Technical Memorandum

To: Denise Wilson, Director, Environmental Review Program – Minnesota Environmental Quality Board (EQB)
From: Barr Engineering Co. Project Team
Subject: Technical and Economic Assessment
Date: May 18, 2021
Project: Environmental Review Implementation Subcommittee (ERIS) Engagement (Project)

1.0 Introduction

As directed by EQB's 2020-2021 Workplan, and in response to Executive Order 19-37 on climate change, ERIS (a subcommittee of the Environmental Quality Board [EQB]) convened an Interagency Environmental Review Climate Technical Team to advise them on changes to the State Environmental Review Program requirements.

Accordingly, the Environmental Review Climate Technical Team developed the *DRAFT Recommendations: Integrating Climate Information into MEPA Program Requirements, dated December 2020*, (DRAFT Recommendations). EQB contracted with Barr Engineering Co. (Barr) to perform a technical assessment of potential impacts of the DRAFT Recommendations. Specifically:

- EQB provided Barr data detailing a five-year history of environmental review projects by mandatory category and RGU type. Barr selected a limited number of examples of project types that will potentially exceed 25,000 tons per year (TPY) carbon dioxide equivalent (CO_2e).
- Barr evaluated the potential annual number of mandatory category project types and project descriptions that will potentially have no Greenhouse Gas (GHG) emissions sources and projects that will potentially exceed 25,000 TPY CO_2e by mandatory category, by Responsible Governmental Unit (RGU) type.
- Barr assessed two examples of project types that will potentially exceed the 25,000 TPY CO_2e threshold.
- Barr identified project types and numbers of projects that may be subject to new Environmental Impact Statement (EIS) mandatory category.
- Barr assess two examples of project types that will potentially exceed the criteria for new EIS mandatory category.

In addition, EQB contracted with Barr to perform a high-level economic assessment of the DRAFT Recommendations. Specifically:

- Evaluate the economic impact on responsible governmental units to complete additional climate assessment requirements.

- Assess the economic impact on Minnesota if the DRAFT Recommendations are not implemented

This memorandum summarizes the results of the assessments. Section 2.0 of this memorandum describes the methods and results of the technical assessment. Section 3.0 of this memorandum describes the methods and results of the economic assessment.

2.0 Technical Assessment

2.1 Evaluation of Mandatory Project Types

The number of approved EAWs and EISs from 2016 – 2020 were broken out by each mandatory category outlined in Minnesota Rules Chapter 4410.4300 and the governing RGU involved for each project. Table 2-1 provides a summary.

Table 2-1 Quantity of Environmental Review Process Projects in Minnesota by Mandatory Category and RGU for 2016 - 2020

Environmental Review Process	Number of Projects by RGU		
	State	Local	Total
EAW	**120**	**215**	**335**
Subp 10 Storage facilities	3	0	3
Subp 12 Nonmetallic mineral mining	2	28	30
Subp 14 Industrial, commercial, and institutional facilities	3	20	23
Subp 15 Air pollution	3	0	3
Subp 17 Solid waste	7	0	7
Subp 18 Wastewater systems	7	0	7
Subp 19 Residential development	1	45	46
Subp 20 Campgrounds and RV parks	0	6	6
Subp 21 Airport projects	2	0	2
Subp 22 Highway projects	22	22	44
Subp 25 Marinas	0	6	6
Subp 26 Stream diversion	3	12	15
Subp 27 Public waters, public waters wetlands, and wetlands	14	28	42
Subp 29 Animal feedlots	41	1	42
Subp 3 Electric-generating facilities	1	1	2
Subp 30 Natural areas	1	1	2
Subp 31 Historical places	2	10	12
Subp 32 Mixed residential and industrial-commercial projects	0	20	20
Subp 34 Sports or entertainment facilities	0	1	1
Subp 36 Land use conversion, including golf courses	0	10	10
Subp 37 Recreational trails	8	3	11
Subp 6 Transmission lines	0	1	1

Environmental Review Process	Number of Projects by RGU		
	State	Local	Total
EIS	**2**	**2**	**4**
Subp 15 Airport runway projects	0	1	1
Subp 18 Water appropriation and impoundments	1	0	1
Subp 24 Pipelines	1	0	1
Subp 9 Nonmetallic mineral mining	0	1	1
Grand Total	**122**	**217**	**339**

Note: The other mandatory categories not listed in the table did not have any projects from 2016-2020.

Four mandatory categories had greater than 40 projects:

- Subp Residential Development;
- Subp 22 Highway Projects;
- Subp 27 Public waters, public waters wetlands, and wetlands; and,
- Subp 29 Animal feedlots.

Each of the mandatory categories were qualitatively analyzed to identify those that could potentially contribute CO_2e emissions greater than 25,000 TPY for each of three scopes outlined in Table 3 of Appendix B1 of the DRAFT Recommendations. The results from this analysis are summarized in Attachment A. Table 2-2 shows a summary of the number of each project that could potentially exceed 25,000 TPY CO_2e, contribute less than 25,000 TPY of CO_2e but greater than 0 TPY, and those projects that likely would contribute to 0 TPY CO_2e.

Table 2-2 The Number of Projects for each Scope of the DRAFT Recommendations that Potentially Exceed 25,000 TPY CO_2e, Exceed 0 TPY but Less than 25,000 TPY CO_2e, and are 0 TPY

Criteria	Scope 1 (Direct Operation/ Construction)	Scope 2 (Indirect Operation Off-site Electricity/Steam)	Scope 3 (Indirect Operation Off-site Waste Management)
Potentially > 25,000 tpy	30	15	17
Potentially < 25,000 tpy but > 0 tpy	8	17	7
Potentially 0 tpy	1	7	15

Based on the emission categories that EQB has outlined in Table 3 of Appendix B1 of the DRAFT Recommendations, 31 of the 39 mandatory categories have the potential to exceed 25,000 TPY CO_2e

when calculating their carbon footprint. There were eight mandatory categories that potentially would not exceed 25,000 TPY CO_2e:

- Subp 20 Campgrounds and RV parks;
- Subp 26 Stream diversion;
- Subp 27 Public waters, public waters wetlands, and wetlands;
- Subp 28 Forestry;
- Subp 35 Release of genetically engineered organisms;
- Subp 36a Land conversion in shoreland; and
- Subp 37 Recreational trails.

2.2 Example Project Types Potentially Exceeding 25,000 TPY CO_2e

Two mandatory categories were chosen to calculate a project carbon footprint based on the emission categories outlined in Table 3 of Appendix B1 of the DRAFT Recommendations: Industrial, Commercial, and Institutional Facilities (Subp 14) and Animal Feedlots (Subp 29). These evaluations are for informational purposes only and not representative of all projects that may occur within the mandatory categories selected. They provide example calculations based on the assumptions specified.

2.2.1 Subp 14: Industrial, Commercial, and Institutional Facilities

Industrial, Commercial and Institutional Facilities (Subp 14) was chosen due to the main RGU being the local government. From 2016 – 2020, local governments were the RGU for 20 of the 23 projects [Table 2-1] and projects in this category have scope 1, 2, and 3 emissions.

Barr selected a hospital redevelopment project includes redeveloping an existing footprint to include a new multi-story tower and renovating existing facilities. Elements of the proposed example project include:

- The project is proposed to be constructed and operated in an urban, developed setting;
- There is no land-use change related to the project;
- The construction phase of the project is anticipated to last for 36 months;
- The total project area is 34 acres with a multi-story tower of 920,000 square feet, for a total of 2,401,776.00 square feet;
- The proposed project will add 250 hospital beds to the existing 139 beds, for a total of 389 bed facility;

- The new facility plans to implement waste related best management practices and to recycle and compost appropriate material when applicable; and,
- The anticipated life of the project is 50 years.

The annual estimated carbon footprint based on the calculation guidance in Appendix B1 of the DRAFT Recommendations is 52,025.93 tons CO_2e. Table 2-3 below provides a summary of the results and details of the analysis are provided in Attachment B.

Table 2-3 Summary of Estimated Subp 14 Project Emissions by Scope According to Table 3 of Appendix B1 in the DRAFT Recommendations

Source Type ID	Scope	Project Phase	Type of Emission	Emission Sub-Type	Emitant	Estimated Subp 14 Project CO_2e Emissions (TPY)
Direct Emissions						
DE-1	Scope 1	Operations	Combustion	Stationary Area Mobile	CO_2, N_2O, CH_4	**12,188.90**
DE-2	Scope 1	Operations	Non-Combustion Processes	Stationary	CO_2, CH_4, N_2O, HFCs, PFCs, other fully fluorinated GHGs	**Not applicable**
DE-3	Scope 1	Construction/ Retirement	Combustion	Mobile	CO_2, N_2O, CH_4	**469.36**
DE-4	Scope 1	Construction/ Retirement	Land-Use	Area	CO_2, N_2O, CH_4	**Not applicable**
Indirect Emissions						
IE-1	Scope 2	Operations	Off-Site Electricity/Steam Production	Grid-Based	CO_2, N_2O, CH_4	**38,665.51**
IE-2	Scope 3	Operations	Off-Site Waste Management	Stationary Area Mobile	CO_2, CH_4	**702.16**
Atmospheric Removals of GHGs						
AR-1	Scope 1 Sinks	Construction/ Operations	Land Use	Area	CO_2 removals to terrestrial storage	**Not applicable**
Total Emissions plus Sinks = Direct Emissions + Indirect Emissions + Sinks						**52,025.93**

Approximately 74% of the total CO_2e emissions are from waste generation and electrical consumption of the project. This is a result of the large footprint of the project and the large amount of electrical demand from a heath care facility. The average electricity usage from a large hospital is 29.1 kilowatt-hours per square feet[1]. By removing the Scope 2 emissions, the project total becomes less than the 25,000 TPY CO_2e threshold at 13,360.42 TPY CO_2e.

2.2.2 Subp 29: Animal Feedlots

The second example chosen to calculate a carbon footprint based on the DRAFT Recommendations is Animal Feedlots (Subp 29). Animal Feedlots was chosen due to the large number of comments received during the public engagement process and Animal Feedlots also has one of the highest number of projects from 2016 – 2020 (Table 2-1).

The example project chosen is the development of a Jersey cow dairy feedlot. The feedlot will include the development of a cross-ventilated, total confinement, free-stall barn and will use earthen basins with impermeable covers to collect and store the manure and wastewater. The proposed project also includes the construction of two apartment buildings for employees. Elements of the proposed example project include:

- The number of dairy cows for the proposed project is 10,500;
- The total acreage of the proposed project is 150 acres, 90 of which will be impervious surfaces;
- Liquid manure will be transferred to area farms for use as fertilizer on cropland;
- The approximate amount of acreage required for manure application is 7,300 acres per year;
- The cattle will demand approximately 1,750 acres of alfalfa feed;
- The proposed project is planning to convert forested land into grassland and settlement;
- The lifetime of the proposed project is 50 years; and
- The alfalfa consumed by the dairy cows is grown off-site.

The annual estimated carbon footprint based on the calculation guidance in Appendix B1 of the DRAFT Recommendations is 86,550.74 tons CO_2e. Table 2-4 below provides a summary of the results and details of the analysis are provided in Attachment C.

[1] U.S. Energy Information Administration, 2007. Energy Characteristics and Energy Consumed in Large Hospital Buildings in the United States in 2007. https://www.eia.gov/consumption/commercial/reports/2007/large-hospital.php

Table 2-4 Summary of Estimated Subp 29 Project Emissions by Scope According to Table 3 of Appendix B1 in the DRAFT Recommendations

Source Type ID	Scope	Project Phase	Type of Emission	Emission Sub-Type	Emitant	Estimated Subp 29 Project CO_2e Emissions (TPY)
Direct Emissions						
DE-1	1	Operations	Combustion	Stationary Area Mobile	CO_2, N_2O, CH_4	**1,229.94**
DE-2	1	Operations	Non-Combustion Processes	Stationary	CO_2, N_2O, CH_4, HFCs, PFCs, other fully fluorinated GHGs	**76,105.20**
DE-3	1	Construction/ Retirement	Combustion	Mobile	CO_2, N_2O, CH_4	**127.85**
DE-4	1	Construction/ Retirement	Land-Use	Area	CO_2, N_2O, CH_4	**5,394.70**
Indirect Emissions						
IE-1	2	Operations	Off-Site Electricity/Steam Production	Grid-Based	CO_2, N_2O, CH_4	**5,808.82**
IE-2	3	Operations	Off-Site Waste Management	Stationary Area Mobile	CO_2, CH_4	**1.73**
Atmospheric Removals of GHGs						
AR-1	1 Sinks	Construction/ Operations	Land Use	Area	CO_2 removals to terrestrial storage	**(2,117.50)**
Total Emissions plus Sinks = Direct Emissions + Indirect Emissions + Sinks						**86,550.74**

Approximately 88% of the total CO_2e emissions from the proposed project are from manure storage and enteric fermentation (scope 1 – operations, non-combustion activity). Both of these processes emit large amounts of methane (CH_4) and nitrous oxide (N_2O), which have global warming potentials (GWPs) of 25 and 298, respectively.

2.3 Potential Project Types Subject to New EIS Category

The DRAFT Recommendations include a potential new EIS category:

"MR 4410.4400 subp. XX. Greenhouse Gas Pollution (GHG). A proposed project that results in cumulative GHG emissions for existing and future operations that exceeds an interim value of 100,000 tons per year CO_2e unless the proposed project:*

1. Is subject to a Best Achievable Control Technology analysis through federal air permitting requirements;

2. Has a GHG reduction plan that is publicly available and demonstrates the proposed project's GHG emissions will not significantly detract from the ability to meet state and/or local GHG reduction goals; or

3. Is subject to other federal, state or local permitting or environmental review that includes an assessment of the project's GHG emissions.

**"This number is proposed as an interim value using currently available information to support its use as an indicator for proposed projects that have the potential for significant environmental effects."*

Based on the EAW technical assessment, the projects that may potentially exceed 100,000 TPY are those that have a high electrical demand, high emissions from non-CO_2 GHGs that have a high GWP, and those that include operating large processing equipment (stationary sources with direct emissions). Therefore, there are approximately 10 project types have the potential to be subject to the new EIS category. They include:

- Subp 2 Nuclear fuels and nuclear waste;
- Subp 3 Electric generating facilities;
- Subp 4 Petroleum refineries;
- Subp 5 Fuel conversion facilities;
- Subp 11 Metallic mineral mining and processing;
- Subp 12 Nonmetallic mineral mining;
- Subp 13 Paper or pulp processing mills;
- Subp 19 Residential development;
- Subp 19a Residential development in shoreland outside of the seven-county Twin Cities metropolitan area; and
- Subp 21 Airport runway projects.

2.4 Example Project Types Potentially Exceeding New EIS Category

The Animal Feedlot (Subp 29) example from Section 2.2, had approximately 85,826.48 TPY CO_2e. This number may vary based on actual numbers of construction and operational equipment, mobile sources, electrical consumption, and number of dairy cows. The Animal Feedlot (Subp 29) example provided in Section 2.2 included 10,500 dairy cows at a proposed feedlot. If the number of dairy cows was increased by approximately 2,000, the projected CO_2e from the proposed project would be 100,322.71 TPY CO_2e.

Similarly with the Hospital Redevelopment (Subp 14), the majority of the CO_2e emissions are from electrical consumption. Therefore, project types that have high electrical demands may exceed 100,000 TYP. According to the U.S. Energy Information Administration, in 2019 the average annual electricity consumption of a U.S. residential home was 10,649 KWh[2]. For a 50 home development in the Midwest, that is approximately 585,000 TPY CO_2e.

3.0 Economic Assessment

3.1 Impact to RGUs to Complete Additional Climate Assessment Requirements

The level of effort necessary to prepare an EAW varies based on the scale and complexity of a project and depending on type, location, and potential impacts. Therefore, this economic assessment focuses on the estimated incremental effort and associated costs to quantify GHG emissions and climate adaptation/resiliency information for a range of projects within the mandatory categories listed in Minnesota Rules Chapter 4410.4300 based on the guidance and EAW form content specifically presented as appendices to the DRAFT Recommendations. Therefore, the costs may vary depend on the requirements adopted by the EQB.

3.1.1 Quantification of GHG Emissions

As detailed in Section 2.1; Barr estimates there will be projects within the mandatory categories listed in Minnesota Rules Chapter 4410.4300 that will have GHG emissions less than 25,000 TPY CO_2e and projects with emissions greater than 25,000 TPY CO_2e. This will result in a range of estimated levels of effort required to quantify GHG emissions. Accordingly, Tables 3-1 and 3-2 provide costs estimates to quantify GHG emissions for projects with less than and greater than 25,000 TPY CO_2e, respectively. The estimated level of effort to quantify GHG emissions for projects with greater than 25,000 TPY CO_2e assumes that there will be a greater number of sources to identify, calculate emissions, and prepare responses to the EAW form than for smaller projects. Therefore, the estimated incremental cost to prepare emission calculations and responses to the EAW form as presented in Appendix A of the DRAFT Recommendations is $3,360 to $6,720. Assuming a range of consulting rates, the estimated incremental costs could be +/- 10% of these values (Tables 3-1 and 3-2).

[2] U.S. Energy Information Administration, 2019. How much electricity does an American home use? https://www.eia.gov/tools/faqs/faq.php?id=97&t=3#:~:text=How%20much%20electricity%20does%20an,about%20877%20kWh%20per%20month.

Table 3-1 Estimated Costs to Quantify GHG Emissions – Project With Less than 25,000 TPY CO_2e

EAW Item	Average Estimated Hours	Average Rate[(A)]	Estimated Cost
GHG Quantification	16	$120	$1,920
Description of planned mitigation	12	$120	$1,440
Additional Information for GHG emissions greater than 25,000 TPY CO_2e	Not applicable	Not applicable	Not applicable
Total	**28**	**Not applicable**	**$3,360**
Total +10%	**Not applicable**	**Not applicable**	**$3,696**
Total – 10%	**Not applicable**	**Not applicable**	**$3,024**

(A) Average rate for a consultant preparing air emission inventories with 0 to 10 years of experience.

Table 3-2 Estimated Costs to Quantify GHG Emissions – Project With More than 25,000 TPY CO_2e

EAW Item	Average Estimated Hours	Average Rate[(A)]	Estimated Cost
GHG Quantification	20	$120	$2,400
Description of planned mitigation	16	$120	$1,920
Additional Information for GHG emissions greater than 25,000 TPY CO_2e	20	$120	$2,400
Total	**56**	**Not applicable**	**$6,720**
Total +10%	**Not applicable**	**Not applicable**	**$7,392**
Total – 10%	**Not applicable**	**Not applicable**	**$6,048**

(A) Average rate for a consultant preparing air emission inventories with 0 to 10 years of experience.

3.1.2 Climate Adaptation and Resiliency

Similar to GHG emission quantification, Barr estimates the level of effort required to develop responses to the climate adaptation and resiliency components included in the DRAFT Recommendations will vary with scale and complexity of a project. Table 3-3 provides a cost estimate for preparing the climate adaptation and resiliency components. The estimated incremental cost to prepare climate adaptation and resiliency responses to the EAW form as presented in Appendix A of the DRAFT Recommendations is $6,680. Assuming a range of consulting billing rates, the estimated incremental costs could be +/- 10% of these values (Tables 3-3). The costs assume the climate adaptation and resiliency assessment is based on a screening level of design, relatively early in the project's definition. The costs do not include any detailed quantitative risk analysis, engineering scenario technical modeling or downscaled climate modeling. If comments from the public or RGU indicate specific technical work is required for mapping, modeling and quantifying risks and resiliency, then costs could increase.

Table 3-3 Estimated Costs to Prepare Climate Adaptation and Resiliency Information

Component	Average Estimated Hours	Average Rate	Estimated Cost
Summarizing existing climate trends(A)	8	$120	$960
Describing how the project's proposed activities and design will interact with general climate trends (B)	16	$130	$2,080
Describing how the proposed project may worsen problems already accentuated by climate change(B)	16	$130	$2,080
Describe proposed adaptations to address the project effects identified(B)	12	$130	$1,560
Total	**52**	**Not applicable**	**$6,680**
Total + 10%	**Not applicable**	**Not applicable**	**$7,348**
Total – 10%	**Not applicable**	**Not applicable**	**$6,012**

(A) Average 2021 billing rate for an air quality/climate consultant with 0 to 10 years of experience.
(B) Average 2021 billing rate for a consultant specializing in climate adaptation and resiliency/green infrastructure

3.1.3 Overall Estimated Costs

Based on costs estimated in Sections 3.1.1 and 3.1.2, the total estimated incremental costs to prepare the emission calculations and climate adaptation/resiliency responses to the EAW form as presented in Appendix A of the DRAFT Recommendations are $10,040 to $13,400 (assuming a range of consulting rates, the estimated incremental costs could be +/- 10% of these values). To illustrate the costs another way; if the total cost to prepare an EAW without the GHG and climate adaptation/resiliency information is $30,000, adding greenhouse gas and adaptation/resiliency information would represent a cost increase of approximately 33%.

Estimated level of effort and costs provided in this document represent our professional opinion and were developed using information from similar projects and the consulting team's experience and qualifications. The opinion of cost represents the team's best judgment as experienced and qualified professionals familiar with preparing EAW's, based on environmental review related information available at this time and available cost information from other similar efforts. The opinion of probable cost will change depending on specific project types and information. In addition, since the team has no control over the cost of labor, materials, equipment, or services furnished by others, or over project proposer or RGU's methods of determining prices, or over competitive bidding or market conditions, it can be expected that proposals, bids, or actual costs will vary from this opinion of probable cost. If a more accurate opinion of probable cost is desired, a more defined scope for individual project is likely necessary.

3.2 Impact to Project Proposers

The development of GHG emissions reduction, mitigation and/or offsets could be a new work activity for project proposers. Determining the geography, timing and duration of mitigation efforts relative to

implementation of the proposed action will be an additional important cash flow consideration for the proposer. If GHG emissions reduction has not been part of a proposer's previous implementation approach, this additional consideration within the project's intended purpose and need could be new effort and added cost to the proposer.

Some private and public sector proposers may already have active Environmental, Social and Corporate Governance (ESG) efforts, Corporate Social Responsibility (CSR) efforts, or local city/county sustainability and climate action plans. In some cases, these efforts might improve the public's, proposer's and RGU's competencies related to estimating and reducing GHG emissions, identifying climate risks/impacts, and/or suggesting resiliency strategies. Some entities and proposers may not be actively involved in such efforts and could face a "learning curve", adding cost or time to complete the environmental review process.

3.3 Impact to Minnesota if DRAFT Recommendations are not Implemented

The impact to Minnesota for non-attainment of GHG reduction goals is a real cost borne by the people, businesses and public entities of the state. Conversely, GHG reductions provide real economic benefit in the form of reduced costs borne by society. GHG impacts, and therefore costs, are cumulative over time. Impacts due to GHGs are not regionalized, but rather borne globally. With this frame in mind, the relative economic tradeoffs for costs associated with GHG impacts, the benefits of avoiding portions of these impacts, and the cost of mitigating or reducing GHG emissions are discussed below.

The economic impact to Minnesota is considered relative to the legislative charge to reduce GHGs in Minnesota. This charge is summarized in the GHG Emissions Inventory 2005-2018 Biennial Report to the Legislature, March 2021 as:

> *Minn. Stat. § 216H.02 Greenhouse gas emissions control.*
> *"Subd. 1. Greenhouse gas emissions-reduction goal. It is the goal of the state to reduce statewide greenhouse gas emissions across all sectors producing those emissions to a level at least 15 percent below 2005 levels by 2015, to a level at least 30 percent below 2005 levels by 2025, and to a level at least 80 percent below 2005 levels by 2050. The levels shall be reviewed based on the climate change action plan study.*
>
> *Minn. Stat. § 216H.07 Emissions-reduction attainment; policy development process.*
> *Subd. 3. Biennial report. (a) By January 15 of each odd-numbered year, the commissioners of commerce and the Pollution Control Agency shall jointly report to the chairs and ranking minority members of the legislative committees with primary policy jurisdiction over energy and environmental issues the most recent and best available evidence identifying the level of reductions already achieved and the level necessary to achieve the reductions timetable in section 216H.02. (b) The report must be in easily understood nontechnical terms."*

According to the same state-wide inventory and as summarized in the Next Generation Energy Act goals, the 2016 state-wide GHG emissions of 161 million CO_2-e TPY are being targeted for reduction to 34.9 million CO_2-e TPY by 2050 (Figure 3-1).

In 2007, Governor Tim Pawlenty signed the bipartisan Next Generation Energy Act into law, setting statutory goals to reduce greenhouse gas (GHG) emissions by 15% from 2005 levels by 2015, 30% by 2025, and 80% by 2050. Minnesota missed its goal in 2015, and currently is not on track to meet future goals, either. Since 2005, overall GHG emissions overall have declined just eight percent.

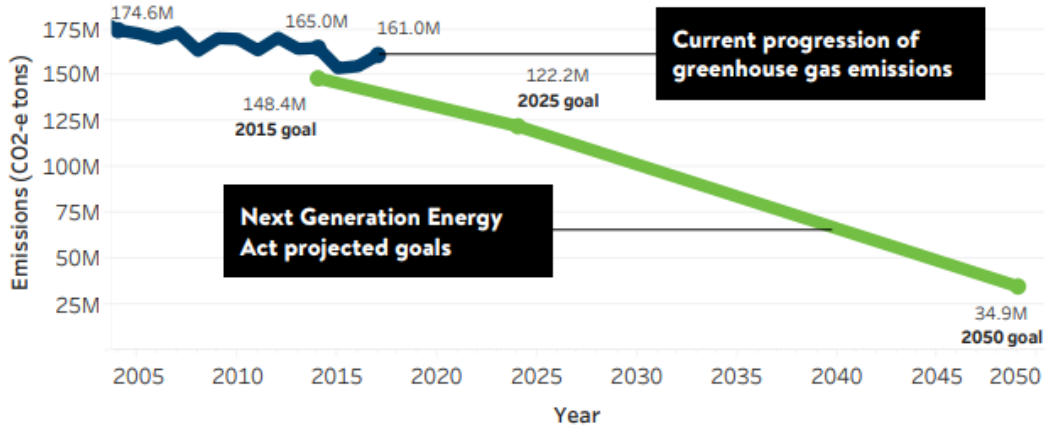

Figure above: Minnesota's greenhouse gas emissions (million tons CO2-e), 2005-2018, compared to the 2015, 2025, and 2050 goals of the Next Generation Energy Act.

Figure 3-1 Minnesota's GHG Emissions. Source: GHG Emissions Inventory 2005-2018. Biennial Report to the Legislature, March 2021.

US EPA and other federal agencies use estimates of the social cost of carbon (SC-CO2) to value the climate impacts of rulemakings. As defined by EPA, *"the SC-CO2 is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide (CO_2) emissions in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e. the benefit of a CO_2 reduction). The SC-CO_2 is meant to be a comprehensive estimate of climate change damages and includes, among other things, changes in net agricultural productivity, human health, property damages from increased flood risk and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning."*

Globally and locally, definitions and valuation of the SC-CO_2- vary. Various entities have assigned a value per ton GHG emitted by linking the global warming potential of the emissions (Figures 3-2 and 3-3)

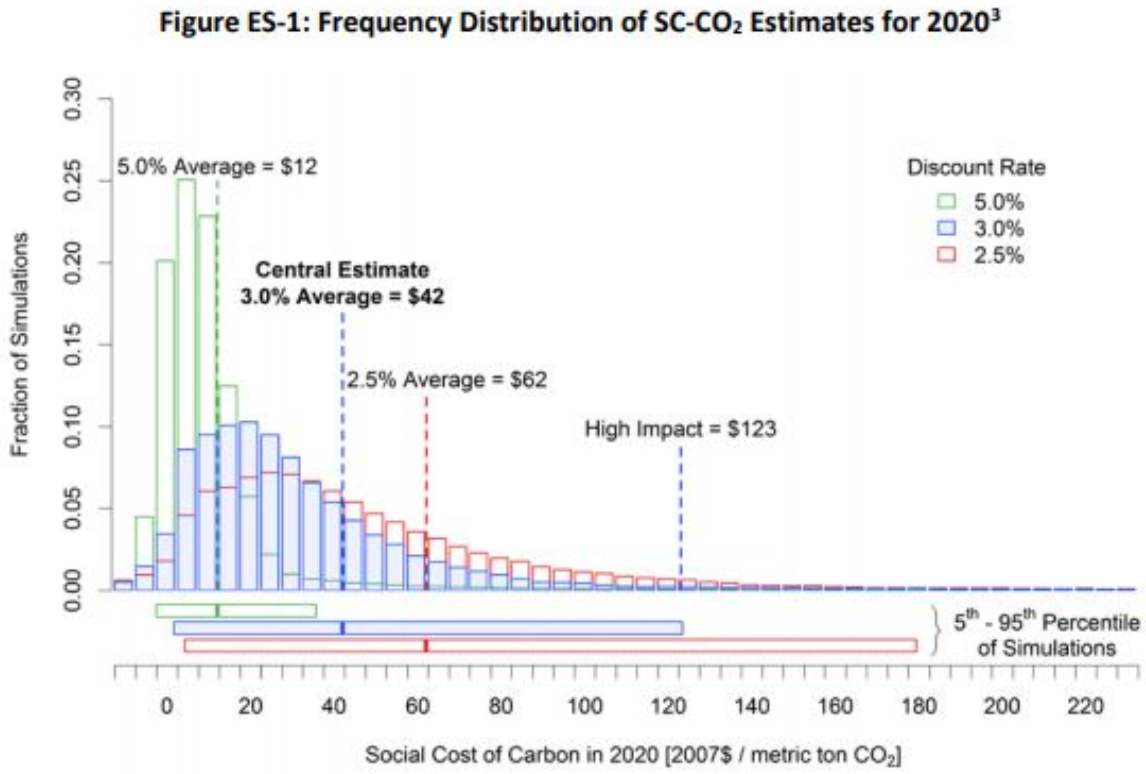

Figure 3-2 Typical United States Government Interagency Working Group Estimated Social Cost of Carbon Simulations Summary. Source: Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866

Social Cost of CO_2, 2015-2050 [a] (in 2007 dollars per metric ton CO_2)

Source: Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013, Revised August 2016)

	Discount Rate and Statistic			
Year	5% Average	**3% Average**	2.5% Average	High Impact (3% 95th percentile)
2015	$11	**$36**	$56	$105
2020	$12	**$42**	$62	$123
2025	$14	**$46**	$68	$138
2030	$16	**$50**	$73	$152
2035	$18	**$55**	$78	$168
2040	$21	**$60**	$84	$183
2045	$23	**$64**	$89	$197
2050	$26	**$69**	$95	$212

[a] The SC-CO_2 values are dollar-year and emissions-year specific.

Figure 3-3 Typical EPA Estimated Social Cost of Carbon 2015-2050. Source: EPA Fact Sheet. Social Cost of Carbon. 2016.

For comparative order-of-magnitude quantification, a 2025 social cost of carbon of $42/ton ($46/metric ton) was chosen from the EPA summary above, assuming 3% average discount rate, but other values are certainly relevant. Note that the federal guidance does consider range of SC-CO_2 values, with High Impact (95th percentile observed) 2025 is $125/ton ($138/metric ton) intended to represent simulations of lower-probability, higher-impact outcomes (Table 3-4). The range of values for SC-CO2 will continue to evolve as the economics of impacts are continually observed, studied and further defined.

Table 3-4 Estimated Social Cost of Carbon Emissions for Various Emissions Scenarios.

Emissions Scenario	Estimated CO_2e (TPY)	Assumed Social Cost of Carbon ($/T) [A]	Estimated Social Cost ($/Y)[B]
25,000 TPY EAW Threshold Value	25,000	$42	$1 million
100,000 TPY EIS Threshold Value	100,000	$42	$4 million
Project Scenario 1 (see Subpart 14 case study Section 2.2 Above)	52,000	$42	$2 million
Project Scenario 2 (see Subpart 29 case study Section 2.2 Above)	87,000	$42	$4 million
2016 Actual Statewide (2016 Minnesota Emission Inventory)	161,000,000	$42	$6,800 million
2050 Goal Statewide (2016 Minnesota Emission Inventory)	34,000,000	$42	$1,400 million

(A) Typical EPA Estimated Social Cost of Carbon 2015-2050. Source: EPA Fact Sheet. Social Cost of Carbon. 2016.
(B) Time-value-of-money discount rate for future years not included in the comparative SC-CO2 estimates in the table above.

Impacts borne by society due to GHG emissions and global climate change are represented in the SC-CO_2 valuations. Avoided emissions and the commensurate avoided social costs are an opportunity for the State of Minnesota to capture value and share that value with its neighbors, both locally and globally.

The incorporation of SC-CO_2 into project economics considerations continues to evolve at federal, state and local levels. For example, the January 2021 *Executive Order 13990*[3] outlines cost-benefit-analysis methods to monetize and link the interacting social, financial and environmental aspects of GHG emissions, mitigation and resiliency; in some cases, proposed project return-on-investment accounting can be formulated to incorporate SC-CO_2 considerations over the life of the project into payback period calculations, estimated rate of return and broader estimates of an action's broader societal costs and benefits. These project-specific approaches may supplement, but rarely entirely replace, baseline financial analysis for a proposed project.

Avoiding local costs directly attributable to specific climate-driven events influencing a specific proposer's action, infrastructure or community context are an additional opportunity to capture value. Climate change trends and impacts due to extreme precipitation, observed pattern changes to the hydrologic cycle create the risk of increased expenditures by project proposers, the public and public entities. Examples of expenditures at risk of increase includes repairing infrastructure damaged during extreme precipitation events, flooding damages, drought impacts to crops, infrastructure service interruptions, decreased level of service provided by an infrastructure asset, etc. Climate risk assessments and resilience strategies for individual projects may be aimed at capturing value in the form of risk reduction and avoided future impacts to people and damage to property or ecosystem services. These costs and benefits may be considered separately from broader social costs and benefits SC-CO_2 due to GHG emissions and emission reduction.

To summarize, calculating individual project GHG emissions estimates, considering emissions reduction and resiliency measures, and making this information available to the public during environmental review are one strategy the State of Minnesota can deploy to incrementally work toward meeting the state's emissions reduction goals. The state's efforts to further incorporate these considerations into environmental review are intended to incrementally generate benefits of avoided social costs linked to emissions-driven impacts to people, property and ecosystem services at both the global and local scales.

[3] Executive Order 13990 of January 20, 2021. Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis. Federal Register/Vo. 86, No. 14 / Presidential Documents. https://www.govinfo.gov/content/pkg/FR-2021-01-25/pdf/2021-01765.pdf

Attachment A

EAW Categories Potentially Contributing CO_2e Emissions Greater than 25,000 TPY

Attachment A

EAW Categories Potentially Contributing CO_2e Emissions Greater than 25,000 TPY

Mandatory Category - EAW[1]	Scope 1 (Direct. Operation/Construction)[2]			Scope 2 (Indirect Operation Off-site Electricity/Steam)[2]			Scope 3 (Indirect Operation Off-site Waste Management)[2]			Annual Number of Projects for each EAW Category					
	Potentially > 25,000 TPY	Potentially 0 TPY	Comments	Potentially > 25,000 TPY	Potentially 0 TPY	Comments	Potentially > 25,000 TPY	Potentially 0 TPY	Comments	2016	2017	2018	2019	2020	Total
Subp 2 Nuclear fuels and nuclear waste	X		Operation and construction	X			X			-	-	-	-	-	-
Subp 3 Electric generating facilities	X		Operation and construction	X					Potentially off-site waste > 0 TPY but < 25,000 TPY	-	1	-	1	-	2
Subp 4 Petroleum refineries	X		Operation and construction	X			X			-	-	-	-	-	-
Subp 5 Fuel conversion facilities	X		Operation and construction	X					Potentially off-site waste > 0 TPY but < 25,000 TPY	-	-	-	-	-	-
Subp 6 Transmission lines	X		Construction			Potentially off-site electricity for maintence facilities > 0 TPY but < 25,000 TPY		X		-	-	-	1	-	1
Subp 7 Pipelines	X		Construction			Potentially off-site electricity for maintence facilities > 0 TPY but < 25,000 TPY		X		-	-	-	-	1	1
Subp 8 Transfer facilities	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY			Potentially off-site waste > 0 TPY but < 25,000 TPY	-	-	-	-	-	-
Subp 9 Underground storage	X		Construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY		X		-	-	-	-	-	-
Subp 10 Storage facilities	X		Construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY		X		-	1	-	1	1	3
Subp 11 Metallic mineral mining and processing	X		Operation and construction	X			X			-	-	-	-	-	-
Subp 12 Nonmetallic mineral mining	X		Operation and construction			Potentially off-site electricity if electric trucks used in mining operations > 0 TPY but < 25,000 TPY	X			7	9	8	3	4	31
Subp 13 Paper or pulp processing mills	X		Operation and construction	X			X			-	-	-	-	-	-
Subp 14 Industrial, commercial, and institutional facilities	X		Operation and construction	X			X			7	7	6	-	3	23
Subp 15 Air pollution	X		Operation and construction	X				X		2	1	-	-	-	3
Subp 16 Hazardous waste	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY	X			-	-	-	-	-	-
Subp 17 Solid waste	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY	X			1	1	2	2	1	7
Subp 18 Wastewater systems	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY	X			3	1	-	1	2	7
Subp 19 Residential development	X		Operation and construction	X			X			1	13	16	4	12	46
Subp 19a Residential development in shoreland outside of the seven-county Twin Cities metropolitan area	X		Operation and construction	X			X			-	-	-	-	-	-
Subp 20 Campgrounds and RV parks			Construction to have > 0 TPY but < 25,000 TPY			Potentially off-site electricity > 0 TPY but < 25,000 TPY			Potentially off-site waste > 0 TPY but < 25,000 TPY	1	-	1	3	1	6
Subp 20a Resorts, campgrounds, and RV parks in shorelands	X		Construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY			Potentially off-site waste > 0 TPY but < 25,000 TPY	-	-	-	-	-	-
Subp 21 Airport projects	X		Operation and construction	X			X			-	1	-	1	-	2
Subp 22 Highway projects	X		Construction (potentially operations)			Potentially off-site electricity if accounting for electric vehicle traffic > 0 TPY but < 25,000 TPY		X		10	12	10	8	4	44
Subp 23 Barge fleeting	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY		X		-	-	-	-	-	-
Subp 24 Water appropriation and impoundments	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY		X		-	-	-	-	-	-
Subp 25 Marinas	X		Construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY			Potentially off-site waste > 0 TPY but < 25,000 TPY	6	-	-	-	-	6
Subp 26 Stream diversion			Construction to have > 0 TPY but < 25,000 TPY		X			X		3	3	5	3	1	15
Subp 27 Public waters, public waters wetlands, and wetlands			Construction to have > 0 TPY but < 25,000 TPY		X			X		8	6	11	6	11	42
Subp 28 Forestry			Construction to have > 0 TPY but < 25,000 TPY		X			X		-	-	-	-	-	-
Subp 29 Animal feedlots	X		Operation and construction			Potentially off-site electricity > 0 TPY but < 25,000 TPY			Potentially off-site waste > 0 TPY but < 25,000 TPY	8	10	12	6	6	42
Subp 30 Natural Areas			Construction to have > 0 TPY but < 25,000 TPY		X			X		-	1	-	-	1	2
Subp 31 Historical places	X		Construction (potentially operations depending on what type of replacement facility)	X		Depending on what type of replacement facility	X		Depending on what type of replacement facility	3	5	2	2	-	12
Subp 32 Mixed residential and industrial-commercial projects	X		Operation and construction	X			X			3	1	5	4	7	20
Subp 33 Communication towers			Construction to have > 0 TPY but < 25,000 TPY			Potentially off-site electricity > 0 TPY but < 25,000 TPY		X		-	-	-	-	-	-
Subp 34 Sports or entertainment facilities	X		Operation and construction	X			X			-	-	-	1	-	1
Subp 35 Release of genetically engineered organisms		X			X			X		-	-	-	-	-	-
Subp 36 Land use conversion, including golf courses	X		Construction (potentially operations depending on what type of replacement facility)	X		Depending on what type of replacement facility	X		Depending on what type of replacement facility	-	4	1	2	3	10
Subp 36a Land conversion in shoreland			Construction to have > 0 TPY but < 25,000 TPY		X		X			-	-	-	-	-	-
Subp 37 Recreational Trails			Construction to have > 0 TPY but < 25,000 TPY		X			X		1	1	4	4	1	11

Notes:

[1] https://www.revisor.mn.gov/rules/4410.4300/

[2] Table 3. Emission Categories for Project Carbon Footprint. Appendix B1 of EQB Draft GHG Guidance.

Attachment B

Subp 14: Industrial, Commercial, and Institutional Facilities Analysis

Attachment B
Subp 14: Industrial, Commercial, and Institutional Facilities Analysis

Summary of Estimated Project GHG Emissions

Key Assumptions

- The project is proposed to be constructed and operated in an urban, developed setting.
- There is no land-use change related to the project.
- The construction phase of the project is anticipated to last for 36 months.
- The total project area is 34 acres with a multi-story tower of 920,000 square feet, for a total of 2,401,776.00 square feet.
- The proposed project will add 250 hospital beds to the existing 139 beds, for a total of 389 bed facility.
- The new facility plans to implement waste best management practices and to recycle and compost appropriate material when applicable.
- The anticipated life of the project is 50 years.

Source Type ID	Emission Source	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	SF_6 (tons/year)[1]	PFCs (tons/year)[1]	HFCs (tons/year)[1]	CO_2e (tons/year)[2]
Direct Emissions								
DE-1	Operations - stationary combustion - natural gas	7,292.63	0.14	0.01	-	-	-	7,300.17
DE-1	Operations - stationary combustion - diesel	21.07	8.55E-04	1.71E-04	-	-	-	21.14
DE-1	Operations - stationary combustion - kerosene	87.09	3.47E-03	6.95E-04	-	-	-	87.38
DE-1	Operations - diesel mobile sources	17.56	0.00	0.00	-	-	-	17.82
DE-1	Operations - gasoline mobile sources	4,761.36	0.00	0.00	-	-	-	4,762.38
DE-3	Construction - diesel mobile sources	371.14	0.01	0.02	-	-	-	376.68
DE-3	Construction - gasoline mobile sources	89.32	0.13	0.00	-	-	-	92.68
Subtotal								**12,658.26**
Indirect Emissions								
IE-1	Off-site - electricity	38,384.51	4.16	0.59	-	-	-	38,665.51
IE-2	Off-site - waste - landfill	-	-	-	-	-	-	511.53
IE-2	Off-site - waste - recycling	-	-	-	-	-	-	76.59
IE-2	Off-site - waste - combustion	-	-	-	-	-	-	73.19
IE-2	Off-site - waste - compost	-	-	-	-	-	-	40.85
Subtotal								**39,253.63**
TOTAL		**51,024.68**	**4.44**	**0.63**	**-**	**-**	**-**	**52,025.93**

Notes:

(1) Emissions from cooling and refrigeration systems are not accounted for in this analysis. Literature suggests that GHGs fromrefrigerants are approximately < 5% of the total GHG budget for hospitals. https://practicegreenhealth.org/sites/default/files/2019-06/PracticeGreenhealth_GHG_Toolkit_0.pdf

(2) Global Warming Potentials: CO_2 = 1, CH_4 = 25, and N_2O = 298. EPA, Inventory of US Sources and Sinks of Greenhouse Gases, EPA-430-R-19-001, Table ES-1, Federal Register, CFR part 98, Mandatory Greenhouse Gas Reporting, Table A-1, with additions

Attachment B

Subp 14: Industrial, Commercial, and Institutional Facilities Analysis

Summary of Estimated Stationary Combustion GHG Emissions

1 kg =	0.00110231	short tons

					Heat Content (HHV)[1]		CO_2 Emission Factor[1]		CH_4 Emission Factor[1]		N_2O Emission Factor[1]					
Source Type ID	Emission Source	Average Fuel Usage[2]	Unit	Fuel Type	Value	Unit	Value	Unit	Value	Unit	Value	Unit	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
DE-1	Boilers	121,308,517.65	scf/yr	Natural Gas	0.001026	mmBtu/scf	53.06	kg CO_2/MMBtu	1.0	g CH_4/MMBtu	0.1	g N_2O/MMBtu	7,279.64	0.14	0.01	7,287.15
DE-1	Generators - Diesel	1,873.00	gal/yr	Diesel	0.138	mmBtu/gal	73.96	kg CO_2/MMBtu	3.0	g CH_4/MMBtu	0.6	g N_2O/MMBtu	21.07	8.55E-04	1.71E-04	21.14
DE-1	Generators - Kerosene	7,782.00	gal/yr	Kerosene	0.135	mmBtu/gal	75.2	kg CO_2/MMBtu	3.0	g CH_4/MMBtu	0.6	g N_2O/MMBtu	87.09	3.47E-03	6.95E-04	87.38
DE-1	Comfort Heaters	216,618.00	scf/yr	Natural Gas	0.001026	mmBtu/scf	53.06	kg CO_2/MMBtu	1.0	g CH_4/MMBtu	0.1	g N_2O/MMBtu	13.00	2.45E-04	2.45E-05	13.01
												TOTAL	**7,400.79**	**0.14**	**0.01**	**7,408.69**

Notes:

(1) Table 1, Stationsry Combustion. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Fuel usage estimates are based off a similar and recent hospital EAW example.

Attachment B

Subp 14: Industrial, Commercial, and Institutional Facilities Analysis

Summary of Estimated Mobile GHG Emissions

1 gram =	1.1023E-06	short ton
Life of Project =	50	years
Time of construction =	36	months

											Fuel Amount		CO2 Emission Factors[1]		CH4 Emission Factors		N2O Emission Factors				
Source Type ID	Emission Source	Number of Units	Hours of Operation/ year[8]	Vehicle Type[10]	Estimated Vehicle Year[9]	Fuel Type	MPG	VMT (per day)	hp if applicable	hp-hr if applicable	Value[7]	Unit	Value	Unit	Value	Unit	Value	Unit	CO2 (tons/year)	CH4 (tons/year)	N2O (tons/year)	CO2e (tons/year)
DE-1	Operations - diesel mobile sources - Nonroad	2	260	Construction Equipment[5]	N/A	Diesel	N/A	N/A	60	31,200	1,560	gallon/year	10.21	kg CO2/gallon	0.28	g CH4/gallon[2]	0.49	g N2O/gallon[2]	17.56	0.00	0.00	17.82
DE-1	Operations - gasoline mobile sources[6]	510	3650	Passenger Cars	2007	Gasoline	20	14	N/A	N/A	265,929	gallon/year	8.78	kg CO2/gallon	0.0072	g CH4/mile[3]	0.0052	g N2O/mile[3]	2,573.71	0.00	0.00	2,574.22
DE-1	Operations - gasoline mobile sources[6]	510	3650	Passenger Cars (Light-Duty)	2007	Gasoline	17	14	N/A	N/A	226,039	gallon/year	8.78	kg CO2/gallon	0.0103	g CH4/mile[3]	0.0061	g N2O/mile[3]	2,187.65	0.00	0.00	2,188.17
DE-3	Construction - gasoline mobile sources - Nonroad	50	3650	Construction Equipment[5]	N/A	Gasoline (2 stroke)	N/A	N/A	7	1,277,500	459,900	total gallons	8.78	kg CO2/gallon	12.42	g CH4/gallon[2]	0.07	g N2O/gallon[2]	89.02	0.13	0.00	92.38
DE-3	Construction - gasoline mobile sources	100	3650	Passenger Cars	2007	Gasoline	20	14	N/A	N/A	1,564	total gallons	8.78	kg CO2/gallon	0.0072	g CH4/mile[3]	0.0052	g N2O/mile[3]	0.30	0.00	0.00	0.30
DE-3	Construction - diesel mobile sources - Nonroad	30	3650	Construction Equipment[5]	N/A	Diesel	N/A	N/A	100	10,950,000	1,642,500	total gallons	10.21	kg CO2/gallon	0.28	g CH4/gallon[2]	0.49	g N2O/gallon[2]	369.71	0.01	0.02	375.25
DE-3	Construction - diesel mobile sources - On-Road	10	3650	Medium- and Heavy-Duty Trucks	2007-2018	Diesel	15	5	N/A	N/A	3,285	total gallons	10.21	kg CO2/gallon	0.0095	g CH4/mile[4]	0.0431	g N2O/mile[4]	0.74	0.00	0.00	0.74
DE-3	Construction - diesel mobile sources - On-Road	10	3650	Light Trucks	2007-2018	Diesel	14	5	N/A	N/A	3,066	total gallons	10.21	kg CO2/gallon	0.029	g CH4/mile[4]	0.0214	g N2O/mile[4]	0.69	0.00	0.00	0.69
																		TOTAL	**5,239.38**	**0.14**	**0.02**	**5,249.57**

Notes:

(1) Table 2, Mobile Combustion CO2. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Table 5, Mobile Combustion CH4 and N2O for Non-Road Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(3) Table 3, Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(4) Table 4, Mobile Combustion CH4 and N2O for On-Road Diesel and Alternative Fuel Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(5) Includes equipment, such as cranes, dumpers, and excavators, as well as fuel consumption from trucks that are used off-road in construction.

(6) Based off 2019 total number of hospital workers in MN (132,474 people) and the number of hospitals in MN (130 hospitals) divided by two to split between cars and SUVs.

(7) For nonroad sources, fuel amount is calculated based on fuel useage estimates per horsepower-hour (0.05 gallons for diesel, 0.12 gallons for gasoline) from Table A9-3E in SCAQMD CEQA Air Quality Handbook (https://www.cvwd.org/ArchiveCenter/ViewFile/Item/608).

(8) Based on 10 hrs/day, 6 days/week for 1 year, except for nonroad diesel operational source which is 5hrs/week for 1 year.

(9) Values based off of the most convservative year (2007) for the most recent year average for medium- and heavy-duty tricks and light trucks (2007-2018). https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(10) Numbers are based on a hypethetical assessment and not from a specific source.

Attachment B
Subp 14: Industrial, Commercial, and Institutional Facilities Analysis

Summary of Estimated Indirect GHG Emissions

1lb =	0.0005	short tons
1 metric tons =	1.10231	short tons
Total Project Area =	2,401,776.00	square feet
Total Operational Waste[4] =	2,058.78	short tons

				CO2 Emission Factor		CH4 Emission Factor		N2O Emission Factor		CO2e Emission Factors					
Source Type ID	Emission Source	Value	Unit	Value	Unit	Value	Unit	Value	Unit	Value	Unit	CO2 (tons/year)	CH4 (tons/year)	N2O (tons/year)	CO2e (tons/year)
IE-1	Off-site - electricity[3]	29.1	kWh/ft^2	1098.4	lb/MWh[1]	0.119	lb/MWh[1]	0.017	lb/MWh[1]	N/A	N/A	38,384.51	4.16	0.59	38,665.51
IE-2	Off-site - waste - landfill (MSW)[5]	823.51	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.52	metric tons CO2e/short tons material[2]	N/A	N/A	N/A	472.04
IE-2	Off-site - waste - recycling (Mixed Recyclables)[5]	772.04	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.09	metric tons CO2e/short tons material[2]	N/A	N/A	N/A	76.59
IE-2	Off-site - waste - MSW combustion (medical/hazardous waste)[5]	154.41	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.43	metric tons CO2e/short tons material[2]	N/A	N/A	N/A	73.19
IE-2	Off-site - waste - Food wate (compost, non-meat)[5]	247.05	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.15	metric tons CO2e/short tons material[2]	N/A	N/A	N/A	40.85
IE-2	Off-site - waste - Food wate (landfill, meat only)[5]	61.76	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.58	metric tons CO2e/short tons material[2]	N/A	N/A	N/A	39.49
											TOTAL	**38,384.51**	**4.16**	**0.59**	**39,367.67**

Notes:

(1) Table 6, Electricity. MROW (MRO West) Subregion. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Table 9, Scope 3 Category 5: Waste Generated in Operations and Category 12: End-of-Life Treatment of Sold Products. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(3) Based on information from the U.S Energy Information Administration. 2007 values. https://www.eia.gov/consumption/commercial/reports/2007/large-hospital.php

(4) Value based on 29 lbs of waste per hospital bed per day (https://practicegreenhealth.org/topics/waste/waste-0#:~:text=Hospitals%20generate%20over%2029%20pounds,Recycling%20isn't%20enough.) and 139 current number beds in the hospital (https://www.ahd.com/states/hospital_MN.html) plus the addition of 250 beds from project.

(5) Landfill MSW waste is 40% of total (solid waste), landfill food waste is 3% of total (meat only food waste), recyclable waste is 37.5% of total (including half of all hazardous waste, 7.5%), compost waste is 12% of total (all non-meat food waste), combusted waste is 7.5% of total (half of hazardous waste). Percentages were broken down from Practice Greenhealth (https://practicegreenhealth.org/topics/waste/waste-0#:~:text=Hospitals%20generate%20over%2029%20pounds,Recycling%20isn't%20enough.).

Attachment C

Subp 29: Animal Feedlot Analysis

Attachment C
Subp 29: Animal Feedlot Analysis

Summary of Estimated Project GHG Emissions

Key Assumptions

- The number of dairy cows for the proposed project is 10,500.
- The total acreage of the proposed project is 150 acres, 90 of which will be impervious surfaces.
- Liquid manure will be transferred to area farms for use as fertilizer on cropland.
- The approximate amount of acreage required for manure application is 7,300 acres per year.
- The cattle will demand approximately 1,750 acres of alfalfa feed.
- The proposed project is planning to convert forested land into grassland and settlement.
- The lifetime of the proposed project is 50 years.
- All alfalfa consumed by dairy cows will be grown offsite.

Source Type ID	Emission Source	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	SF_6 (tons/year)[1]	PFCs (tons/year)[1]	HFCs (tons/year)[1]	CO_2e (tons/year)[2]
Direct Emissions								
DE-1	Operations - stationary combustion	526.29	9.03E-04	1.81E-04	-	-	-	526.36
DE-1	Operations - diesel mobile sources	410.79	0.01	0.02	-	-	-	416.95
DE-1	Operations - gasoline mobile sources	279.58	0.21	0.01	-	-	-	286.64
DE-2	Operations - Manure storage	-	1,075.50	14.22	-	-	-	31,125.16
DE-2	Operations - Enteric fermentation	-	1,550.94	-	-	-	-	38,773.40
DE-2	Operations - Manure land application			20.83	-	-	-	6,206.63
DE-3	Construction - diesel mobile sources	30.34	0.00	0.00	-	-	-	30.59
DE-3	Construction - gasoline mobile sources	94.79	0.09	0.00	-	-	-	97.26
DE-4	Land-Use Change	-	-	-	-	-	-	5,394.70
Subtotal								**82,857.69**
Indirect Emissions								
IE-1	Off-site - electricity	5,766.60	0.62	0.09	-	-	-	5,808.82
IE-2	Off-site - waste - landfill	-	-	-	-	-	-	1.55
IE-2	Off-site - waste - recycling	-	-	-	-	-	-	0.11
IE-2	Off-site - waste - compost	-	-	-	-	-	-	0.08
Subtotal								**5,810.55**
Atmospheric Removal Emissions								
AR-1	GHG sink related to row crop converted to alfalfa for cattle feed	-	-	-	-	-	-	(2,117.50)
TOTAL		**7,108.38**	**2,627.38**	**35.16**	**-**	**-**	**-**	**86,550.74**

Notes:

(1) GHG emissions not involved in animal feedlot development and operations and therefore are not accounted for in this analysis.

(2) Global Warming Potentials: CO_2 = 1, CH_4 = 25, and N_2O = 298. EPA, Inventory of US Sources and Sinks of Greenhouse Gases, EPA-430-R-19-001, Table ES-1, Federal Register, CFR part 98, Mandatory Greenhouse Gas Reporting, Table A-1, with additions

Attachment C
Subp 29: Animal Feedlot Analysis

Summary of Estimated Stationary Combustion GHG Emissions

1 kg =	0.00110231	short tons

								Heat Content (HHV)[1]		CO_2 Emission Factor[1]		CH_4 Emission Factor[1]		N_2O Emission Factor[1]					
Source Type ID	**Emission Source**	**Number of Units**	**Hours of Operation/ year**	**hp if applicable**	**hp-hr if applicable**	**Total Gallons**	**Fuel Type**	**Value**	**Unit**	**Value**	**Unit**	**Value**	**Unit**	**Value**	**Unit**	**CO_2 (tons/year)**	**CH_4 (tons/year)**	**N_2O (tons/year)**	**CO_2e (tons/year)**
DE-1	Heater[2]	3	N/A	N/A	N/A	1000	Propane	0.091	MMBtu/gal	62.87	kg CO_2/MMBtu	3.0	g CH_4/MMBtu	0.6	g N_2O/MMBtu	18.92	9.03E-04	1.81E-04	19.00
DE-1	Processing Equipment[3]	3	4380	10	43800	15768	Gasoline	0.125	MMBtu/gal	70.22	kg CO_2/MMBtu	3.0	g CH_4/MMBtu	0.6	g N_2O/MMBtu	152.56	6.52E-03	1.30E-03	153.12
DE-1	Processing Equipment[3]	1	4380	60	262800	31536	Diesel	0.138	MMBtu/gal	73.96	kg CO_2/MMBtu	3.0	g CH_4/MMBtu	0.6	g N_2O/MMBtu	354.80	1.44E-02	2.88E-03	356.02
Notes:															**TOTAL**	**526.29**	**0.02**	**0.00**	**528.13**

(1) Table 1, Stationary Combustion. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Heater size is based off the average home furnace burn rate of 1,000 gal/yr. https://www.kauffmangas.com/blog/how-much-propane-gas-do-you-need-to-fuel-your-home/

(3) This includes equipment for feed processing and milk pumping. Assuming 12hrs/day for 7 days per week. Fuel amount is calculated based on fuel usage estimates per horsepower-hour (0.05 gallons for diesel, 0.12 gallons for gasoline) from Table A9-3E in SCAQMD CEQA Air Quality Handbook (https://www.cvwd.org/ArchiveCenter/ViewFile/Item/608).

Attachment C
Subp 29: Animal Feedlot Analysis

Summary of Estimated Mobile GHG Emissions

1 gram =	1.1023E-06	short ton
Life of Project =	50	years
Time of construction =	36	months

											Fuel Amount		CO_2 Emission Factors[1]		CH_4 Emission Factors		N_2O Emission Factors					
Source Type ID	Emission Source	Number of Units[10]	Hours of Operation/ year[7]	Vehicle Type	Estimated Vehicle Year[8]	Fuel Type	MPG	VMT/day	hp if applicable	hp-hr if applicable	Value[6]	Unit	Value	Unit	Value	Unit	Value	Unit	CO_2 (tons/year)	CH_4 (tons/year)	N_2O (tons/year)	CO_2e (tons/year)
DE-1	Operations - gasoline mobile sources - Nonroad	1	3650	Agricultural Equipment/Off-road Trucks[5]	N/A	Gasoline (4 stroke)	N/A	N/A	60	219000	26,280	gallon/year	8.78	kg CO_2/gallon	7.24	g CH_4/gallon[2]	0.21	g N_2O/gallon[2]	254.34	0.21	0.01	261.40
DE-1	Operations - diesel mobile sources - Nonroad	2	3650	Agricultural Equipment/Off-road Trucks[5]	N/A	Diesel	N/A	N/A	100	730000	36,500	gallon/year	10.21	kg CO_2/gallon	0.28	g CH_4/gallon[2]	0.49	g N_2O/gallon[2]	410.79	0.01	0.02	416.95
DE-1	Operations - gasoline mobile sources	5	3650	Passenger Cars	2007	Gasoline	20	14	N/A	N/A	2,607	gallon/year	8.78	kg CO_2/gallon	0.0072	g CH_4/mile[3]	0.0052	g N_2O/mile[3]	25.23	0.00	0.00	25.24
DE-3	Construction - gasoline mobile sources - Nonroad	6	2600	Construction Equipment[5]	N/A	Gasoline (2 stroke)	N/A	N/A	60	936000	336,960	total gallons	8.78	kg CO_2/gallon	12.42	g CH_4/gallon[2]	0.07	g N_2O/gallon[2]	90.59	0.09	0.00	93.05
DE-3	Construction - diesel mobile sources - Nonroad	2	2600	Construction Equipment[9]	N/A	Diesel	N/A	N/A	100	520000	78,000	total gallons	10.21	kg CO_2/gallon	0.2	g CH_4/gallon[2]	0.47	g N_2O/gallon[2]	24.38	0.00	0.00	24.63
DE-3	Construction - diesel mobile sources - On-Road	3	2600	Medium- and Heavy-Duty Trucks	2007-2018	Diesel	15	5	N/A	N/A	9,855	total gallons	10.21	kg CO_2/gallon	0.0095	g CH_4/mile[4]	0.0431	g N_2O/mile[4]	3.08	0.00	0.00	3.08
DE-3	Construction - diesel mobile sources - On-Road	3	2600	Light Trucks	2007-2018	Diesel	14	5	N/A	N/A	9,198	total gallons	10.21	kg CO_2/gallon	0.029	g CH_4/mile[4]	0.0214	g N_2O/mile[4]	2.88	0.00	0.00	2.88
DE-3	Construction - gasoline mobile sources	10	2600	Passenger Cars	2007	Gasoline	20	14	N/A	N/A	15,643	total gallons	8.78	kg CO_2/gallon	0.0072	g CH_4/mile[3]	0.0052	g N_2O/mile[3]	4.21	0.00	0.00	4.21
																		TOTAL	**815.50**	**0.31**	**0.03**	**831.43**

Notes:

(1) Table 2, Mobile Combustion CO_2. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Table 5, Mobile Combustion CH_4 and N_2O for Non-Road Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(3) Table 3, Mobile Combustion CH_4 and N_2O for On-Road Gasoline Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(4) Table 4, Mobile Combustion CH_4 and N_2O for On-Road Diesel and Alternative Fuel Vehicles. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(5) Includes equipment, such as tractors and combines, as well as fuel consumption from trucks that are used off-road in agriculture.

(6) for Nonroad sources, fuel amount is calculated based on fuel usage estimates per horsepower-hour (0.05 gallons for diesel, 0.12 gallons for gasoline) from Table A9-3E in SCAQMD CEQA Air Quality Handbook (https://www.cvwd.org/ArchiveCenter/ViewFile/Item/608).

(7) Based on 10 hrs/day, 5 days/week for 1 year for construction, 10 hrs/day, 7/days a week for 1 year for operations.

(8) Values based off of the most conservative year (2007) for the most recent year average for medium- and heavy-duty tricks and light trucks (2007-2018). https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(9) Includes equipment, such as cranes, dumpers, and excavators, as well as fuel consumption from trucks that are used off-road in construction.

(10) Numbers are based on a hypothetical assessment and not from a specific source.

Attachment C

Subp 29: Animal Feedlot Analysis

Summary of Estimated Indirect GHG Emissions

1lb =	0.0005	short tons
1 metric tons =	1.10231	short tons

				CO_2 Emission Factor		CH_4 Emission Factors		N_2O Emission Factors		CO_2e Emission Factors					
Source Type ID	**Emission Source**	**Value**	**Unit**	**Value**	**Unit**	**Value**	**Unit**	**Value**	**Unit**	**Value**	**Unit**	**CO_2 (tons/year)**	**CH_4 (tons/year)**	**N_2O (tons/year)**	**CO_2e (tons/year)**
IE-1	Off-site - electricity[3]	1,000.00	kWh/head/year	1098.4	lb/MWh[1]	0.119	lb/MWh[1]	0.017	lb/MWh[1]	N/A	N/A	5,766.60	0.62	0.09	5,808.82
IE-2	Off-site - waste - landfill (MSW)[5]	2.24	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.63	metric tons CO_2e/short tons material[2]	N/A	N/A	N/A	1.55
IE-2	Off-site - waste - recycling (Mixed Recyclables)[5]	1.07	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.09	metric tons CO_2e/short tons material[2]	N/A	N/A	N/A	0.11
IE-2	Off-site - waste - Food waste (Total Organics)[5]	0.40	short tons	N/A	N/A	N/A	N/A	N/A	N/A	0.17	metric tons CO_2e/short tons material[2]	N/A	N/A	N/A	0.08
											TOTAL	**5,766.60**	**0.62**	**0.09**	**5,810.47**

Notes:

(1) Table 6, Electricity. MROW (MRO West) Subregion. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(2) Table 9, Scope 3 Category 5: Waste Generated in Operations and Category 12: End-of-Life Treatment of Sold Products. Emission Factors for Greenhouse Gas Inventories, EPA CCCL. April, 2021. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

(3) Based on average daily farm in the US consuming 800-1200 KWh per cow annually. https://ouc.bizenergyadvisor.com/article/dairy-farms

(4) Based on March 2021 energy prices in Midwest. https://www.bls.gov/regions/midwest/data/averageenergyprices_selectedareas_table.htm

(5) Based on 2018 data for 4.9 lbs/person/day of waste, percentages calculated based on values in article (landfill: 146 million/292.4 million, 50%; recycle: 69 million/292.4 million, 24%; compost: 25 million/292.4 million, 9%). https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials

Attachment C

Subp 29: Animal Feedlot Analysis

Summary of GHG Sources and Sinks From Land Use Changes

Source Type ID	Emission Source	Area (acres)	Net CO_2 Flux for Converted Forest Land (M metric tons CO_2e)[1,2]	2019 Total US Land Use Change from Forest Land (thousands of hectares)[3]	CO_2e emission factor (metric tons CO_2e/acre/year)	CO_2e Emissions (tons/year)
DE-4	Land Use Change - Conversion to grassland[5]	60	14.80	545.00	10.99	726.84
DE-4	Land Use Change - Conversion to settlement[5]	90	62.90	541.00	47.05	4,667.86
AR-1	GHG sink related to row crop converted to alfalfa for cattle feed[4]	1750	N/A	N/A	N/A	(2,117.50)

Notes:

(1) Table 6-44: Net CO_2 Flux from Soil, Dead Organic Matter and Biomass C Stock Changes for Land Converted to Grassland, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2019. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019

(2) Table 6-97: Net CO_2 Flux from Soil, Dead Organic Matter and Biomass C Stock Changes for Land Converted to Settlements, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2019. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019

(3) Table 6-5: Land Use and Land-Use Change for the U.S. Managed Land Base for All 50 States, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2019. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019

(4) Based on calculations from MPCA Tool, *MPCA Tool - Alfalfa acres* tab. Section K of Greenhouse gas reduction potential of agricultural best management practices. https://www.pca.state.mn.us/sites/default/files/p-gen4-19.pdf

(5) Based on the total acreage of the proposed project is 150 acres, 90 of which will be impervious surfaces.

Attachment C

Subp 29: Animal Feedlot Analysis

Summary of Manure Storage, Entric Fermentation, and Manure Land Application GHG Emissions

MPCA Feedlots GHG Emission Calculation Tool

version 5/19/20

	Existing facility	Project/Proposed changes	Totals after construction	
List of Emission Sources (calcs below):				Global Warming Potential (conversion to CO2e)
CH_4 - enteric fermentation	-	38,773	38,773	CH4 = 25
CH_4 - barn and manure storage	-	26,888	26,888	N2O = 298
N_2O - barn and manure storage	-	4,238	4,238	GWP Source: International Panel on Climate Change Fourth Assessment Report.
N_2O - manure land application	-	6,207	6,207	
Total CO2e	-	76,105	76,105	

	Existing facility				Project/Proposed changes				Totals after construction				
	Calves	Heifers	Cows	Total	Calves	Heifers	Cows	Total	Calves	Heifers	Cows	Total	
Total Head				-			10,500	10,500	-	-	10,500	10,500	
Animal units/head	0.2	0.7	1.4		0.2	0.7	1.4		0.2	0.7	1.4		
Total animal units	-	-	0.0	-	0	0	14700	14,700.0	0	0	14700	14,700.0	

The source used for emission factors and equations below came from USEPA, Inventory of US Sources and Sinks of Greenhouse Gases (2019)

	CH_4 - enteric fermentation	Calves	Heifers	Cows	Total	Calves	Heifers	Cows	Total	Calves	Heifers	Cows	Total	
A	animal inventory (head)	-	-	-		-	-	10,500		-	-	10,500		
B	kg CH_4/head/yr (EPA)	12.00	58.66	134.00		12.00	58.66	134.00		12.00	58.66	134.00		Minnesota-specific estimates, **Table A-181**
C	conversion to tons/head/year	0.0011	0.0011	0.0011		0.0011	0.0011	0.0011		0.0011	0.0011	0.0011		
	tons CH_4 (A*B*C)	-	-	-	-	-	-	1,550.94	1,550.94	-	-	1,550.94	**1,550.94**	
	tons CO_2-e	**-**	**-**	**-**	**-**	**-**	**-**	**38,773.40**	**38,773.40**	**-**	**-**	**38,773.40**	**38,773.40**	
	CH_4 - barn and manure storage													
D	livestock (head)	-	-	-		-	-	10,500		-	-	10,500		
E	animal liveweight (kg/head)	122	408	680		122	408	680		122	408	680		US average basis, Table A-160 heifers appears to be wrong
F	volatile solids (vs) production rate (kg VS/kg animal liveweight/yr)	2.81	3.07	3.98		2.81	3.07	3.98		2.81	3.07	3.98		Minnesota-specific estimates, **Tables A-184 and A-185**
G	rate of CH_4 production (potential) (m^3 CH_4/kg VS)	0.17	0.17	0.24		0.17	0.17	0.24		0.17	0.17	0.24		US average basis, Table A-185?
H	convert from m^3 to kgs (kg CH_4/m^3 CH_4)	0.622	0.622	0.622		0.622	0.622	0.622		0.622	0.622	0.622		
I	maximum potential CH_4 production (kg/yr) (D*E*F*G*H)	-	-	-		-	-	4,242,120		-	-	4,242,120		
J	methane conversion factor (MCF) (% of potential CH_4)	0.230	0.230	0.230		0.230	0.230	0.230		0.230	0.230	0.230		US average basis
K	CH_4 (metric tons/yr) (I*J)	-	-	-		-	-	975.69		-	-	975.69		
L	convert to short tons	1.1023	1.1023	1.1023		1.1023	1.1023	1.1023		1.1023	1.1023	1.1023		
M	CH_4 (short tons/yr) (K*L)	-	-	-	-	-	-	1,075.50	1,075.50	-	-	1,075.50	**1,075.50**	
N	short tons/yr CO_2-e	-	-	-	-	-	-	26,887.51	**26,887.51**	-	-	26,887.51	**26,887.51**	
	N_2O - barn and manure storage													
O	livestock (head)	-	-	-		-	-	10,500		-	-	10,500		
P	animal liveweight (kg/head)	122	408	680		122	408	680		122	408	680		US average basis, Table A-160 heifers appears to be wrong
Q	excreted nitrogen (N) (kg N/kg animal liveweight/yr)	0.4	0.17	0.23		0.400	0.170	0.230		0.40	0.17	0.23		US average basis, Table A-185?
R	emission factor from manure storage (kg N/kg excreted N)	0.005	0.005	0.005		0.005	0.005	0.005		0.005	0.005	0.005		US average basis
S	Convert N to N_2O	1.57	1.57	1.57		1.571	1.571	1.571		1.571	1.571	1.571		
T	N_2O emissions (metric tons) (O*P*Q*R*S/1000)	-	-	-		-	-	12.90		-	-	12.90		
U	convert to short tons	1.1023	1.1023	1.1023		1.102	1.102	1.102		1.10	1.10	1.10		
V	N_2O emissions (short tons) (T*U)	-	-	-	-	-	-	14.22	14.22	-	-	14.22	14.22	
W	short tons/yr CO_2-e	**-**	**-**	**-**	**-**	**-**	**-**	**4,237.65**	**4,237.65**	**-**	**-**	**4,237.65**	**4,237.65**	
	N_2O - manure land application													
X	N remaining in manure used as fertilizer ((O+P+Q)-T*1000/S) (kg/yr)	-	-	-		-	-	1,633,989		-	-	1,633,989		
Y	feedlot runoff/leaching rate (%)	0%	0%	0%		0%	0%	0%		0%	0%	0%		regional basis
Z	feedlot volatilization rate (%)	26%	26%	26%		26%	26%	26%		26%	26%	26%		regional basis
AA	emission factor (%)	1%	1%	1%		1%	1%	1%		1%	1%	1%		US average basis, "Nitrogen Oxide Emission Factors" or "Emission Factor for Volatilization"
AB	convert N to N2O	1.57	1.57	1.57		1.57	1.57	1.57		1.57	1.57	1.57		
AC	N_2O emissions (metric tons) ([X-(X*(Y+Z))*AA*AB/1000])	-	-	-		-	-	18.89		-	-	18.89		
AD	convert to short tons	1.1023	1.1023	1.1023		1.10	1.10	1.10		1.10	1.10	1.10		
AE	N_2O emissions (short tons) (AC*AD)	-	-	-	-	-	-	20.83	20.83	-	-	20.83	20.83	
AF	short tons/yr CO_2-e	**-**	**-**	**-**	**-**	**-**	**-**	**6,206.63**	**6,206.63**	**-**	**-**	**6,206.63**	**6,206.63**	

Attachment C
Subp 29: Animal Feedlot Analysis

Summary of Alfalfa Crop GHG Sink Emissions
MPCA Feedlots GHG Emission Calculation Tool

version 5/21/20

		Existing facility			Project/Proposed changes			Totals after construction		
		min	mean	max	min	mean	max	min	mean	max
A	Alfalfa crop (acres)					1,750		0	1,750	0
B	CO2e avoidance emission factor (tons/acre/yr)	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
	TOTAL CO2e avoided (tons/yr) (A*B)	**0**	**0**	**0**	**0**	**2118**	**0**	**0**	**2118**	**0**

CO2e avoidance data source: MPCA, Greenhouse Gas Reduction Potential of Agricultural Best Management Practices, p-gen4-19, October 2019, section K
https://www.pca.state.mn.us/sites/default/files/p-gen4-19.pdf

Note: For the EAW, round the total CO2e to the nearest 100 ton.