CCE AWARD SUBMISSION

MULTI-CRITERIA INDUSTRIAL SITE LOCATION ANALYSIS IN THE EDMONTON ENERGY TECHNOLOGY PARK

Golder Associates

SUMMARY

In 2009, Edmonton City Council approved a plan for an Energy and Technology Park based on an eco-industrial hub concept that may include polypropylene, ethylene, polyethylene and glycol plants, and fertilizer and/or methanol plants. Golder Associates Ltd. undertook a multi-criteria spatial analysis, which evaluated and balanced 43 key project concerns and trade-offs including environmental, social and technical factors, allowing the City to explore numerous options, save time, reduce risk, and have confidence in its strategy.

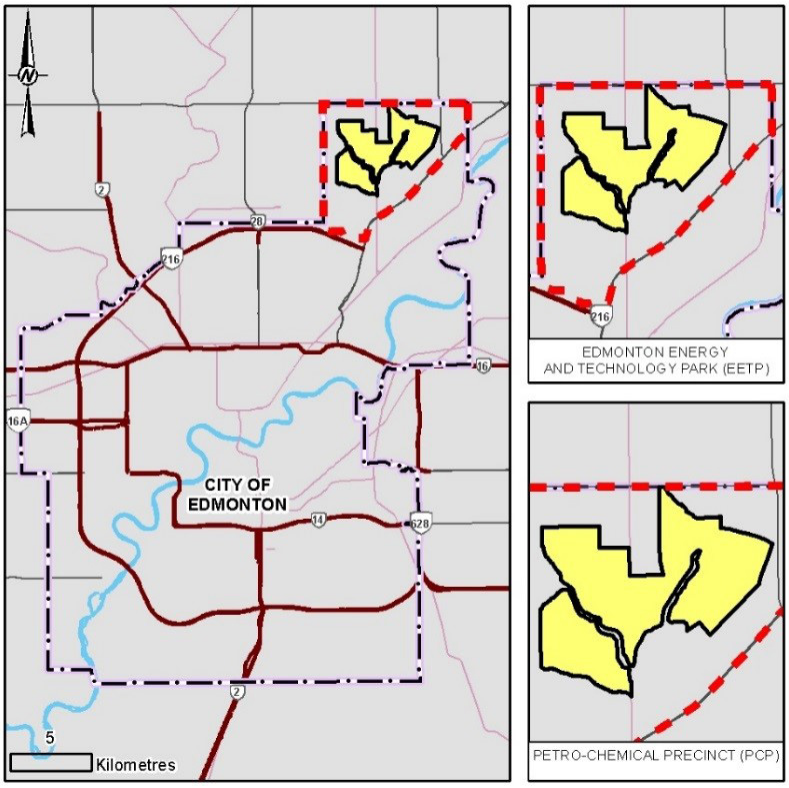

Figure 1 – Project Study Area and Location of the Edmonton Energy and Technology Park (EETP).

INNOVATION

The City of Edmonton wishes to establish a new eco-industrial hub in the chemical precinct of the Edmonton Energy and Technology Park (EETP) which could include projects such as a polypropylene plant, an integrated ethylene, polyethylene and glycol plant, a fertilizer plant and/or a methanol plant. Golder Associates Ltd. (Golder) was retained to assist in determining potential and optimal site locations for a propane dehydrogenization plant, an ammonia/urea fertilizer plant and a methanol plant including linear infrastructure within the EETP.

Golder applied a rigorous approach which evaluates and balances diverse environmental and social priorities as well as technical plant-related prerequisites--all of which must be taken into consideration when siting these types of large-scale projects. Golder's methodology uses a multi-criteria spatial analysis process called GoldSET--Golder's Sustainability Evaluation Toolkit--which takes into account environmental, social and technical factors.

GoldSET allowed the project team to combine the spatial effects of 43 different decision criteria, known as indicators in GoldSET, into four "what if" scenarios for each plant type, thus providing the City with clear rationale for decision-making related to selecting locations; a degree of spatial analysis that had never before been attempted or applied by the City to a site selection process. At the same time, the process provided greater transparency and enabled the City to explore numerous options, save months of effort, reduce risk, and ultimately have greater confidence in the pursuit of its eco-industrial strategy.

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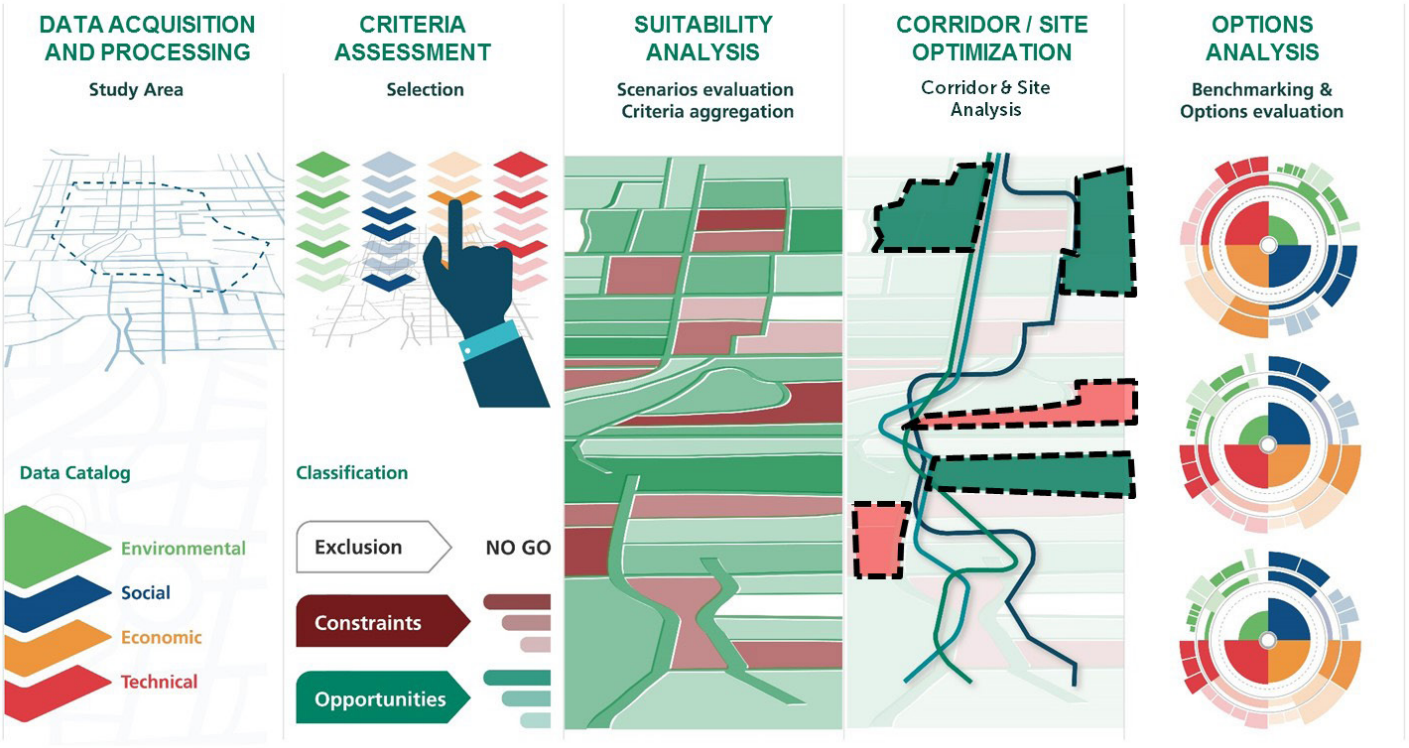


Figure 2: Overview of GoldSET Siting Approach

For this work, Golder assembled a multi-disciplinary project team comprised of specialists in industrial development, natural gas processing and GIS, collaborating from offices around the world.

An unexpected bonus of the process was the effective combination of Golder's scientific and technological knowledge (specifically our experience in spatial modeling, industrial processes, land use planning, environmental health, logistics and risk) with the City's deep understanding of the political, social, and economic contexts within the study area. By combining best practices from all parties in a facilitated workshop setting, our team was able to implement a modeling framework that was balanced, flexible and mutually agreed upon by all parties, thus allowing for a ready acceptance of modeling outputs.

Golder was able to add both scientific rigor and speed to the industrial site selection and permitting process by pre-screening and validating an entire region simultaneously through the incorporation of a complete set of valid, meaningful and differentiating spatial data.

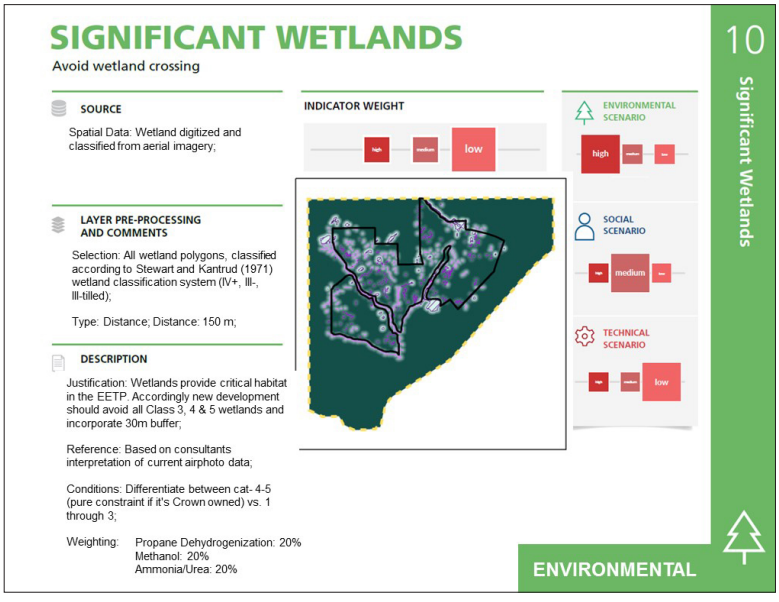


Figure 3: Sample Indicator Workbook Page

COMPLEXITY

The true challenge of the work then lay with the creation and implementation of the integrated framework which allowed expert and potential stakeholder knowledge to be captured up-front, and used models to leverage that knowledge to provide a better understanding of the trade-offs and implications inherent in industrial facility siting.

Other aspects which made this work challenging included the following:

- To mitigate potential risks with respect to public perception of industrial development siting, Golder required the consideration of diverse points of view which could simulate the results of decision making by potential project stakeholders. Accordingly, embedded sustainability criteria such as social, environmental and economic considerations were directly input into the decision framework process and weighted in four different scenarios to provide a range of options that could be interpreted to suit the City's needs.
- This work was to be executed within a tight timeline. To meet this challenge, there was a requirement to develop and implement extensive use of model automation to reduce effort and allow the model to run rapidly. Accordingly, the Golder team developed one-of-a-kind automation software to efficiently run multiple model iterations in a timely way versus the typical manual approach.
- The GoldSET process required engaged participation from City staff as well as subject matter experts (SMEs). As with most multidisciplinary projects, there were initial challenges with respect to departmental or organizational silos. To meet this challenge, the executed process was designed to be inclusive, transparent and cross-disciplinary.

SOCIAL AND/OR ECONOMIC BENEFITS

Golder's modeling approach was implemented to reflect multiple City priorities along the lines of four distinct points of view: Environmental protection, social sustainability and human health, technical feasibility and a scenario which balanced these respective trade-offs in a logical and defensible way. By comparing and contrasting different spatial outcomes that represented the various points of view, the City was able to identify areas of concern and ultimately agree upon a final scenario which respected and mitigated the greatest concerns for industrial development.

Golder's work showed that environmental and social concerns can be embedded into the development process at the earliest stages of project conceptualization, in contrast to the traditional approach of advancing project based on engineering needs rather than obtaining social and regulatory consent.

Criteria considered impacts to residents including emissions (air and noise) as well as accident risks, i.e., Major Industrial Accident Council of Canada (MIACC).

Siting industrial facilities, pipelines, transmission lines, and other significant infrastructure is a demanding process which includes significant engineering challenges, economic consequences and the potential for stakeholder backlash. The GoldSET process integrated the "hard" applied sciences of multivariate spatial modelling and engineering design with a qualitative but practical and transparent decision making framework based on multidisciplinary SME input and consensus.

ENVIRONMENTAL BENEFITS

Golder's multi-criteria spatial analysis process called GoldSET, applies a rigorous approach which evaluates and balances diverse environmental and social priorities as well as technical plant-related prerequisites--all of which must be taken into consideration when siting such large-scale projects.

GoldSET allowed the project team to combine the spatial effects of 43 different decision criteria, known as indicators in GoldSET, into four "what if" scenarios for each plant type. The indicators and process enabled the team to explore the most suitable locations, while providing greater transparency and incorporating City priorities. The City was able to consider numerous options, reduce risk, and ultimately have greater confidence in the pursuit of its eco-industrial strategy.

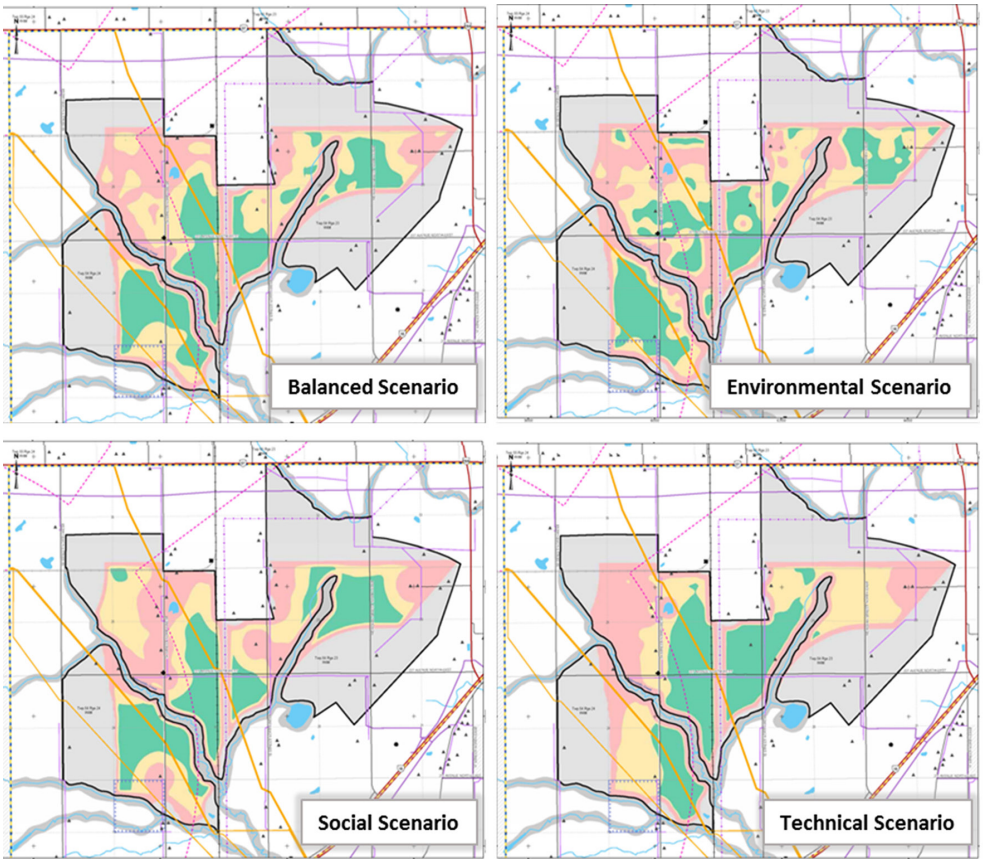


Figure 4: Sample Dehydrogenization Plant Results (Green=High Suitability, Red=Low Suitability)

Quarter Section	Propane Dehydrogenization			
	Environmental	Social	Technical	Balanced
13-NE	9	13	12	13
18-NW	7	12	3	9
19-NE	5	1	1	1
19-NW	12	3	4	4
19-SW	10	2	5	2
24-NE	11	9	15	11
24-SE	1	5	13	3
25-NE	19	16	17	19
25-NW	18	8	19	15
25-SE	13	17	16	17
25-SW	20	19	20	20
28-NE	6	20	18	18
28-NW	3	10	14	10
29-NE	16	4	10	8
29-NW	14	15	8	14
29-SE	8	6	9	7
29-SW	15	14	7	12
30-NW	17	18	11	16
30-SE	2	11	2	6
30-SW	4	7	6	5

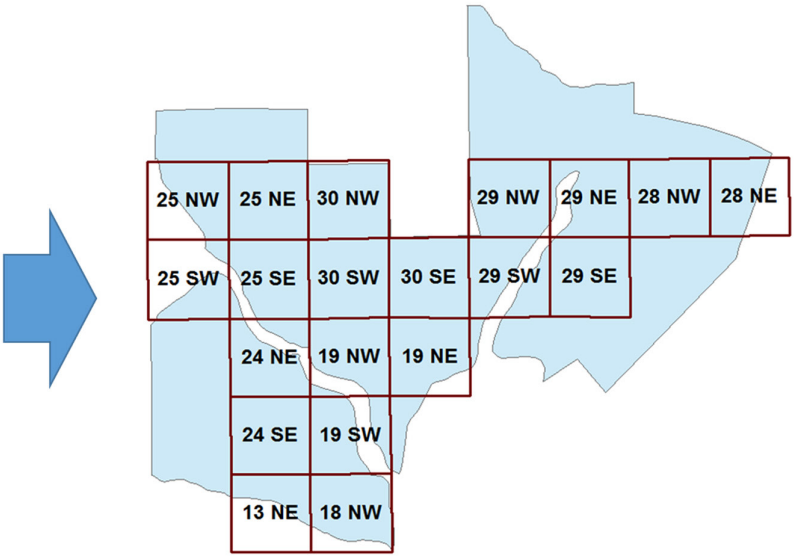


Figure 5: Suitability Ranking by Quarter Section and Scenario

The City identified the environmental scenario as a key input into decision-making as it aligned with the City's stated vision, goals and direction with respect to development policy, and gave priority to environmental indicators such that industrial facility location would avoid or minimize close proximity to constraints such as wetlands, the ecological network, riparian areas, water bodies, natural areas, parks, sensitive species and soil.

Because these considerations have been built into the site selection process, the potential negative effects of constructing and operating a petrochemical facility over the lifespan of the plant should have been minimized. Likewise, by co-optimizing the site location with other considerations such as logistics and transportation, and the use of energy, water and other resources, the overall development footprint has been reduced to some extent through efficiency gains and material reductions.

MEETING CLIENT'S NEEDS

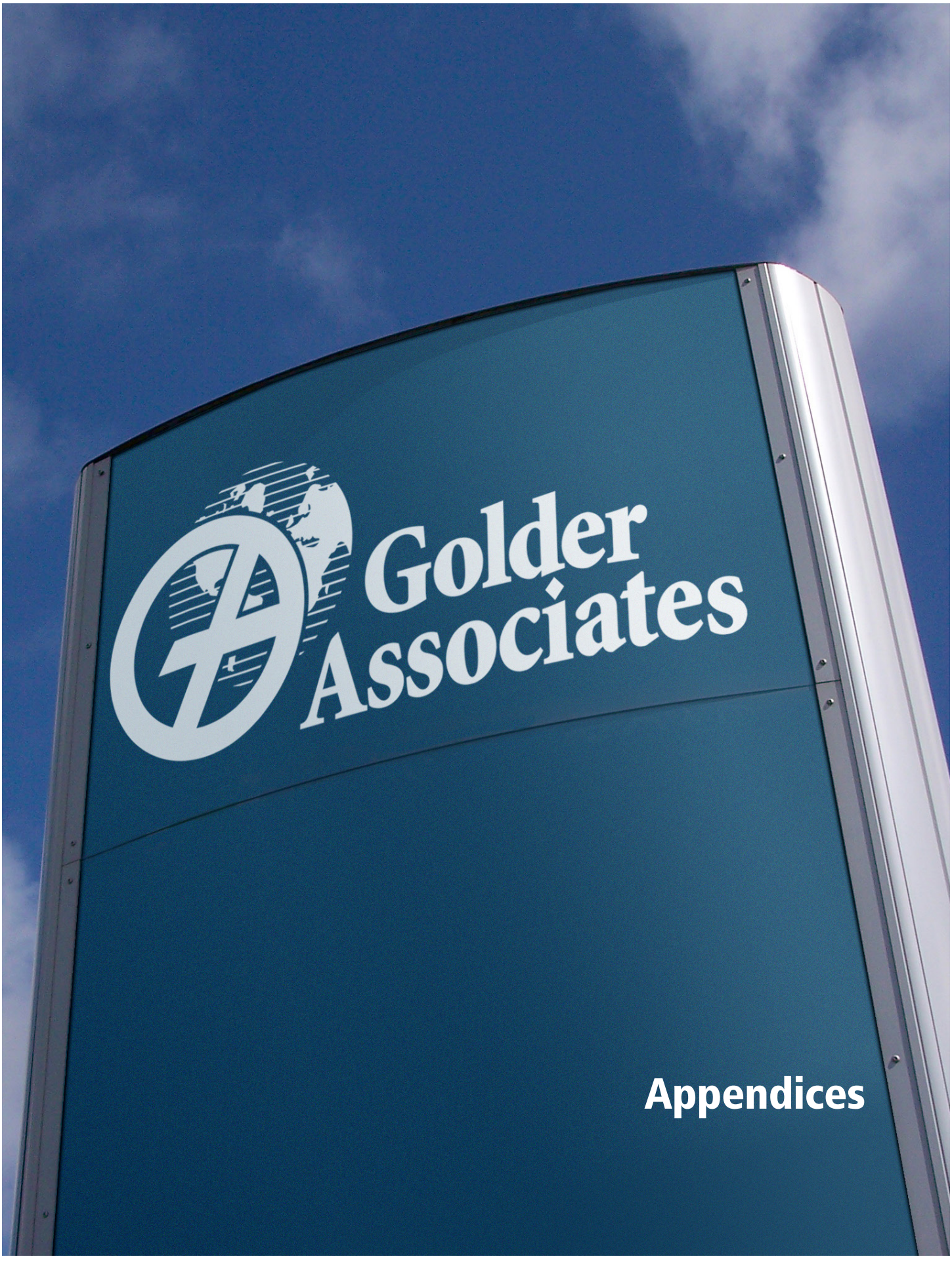
The main project goals for the City were to determine potential and optimal site locations for a propane dehydrogenization plant, an ammonia/urea fertilizer plant and a methanol plant including linear infrastructure within the EETP.

Golder assisted in a multi-criteria spatial analysis using a unique sustainability analysis approach that evaluated and balanced 43 key project concerns and trade-offs including environmental, social and technical factors. This allowed the City to explore numerous options, save several months of effort, reduce risk, and have greater confidence in its strategy.

Golder's modeling approach was implemented to reflect multiple City priorities along the lines of four distinct points of view: Environmental protection, social sustainability and human health, technical feasibility and a scenario which balanced these respective trade-offs in a logical and defensible way. By comparing and contrasting different spatial outcomes that represented the various points of view, the City was able to identify areas of concern and ultimately agree upon a final scenario which respected and mitigated the greatest concerns for industrial development.

As explained by our client, Rily Welden, Project Advisor, City of Edmonton:

> "Without Golder's analysis it would have taken us several months longer to determine the ideal sites for these petrochemical facilities. The science behind the spatial analysis also gave our site recommendation a high degree of credibility. We're now more informed about the sites, which benefits us when we're discussing the locations with our industry partners."



Appendices

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