Smart Ag Research

Transforming Marginal Cropland of Olds College Smart Farm into Perennial Vegetation — 2024 Season

This project aims to apply alternative uses and management strategies to marginal farmland. The work included identifying supporting technologies, analyzing operational changes, and evaluating the environmental and economic impacts.

SUMMARY

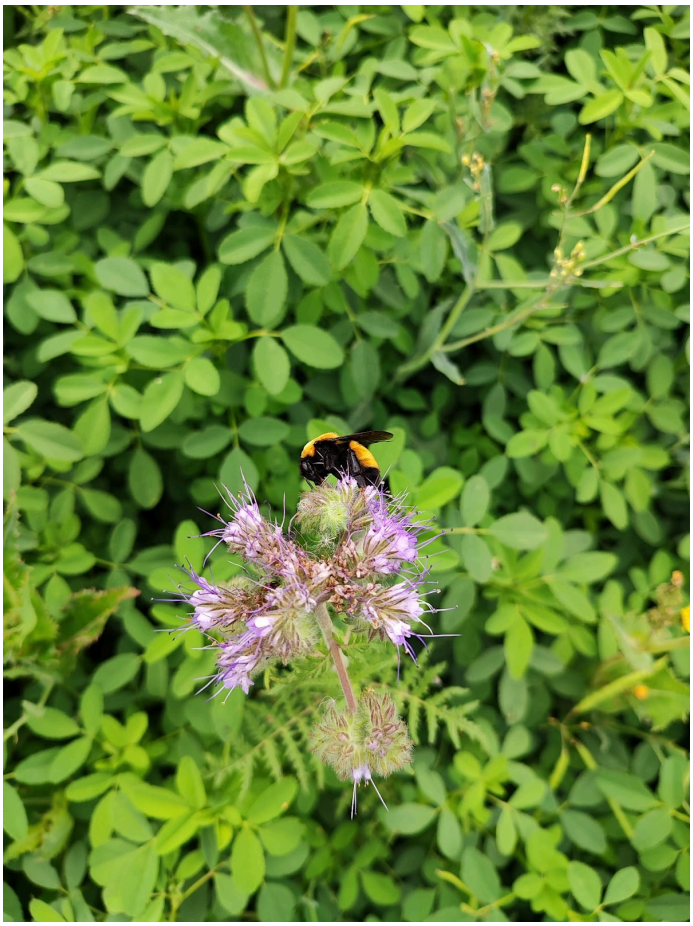
Marginal land within cultivated fields of annual crops can be found in many areas within Canada, with marginal land meaning unsuitable for, or less suitable for, producing a desired crop within the field. Conducting conventional farming practices across both productive and nonproductive acres results in reduced profitability and the deterioration of land. Strategies and practices to segregate and farm the marginal land differently presents various opportunities to increase profitability, better the soil and promote long-term sustainability of annual agriculture production. Precision agriculture provides opportunities to implement these strategies. Applying BMPs to targeted areas of marginal farmland using precision agriculture equipment is commonly referred to as precision conservation.

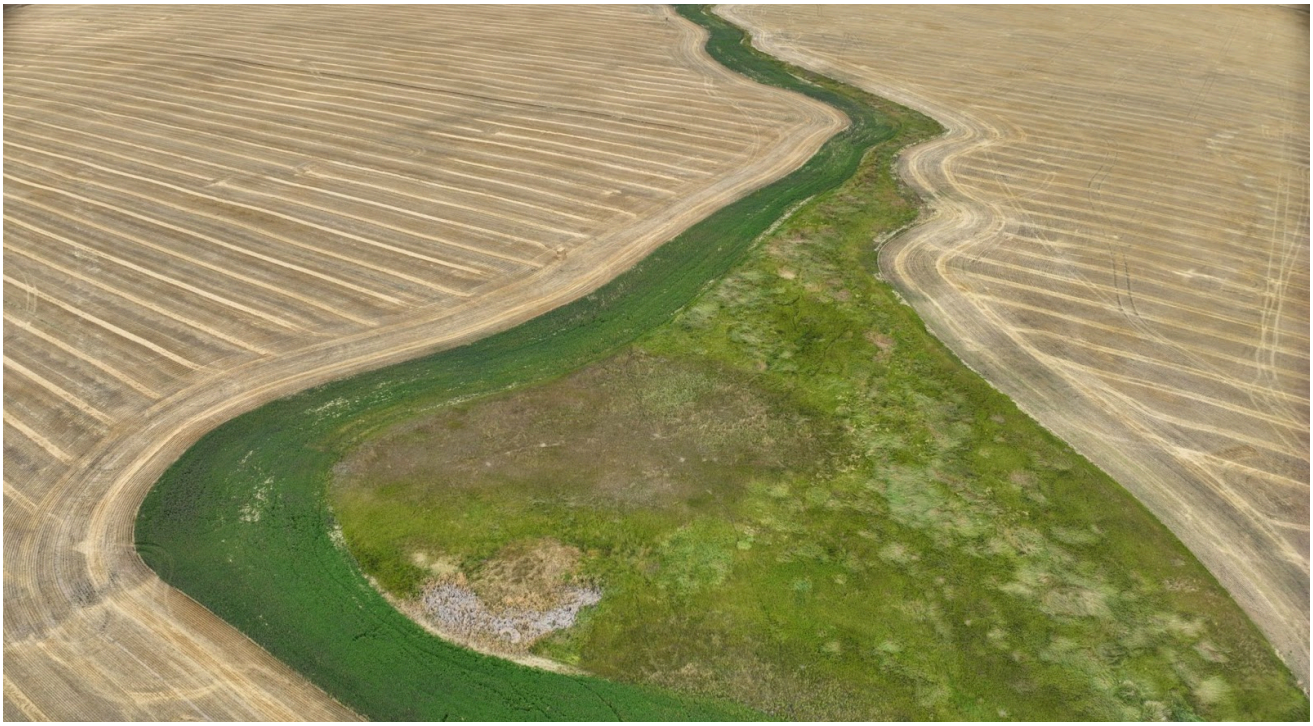
Starting January 2023 through April 2024, OCCI conducted an extensive project with FCC, identifying multiple alternative uses for marginal farmland and the associated implications and impacts. Informed by the reports and deliverables from year one of the project, approximately 11 acres of marginal land across two Olds College Smart Farm fields were converted. In the 2024 growing season, implementation plans were developed and executed for these areas with FCC's priorities in mind.

The collection of this information and research enables FCC to better understand the work, implications, and impacts of removing marginal cropland from continuous annual production. Additionally, it enables FCC and OCCI to share this information with producers in Western Canada who may consider adopting these best management practices and learning from the establishment experiences of Olds College.

OBJECTIVES

- Remove marginal land from annual production in two fields of the Smart Farm, establishing each area with appropriate perennial plants.
- Measure environmental and economic metrics within and surrounding the converted marginal area to quantify the impacts of marginal land conversion:
  - Site-specific weather and conditions.
  - Soil nutrient and property changes.
  - Plant establishment and competition.
  - Changes in aerial imagery.
  - Flowering duration and schedule.
  - Pollinator quantification observations.
- Calculate economic impact:
  - Cost of inputs.
  - Reduced costs of annual inputs and crop management.
  - Record observations regarding operational and environmental impacts.

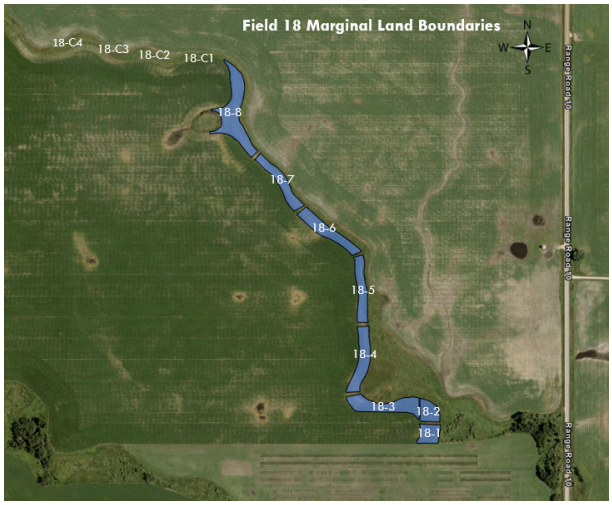




STUDY DETAILS

- Where/When - The trial took place during the 2024 growing season across two previously farmed Olds College sites: Field 18 and the Steckler field, both identified in the 2023 project as economically marginal.
    - At the Steckler Field, a three-acre marginal area was established for perennial grasses and legumes.
    - An eight-acre marginal area within Field 18 was converted to perennial flowers for pollinator habitats.
    - Control areas, consisting of marginal lands left in annual crop production, were chosen for comparable measurements.
- The Research - Throughout the growing season, ongoing monitoring was conducted, including weather monitoring, soil sampling, biomass measurements, drone imagery collection, site observations, and the identification of plants and pollinators. A financial evaluation included the revenues and expenses of the conventional cropping activities surrounding the marginal land, and costs associated with establishing the perennial crops within the marginal area.
    - Area and plot maps were created after seeding to accurately map the exterior and plot boundaries of each marginal area.
    - Soil samples of the respective areas and controls were taken pre-seeding, in-season, and at the end of the season.
    - Germination tests were conducted on all five seed blends (Operation Pollinator, Proven Seed Pollinator, Meadowmaster, Brinemaster and Floodmaster) to compare in-lab germination rates to field plant establishment.
    - Bi-weekly scouting and associated measurements were collected at each site to monitor vegetative establishment and species adaptation to soil conditions.
    - To measure forage yields of the treatment areas, biomass samples were clipped and dried to calculate yields per acre (lbs/acre).
    - Drone imagery was collected throughout the season using multispectral, thermal and LiDAR sensors to assess seasonal changes and differences between treatments.
    - Weather stations were installed at each site for continuous local measurements, including ambient conditions, precipitation, and soil data.
    - Expenses to convert the marginal areas in each field were calculated, and all conventional cropping activities for Field 18 and Steckler were recorded within AgExpert Fields. This information enabled a partial budget to estimate the net financial impact of the area's conversion.

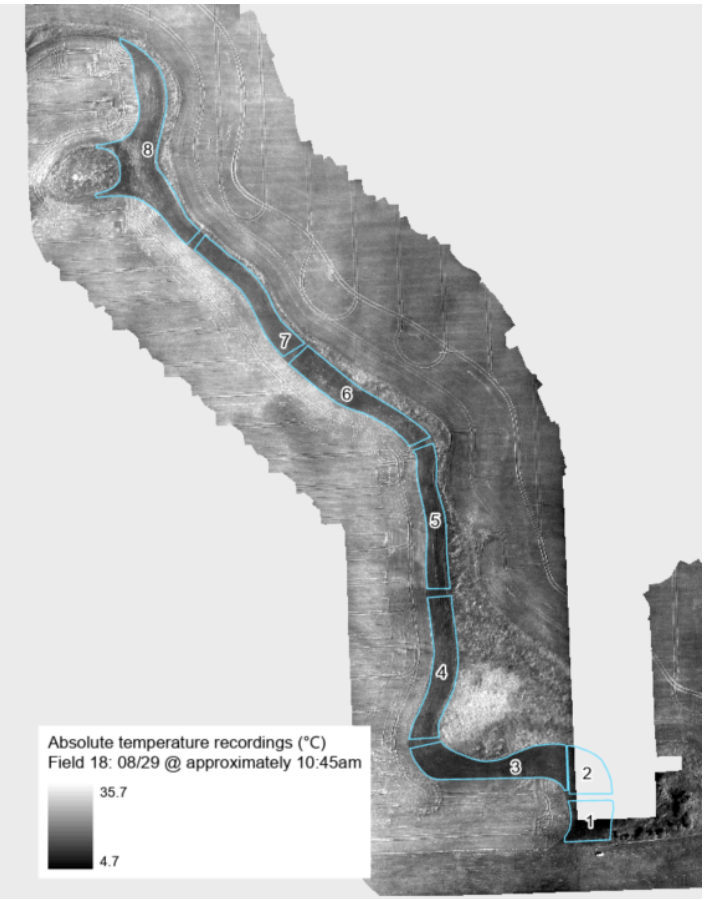
Results & Observations Unique to Field 18

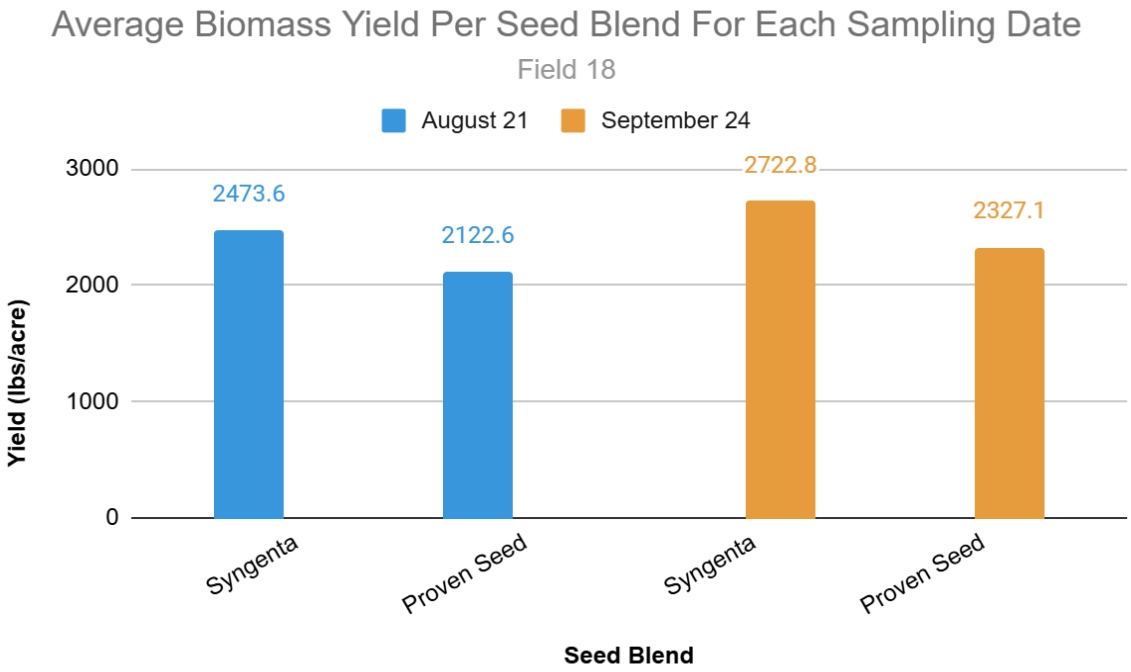


- Field 18 marginal area consisted of eight plots and four controls, all used for repeated assessments. The seed blend used per plot was alternated between two seed blends: Syngentas' Operation Pollinator and Proven Seeds' Perennial Pollinator.
- To assess pollinator biodiversity and habitat stability, four sweep events were conducted during marginal land flowering. Over 7,000 insects were identified from more than 40 distinct families. The flowers provided an excellent and diverse food source and habitat for pollinating insects.
- Within six weeks of seeding, plants began to flower, and by nine weeks after seeding, the majority of the flowering species planted were in flower. Biodiversity of pollinators and animals flourished within the marginal area, with plenty of pollinators appearing in sync with the flowering cycles.
- During bi-weekly scouting, many desirable plants were observed, with dominating plant types of phacelia, alfalfa, and various kinds of clovers.
- Peak pollinator activity was aligned closely with bloom periods, occurring primarily from mid-to-late August through September. Levels of flower blooms, general vegetation, and pollinators concluded for the season

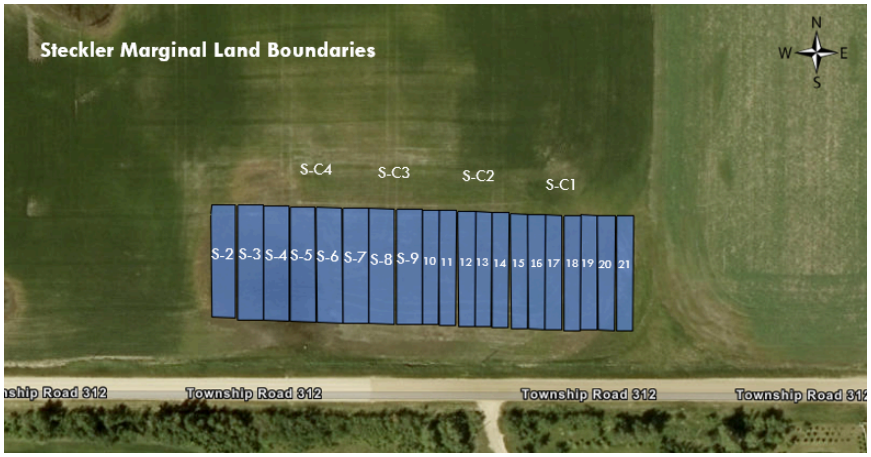
around Oct. 11 when temperatures began to drop to -5°C.

- By the end of the growing season, the area generated an average of 2,524 lbs/ac of dry forage. Field observations from the 2024 season generally classified the area as having good to optimal establishment, and the germination of both pollinator seed blends used was very high.
- Results of the financial partial budget indicated that the conversion of the marginal area in Field 18 increased profitability by $12.34 per converted acre for 2024. This calculation applied the entire cost of conversion and establishment in year one, and excluded any revenues from potential forage production.



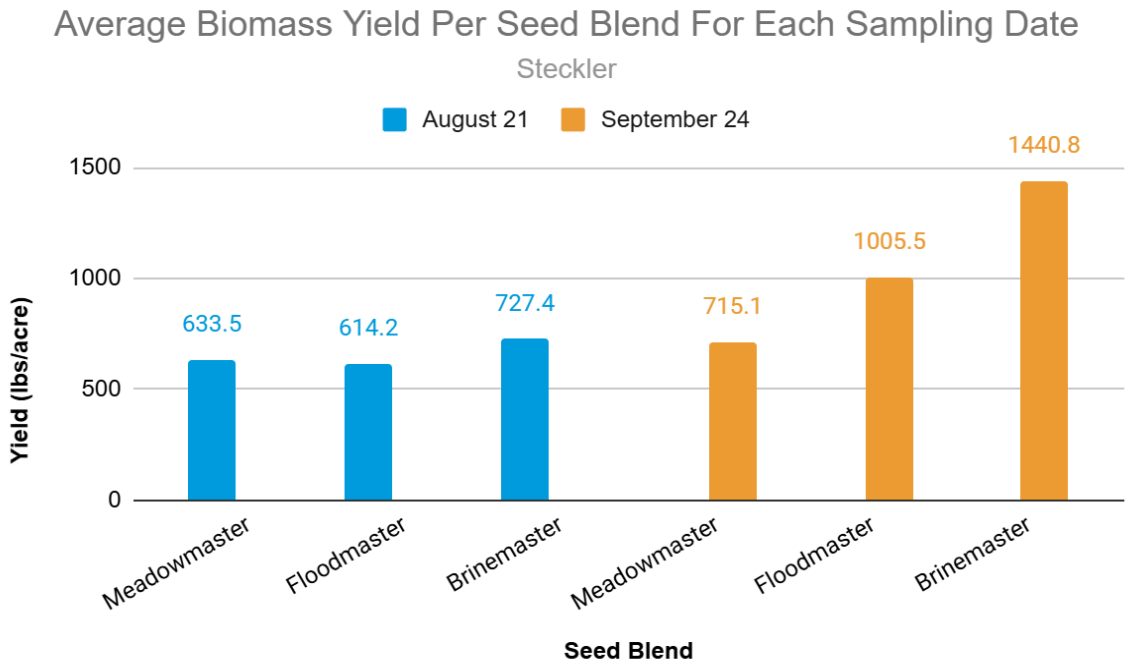


Steckler



Results & Observations Unique to Steckler

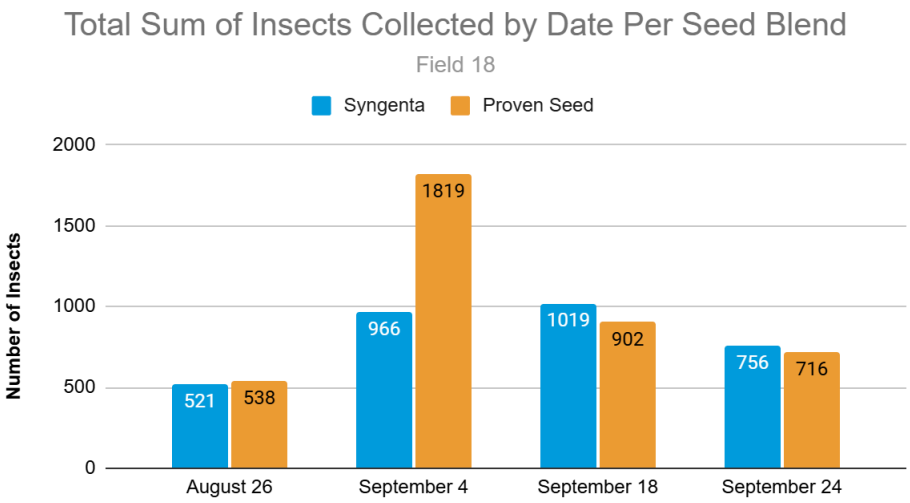
- The Steckler marginal area consists of 20 plots and an additional 4 control locations. 12 plots and the controls were used for repeated assessments. Three different Proven seed blends were used: Meadowmaster, Brinemaster, and Floodmaster. Seed blends were repeated on every third plot.
- Initial plant establishment was slower than anticipated. This could be due to high soil moisture conditions as a result of the rainfall that occurred shortly after seeding. August scouting events showed that some grass species had started to establish.
- Steckler Field showed greater variability among treatment plots than Field 18. All plots had positive NDVI growth from July 10 to October 10, with Brinemaster plots experiencing the most significant increases. NDRE trends followed a similar pattern but with less pronounced differences.
- The Steckler marginal area, seeded with three different perennial grass and legume blends, yielded an average of 1,053 lbs/ac dry matter by end of season. Establishment was noted to have been negatively impacted by initial flooding after seeding, which likely contributed to the lower yields and poorer establishment. Encouragingly, most plant species thrived despite invasive plants and challenging site conditions.
- The partial budget decreased profitability by $368.92 per converted acre in 2024. This calculation applied the entire cost of conversion and establishment in year 1, and excluded any revenues from potential forage production.



Month	Field 18		Steckler	
	Accumulated Precipitation (mm)	Average Temperature (°C)	Accumulated Precipitation (mm)	Average Temperature (°C)
July	13	19.1	15.2	19
August	49.4	16.1	57	15.7
September	36	12.9	39.4	12.5
October	10.2	5	9.2	5
Total	**108.6mm**		**120.8mm**	

CONCLUSION

- The study provided valuable insight into weather, soil, and plant conditions across each marginal area, highlighting site-specific variations.
- Removing two marginal land areas of the Smart Farm from annual crop production in 2024 and converting them to different types of alternative uses has provided many valuable insights for OCCI and FCC to share with producers, industry professionals, and students.
- The financials calculated for 2024 are expected to become more advantageous in future years as the establishment and maintenance costs will greatly reduce, while the ability of the area to generate revenue increases.
- Soil health and soil property measurements showed slight fluctuations throughout the season, but overall, the various treatments performed similarly to untreated controls throughout the season. The soil-related results aligned with team expectations, as objectives to improve soil productivity by utilizing alternative land management practices can take multiple seasons for perennial plants to establish and make an impact on the soil properties.
- These findings support that the establishment of perennial plants within unproductive areas of crop fields benefit the ecological outputs of the land as well as field profitability. As the areas further establish in future growing seasons, it will continue to encourage the development and significance of ecosystem services for the area, including water management, erosion control, and habitat for wildlife and insects.



Location	Date	Temperature (°C)
Field 18	September 16	0, -2
	October 11	-5
	October 22	-10
Steckler	September 20	0
	September 21	-2
	October 3	-5
	October 18	-10

NEXT STEPS/FUTURE RESEARCH

While several beneficial impacts of converting the marginal land to a perennial cover were observed in the establishment year, other parameters and environmental indicators take several years to develop, establish or change. It is recognized that management changes made for the purpose of soil and water improvement take long periods of time, and immediate changes cannot be expected.

As a result, these environmental factors need to be studied for multiple years to identify and quantify the impacts of the land use conversion. From this, continued study of each area with FCC is taking place to better quantify the long-term impacts of the area's conversion, as well as to explore other industry-driven research questions utilizing the newly established marginal lands.

RECOGNITION

OCCI wishes to thank FCC for their support in this project. Researchers would also like to recognize Syngenta for their contribution of their Operation Pollinator Seed Blend and Nutrien Ag Solutions for their contribution of the following seed blends all used in the establishment of the marginal areas: Perennial Pollinator Seed, Brinemaster, Meadowmaster and Floodmaster.