calgary, Executive Summaries, Ke Metrics. IBI Group, page 1, Reports for MC1, SR1, and Glenmore Diversion

4. The Costs of "Replicating" the Recreation Facilities Affected by the MC1 Proposal

The MC1 proposal would create a small permanent pool behind the proposed dam in order to limit the impacts of inflowing flood waters and the sediment it will carry. Except for periods of significant flood waters, the Elbow River would be allowed to flow into this pool and out with minimal reservoir level rise. The gates on the dam would be strategically closed during flood events to hold back a significant portion of the Elbow River flow in reservoir storage. [27]

Flood mitigation projects of this sort are typically considered to be consistent with recreational use of the lands outside of the flood period. That is why the province's consultants who analyzed the MC1 proposal saw that small permanent pool created by the dam as a "replacement" for the previously existing Allen Bill Pond at the same site that was destroyed by the 2013 flood.[28] The MC1 project site could again provide a hiking trailhead, day use picnic, and fishing site. There are two other recreation facilities in the MC1 project area, Paddy's Flat and Station Flat that are outside of the 100-year flood area. They provide group and public camping with the usual amenities as well as hiking and horseback trailhead facilities including small parking lots and vault toilets. The existing River Cove group camping facility, however, would be within the flood area and its facilities that could be damaged by flooding would have to be removed.[29] This

[27] P. 3.
[28] P. 3 and 5.
[29] Ibid.

camp ground was damaged by the 2013 flood and has been closed since then. In spring of 2015 it had not yet reopened.

Within the 100-year flood area at the MC1 site is a complex of buildings and facilities, the Elbow Ranger Station site, that in the past supported Alberta Forestry Services, Alberta Parks and Recreation, and Alberta Fish and Wildlife activities. The 2015 analysis of the benefits and costs of the MC1 proposal stated: "It is not known to what extent these facilities are currently used, if at all."[30]

Currently these recreation and government facilities can be reached from the east or west on Highway 66. The MC1 proposal would re-route Highway 66 with a new bridge crossing the Elbow River south and west of the proposed project. This would end access to the area from the east and would allow access from the west only if the old highway was maintained as an access road to the Paddy's Flat and Station Flats recreation facilities and the approach to the new permanent reservoir. The old highway could be abandoned beyond the 100-year flood level just northeast of the Station Flats recreation area. This more limited access to these recreation facilities and sites might reduce their usefulness but might also increase their attractiveness because they were no longer bisected by a busy highway.

As mentioned above, $45 million has been added to the cost of the MC1 proposal as a "conservative" "cost of replicating facilities within the general area."[31] Keep in mind that this is not a cost associated with relocating Highway 66. It is the cost of "replicating" other facilities in the MC1 project area. Since only one of the recreation facilities, the River Cove group campground that has 15 campsites, might have to be relocated, most of the projected "replication" costs must be associated with replacing the entirety of the Elbow Ranger Station complex of facilities. That complex includes offices for various provincial natural resource agencies, a maintenance compound, a dining hall, 8 seasonal bunk houses, 11 permanent residences, two mobile homes and a cold compound storage building.[32]

The "[c]osts of replicating the…facilities within the general area [of the MC1 project] and on Crown Land has been conservatively estimated at between $40 and $50 million" by Alberta Environmental and Sustainable Resource Development. At the same time, apparently the same agency could not tell its consultants "to what extent these facilities are currently used, if at all."

There would be no economic logic to incurring the "costs of replicating" these facilities if they are not all being regularly used and the value of their use justifies "replicating" them at a nearby location. That appears not to be the case. In that situation, including a $40 to $50 million cost in evaluating this flood mitigation project is simply not appropriate. It represents an arbitrary non-economic cost that exaggerates the apparent cost of the MC1 project in comparison to alternatives.

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[30] Ibid.
[31] Ibid.
[32] Op. Cit. MC1 Flood Storage Project, IBI Group Report, p. 5.

5. Including All of the Costs Associated with the SR1 Project

Just as including "replication costs" for structures and infrastructure in the MC1 project area that are no longer very useful exaggerates the costs of that project, under-stating some of the major costs associated with the SR1 flood mitigation project also distorts the apparent economic characteristics of that project.

Unlike the MC1 project that will be primarily located on Crown land, the SR1 project will be constructed on private land that will have to be bid away from the current owners in order to dedicate that land to the proposed public flood mitigation project.[33] For that reason the IBI Group benefit-cost analysis studied the cost of acquiring the land necessary to build and operate the Spring Bank project.

The IBI Group estimated that 1,760 acres, plus or minus, of private land would need to be purchased. Although that land is currently being used in agriculture, under cultivation or pasture, it is located in an area where more and more land is being converted to residential use as Calgary urban development expands outward. The IBI Group analyzed the 2014 Multiple Listing Service sales transactions for raw land and country residential style land developments in the SR1 area. It also looked at the areas with suggested or approved structure plans in the vicinity, including the North SR1 and Central SR1 Structure Plan areas a mile or so east of the proposed SR1 flood mitigation project. The Harmony mixed-use community one to two miles north of the proposed flood mitigation project was also considered in estimating local land values for development purposes. IBI also solicited opinions from real estate brokers on potential land values in the general area. [34]

IBI estimated the cost of 1,760 acres of agricultural land in the area to be $10,000 per acre at the upper end of the value range. The total acquisition cost would be $17.6 million. At the other end of the spectrum, the value of a large acreage for the purpose of a planned community mixed-use development could be as high as $50,000 per acre or $88 million for the whole acreage. IBI used $10,000 per acre for the lower end of the acquisition cost and about $23,000 per acre at the high end. The $23,000 per acre land value was used as the land acquisition costs in the benefit-cost analysis of the proposed SR1 project.[35]

The land area that will be impacted by the proposed SR1 flood mitigation project appears to be much larger than the 1,760 acres used by IBI in its benefit-cost analysis. The 1,760 may have represented the area of a possible multi-use storage reservoir at full supply level or the area of the 100-year flood storage. That would have ignored the flood-plain berm, the diversion weir/fish way/sluiceway, the diversion outlet and the

[33] Op. Cit. Springbank Off-Stream Flood Storage Project, IBI Group Report, p. 4.
[34] Ibid, p. 4 and page 13, Exhibit A-2.
[35] Ibid. pp. 4-5.

diversion channel that would deliver the water to off-stream storage reservoir, as well as the outlet structure and return channel to the Elbow River from the reservoir. The more recent (March 3, 2015) estimate of the land within the project perimeter was 3,909 acres. The total impacted lands were estimated to be 6,884 acres.[36]

These land areas are 2 to 4 times the land area used by IBI for the benefit cost analysis. If IBI estimated land cost of $23,000 per acre is applied to the total acreage impacted by the SR1 project, the land acquisition cost would be $156 million, not $40 million. If it were possible to purchase only the land that would be within the project perimeter and not have to pay for other impacted lands, the land acquisition cost would be $89 million, not $40 million. Either change would have a significant impact on the SR1 benefit-cost ratio and net present value of benefits undermining the economic viability of the SR1 project.

[36] "Springbank Off-stream Reservoir Open House Perimeter Map. Prepared for Alberta Transportation by Stantec, March 3, 2015.
http://www.alberta.ca/AlbertaCode/images/springbank-off-stream-reservoir-map.pdf