

**Addendum:  
Economic Impact of North Saskatchewan River Water  
Management Options on the Saskatchewan Economy – Weir  
and Ethanol Plant**

**Draft Final Report**

**Prepared For Golder Associates**

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## 1.0 Executive Summary

Golder Associates contracted SJ Research Services to assess the economic impact of the North Saskatchewan River water management options on the Saskatchewan economy. SJ Research Service's Saskatchewan Input-Output Model was used to measure the provincial economic impacts associated with various water management options in terms of construction, investment, irrigation operation and tourism impacts.

Initially, three scenarios were examined.

Scenario 1: Non-structural Investments to develop water resource – no storage capacity

Scenario 2: Off-channel Reservoir

Scenario 3: Highgate Dam – full supply level option

This paper deals with the impact of an additional scenario: the construction of a series of low head weirs facilitating the construction and operation of a \$150M ethanol plant in the region.

Weir construction would begin in 2015 and ethanol plant construction would begin in 2016 and become operational in 2017. No irrigation and tourism impacts are assumed to occur.

**All impacts are expressed as impacts over the status quo (no investment) case.**

### 1.1 Summary of Provincial Employment Impacts

At the provincial level, the weir/ethanol scenario will have the following incremental impacts on employment levels.

Employment Impacts (Positions) Low Weir Head Construction and Operation	2015	2016	2017	2018	2019
Direct Employment	139.9	0.1	0.1	0.1	0.1
Indirect Employment	71.7	0.0	0.0	0.0	0.0
Induced Employment	119.4	0.1	0.1	0.1	0.1
<b>Total Employment</b>	<b>331.0</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>

\*totals may not add due to rounding

Employment Impacts (Positions) Ethanol Plant Construction and Operation	2015	2016	2017	2018	2019
Direct Employment	0.0	505.8	245.9	245.9	245.9
Indirect Employment	0.0	377.3	198.2	198.2	198.2
Induced Employment	0.0	483.0	237.6	237.6	237.6
<b>Total Employment</b>	<b>0.0</b>	<b>1366.1</b>	<b>681.8</b>	<b>681.8</b>	<b>681.8</b>

\*In all cases in this study, direct impacts are impacts after adjusting for leakages for imports and inventory withdrawals.

Total Impacts are the sum of direct, indirect and induced impacts. Direct impacts reflect initial expenditures after adjusting for leakages. Indirect impacts measure the secondary business transactions that result from initial expenditures. Induced impacts are third round impacts from the spending of incremental labour income in the economy after removing a portion for taxes and savings. A complete accounting of definitions is available in Appendix A.

## 1.2 Summary of Provincial Gross Domestic Product Impacts

At the provincial level, the weir/ethanol scenario will have the following incremental impacts on Gross Domestic Product (GDP):

GDP Impacts (Millions of Current Dollars) Low Weir Head Construction and Operation	2015	2016	2017	2018	2019
Direct GDP	9.184	0.008	0.008	0.008	0.008
Indirect GDP	5.378	0.003	0.003	0.003	0.003
Induced GDP	6.214	0.003	0.003	0.003	0.003
<b>Total GDP</b>	<b>20.776</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>

GDP Impacts (Millions of Current Dollars) Ethanol Plant Construction and Operation	2015	2016	2017	2018	2019
Direct GDP	0.000	45.012	21.386	21.386	21.386
Indirect GDP	0.000	29.666	15.580	15.580	15.580
Induced GDP	0.000	25.996	12.911	12.911	12.911
<b>Total GDP</b>	<b>0.000</b>	<b>100.674</b>	<b>49.878</b>	<b>49.878</b>	<b>49.878</b>

Note: Gross Domestic Product (GDP) is the measure of the sum of all goods and services produced within a geographic area and is the measurement of the "size" of an economy. GDP is included within gross output, represents value added or payments to final factors of production, and includes both profits and labour income.

## 1.3 Summary of Labour Income Impacts

At the provincial level, the weir/ethanol scenario is expected to have the following incremental impact on Labour Income:

Labour Income Impacts (Millions of Current Dollars) Low Weir Head Construction and Operation	2015	2016	2017	2018	2019
Direct Labour Income	6.913	0.003	0.003	0.003	0.003
Indirect Labour Income	2.545	0.001	0.001	0.001	0.001
Induced Labour Income	3.982	0.002	0.002	0.002	0.002
<b>Total Labour Income</b>	<b>13.440</b>	<b>0.006</b>	<b>0.006</b>	<b>0.006</b>	<b>0.006</b>

Labour Income Impacts (Millions of Current Dollars) Ethanol Plant Construction and Operation	2015	2016	2017	2018	2019
Direct Labour Income	0.000	23.621	11.116	11.116	11.116
Indirect Labour Income	0.000	11.840	5.995	5.995	5.995
Induced Labour Income	0.000	16.224	7.995	7.995	7.995
<b>Total Labour Income</b>	<b>0.000</b>	<b>51.686</b>	<b>25.106</b>	<b>25.106</b>	<b>25.106</b>

Labour income is included in gross domestic product and includes wages, salaries, and supplementary labour income (employer contributions to pension plans and benefit packages).

## 1.4 Employment Impacts by Industry

Total (direct, indirect, and induced) employment impacts by industry for this scenario are presented below:

Employment Impacts By Industry (Positions) Low Weir Head Construction and Operation	2015	2016	2017	2018	2019
Crop and Animal Production	4.2	0.0	0.0	0.0	0.0
Forestry and Logging	0.1	0.0	0.0	0.0	0.0
Fishing, Hunting and Trapping	0.0	0.0	0.0	0.0	0.0
Support Activities for Agriculture and forestry	0.2	0.0	0.0	0.0	0.0
Mining and Oil and Gas Extraction	3.7	0.0	0.0	0.0	0.0
Utilities	1.1	0.0	0.0	0.0	0.0
Construction	141.4	0.0	0.0	0.0	0.0
Manufacturing	6.2	0.0	0.0	0.0	0.0
Wholesale Trade	10.3	0.0	0.0	0.0	0.0
Retail Trade	42.5	0.0	0.0	0.0	0.0
Transportation and Warehousing	4.8	0.0	0.0	0.0	0.0
Information and Cultural Industries	5.7	0.0	0.0	0.0	0.0
Finance, Insurance, Real Estate and Rental and Leasing	15.4	0.0	0.0	0.0	0.0
Professional, Scientific and Technical Services	12.0	0.0	0.0	0.0	0.0
Administrative and Support, Waste Management and Remediation Services	11.2	0.0	0.0	0.0	0.0
Educational Services	1.5	0.0	0.0	0.0	0.0
Health Care and Social Assistance	5.8	0.0	0.0	0.0	0.0
Arts, Entertainment and Recreation	6.3	0.0	0.0	0.0	0.0
Accommodation and Food Services	18.2	0.0	0.0	0.0	0.0
Other Services (Except Public Administration)	16.1	0.0	0.0	0.0	0.0
Operating, Office, Cafeteria & Laboratory Supplies	0.0	0.0	0.0	0.0	0.0
Travel, Entertainment, Advertising and Promotion	0.0	0.0	0.0	0.0	0.0
Transportation Margins	0.0	0.0	0.0	0.0	0.0
Non-Profit Institutions Serving Households	10.3	0.0	0.0	0.0	0.0
Government Sector	13.9	0.0	0.0	0.0	0.0
<b>Total</b>	<b>331.0</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>

\*totals may not add due to rounding

Employment Impacts By Industry (Positions) Ethanol Construction and Operation	2015	2016	2017	2018	2019
Crop and Animal Production	0.0	111.5	69.7	69.7	69.7
Forestry and Logging	0.0	6.6	4.2	4.2	4.2
Fishing, Hunting and Trapping	0.0	0.2	0.1	0.1	0.1
Support Activities for Agriculture and forestry	0.0	4.2	2.6	2.6	2.6
Mining and Oil and Gas Extraction	0.0	30.3	11.0	11.0	11.0
Utilities	0.0	8.6	4.7	4.7	4.7
Construction	0.0	125.2	4.4	4.4	4.4
Manufacturing	0.0	406.0	259.0	259.0	259.0
Wholesale Trade	0.0	44.2	22.3	22.3	22.3

Retail Trade	0.0	165.2	80.3	80.3	80.3
Transportation and Warehousing	0.0	26.9	14.3	14.3	14.3
Information and Cultural Industries	0.0	23.0	11.2	11.2	11.2
Finance, Insurance, Real Estate and Rental and Leasing	0.0	65.1	32.1	32.1	32.1
Professional, Scientific and Technical Services	0.0	35.3	15.3	15.3	15.3
Administrative and Support, Waste Management and Remediation Services	0.0	35.2	15.6	15.6	15.6
Educational Services	0.0	5.2	2.5	2.5	2.5
Health Care and Social Assistance	0.0	23.3	11.4	11.4	11.4
Arts, Entertainment and Recreation	0.0	23.3	11.1	11.1	11.1
Accommodation and Food Services	0.0	76.8	38.2	38.2	38.2
Other Services (Except Public Administration)	0.0	60.3	28.9	28.9	28.9
Operating, Office, Cafeteria & Laboratory Supplies	0.0	0.0	0.0	0.0	0.0
Travel, Entertainment, Advertising and Promotion	0.0	0.0	0.0	0.0	0.0
Transportation Margins	0.0	0.0	0.0	0.0	0.0
Non-Profit Institutions Serving Households	0.0	41.7	20.5	20.5	20.5
Government Sector	0.0	48.1	22.4	22.4	22.4
<b>Total</b>	<b>0.0</b>	<b>1366.1</b>	<b>681.8</b>	<b>681.8</b>	<b>681.8</b>

## 1.6 Conclusion

Combined weir and ethanol construction and operation impacts on the Saskatchewan economy are presented below:

Employment Impacts (Positions) Total Weir and Ethanol	2015	2016	2017	2018	2019
Direct Employment	139.9	505.9	246.0	246.0	246.0
Indirect Employment	71.7	377.3	198.2	198.2	198.2
Induced Employment	119.4	483.0	237.6	237.6	237.6
<b>Total Employment</b>	<b>331.0</b>	<b>1366.2</b>	<b>681.9</b>	<b>681.9</b>	<b>681.9</b>

GDP Impacts (Millions of Current Dollars) Total Weir and Ethanol	2015	2016	2017	2018	2019
Direct GDP	9.2	45.0	21.4	21.4	21.4
Indirect GDP	5.4	29.7	15.6	15.6	15.6
Induced GDP	6.2	26.0	12.9	12.9	12.9
<b>Total GDP</b>	<b>20.8</b>	<b>100.7</b>	<b>49.9</b>	<b>49.9</b>	<b>49.9</b>

Labour Income Impacts (Millions of Current Dollars) Total Weir and Ethanol	2015	2016	2017	2018	2019
Direct Labour Income	6.9	23.6	11.1	11.1	11.1
Indirect Labour Income	2.5	11.8	6.0	6.0	6.0
Induced Labour Income	4.0	16.2	8.0	8.0	8.0
<b>Total Labour Income</b>	<b>13.4</b>	<b>51.7</b>	<b>25.1</b>	<b>25.1</b>	<b>25.1</b>

Employment Impacts By Industry (Positions) Total Weir and Ethanol	2015	2016	2017	2018	2019
Crop and Animal Production	4.2	111.5	69.7	69.7	69.7

Forestry and Logging	0.1	6.6	4.2	4.2	4.2
Fishing, Hunting and Trapping	0.0	0.2	0.1	0.1	0.1
Support Activities for Agriculture and forestry	0.2	4.2	2.6	2.6	2.6
Mining and Oil and Gas Extraction	3.7	30.3	11.0	11.0	11.0
Utilities	1.1	8.6	4.7	4.7	4.7
Construction	141.4	125.2	4.4	4.4	4.4
Manufacturing	6.2	406.0	259.0	259.0	259.0
Wholesale Trade	10.3	44.2	22.3	22.3	22.3
Retail Trade	42.5	165.2	80.3	80.3	80.3
Transportation and Warehousing	4.8	26.9	14.3	14.3	14.3
Information and Cultural Industries	5.7	23.0	11.2	11.2	11.2
Finance, Insurance, Real Estate and Rental and Leasing	15.4	65.1	32.1	32.1	32.1
Professional, Scientific and Technical Services	12.0	35.3	15.3	15.3	15.3
Administrative and Support, Waste Management and Remediation Services	11.2	35.2	15.6	15.6	15.6
Educational Services	1.5	5.2	2.5	2.5	2.5
Health Care and Social Assistance	5.8	23.3	11.4	11.4	11.4
Arts, Entertainment and Recreation	6.3	23.3	11.1	11.1	11.1
Accommodation and Food Services	18.2	76.8	38.2	38.2	38.2
Other Services (Except Public Administration)	16.1	60.4	28.9	28.9	28.9
Operating, Office, Cafeteria & Laboratory Supplies	0.0	0.0	0.0	0.0	0.0
Travel, Entertainment, Advertising and Promotion	0.0	0.0	0.0	0.0	0.0
Transportation Margins	0.0	0.0	0.0	0.0	0.0
Non-Profit Institutions Serving Households	10.3	41.7	20.5	20.5	20.5
Government Sector	13.9	48.2	22.4	22.4	22.4
<b>Total</b>	<b>331.0</b>	<b>1366.2</b>	<b>681.9</b>	<b>681.9</b>	<b>681.9</b>

The weir/ethanol scenario will have a significant economic impact on the provincial economy. Over the course of the study period (2015-2019), the project will add the following to the Saskatchewan economy:

- An average of 749 new positions within the province per year, including 682 new long term jobs;
- A cumulative \$271 million to provincial gross domestic product;
- An average of \$54 million to provincial gross domestic product per year; and
- An average of \$28 million in new wages and salaries (included in GDP) in Saskatchewan per year.

It should be noted that while the construction impacts will be felt throughout the provincial economy, the bulk of operational impacts will occur with the Lloydminster/Battledorfs region. As such, impacts at the regional level will be magnified.

## 2.0 Introduction and Methodology

### 2.1 Background

Golder Associates contracted SJ Research Services to assess the economic impact of the North Saskatchewan River water management options on the Saskatchewan economy. SJ Research

Service's Saskatchewan Input-Output Model was used to measure the provincial economic impacts associated with various water management options in terms of construction, investment, irrigation operation and tourism impacts.

The Saskatchewan Input-Output Model is a tool to assess the economic impact of an event, tourist spending, a new industry, or other shock to the provincial economy. The model expresses impacts on the local economy in terms of gross output, gross domestic product, new employment, and labour income. With the exception of employment, impacts are reported in millions of current dollars.

A more detailed discussion of the provincial input-output model is available in Appendix A.

SJ Research Service's input-output model of the provincial economy is based on Statistics Canada's 2003 Saskatchewan input-output table, the latest available. The model is rectangular with 21 industries and 57 commodities.

## 2.2 Study Focus

Initially, three scenarios were examined.

Scenario 1: Non-structural Investments to develop water resource – no storage capacity

Scenario 2: Off-channel Reservoir

Scenario 3: Highgate Dam – full supply level option

This paper deals with the impact of an additional scenario: the construction of a series of low head weirs facilitating the construction and operation of a \$150M ethanol plant in the region.

Weir construction would begin in 2015 and ethanol plant construction would begin in 2016 and become operational in 2017. No irrigation and tourism impacts are assumed to occur.

No resort development is assumed in this study. A five year horizon is considered too short a time period for resort development to occur. The region is already well served by a number of resort communities: Jackfish Lake, Cochin, Aquadeo, Sunset View Beach, and Turtleford/Turtle Lake. Finally, the province's relatively soft population growth is assumed to continue in the medium term.

In order to develop a profile of when incremental activity occurs within the region a number of assumptions were made:

### 1. Weir Construction and Operation

- Construction cost is \$30M
- Construction schedule is one year
- Construction costs are modeled as an increase in the non-residential component of gross fixed capital formation
- Construction costs are adjusted for leakages from imports
- Operating costs are .05% of construction costs (as per the Meridian Dam Study)
- No irrigation impacts are assumed
- No tourism impacts will occur

### 2. Ethanol Plant Construction and Operation.

- Construction cost is \$150M
- Construction schedule is one year

- A 2002 SJ Research Services study on an ethanol plant was used to determine the building and equipment mix of construction costs. Costs were inflated to 2016 levels using priced deflators from the Saskatchewan Bureau of Statistics economic accounts.
- Construction costs are modeled as an increase in the non-residential component of gross fixed capital formation. Equipment investment was assigned to the machinery and equipment component of gross fixed capital formation and adjusted for import leakages.
- Plant production begins in 2017.
- Value of plant output from the 2002 study was inflated to 2017 prices and scaled up to reflect differing plant sizes.
- Incremental plant output was modeled as an increase in manufacturing industry exports. Resulting direct employment was estimated by the input-output model.

### 3.0 Weir Construction and Operation

#### 3.1 Summary of Results

Employment Impacts - Saskatchewan - Weir		2015	2016	2017	2018	2019
Construction and Investment	Direct Employment	139.9	0.0	0.0	0.0	0.0
	Indirect Employment	71.7	0.0	0.0	0.0	0.0
	Induced Employment	119.4	0.0	0.0	0.0	0.0
	<b>Total Employment</b>	<b>331.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Operation	Direct Employment	0.0	0.1	0.1	0.1	0.1
	Indirect Employment	0.0	0.0	0.0	0.0	0.0
	Induced Employment	0.0	0.1	0.1	0.1	0.1
	<b>Total Employment</b>	<b>0.0</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>Total</b>		<b>331.0</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>

\*totals may not add due to rounding

GDP Impacts - Saskatchewan - Weir – Millions of Current Dollars		2015	2016	2017	2018	2019
Construction and Investment	Direct GDP	9.184	0.000	0.000	0.000	0.000
	Indirect GDP	5.378	0.000	0.000	0.000	0.000
	Induced GDP	6.214	0.000	0.000	0.000	0.000
	<b>Total GDP</b>	<b>20.776</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
Operation	Direct GDP	0.000	0.008	0.008	0.008	0.008
	Indirect GDP	0.000	0.003	0.003	0.003	0.003
	Induced GDP	0.000	0.003	0.003	0.003	0.003
	<b>Total GDP</b>	<b>0.000</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>
<b>Total</b>		<b>20.776</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>	<b>0.014</b>

It should be noted that 2015 direct impacts are confined solely to the construction industry. 2016 to 2019 direct impacts are limited to the utilities (water distribution) industry.

#### 3.2 Impacts by Industry – Construction and Investment

The following table provides total impacts (sum of direct, indirect, and induced) by industry of project construction on the provincial economy for a single year, 2015 in this case. The bulk of total and direct activity occurs within the construction industry itself (direct impacts). Indirect

impacts are observed in the industries providing inputs to construction. Induced impacts, which represent the additional impacts of consumer spending of wages earned, is concentrated heavily within the retail trade and service industries.

Total Impacts (\$M) Construction and Investment -2015 – Weir	Gross Output Impact	GDP @ Factor Cost Impact	GDP @ Market Prices Impact	Employment Impact (Positions)	Labour Income Impact
Crop and Animal Production	0.481	0.185	0.115	4.2	0.044
Forestry and Logging	0.054	0.010	0.016	0.1	0.008
Fishing, Hunting and Trapping	0.002	0.000	0.000	0.0	0.000
Support Activities for Agriculture and Forestry	0.010	0.006	0.006	0.2	0.006
Mining and Oil and Gas Extraction	2.980	1.718	1.823	3.7	0.273
Utilities	0.617	0.329	0.354	1.1	0.076
Construction	30.336	9.287	10.687	141.4	6.991
Manufacturing	1.830	0.536	0.549	6.2	0.279
Wholesale Trade	1.510	0.797	0.853	10.3	0.396
Retail Trade	2.070	1.148	1.211	42.5	0.949
Transportation and Warehousing	0.677	0.397	0.436	4.8	0.207
Information and Cultural Industries	0.731	0.443	0.467	5.7	0.242
Finance, Insurance, Real Estate and Rental and Leasing	5.039	2.833	3.443	15.4	1.379
Professional, Scientific and Technical Services	0.875	0.542	0.545	12.0	0.465
Administrative and Support, Waste Management and Remediation Services	0.428	0.322	0.329	11.2	0.237
Educational Services	0.045	0.029	0.028	1.5	0.028
Health Care and Social Assistance	0.351	0.263	0.259	5.8	0.233
Arts, Entertainment and Recreation	0.286	0.121	0.126	6.3	0.097
Accommodation and Food Services	0.852	0.395	0.431	18.2	0.307
Other Services (Except Public Administration)	0.561	0.346	0.359	16.1	0.274
Operating, Office, Cafeteria and Laboratory Supplies	1.185	0.000	0.000	0.0	0.000
Travel, Entertainment, Advertising and Promotion	0.833	0.000	0.000	0.0	0.000
Transportation Margins	0.162	0.000	0.000	0.0	0.000
Non-Profit Institutions Serving Households	0.524	0.359	0.369	10.3	0.344
Government Sector	1.171	0.712	0.728	13.9	0.606
<b>Total</b>	<b>53.610</b>	<b>20.776</b>	<b>23.133</b>	<b>331.0</b>	<b>13.440</b>

### 3.3 Operational Impacts

The following table provides total impacts (sum of direct, indirect, and induced) by industry of project operation on the provincial economy in 2016. The bulk of total and direct activity occurs within the utilities industry (which includes water distribution systems). Both indirect impacts (industries providing inputs to the utility sector) and induced impacts, which represent the additional impacts of consumer spending of wages earned, are minimal given the modest activity increase in utility output.

Total Impacts (\$M) Operational – 2016 - Weir	Gross Output Impact	GDP @ FC Impact	GDP @ Market Prices Impact	Employment Impact (Positions)	Labour Income Impact
Crop and Animal Production	0.000	0.000	0.000	0.0	0.000
Forestry and Logging	0.000	0.000	0.000	0.0	0.000

Fishing, Hunting and Trapping	0.000	0.000	0.000	0.0	0.000
Support Activities for Agriculture and Forestry	0.000	0.000	0.000	0.0	0.000
Mining and Oil and Gas Extraction	0.003	0.002	0.002	0.0	0.000
Utilities	0.013	0.007	0.007	0.0	0.002
Construction	0.001	0.000	0.000	0.0	0.000
Manufacturing	0.000	0.000	0.000	0.0	0.000
Wholesale Trade	0.000	0.000	0.000	0.0	0.000
Retail Trade	0.001	0.000	0.000	0.0	0.000
Transportation and Warehousing	0.000	0.000	0.000	0.0	0.000
Information and Cultural Industries	0.000	0.000	0.000	0.0	0.000
Finance, Insurance, Real Estate and Rental and Leasing	0.002	0.001	0.001	0.0	0.001
Professional, Scientific and Technical Services	0.000	0.000	0.000	0.0	0.000
Administrative and Support, Waste Management and Remediation Services	0.001	0.001	0.001	0.0	0.000
Educational Services	0.000	0.000	0.000	0.0	0.000
Health Care and Social Assistance	0.000	0.000	0.000	0.0	0.000
Arts, Entertainment and Recreation	0.000	0.000	0.000	0.0	0.000
Accommodation and Food Services	0.000	0.000	0.000	0.0	0.000
Other Services (Except Public Administration)	0.000	0.000	0.000	0.0	0.000
Operating, Office, Cafeteria and Laboratory Supplies	0.001	0.000	0.000	0.0	0.000
Travel, Entertainment, Advertising and Promotion	0.000	0.000	0.000	0.0	0.000
Transportation Margins	0.000	0.000	0.000	0.0	0.000
Non-Profit Institutions Serving Households	0.000	0.000	0.000	0.0	0.000
Government Sector	0.002	0.001	0.001	0.0	0.001
<b>Total</b>	<b>0.026</b>	<b>0.014</b>	<b>0.015</b>	<b>0.1</b>	<b>0.006</b>

\*totals may not add due to rounding

### 3.4 Employment Quality

Quality of jobs created is rated high during the construction phase. 141 jobs are expected to be created in the construction industry with an average wage of \$50,000-\$60,000 per year in 2003 dollars.

Long term employment quality is low with little incremental employment expected.

## 4.0 Ethanol Plant Construction and Operation

### 4.1 Summary of Results

Employment Impacts - Saskatchewan - Ethanol Plant		2015	2016	2017	2018	2019
Construction and Investment	Direct Employment	0.0	505.8	0.0	0.0	0.0
	Indirect Employment	0.0	377.3	0.0	0.0	0.0
	Induced Employment	0.0	483.0	0.0	0.0	0.0
	<b>Total Employment</b>	<b>0.0</b>	<b>1366.1</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Operation	Direct Employment	0.0	0.0	245.9	245.9	245.9
	Indirect Employment	0.0	0.0	198.2	198.2	198.2
	Induced Employment	0.0	0.0	237.6	237.6	237.6
	<b>Total Employment</b>	<b>0.0</b>	<b>0.0</b>	<b>681.8</b>	<b>681.8</b>	<b>681.8</b>

<b>Total</b>	<b>0.0</b>	<b>1366.1</b>	<b>681.8</b>	<b>681.8</b>	<b>681.8</b>
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<b>GDP Impacts - Saskatchewan - Ethanol Plant – Millions of Current Dollars</b>		<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
<b>Construction and Investment</b>	<b>Direct GDP</b>	0.000	45.012	0.000	0.000	0.000
	<b>Indirect GDP</b>	0.000	29.666	0.000	0.000	0.000
	<b>Induced GDP</b>	0.000	25.996	0.000	0.000	0.000
	<b>Total GDP</b>	<b>0.000</b>	<b>100.674</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
<b>Operation</b>	<b>Direct GDP</b>	0.000	0.000	21.386	21.386	21.386
	<b>Indirect GDP</b>	0.000	0.000	15.580	15.580	15.580
	<b>Induced GDP</b>	0.000	0.000	12.911	12.911	12.911
	<b>Total GDP</b>	<b>0.000</b>	<b>0.000</b>	<b>49.878</b>	<b>49.878</b>	<b>49.878</b>
<b>Total</b>	<b>0.000</b>	<b>100.674</b>	<b>49.878</b>	<b>49.878</b>	<b>49.878</b>	

It should be noted that 2016 direct impacts are confined solely to the construction industry. 2017 to 2019 direct impacts are limited to the manufacturing industry.

#### 4.2 Impacts by Industry – Construction and Investment

The following table provides total impacts (sum of direct, indirect, and induced) by industry of project construction on the provincial economy for a single year, 2016 in this case. Although a significant portion of direct activity occurs within the construction industry itself, a larger portion occurs within the manufacturing industry, reflecting the higher proportion of machinery and equipment required in ethanol plant construction. Indirect impacts are observed in the industries providing inputs to the construction and manufacturing industries. Induced impacts, which represent the additional impacts of consumer spending of wages earned, is concentrated heavily within the retail trade and service industries.

<b>Total Impacts (\$M) Construction and Investment -2016 – Ethanol Plant</b>	<b>Gross Output Impact</b>	<b>GDP @ Factor Cost Impact</b>	<b>GDP @ Market Prices Impact</b>	<b>Employment Impact (Positions)</b>	<b>Labour Income Impact</b>
<b>Crop and Animal Production</b>	12.865	4.953	3.092	111.5	1.191
<b>Forestry and Logging</b>	2.398	0.431	0.687	6.6	0.338
<b>Fishing, Hunting and Trapping</b>	0.014	0.005	0.002	0.2	0.003
<b>Support Activities for Agriculture and Forestry</b>	0.204	0.120	0.123	4.2	0.109
<b>Mining and Oil and Gas Extraction</b>	24.552	14.155	15.019	30.3	2.247
<b>Utilities</b>	4.683	2.496	2.690	8.6	0.580
<b>Construction</b>	26.852	8.221	9.460	125.2	6.188
<b>Manufacturing</b>	120.436	35.303	36.160	406.0	18.349
<b>Wholesale Trade</b>	6.505	3.433	3.672	44.2	1.706
<b>Retail Trade</b>	8.038	4.458	4.704	165.2	3.687
<b>Transportation and Warehousing</b>	3.827	2.241	2.460	26.9	1.167
<b>Information and Cultural Industries</b>	2.975	1.804	1.900	23.0	0.987
<b>Finance, Insurance, Real Estate and Rental and Leasing</b>	21.326	11.991	14.570	65.1	5.834
<b>Professional, Scientific and Technical Services</b>	2.565	1.590	1.597	35.3	1.364
<b>Administrative and Support, Waste Management and Remediation Services</b>	1.341	1.006	1.028	35.2	0.741
<b>Educational Services</b>	0.156	0.099	0.097	5.2	0.096

Health Care and Social Assistance	1.411	1.055	1.039	23.3	0.934
Arts, Entertainment and Recreation	1.056	0.445	0.464	23.3	0.356
Accommodation and Food Services	3.603	1.669	1.825	76.8	1.300
Other Services (Except Public Administration)	2.098	1.293	1.343	60.3	1.026
Operating, Office, Cafeteria and Laboratory Supplies	8.586	0.000	0.000	0.0	0.000
Travel, Entertainment, Advertising and Promotion	4.176	0.000	0.000	0.0	0.000
Transportation Margins	1.103	0.000	0.000	0.0	0.000
Non-Profit Institutions Serving Households	2.110	1.445	1.485	41.7	1.387
Government Sector	4.050	2.462	2.520	48.1	2.095
<b>Total</b>	<b>266.931</b>	<b>100.674</b>	<b>105.935</b>	<b>1366.1</b>	<b>51.686</b>

### 4.3 Operational Impacts

The following table provides total impacts (direct, indirect, and induced) by industry of project operation on the provincial economy in 2017. The bulk of total and direct activity occurs within the manufacturing industry. Indirect impacts (industries providing inputs to the manufacturing sector) are concentrated in agriculture and specialized business services. Induced impacts, which represent the additional impacts of consumer spending of wages earned, are concentrated heavily in trade and personal services.

Total Impacts (\$M) Operational – 2017 – Ethanol Plant	Gross Output Impact	GDP @ FC Impact	GDP @ Market Prices Impact	Employment Impact (Positions)	Labour Income Impact
Crop and Animal Production	8.036	3.094	1.931	69.7	0.744
Forestry and Logging	1.519	0.273	0.435	4.2	0.214
Fishing, Hunting and Trapping	0.008	0.003	0.001	0.1	0.002
Support Activities for Agriculture and Forestry	0.126	0.074	0.076	2.6	0.067
Mining and Oil and Gas Extraction	8.950	5.160	5.475	11.0	0.819
Utilities	2.557	1.362	1.469	4.7	0.317
Construction	0.938	0.287	0.331	4.4	0.216
Manufacturing	76.845	22.525	23.072	259.0	11.708
Wholesale Trade	3.276	1.729	1.850	22.3	0.859
Retail Trade	3.907	2.166	2.286	80.3	1.792
Transportation and Warehousing	2.037	1.193	1.309	14.3	0.621
Information and Cultural Industries	1.455	0.882	0.929	11.2	0.483
Finance, Insurance, Real Estate and Rental and Leasing	10.514	5.912	7.183	32.1	2.877
Professional, Scientific and Technical Services	1.111	0.688	0.692	15.3	0.591
Administrative and Support, Waste Management and Remediation Services	0.595	0.447	0.457	15.6	0.329
Educational Services	0.073	0.046	0.045	2.5	0.045
Health Care and Social Assistance	0.693	0.518	0.510	11.4	0.459
Arts, Entertainment and Recreation	0.504	0.213	0.222	11.1	0.170
Accommodation and Food Services	1.794	0.831	0.908	38.2	0.647
Other Services (Except Public Administration)	1.005	0.619	0.644	28.9	0.492
Operating, Office, Cafeteria and Laboratory Supplies	4.487	0.000	0.000	0.0	0.000
Travel, Entertainment, Advertising and Promotion	2.162	0.000	0.000	0.0	0.000
Transportation Margins	0.616	0.000	0.000	0.0	0.000
Non-Profit Institutions Serving Households	1.037	0.710	0.730	20.5	0.682
Government Sector	1.882	1.144	1.171	22.4	0.974

<b>Total</b>	<b>136.129</b>	<b>49.878</b>	<b>51.725</b>	<b>681.8</b>	<b>25.106</b>
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#### 4.4 Employment Quality

Quality of jobs created is rated high during the construction phase. 505 jobs are expected to be created in the construction industry with an average wage of \$50,000-\$60,000 per year in 2003 dollars.

As expected, long term employment quality is also highly rated with the concentration of employment within manufacturing. Average annual wages are in the \$45,000 to \$50,000 range in 2003 dollars

#### 5.0 Conclusion

This study measured the economic contribution of the weir water management option for the North Saskatchewan River and expected ethanol plant construction and operation over the course of 2015 to 2019. Impacts were the results of construction, investment, and increased manufacturing output. These impacts were stated in terms of gross output, gross domestic product (GDP), employment and labour income.

Over the period of 2015 to 2019, the weir/ethanol scenario is expected to add the following to the provincial economy:

- An average of 749 new positions within the province per year, including 682 new long term jobs;
- A cumulative \$271 million to provincial gross domestic product;
- An average of \$54 million to provincial gross domestic product per year; and
- An average of \$28 million in new wages and salaries (included in GDP) in Saskatchewan per year.

It should be noted that while the construction impacts will be felt throughout the provincial economy, the bulk of operational impacts will occur with the Lloydminster/Battelfords region. As such, impacts at the regional level will be proportionally higher.

## Bibliography

*An Approach to Estimating the Economic Impact of Climatic Change on a Regional Economy, Environment and Planning A*, 23:1197-1208. Johnson, S.G. and Jack C. Stabler. 1990

*Community Level Multipliers for Rural Development Initiatives*, Olfert, M. Rose and Jack C. Stabler. 1994. *Growth and Change*, 25: 467-486.

*Economic Impact of an Ethanol/Feedlot Operation on the Provincial Economy*, SJ Research Services, 2002

*Economic Impact of the Moose Jaw Communiplex on the Provincial and Local Economies*, SJ Research Services, 2006

*Economic Impact of Diamond Mine on the Provincial Economy*, SJ Research Services, 2000

*Experienced labour force 15 years and over by class of worker, by province and territory (2001 Census)* Statistics Canada, Census of Population

*Fact Sheet - Oil in Saskatchewan* – Saskatchewan Industry and Resources, 2007

*Fact Sheet– Gas in Saskatchewan* - Saskatchewan Industry and Resources, 2007

*Input-Output Analysis: Foundations and Extensions*, Miller, R. E., and P. Blair, 1985, Prentice Hall, Inc.

*Meridian Dam Preliminary Feasibility Study*, Golder Associates, 2002.

*Provincial Economic Accounts*, Saskatchewan Bureau of Statistics.

*Restructuring Rural Saskatchewan: the Challenge of the 1990s*, Stabler, Jack C. and M. Rose Olfert. 1992. Regina: Canadian Plains Research Center.

*Saskatchewan 2003 Input-Output Tables*, Statistics Canada Industry Accounts Division / System of National Accounts, 2006

*Socio-Economic Impact of Hog Operations in Alberta, Phase II: Case Study And Socio-Economic Findings*, Alberta Agriculture and Food 2004

*Tourism in West Central Saskatchewan*, Tourism Saskatchewan, 2006

## Appendix A: Definitions and Model Description

Final Demand: sum of personal expenditure, government purchases of goods and services, business and government investment, and net exports.

Gross Output: total expenditures on local goods and services as well as payments to labour and business profits. Gross output includes double counting because it includes the value of inputs used in production rather than net value added alone.

GDP at factor cost: measure of net economic activity within a prescribed geographic area. It represents the payments made to final factors of production: labour, unincorporated business profits, and other operating surplus (corporate profits, interest income, inventory valuation adjustments, and capital consumption allowances). GDP at factor cost excludes the value of intermediate goods and services used in production.

GDP at market prices: GDP at factor cost plus indirect taxes less subsidies.

Employment: measured in positions.

Direct Impact: total project expenditure, usually construction or operating outlays.

Indirect Impact: the secondary impact that includes inter-industry transactions, purchases of inputs from supporting industries

Induced impact: the additional impact from changes in household spending as industries modify labour input requirements in response to altered levels of demand for output.

Industry outputs are calculated as  $(I-D(I-\mu-\alpha-\beta)B)^{-1}D((I-\mu-\alpha-\beta)e^*+(I-\mu)\beta)X_d+(I-\mu)X_r=X$

Where:

I = an identity matrix of industry by industry dimension

D = a matrix of coefficients representing commodity output proportions

B = a matrix of coefficients representing commodity input proportions (technical coefficients) by industry

$\mu$  = a diagonal matrix whose elements represent the ratio of imports to use

$\alpha$  = a diagonal matrix whose elements represent the ratio of government production to use

$\beta$  = a diagonal matrix whose elements represent the ratio of inventory withdrawals to use

$e^*$  = final demand categories of consumption, government purchases of goods and services, business and government investment, and inventory additions.

$X_d$  = final demand category of domestic exports

$X_r$  = final demand category of re-exports.

Employment is calculated as a fixed number of positions per dollar of industry output.