### Summary Final project report: Activities and accomplishments

#### ECCC Project number: # GCXE23C446

**Project Title:** Wetland as Natural Solutions: Baselines and projections for Wetlands on Agricultural Land

#### Summary generated from the closing meeting with ECCC on April 14.

#### **Prairies Wetlands Extension Project**

As a collective of hydrologists, ecologists, economists and remote-sensing specialists from the Universities of Toronto, Saskatchewan and Alberta, we set out to close three stubborn knowledge gaps that limit wetland policy on the Canadian Prairies. First, we needed to know how many wetlands are left, where they sit on the landscape and how quickly they are changing. Second, we wanted reliable numbers on what it truly costs producers to retain or restore them. Third, we aimed to understand how provincial rules either reinforce or undermine federal conservation spending through "leakage," that is, drainage simply shifting to laxer jurisdictions. The work was funded by Environment and Climate Change Canada's Nature Smart Climate Solutions Fund, and our outputs feed directly into national carbon-accounting and incentive programs.

#### Mapping wetland extent and change

We produced high-resolution wetland layers by processing 30-metre Landsat imagery in Google Earth Engine, then cross-referenced them with Agriculture and Agri-Food Canada's crop inventory. By tracking every 1 800 m<sup>2</sup> pixel from 1984 to 2022 we measured both losses and incidental gains across the Prairie Pothole Region. We found that total wetland area continues to decline, with the steepest contraction in the most intensively cultivated zones. Small basins under 0.1 ha were the most vulnerable; they disappear fastest yet yield a disproportionate share of biodiversity and soil-carbon benefits. Those spatial products are now ready for compliance checks, carbon-flux models and future incentive targeting.

#### Synthesizing the drivers of conversion

We sifted 47 peer-reviewed articles to clarify why wetlands vanish. Across studies, agricultural expansion and intensification dominate, followed by urban growth near larger centers. We confirmed that drainage decisions hinge on three intertwined elements: agronomic penalties such as yield loss and machinery maneuvering time, direct conversion costs, and the clarity or ambiguity of provincial permitting systems. We also logged the ecosystem services that most often justify wetland retention: flood mitigation, water-quality improvement and wildlife habitat, creating a crosswalk that links each service to measurable indicators for program monitoring.

#### Listening to producers

To ground those literature insights in lived experience, we surveyed 1 000 producers: 600 on the Prairies, 400 in Ontario and Québec, through Kynetec's verified farm panel. Each respondent completed six choice-experiment tasks that forced trade-offs among contract size, length, early-exit penalty, compatible activities and annual payment.

• We observed a clear premium for restoration contracts even when earth-moving costs are prepaid, confirming that additionality drops if payments ignore baseline conditions.

- We saw enrolment surge for five- and ten-year terms and plummet for twenty-five- and forty-year terms, suggesting that stacking short renewals may secure more hectares at lower present-value cost.
- We learned that doubling early-exit penalties inflates required payments by about \$166 per acre, signaling that strict penalties can backfire unless budgets rise accordingly.
- We tested four framings: climate, water-management, habitat and generic, and discovered that wording alone does not materially change uptake; producers weigh concrete terms, not narratives.

Roughly one quarter of prairie respondents acknowledged draining wetlands in the last decade. Their main motives were adding farmable acres, avoiding low-yield buffer zones and trimming fieldwork time. The chief reason for leaving wetlands intact was that drainage costs exceeded expected gains.

# Counting the real costs

We triangulated wetland economics with three complementary models.

- 1. **Field-scale financial simulation:** By fusing enterprise budgets with combine yield maps from 36 fields, we showed that yields within 50 m of intact wetlands averaged 80 percent of field mean in wet years but matched upland yields in dry years. As climate warming drives longer dry spells, those penalties will shrink, reducing the temptation to drain.
- 2. Landscape econometrics: Drawing on 1.7 million crop-insurance yield records and 7 000 land-sale transactions, we estimated that each additional wetland acre shaves 0.7 percent off land value; the hit is twice as large when the acre is split into many micro-basins.
- 3. **Structured rental choice survey:** In an earlier 450-respondent poll, we isolated "dispersion costs," the hidden expense of driving around scattered potholes. We found that, on average, 40 percent of a tenant's rental discount is generated by dispersion rather than lost cropland. In municipalities rife with micro-wetlands dispersion exceeds 60 percent.

Our takeaway is that flat per-acre incentives misprice the resource. When we pay only for foregone acreage, we under-compensate some producers and over-compensate others. Differentiated rates that reward consolidation or retention of small basins can stretch budgets and curb perverse incentives.

## Reviewing policy and leakage

We catalogued every major wetland instrument in Alberta, Saskatchewan and Manitoba, then scored each for legal strength, enforcement capacity and climate relevance. Saskatchewan's 2025 Agricultural Water Management Framework, with its 40 percent watershed retention target, illustrates the leakage dilemma. Because protected-area wetlands count toward the quota, new conservation easements by third parties could invite drainage elsewhere. Rather than chase a single leakage coefficient, as US studies have attempted for the Conservation Reserve Program, we built qualitative scenarios that show how leakage risk grows or shrinks with retention targets, enforcement budgets and third-party acquisitions.

## Highlights and forward path

- We now own the largest, most detailed producer dataset ever assembled on Canadian wetland attitudes and contract preferences.
- We have already published one peer-reviewed article (*Agricultural Systems*, 2025) and are preparing three more manuscripts plus a master's thesis for 2026.

- Our mapping layers are live and can feed directly into federal carbon models and provincial compliance audits.
- We demonstrated that protecting small wetlands delivers high ecological return yet requires either higher per-acre payments or tighter regulation because those basins depress land value sharply.
- We confirmed that stacking five-year contracts can approach forty-year security if renewal friction is held low, a design worth piloting.
- We laid out leakage scenarios that ECCC and provinces can test as they refine permitting and incentive rules.

## Conclusion

Working as a single, multidisciplinary team, we have connected wetland extent, producer behavior, real farm costs and policy architecture in one coherent evidence base. Our central conclusion is that retaining prairie potholes remains cost-effective compared with Canada's rising carbon price, but success hinges on fine spatial targeting and contract design. With our maps, models and survey insights in hand, policymakers can move immediately toward shorter, better-weighted contracts that prioritize vulnerable micro-basins, minimize leakage and deliver durable carbon, water and biodiversity gains across the Prairies.