State of the Prairie

Technical Report

Prairie Conservation Forum
September 11, 2019

List of acronyms used in this Technical Report
(in order of appearance)

AA&F	Alberta Agriculture and Forestry
AE&P	Alberta Environment and Parks
DLR	German Aerospace Centre
PCF	Prairie Conservation Forum
NPVI	Native Prairie Vegetation Inventory
GVI	Grassland Vegetation Inventory
PFRA	Prairie Farm Rehabilitation Administration
AAFC	Agriculture and Agri-Food Canada
AAFCACI	Agriculture and Agri-Food Canada Annual Crop Inventory
AAFCLU	Agriculture and Agri-Food Canada Land Use
ATS	Alberta Township System
TS	Time Scan
NDBI	Normalized Difference Built-up Index
MNDWI	Modified Normalized Difference Water/Wet Index
NDVI	Normalized Difference Vegetation Index
NDMIR	Normalized Difference Mean Infra-Red
NDRB	Normalized Difference Red Blue
NDGB	Normalized Difference Green Blue
CPVI	Central Parkland Vegetation Inventory
PLVI	Primary Land Vegetation Inventory
DEM	Digital Elevation Model
ABMI	Alberta Biodiversity Monitoring Institute
CFB	Canadian Forces Base
RGB	Red Green Blue
IPCC	Intergovernmental Panel on Climate Change
LC	Land Cover
LU	Land Use
AGRASID	Agricultural Regions of Alberta Soil Inventory Database
SLC	Scan Line Corrector

Cover photo: Hand Hills Ecological Reserve – Rough Fescue

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1.   Executive Summary

The Prairie Conservation Forum (PCF) is a large, voluntary association of organizations and individuals that exists to promote stewardship by Albertans of the biological diversity of native prairie and parkland ecosystems. The PCF regularly produces a five-year prairie conservation action blueprint, the Prairie Conservation Action Plan (PCAP): http://www.albertapcf.org/rsu_docs/pcap-2016-2020--small-.pdf . The PCAP advocates maintaining large native prairie and parkland landscapes, conserving connecting corridors for biodiversity and protecting isolated native habitats.

In early 2017, the PCF initiated a major undertaking called the 'State of the Prairie'. The project's main goal was to evaluate native cover conditions in the Grassland and Parkland Natural Regions of Alberta. A steering committee and a technical team were convened to address the following question:

- Quantify the change and remaining native cover from the early 1990's (Time 1) to the present day (Time 2) and then summarize and report on the changes by Natural Region, Natural Sub-Region, Ecodistricts, Administrative Areas, and Land Tenure (Public versus Private).

The Technical Team addressed and evaluated a couple of other related subject areas:

- Investigate the viability of the Timescan data analysis process.
- Adjust ecodistrict areas so that consistency and greater biophysical accuracy occurs when nested in the Alberta Natural Region classification framework.

Remaining native cover in both Grassland and Parkland Natural region was determined by evaluating eleven separate datasets that best represented the change. Ultimately, three Time 1 and Time 2 comparisons surfaced:

- NPVI (1991/93) vs. GVI (2006/16) - Grassland Natural Region
- PFRA (1995) vs AAFC Annual Crop Inventory (2016) - Grassland Natural Region
- AAFC Land Use 1990 vs AAFC Land Use 2010 - Grassland and Parkland Natural Region

The results from the three Grassland Natural Region datasets show that native cover has remained quite stable in this region; the relatively small increases or decreases (+2% to -2%) at the regional scale are within the error margins of the first two sets of data used in the change comparisons. The AAFC Land Use data sets did show some measureable and slight decreases. The total amount of native cover left in the Grassland Natural Region is about 48%.

The Parkland Natural Region also showed similar change (about -2%) at the regional scale but the overall proportion of native cover remaining is far less than in the Grassland Natural Region. The total amount of native cover is 20% and only local pockets, mostly in the east and SW portion of the Parkland Natural Region remain.

Most of the sub-regions contain 10-15% native cover. Referring to the Land Use datasets, the Natural Sub-Region and Ecodistrict views showed greater variability in the data. The Mixedgrass and Foothills Parkland Sub-Regions indicated a loss of 5% and 6%, respectively. At the ecodistrict level the losses were also more prominent with the Lethbridge Plain and the Black Diamond Upland showing losses of 8% and 6%, respectively. The ecodistricts with the greatest amount of native cover were the Cypress Hills Slope (92%) and the Ribstone Plain (71%) in the Grassland and Parkland Natural Regions, respectively. Conversely, the ecodistricts with the lowest amount of native cover were the Standard Plain (9%) and Olds Plain (7%) in the Grassland and Parkland Natural Regions, respectively.

Data stratified by administrative areas reveal similar trends. Those areas adjacent to the large cities of Calgary and Edmonton showing the greatest loss in native cover with the Counties of Rocky View (-8%), Parkland (-5%) and Strathcona (-5%) showing the largest losses. The Kainai First Nation lost the most native cover between 1990 and 2010. The loss was about 19%. Canadian Forces Base (CFB) Suffield and CFB Wainwright contained the greatest amount of native cover at 98% and 92%, respectively.

When the data are stratified by public and private lands the loss of native cover were measurable at a regional scale for both public (-0.6% in the Grassland; -0.3% in the Parkland) and private (-2% in both the Grassland and Parkland) lands. Public lands accounted for 26.5% of the native cover in the Grassland while private lands accounted for 21.3% of the native cover for a total of 48% native cover in the Grasslands. The distribution of native cover among the public and private lands in the Parkland was different with 6% native in public lands and 14% in private lands for a total cover of 20% for this Natural Region. Clearly, a substantial amount of native cover remains on deeded lands in both Natural Regions.

Seven concluding statements and paths forward are recommended:
1. Pursue the AAFCLU analysis with the 2020 datasets to get a further 30-year perspective. Building on the effort, template, and process used in this document it would be relatively easy and straightforward to create a supplemental follow-up. An evaluation of native cover state and change by decade should be a PCF ongoing activity.
2. Consider a micro-scale analytical follow up using a high resolution DEM and the AAFCLU 2020 data (when available) to evaluate native cover with respect to connectivity and fragmentation. This analysis would further isolate key areas for mitigating actions.
3. Fix the NPVI. Address logical inconsistencies in the database. It would also be helpful to compare NPVI with AAFCLU1990 to assess interpretative discrepancies. An ideal summer student project!
4. The Timescan process does show potential and should be pursued with the appropriate classifications and ground truth applied.
5. Analyse the AAFCLU data at the section, quarter section level and possibly even at the pixel level; where did the micro losses occur? Does the data correspond with 'on the ground' knowledge?

6. Reconcile the ABMI land cover product with the AAFCLU data; why the observed discrepancies? Develop a validating process using the 3X7km plots .
7. How interested is the PCF in urban areas state and change? Appropriate datasets to investigate these areas need more investigation.

2.   Background

Native prairie and parkland cover is the foundational structural component of native prairie and parkland ecosystems, so spatially-explicit understanding of its occurrence is essential to support conservation and stewardship actions. Data on native grassland in Alberta are contained in multiple databases using multiple formats and classifications that are often not comparable, resulting in the use of old or inconsistent information for supporting land use decisions and conservation efforts. This project has involved collaborative work to evaluate previous and new land cover data with a standardized process for comparison thereby enabling a scientifically evaluated result. This will support more effective planning and implementation of native prairie stewardship and conservation initiatives in Alberta. The Alberta Prairie Conservation Forum initiated this project with partners from Alberta Agriculture and Forestry, Alberta Environment and Parks as well as key consulting experts to address this need. Native prairie is under increasing pressure for land use change from multiple sources and this collaborative work helps characterize the extent and location of native prairie in the Parkland and Grassland Natural Regions of Alberta. This report is intended to capture the key datasets, methods, analyses and outcomes that will enable readers to understand the approach and provide a foundation for future analysis, decision-making as well as future publications.

2.1.   Importance
Native prairie is foundational for native biodiversity in the Grassland and Parkland Natural Regions of Alberta. Some native species can survive in anthropogenic landscapes but may be compromised or in peril in these simplified and modified environments. A reduced suite of species, diminished ecosystem services and a greater prevalence of non-native and invasive species compromise the functioning of the natural ecosystem. The 'native' in 'native prairie' ties to the structural and functional integrity of native prairie and parkland ecosystems; it is imperative to know its extent and where changes have occurred to inform prairie conservation, management and stewardship. Native prairie provides habitat for wildlife, grazing for livestock, cultural and traditional uses, flood reduction through capture and storage, and safe release of water as well as recreational and aesthetic values enjoyed by many Albertans. By having a science based evaluation of the extent and change over time of native prairie we can make more informed decisions to support the conservation of this essential landscape.

2.2. A Basic Description of Inventories Used
There have been many attempts to inventory native vegetation. Assessment of the state and change of the native vegetation in the Parkland and Grassland Natural regions of Alberta used six of these inventories:

- *Native Prairie Vegetation Inventory (NPVI)* is a proportional summary of six native cover types per Alberta Township System quarter section undertaken in 1992/93. The spatial extent of this survey was the Grassland Natural Region.

- *Grassland Vegetation Inventory (GVI)* is a spatially explicit (polygon, line and point data) biophysical, vegetation and anthropogenic (features and land uses) classification conducted approximately 15-20 years after NPVI and covers approximately the same area of interest as the NPVI. GVI began in 2006 and was completed in 2016.

- *Prairie Farm Rehabilitation Administration (PFRA, 1995)* Land cover of the Prairies is a geospatial raster dataset portraying the rudimentary land cover types of all grain-growing areas of Manitoba, Saskatchewan, Alberta and northeastern British Columbia at a 30-meter resolution for the 1995 timeframe.

- *Agriculture and Agri-Food Canada's Annual Crop Inventory* 2016 (AAFCACI) is a Canada-wide cropland inventory that currently uses a variety of optical (Landsat and AWiFS) and radar (RADARSAT-2) imagery acquired during key crop phenological stages (reproduction, seed development and senescence) at a spatial resolution of 30 meters.

- *Agriculture and Agri-Food Canada Land Use Inventory, datasets 1990 and 2010 (*AAFCLU*).* The 1990 and 2010 Land Use (LU) maps cover all areas of Canada south of 60N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and classify: Forest, Water, Cropland, Grassland, Settlement and Other land (barren land, ice, rock and unclassified). The need is the result of AAFC's commitments in international reporting, especially for the annual National Inventory Report (NIR) to the United Nations Framework Convention on Climate Change (UNFCCC), the Agri-Environmental program of the Organization for Economic Co-operation and Development (OECD) and the FAOSTAT component of the Food and Agriculture Organization of the United Nations (FAO).The 2000 version also exists and was not used in our analysis.

2.3. Prairie Conservation Forum Steering Committee (PCF) Deliverables
Given the different inventories, the different dates and scales and kinds of information that have been captured, the PCF steering committee agreed upon the following set of deliverables to guide the data synthesis, integration, and reporting process undertaken by the technical team:
- An estimate and geographical representation of the remaining native vegetation in the province. It was further specified that these estimates would be classified:
  - According to public or private ownership (Crown or deeded), at the natural region for the latest time period (Time 2).
  - By Grassland and Parkland Natural Regions, Natural Sub-Regions, and ecodistricts.
  - By municipality.
- A tabular, graphic, and geographic representation of the rates and trends of loss classified by public or private ownership, Natural region and Sub-Region, ecodistrict, and by municipal district and county. There was also a requirement to identify what activities are causing the changes as well as identifying locations where native vegetation is most stable and most at risk.
- A tabular, graphic, and spatially explicit summary of condition where the definition of condition was constrained to mean 1) areal extent of native cover, at Time 1

(approximately 20 years ago) minus the aerial extent of native cover at Time 2 (within the last few years) and 2) the change expressed as Time 2 minus Time 1 for each of the four native vegetation inventory approaches considered in this study. This summary would lay the groundwork for further Fragstat - fragmentation analysis in a future peer reviewed paper.
- Presentation to PCF (Nanton; September 20 2018)
- Final Technical Report (this report) of requirements, implementation strategies, results, discussion, and conclusion.

2.4. Intended Use of Analyses and Results

The intended use of the analyses and results of this initiative is to support decision making for conservation and stewardship of native prairie, to inform policy and engage Albertans as to the implications of changes and loss of native prairie. The results described within this technical report will support further occasional and peer reviewed publications by the PCF and partners to highlight and discuss the implications of the findings and the methodology undertaken. These datasets provide the foundation for further work to evaluate or characterize condition and fragmentation of native prairie. As part of maintaining large native landscapes and completing inventories as described in the Strategies of the 2016-2020 PCAP (Prairie Conservation Action Plan), this work was initiated. The analyses and results will also:
- Support plans and policies – various levels of government;
- Support the development of information/tools that our membership and partners can use to support prairie conservation efforts;
- Provide an analytical foundation to support targeted PCF initiatives; and
- Raise awareness and share information amongst all Albertans – young and old, rural and urban – about the value and importance of native prairie and parkland landscapes and their current state.

It is expected the State of the Prairie project will be relevant to ongoing ecosystems services work, various provincial and transboundary initiatives, conservation offsets, industrial site pre-disturbance assessments, future priorities for the Natural Regions classification framework and species recovery strategies. This work supports PCF initiatives related the Status of Biodiversity in the Grassland and Parkland Regions of Alberta with Alberta Biodiversity Monitoring Institute (ABMI) and current projects on connecting corridors for biodiversity and renewable energy.

Other specific outcomes of this project include:
- An occasional paper discussing the implications of the results
- Peer reviewed papers describing the methodology and results of the analyses to support agency and member partner use of the information; and
- Related printed and online extension materials for PCF and member partners.

2.5.   Project approach and Timeline

A State of the Prairie & Parkland Change Analysis Meeting organized by the PCF; a multi-stakeholder group dedicated to conserving native landscapes in the Grassland and Parkland areas of southern Alberta; on February 16th 2017. The purpose of this meeting was to discuss and consider ways to evaluate the State of the Prairie and analyse the extent that the native vegetation in Alberta has changed. Initial data sources suggested by the PCF steering

committee included GVI, ABMI and other databases with the Native Prairie Vegetation Inventory (NPVI) to be used as a baseline. This meeting solicited and discussed other complementary data sets and tool suggestions. In addition, a preliminary discussion was carried out on possibilities, priorities, and limitations of the various data sets and analysis options. The goal was to produce and publish an occasional paper by the fall of 2018 for the 'State of the Prairie' in the Parkland and Grassland Natural Regions of Alberta. A conference call followed this initial meeting on May 31, 2017 to:

- Define the overall deliverable,
- Draw up of a list and gathering the metadata for spatial data sets to support the production of the overall deliverable, and
- Determine roles and responsibilities for those interested in being involved in the project both at the steering committee level, and on the technical subcommittee.

The project proceeded in a collaborative manner with the direct involvement of PCF representatives and appropriate experts working together. It was driven by an *ad-hoc* steering team comprising three PCF Board members and three discipline experts. The steering committee ensured that the project proceeded in a holistic and completely integrated manner. The PCF members were responsible for ensuring the project proceeded in a manner consistent with the PCF Board's direction and the resources it chose to allocate. The discipline experts were responsible for technical product and quality control.

The project proceeded in phases. At the conclusion of each phase, the oversight team evaluated the products and provided detailed direction and expectations for the next phase.

- Phase 1: Detailed design of the analysis phase
    - Develop a specifications document that allowed coherent spatial analyses to be conducted coherently using multiple inventories with attributes aggregated to align with the earliest, simplest inventory – NPVI.
    - Confirm the overall framework for analysis – how data will be presented, what analyses will be conducted, using what datasets and where.
    - Assess the current usability of provincial and federal ecodistricts line work for presenting analysis in a sample Sub-Region to present native vegetation status.

- Phase 2: Analysis conducted by Alberta Environment and Parks (AE&P) and Alberta Agriculture and Forestry (AA&F) in consultation with the technical team and PCF.

- Phase 3: Develop technical report and presentation. A preliminary presentation was given at the PCF meeting in Nanton on Sept. 20, 2018 with the expected completion of the final Technical Report (this report) by the end of 2018 for review by the Steering Committee.

- Phase 4: Final report acceptance and presentation postings on the PCF website.

- Phase 5: Publication and next steps

3. Materials and Methods

The strategy proposed was to standardize all the datasets used in the analysis to what is the oldest and coarsest datasets used in this analysis, the NPVI, for both attribute data and topology. A specification document was developed that defines the datasets that needed to be converted, the fields in each of the datasets that needed to be re-mapped to the NPVI structure, and some basic process strategy to create quarter section coverages for each of the datasets. The document was a generalized specifications/process document for creating GIS-ready datasets for further change analysis as proposed by the working group at a meeting held May 31, 2017. As the project progressed, only the GVI was converted to quarter section topology to enable comparisons with the NPVI; the products sourced from satellites were all topologically consistent based on a 30m pixel unit.

The commonality of these data are twofold; they are generally regional in nature and therefore allow the type of broad scale change analysis envisioned and they also identify a component of native or natural cover as part of their landscape descriptors. The change time interval was from 1990 to about 2016, the range being about 20-25 years. The datasets (described earlier) are listed below:

- NPVI -Native Prairie Vegetation Inventory
- GVI - Grassland Vegetation Inventory
- PFRA 1995 - Land Cover of the Prairies (1995)
- AAFCACI 2016 - Annual Crop Inventory (2016)
- AAFCLU 1990 AND 2010 - Land Use (1990 & 2010)

Although common elements of the datasets facilitated change analysis, other aspects of the data introduced issues that required resolution. A measure of consistency needed to be adopted so that the analysis maintained integrity. First was to ensure that the field or attribute descriptors for all the databases were referring to a similar description of the landscape. The specifications document compiled in 2017 facilitated this cross-database comparison. The NPVI field descriptors provided a measure of compatibility between the GVI, PFRA, AAFCACI and AAFCLU databases. A secondary purpose of the specifications document was to ensure that the spatial differences between two particularly different databases, the NPVI and GVI, were also resolved to some common denominator: the quarter section of the Alberta Township System. The spatial resolution of the satellite-sourced datasets was the native 30-metre pixel.

4. The Data Sources - General Descriptions

4.1. Air Photo Inventories

4.1.1 *Native Prairie Vegetation Inventory (NPVI): used for Time 1 in the NPVI-GVI change analysis for the Grassland Natural Region*
The Native Prairie Vegetation Inventory (NPVI) Polygons is a quarter section-based vegetation inventory that covers the southern part of Alberta. The definition of native prairie in the Native Prairie Conservation Action Plan is an area of unbroken grassland or parkland dominated by non-introduced species, and an area of previously broken grassland that reverted

to natural vegetation (30 to 60 years). The NPVI extends beyond the Grasslands Natural Region to include data for adjacent areas, such as the Cypress Hills. In addition to the Grassland Natural Region, the NPVI Polygons include areas that belong to the Foothills Parkland, Central Parkland, Montane, Dry Mixedwood Boreal and Lower Foothills Natural Sub-Regions. This database covers the original Public Lands Southern Region of 1993, the Grassland Natural Region, the Alberta Environmental Protection Prairie Corporate Region of 1998 and the 2001 Foothills and Addition / Crown Update. Compiling of the database occurred in two stages. The initial stage, undertaken by interpreters from the Resource Evaluation and Planning Division in Edmonton, completed the Southern Region regional area (1993). Completion of the second stage, covering Alberta Environmental Protection's Prairie Corporate Region, was performed by the Resource Information Unit in Lethbridge and occurred in 1997. The 1:30,000 scale photography used was vintage 1991-93 for all compilations; this photography sets the time stamp for the database. The base of the NPVI polygons was the quarter section grid. The quarter section grid extends well beyond the inventoried quarter sections. The Native Prairie Vegetation Class (NPC) field that contain non-zero values characterize the NPVI inventoried polygons with native prairie information. Aerial photography initially classified native vegetation cover classes within the Prairie Region. Ground truthing and local knowledge of the District Fish and Wildlife and Agriculture Food and Rural Development personnel also contributed to the process. Crown ownership from Land Status Automated System (LSAS) also described each NPVI assessed quarter section. Description of the proportion of Native Prairie Vegetation Class (based on percent cover) and Cover Type (shrubland, graminoid, lake, riparian, treed, wetland), total percent native vegetation and Natural Sub-Region as well as grazing status are part of the information characterizing each NPVI, quarter section polygon. Generally, native cover is undisturbed by humans. Areas were not classed as native vegetation if active erosion (often south-facing slopes in river valleys) with no visible signs of vegetation as they are essentially devoid of vegetation. This inventory was initially produced from tabular databases generated from interpreted 1:30 000 and some 1:40 000 scale aerial photography for the years 1992 and 1993. The inventory initially covered the Grassland Natural Region. Additional the inventory undertook to compile areas adjacent to the Grassland Natural Region within the Foothills and Montane Natural Regions (outside of Waterton Lakes National Park and within the Prairie Corporate Region) in 2001. That year, updates to the Crown Lands for the entire area, and the Tax Recovery Lands in the Special Areas from the Municipal Affairs office in Hanna, also occurred. Areas within the Counties of Mountain View and Rocky View that had not been interpreted were captured in 2003 (Reference 1; see Appendix A, Table A1 for the field descriptors).

4.1.2 *Grassland Vegetation Inventory (GVI): used for Time 2 in the NPVI-GVI change analysis for the Grassland Natural Region*

The Grassland Vegetation Inventory (GVI) represents the Government of Alberta's comprehensive biophysical, anthropogenic and land-use inventory of the southernmost portion of the province's White Area. The compilation of the inventory commenced in 2006 in the southeast corner of the province and completed in 2016 in the northern periphery of the Grassland Natural Region using digital colour-infrared stereo photography and softcopy photogrammetric techniques. The GVI product is a comprehensive and detailed geospatial representation of land cover that meets a multitude of business needs integral to land-use planning and management in Alberta. The GVI is also a biophysical and land-use inventory rather than a purely a vegetation inventory. It is comprised of ecological range sites based on

soils information for areas of native vegetation and general land use for areas of non-native vegetation, namely those associated with agricultural, industrial, and residential developments. Landscape polygons are the basic map units in the GVI digital product. These polygons represent interpretations of relatively uniform biophysical or anthropogenic areas. Records capture the Landscape polygon's characterisation in the Sites table. The GVI site type classification captured under the Site Types column in the Sites table captures a maximum of four site types per Landscape Polygon. The Grassland Vegetation Inventory Specifications document (Reference 2) describes the GVI site types and their associated information and the data capture methodology. The primary source of imagery used for GVI interpretation varied from year to year, but imagery acquisition specifications were consistent throughout the GVI data capture period. Sensors used over the ten-year period included Leica ADS40, ADS80 and DiMAC. The resolution of the Colour infrared, RGB and Panchromatic photography was normally around 0.4-metre resolution. GVI interpretation used colour infrared digital stereo imagery, with the RGB and Panchromatic being used for tree and shrub height assessments if necessary. All stereo imagery was supplied with aerial triangulation information as well as all supplementary files and DEM data needed for 3D softcopy photogrammetry setup (see Appendix A, Table A2, for the GVI-to-NPVI remapped fields).

4.1.3   NPVI and GVI Accuracies:

The stated accuracies for these air photo based inventories is 80%. The accuracy for the NPVI was determined, after its completion in 1997, by a quarter section sampling the areal extent of the coverage followed by ground truthing the calls made by the photo-interpreters. Summation of the percentage cover differences by quarter section occurred and those sums accounted for the error per sampled quarter section. An average of all the sampled quarter sections led to the final figure of 80% accuracy.

The GVI accuracy determination of 80% was more elaborate. It included both an attribute and spatial error component. Attribution error splits into two components, one for site types and one for vegetation. The site type accuracy reports 65% for GVI while the vegetation accuracy is 90%. This second accuracy value best defines the restructuring of the GVI into the quarter section version used to compare with the NPVI. Determination of overall attribute error by sampling polygons throughout the initial coverage occurred producing confusion matrices of all the attributes. Assessment and derivation of Error and Kappa statistic followed. It is interesting to note that 10 % was generally the attribute error for this part of the analysis. The spatial component of the error analysis involved assessing the lineal deviations of the polygon structures. These deviations, along with the site type, accuracy level, were lower in overall accuracy and relegated the inventory to the 80% accuracy level. Extensive audits of GVI occurred throughout its production cycle; that audit further enforced the minimum 90% accuracy for vegetation cover.

The generalization process to produce a quarter section NPVI version of the GVI introduced additional error considerations both, spatially and in attribution accuracy. The error magnitudes of the polygonal line work would both be reduced when generalization of the polygons to a quarter section polygons and increased when an ATS line transects the polygons and their attributes. Without much more investigation, the level of the error reduction and increase remains unknown. However, as the analysis progressed, it became obvious that the quarter section level comparison between NPVI and GVI had issues; showing gains and losses in native cover where none was known to have occurred. What the team was

seeing were the artifacts of the databases and the consequences of driving the analysis to too fine a level using inconsistent datasets. In hindsight, making the GVI granularity coarser, to the ecodistrict level, would have averaged out the data issues encountered in the comparison to NPVI. This fact became even more apparent when the AAFCLU could serve as a better substitute for a consistent spatial Time 1-2 comparison. Section 5.1.1 provides some more insight as to the issues encountered in generalizing GVI to the quarter section level.

4.2. Satellite/Raster Inventories - Conventional Classification

4.2.1 PFRA - A Circa 1995 Land cover of the Prairies: used for Time 1 in the PFRA-AAFCACI analysis for the Grassland Natural Region

PFRA - A circa 1995 Land cover of the Prairies datasets was undertaken by the Prairie Farm Rehabilitation Administration. It is a geospatial raster data layer portraying the rudimentary land cover types of all grain-growing areas of Manitoba, Saskatchewan, Alberta and northeastern British Columbia at a 30-metre resolution for the 1995 timeframe. It is the collection of all the classified imagery (1993 to 1995) of the Western Grain Transition Payment Program (WGTPP) assembled into a single seamless raster data layer. It captures 11 classification categories including a Grassland layer comprising native range, seeded tame pasture, abandoned farm areas and other non-cultivated uses (Reference 4; see Appendix A, Table A4 for the PFRA-to-NPVI remapped fields)

4.2.2 AAFCACI - Annual Crop Inventory: used for Time 2 (2016) in the PFRA-AAFCACI analysis for the Grassland Natural Region

AAFC - Agriculture and Agri-Food Canada's Annual Crop Inventory (ACI) 2009 to 2016 is a Canada-wide cropland inventory that currently uses a combination optical (Landsat-8) and radar (RADARSAT-2) imagery acquired during key crop phenological stages (reproduction, seed development and senescence). The overall target accuracy is at least 85% with a spatial resolution of 30m (Reference 5; see Appendix A, Table A5, for the AAFCACI-to-NPVI remapped fields).

4.2.3 AAFC Land Use (AAFCLU): used for Times 1 and 2 in both the Grassland Natural Region and the Parkland Natural Region

The LU maps were prepared using existing source data, including a variety of land cover (LC) and crop maps and various topographic layers such as Buildings and Structures, Hydrography, Industrial and Commercial Areas, Transportation and Wetlands from the CanVec program of Natural Resources Canada (NRCan). All available source data were carefully co-registered and a series of 'rules' were developed in order to generate a LU class for each year for each of 6.7 billion pixels. The rules followed the principle of "preponderance of evidence" and developed using logic, class accuracies of the various products and expert knowledge. The use of a variety of input products covering the period from 1990 to 2012 also enabled the development of 'logical' rules such as "settlement does not disappear". The development of a LU map based on IPCC classes also necessitated the elimination of the input LC class "shrubland". The class, "shrubland", was not considered a use. "Shrubland" was converted to other classes (primarily forest or grassland) based on other inputs, location and proximity (Reference 6; see Appendix A, Table A6, for the AAFCLUI-to-NPVI remapped fields).

4.2.4 Satellite Inventory Accuracies:

The estimated PFRA inventory accuracy is about 60% in other words 40 percent of the classification in this inventory was noise. The overall target accuracy of the AAFCACI is at least 85% meaning that approximately 15 percent of the classification in this inventory was thought to be noise. The estimated AAFCLU overall accuracy was 84.0% and 92.7% for 1990 and 2010 respectively. Since some locations can legitimately, be both Wetland and Forest and others can be both Water and Wetland, overall accuracies improve to 89.1% and 94.7% for 1990 and 2010 respectively if misclassifications between those classes are not errors. The accuracy assessment used 7138 and 4063 randomly selected points for 1990 and 2010 respectively (Reference 6).

The spatial issues inherent in the NPVI-GVI analyses were not an issue in the satellite raster analyses. The 30 metre pixel was the basic information unit that could allow the inventories to be cross-analyzed although this mixing of products only occurred with the PFRA-AAFCACI analysis for the Grassland Natural Region.

5.   Data Standardization

5.1.   Spatial

5.1.1. ATS Quarter Section Standard:

As noted the NPVI and the GVI are very different databases spatially. In fact the NPVI more closely resembles the structure of the satellite inventories with its uniform quarter section sized spatial unit. Since one of the initial requirements of the State of the Prairie steering committee was to perform a NPVI-GVI analysis, the polygonal structure of the GVI had to be matched to that of the NPVI. Deconstructing a highly detailed inventory like GVI into a coarse quarter section representation would introduce some data issues. This was accomplished by a series of processing steps which started with adding the 6 NPVI classes (Shrub, Tree, Graminoid, Lake, Riparian and Wetland) to the GVI dataset, followed by calculating the proportional percentages of each cover type (% Tree, % Shrub, % Grass or Herbaceous, % Water, and % Non-Veg) within each GVI polygon.

Two different ways of calculating proportional percentages of each cover type occurred depending on the site type of the polygon. The native/natural upland site types (Subirrigated, Overflow, Clayey, Loamy, Sandy, Limy, Sand, Blowouts/Solonetzic, Choppy Sandhills, Thin Breaks, Shallow to Gravel, Saline Lowland, Gravel and Badlands/Bedrock) were calculated by taking the cover type percentage and multiplying it by the percentage of the site type present in the polygon. This procedure was also applied to the Lentic Open Water site type since they are not always classified as 100% water and can contain a subset of different cover types. The "% Non-Veg" cover type present in GVI was also calculated into a "Bare Ground" class which was later removed from the final statistics due to NPVI not classifying bare ground as native. For the remaining native/natural wetland site types;

- Lentic Temporary, Lentic Seasonal, Lentic Alkali, Lentic Semi-Permanent to Permanent; and
- native/natural riparian site types (Lotic River, Lotic Coniferous, Lotic Deciduous, Lotic Shrub and Lotic Herbaceous)

The assumption was made that they are purely wetland and purely riparian since there was no

wetland or riparian cover type to translate from GVI to NPVI. This means that for those site types a simple transfer of the percent of the polygon to the NPVI wetland and riparian classes occured.

With the proportional cover type percentages calculated for all site types, the next step was to calculate the proportional areas of each cover type within each site type. To accomplish this multiplication the proportional cover type percentages by the area of the polygon and dividing by 100 occured. This resulted in areas for the six NPVI classes and bare ground class which when summed up for all site types within a polygon, equalled the area of the GVI polygon. With the processing of the GVI dataset now complete, the dataset was then intersected and cross-tabulation of areas into quarter sections occurred. The final step of the process was to join it to the original NPVI dataset and compare classes.

5.1.2. Updating of Ecodistrict Boundaries

Alberta's Natural region and Sub-Region classification system (Natural Regions Committee 2006) defines the ecological character and extent of prairie and parkland landscapes (as defined by climate, vegetation and soils) and provides an essential framework to evaluate the changing state of natural landscapes. The 2006 work was an update of the initial classification by Strong and Leggat (1981) (Reference 10).
One important component of the earlier work by Strong and Leggat (1981) was a subdivision of Natural Sub-Regions into ecodistricts. Ecodistricts are further subdivisions of Natural Sub-Regions based on units of relatively homogeneous biophysical and climatic conditions. These units are useful in developing operational plant community classifications by partitioning the wider variability of the Natural Sub-Region, adding important value to a spectrum of resource management and land use activities. Since the 2006 work of the Natural Regions Committee (Reference 9) did not include the update of ecodistrict boundaries to Sub-Region boundaries, this was an important first step for the current project.

Updating ecodistrict boundaries within the 2006 Natural region and Sub-Region boundaries for the Grassland Natural Region came next. A working group, including terrain/soils specialists and GIS analyst worked through an iterative process to reconnect the old ecodistrict boundaries within the Natural Sub-Region boundaries that resulted from work of the Natural Regions Committee in 2006. Information for this process came from the recently completed Grassland Vegetation Inventory (GVI) and by published soils inventory information from AGRASID (ASIC 2001) (Reference 8).

The GIS exercise compared the 1988 Ecodistrict delineation and 2006 Natural Sub-Region line enhancements in the Grassland Natural Region and examples included significant Ecodistrict line improvements especially in locations with pronounced climatic gradients and modifications to previous Ecodistricts where an area is better fitting with an adjacent Ecodistrict.

For example, providing line enhancements d at the Cypress Hills where the Cypress Slope Ecodistrict (low elevation Mixedgrass) now results in a continuous ring adjacent to the higher elevation Cypress Hills Ecodistrict (high elevation Mixedgrass Maps 1a and 1b). These Ecodistrict modifications are substantiated by Soil Survey and AGRASID work in the 1990s

and plant community characterization in the 2000s to present.

Map 1a and Map 1b. Cypress Slope ecodistrict modifications showing before (green line) and after (orange line) the applied changes.
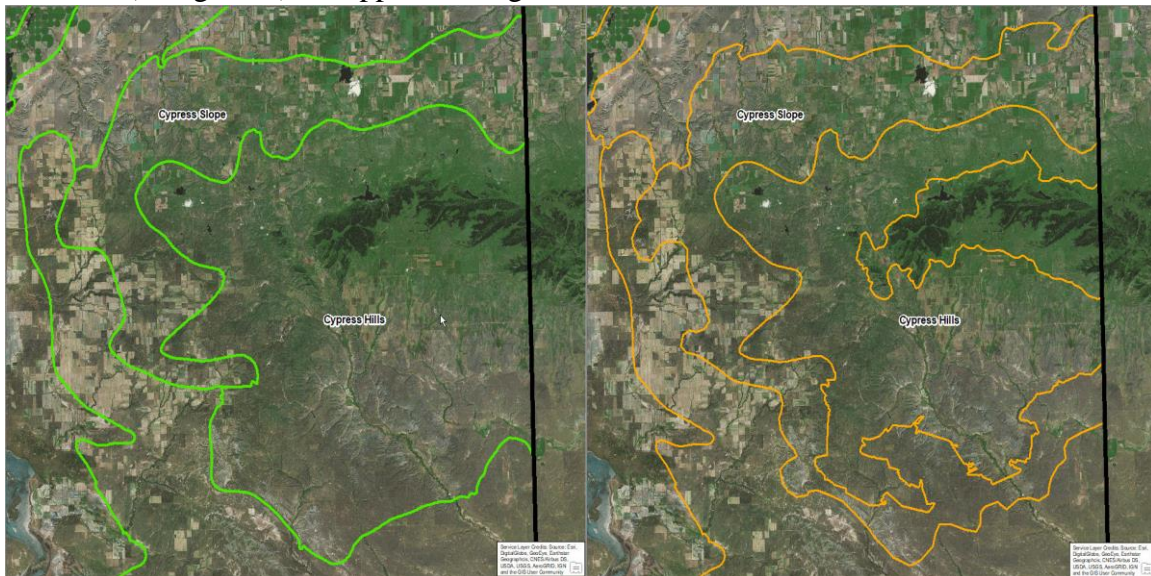
Line enhancement based on more precise mapping products also occurred in the Porcupine Hills, the Sweetgrass Upland and at the Foothills Fescue and Foothills Parkland Natural Sub-Region boundaries. A modification was made making the Bindloss Plain Ecodistrict larger and the Shuler Plain Ecodistrict smaller. This modification is justified as the sand dune and sand plain area located north and west of Hilda best fits with the Bindloss Plain.

A new Ecodistrict was added where the former Majorville Upland Ecodistrict spanned both south and north of the Bow River (Map 1c and Map 1d). The Bow River valley and plains to both the west and east are best fitting with each of the Blackfoot Plain Ecodistrict (west) and the Bow City Plain (east). The new area recognized at the north is named the Makepeace Plain Ecodistrict and requires characterization.

Map 1c and Map 1d. Ecodistrict modifications around the Majorville Upland ecodistrict showing changes before (green lines) and after (orange lines).
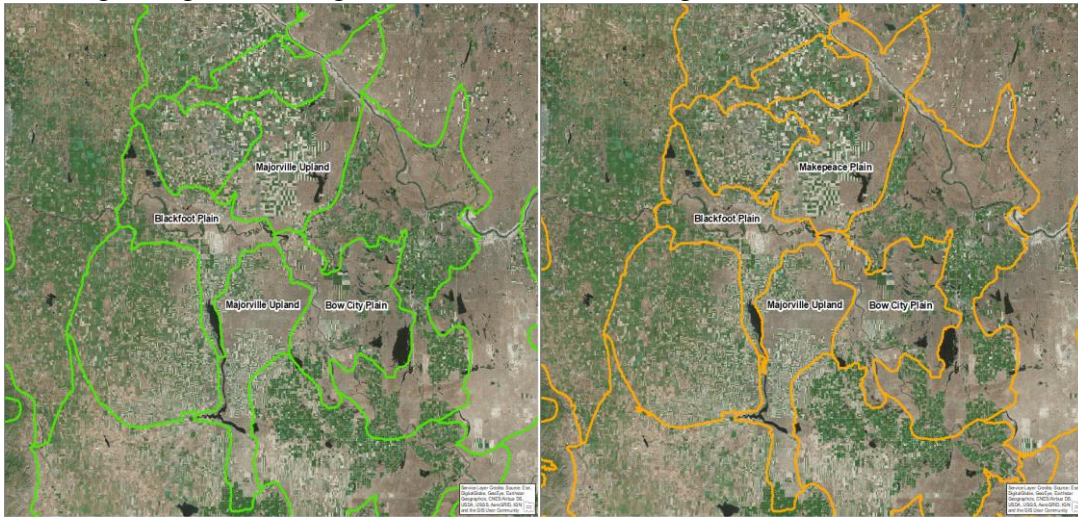
5.2.   Attributes

5.2.1   NPVI standard
A key consideration for the technical team was to compare datasets that had different resolutions, units and attributes. As the NPVI was one of the oldest datasets, its inclusion into the time change analysis was a requirement but it was also the dataset with the coarsest spatial resolution (quarter section based) and with minimal attribution. Enabling a modicum of change analysis required the higher resolution datasets (specifically, GVI) to be compatible with the NPVI both spatially and attribute-wise. As described earlier, GVI was generalized to the NPVI standard for quarter section comparison and for the six basic landscape cover types: Shrub, Gramanoid, Lake/Water, Riparian, Treed and Wetland. The PFRA, AAFCACI and AAFCLU datasets only needed to be standardized for the six basic landscape cover types; since their native 30m pixel resolution was consistent among them. Appendix A covers the details of the re-mapping exercise including the re-mapping for AAFCLU which was completed after the original specifications document was completed. (Reference 7)

5.2.2   Attribute Inconsistencies in NPVI and GVI
In NPVI, areas of active erosion (Badlands landscapes) with no visible signs of vegetation (Thin Breaks, Saline Lowland, Choppy Sandhills with sand modifier) were not considered to be native vegetation as they are essentially devoid of vegetation. Therefore, these site types in GVI were not included as part of the native vegetation calculations.

Other assumptions were also made; wetland and riparian site types were assumed to be 100% wetland or riparian in the NPVI conversion, when in reality there would have been components of shrub, tree or herbaceous cover attributed in GVI. This was to accommodate the NPVI interpretation of Riparian and Wetland. In NPVI, Riparian included the flowing water and surrounding floodplain regardless of vegetation cover type. In GVI these areas would have been interpreted as Lotic Shrub, Lotic Deciduous etc. In the conversion of GVI to NPVI cover classes, all vegetated Lotic sites would have been considered Riparian. NPVI addressed wetland types in similar manner. Rings of shrubs and trees growing around the perimeter of wetlands were included with the Wetland classification. In GVI these may have

been interpreted as separate cover types. These treed and shrub areas were included in the Wetland classification when converted to NPVI classes.

6.   Results by Natural Region

6.1 Grassland
Ultimately, three data sets characterized change and state of the prairie for the Grassland Natural Region in a comparative context. The Time 2 datasets are anchored by the GVI's accuracy, comprehensiveness and general robustness as an inventory of the Grassland Natural Region but the Time1 datasets are not as easily validated and are prone to more uncertainty. Regarding internal consistency of the Time 1 - Time 2 change results, the AAFCLU analysis likely offers the best process-driven perspective since the methodology of the two time periods are exactly the same. This analysis also provides a most appropriate vehicle to monitor state and change into the future as the next iteration is expected in 2020.

6.1.1 Region Results.

The results from the three sets of Time 1 and Time 2 analyses, the NPVI-GVI, PFRA1995-AAFCACI2016 and AAFCLU1990-AAFCLU 2010, indicate that no significant change occurred in the Grassland Natural Region from the early-to-mid-nineties (Time 1) to the more current Time 2 period (2006-16 for GVI, 2016 for AAFCACI and 2010 for AAFCLU). All sets of analyses are consistent in quantifying minimal overall change; NPVI-GVI indicating a change of about 2% the PFRA-AAFCAIC showing a similar change and the AAFCLU1990-AAFCLU2010 with a negative change of 2.6% (Tables1a, 1b, and 1c, respectively and Appendix D Tables D1, D2 and D3). Considering the error in the three sets of data and the propagation of that error in the difference calculations, the overall change is within the noise level of the data and is not significant.

Table 1a. Grassland Vegetation Cover Totals for the NPVI-GVI analyses.

Grassland Natural Region					
Cover Type	Area (ha)		Percent Area		% Difference
	NPVI	**GVI**	**NPVI**	**GVI**	
Shrub	126982	132208	1.3	1.4	0.1
Treed	27209	33283	0.3	0.3	0.1
Graminoid	3297290	3350063	34.5	35	0.6
Riparian	119210	203130	1.2	2.1	0.9
Lake	81749	132555	0.9	1.4	0.5
Wetlands	386186	363943	4	3.8	-0.2
Total Native	**4038626**	**4215181**	**42.3**	**44.1**	**1.8**
Total Natural Region Area		**9558049**			

Table 1b. Grassland Vegetation Totals for the PFRA- AAFCACI analyses

Cover Type	Area (ha)		% of Total Area		% Difference
	PFRA	**AAFCACI**	**PFRA**	**AAFCACI**	
Shrub	60648	81743	0.6%	0.9%	0.2%
Treed	21408	47497	0.2%	0.5%	0.3%
Gaminoid	4825822	4728526	50.5%	49.5%	-1.0%
Riparian	N/A-	N/A	N/A	N/A	N/A
Lake	169020	139195	1.8%	1.5%	-0.3%
Wetlands	43935	276915	0.5%	2.9%	2.4%
Total Native	**5120833**	**5273876**	**53.6%**	**55.2%**	**1.6%**
Total Natural Region Area	**9558049**				

Table 1c. Grassland Vegetation Totals for the AAFCLU1990-AAFCLU2010 analysis

Cover Type	Area (ha)		% of Total Area		% Difference
	AAFCLU('90)	**AAFCLU('10)**	**AAFCLU('90)**	**AAFCLU('10)**	
Shrub					
Treed	81666	77576	0.9	0.8	0.1
Gaminoid	4338372	4094117	45.4	42.8	-2.6
Lake	317972	318018	3.3	3.3	0
Wetlands	86729	85049	0.9	0.9	0
Total Native	**4824747**	**4574761**	**50.5**	**47.9**	**-2.6**
Total Natural Region Area	**9558049**				

Map 2 shows the NPVI-GVI distribution of the native vegetation cover for Time 1 and Time 2. The change is relatively minor and in accordance with the actual numbers in the tables above. Some discrepancy can be seen in the NPVI - GVI where GVI seems to show an increase in the 0-25% quartile vegetation cover in areas such Bow City, Foremost and the area between Calgary and Lethbridge. This is likely an artefact of the resolution of the NPVI and GVI datasets with GVI portraying native cover down to 2 ha polygons while NPVI estimating vegetation cover as a percent figure at the quarter section level.

Map 3 shows the AAFCLU1990-AAFCLU2010 distribution of the native vegetation cover for Time 1 and Time 2. These maps may be more spatially relevant because the methodology used to create the Time 1 and Time 2 maps are internally consistent (as opposed to the quarter-section-polygon dichotomy of NPVI-GVI as noted earlier). The loss of native cover in the Kainai First Nation stands out in this portrayal.

Map 2. Spatial distribution of native vegetation cover for NPVI and GVI. Data shown in quartiles.
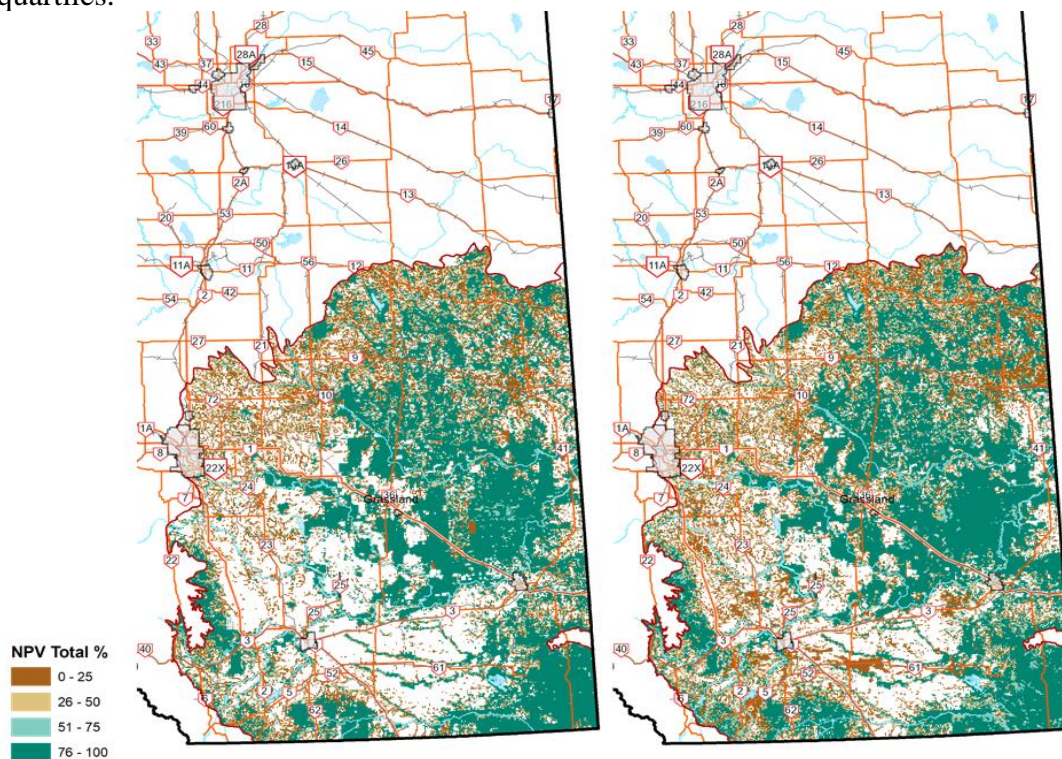
Map 3. Spatial distribution of native vegetation cover for AAFCLU1990 and AAFCLU2010 for the Grassland Natural Region.
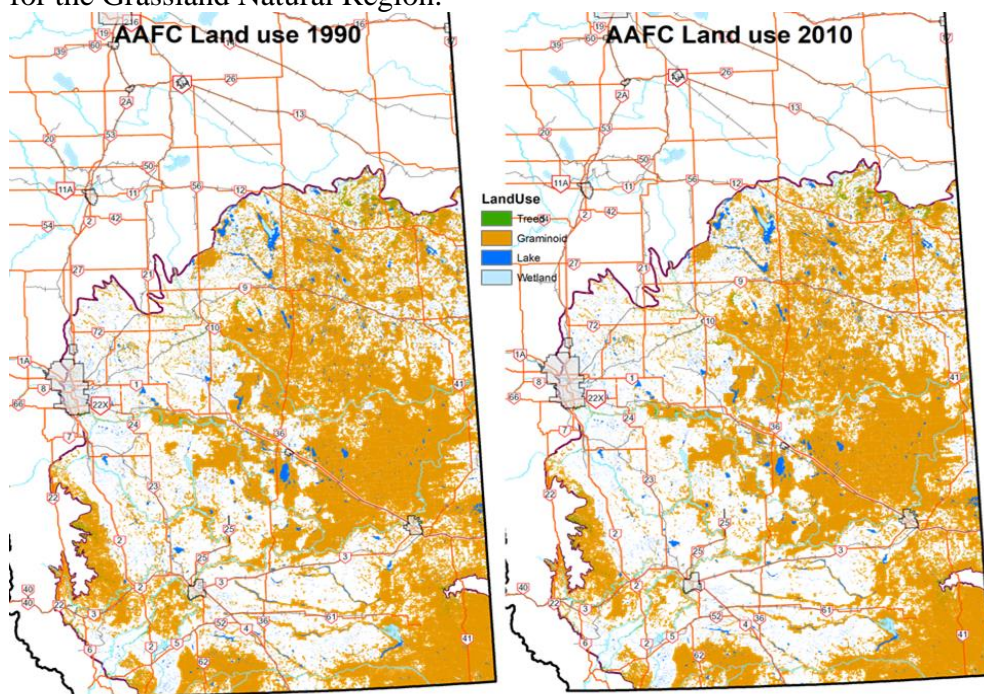
The three sets of analyses do differ to some extent in the reporting of remaining native cover. The GVI dataset indicates a total native cover of about 44%, the AAFCLU (2010) shows a figure of about 48%, and the AAFCACI (2016) indicates a total native cover of about 55%. Given the original GVI's intensive and extensive auditing process, the GVI figure is likely the closest to truth; however, the quarter section generalization did introduce some polygon slivering error in the quarter sectioned GVI (see Section 5.1.1). <u>When the raw GVI data is used, the total native cover for the Grassland Natural Region amounts to about 48%, the same value as the AAFCLU 2010.</u> This not only validates the AAFCLU 2010 data but also qualifies it as a robust alternative, in fact, as future change analyses are considered, the AAFCLU products are likely best positioned to provide consistent continuity to quantify change.

6.1.2 Sub-Region Results.

At the Sub-Region level the change results relate to the findings at the Region level; no change within the margin of error observed within the three sets of analyses. The Sub-Region showing the greatest amount of native cover is the Dry Mixedgrass (GVI = 54%, AAFCLU2010 = 60%, and AAFCACI = 65%), while the Sub-Region with the lowest amount of native cover is the Foothills Fescue (GVI = 30%, AAFCLU2010 = 29%, AAFCACI = 44%) ((Figures 1, 2 and 3). This is a statistically significant difference between these two Sub-Regions.

Figure 1. NPVI - GVI % Total Native for the Grassland Natural Region and Sub-Regions
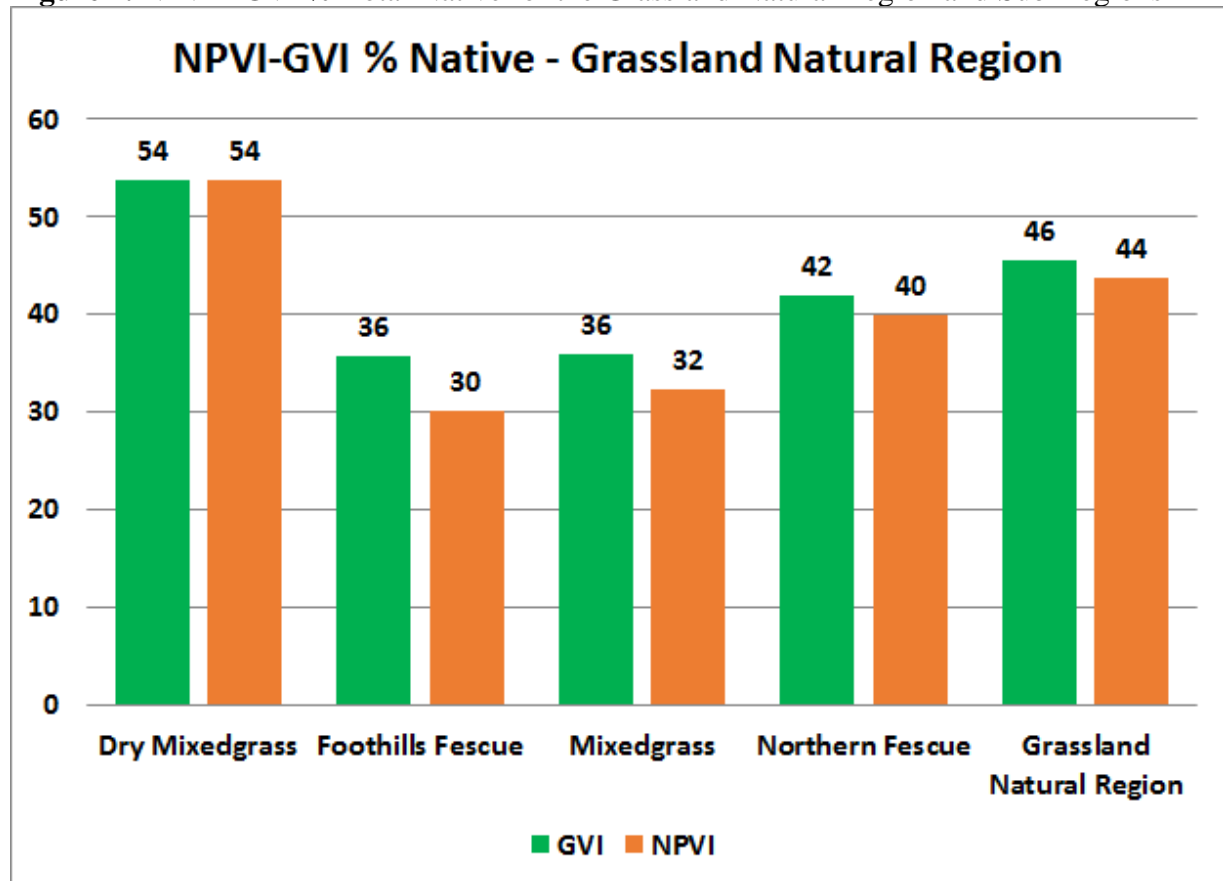
Figure 2. AAFCLU1990 - AAFCLU2010Total Native for the Grassland Natural Region and Sub-Regions
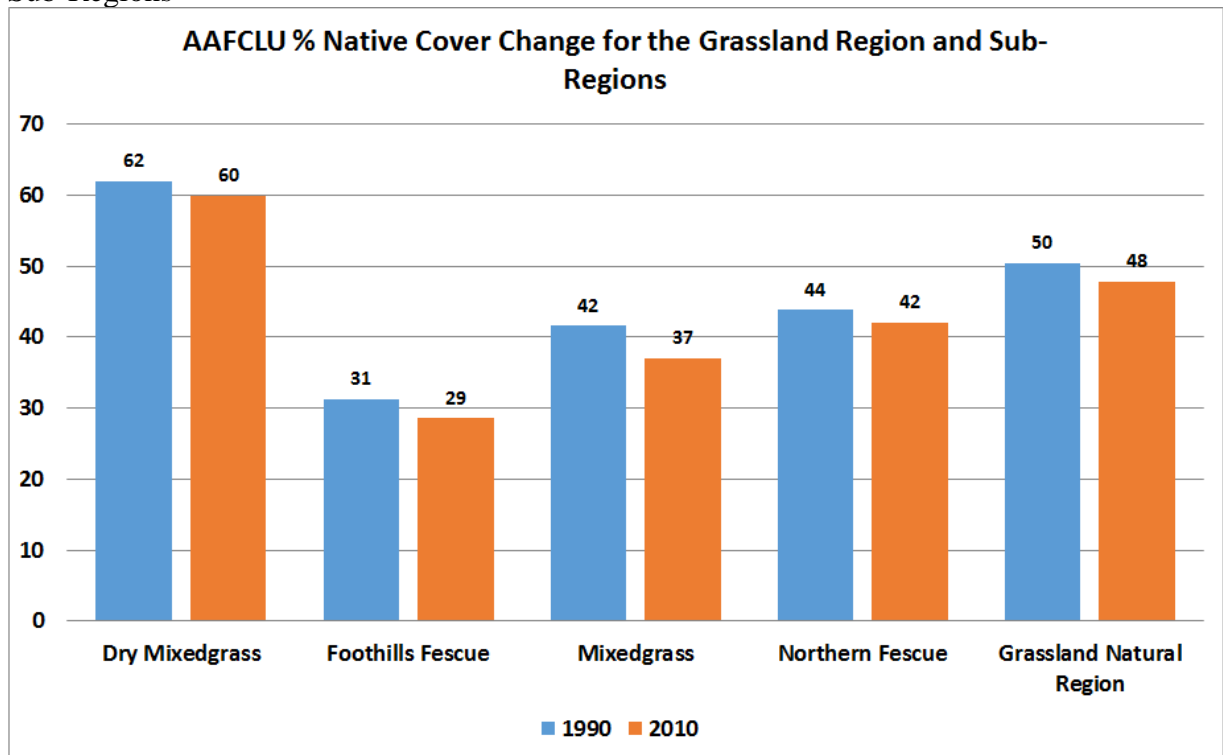
Figure 3. PFRA - AAFCACI % Total Native for the Grassland Natural Region and Sub-Regions
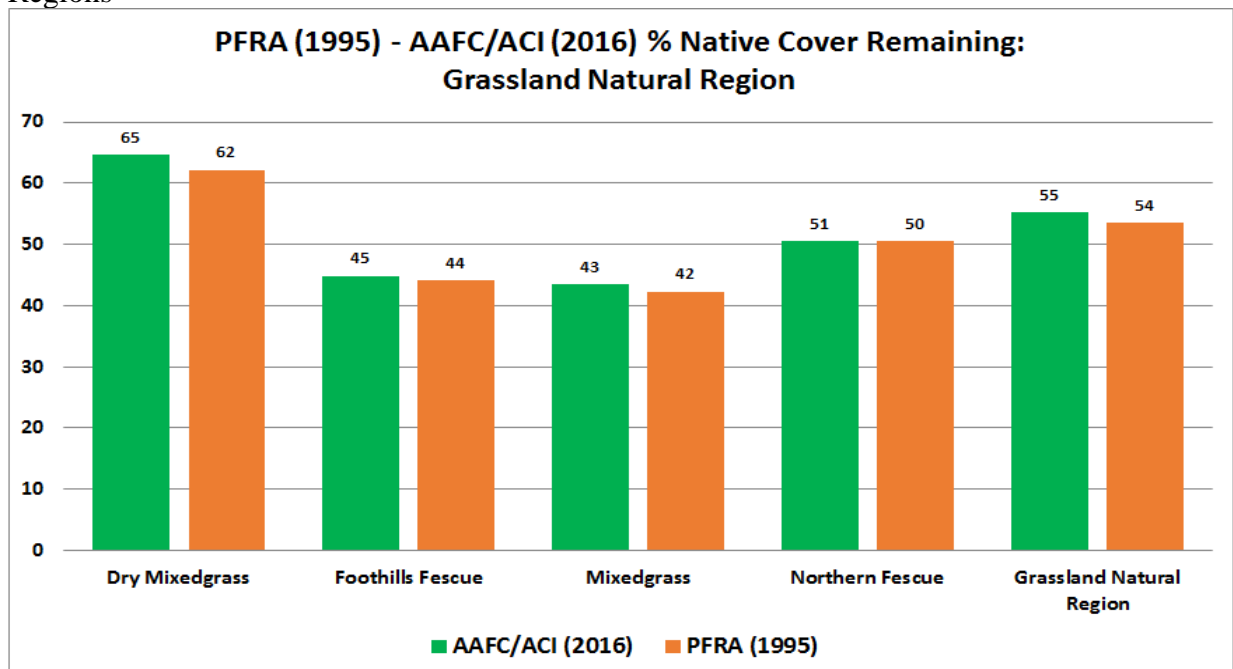
6.1.3 Ecodistrict Results.

As the areal extent diminishes with the ecodistricts, the variability in the analysis increases. Although most ecodistricts show small changes from the Time 1 datasets to the Time 2 datasets, higher than average differences of 8% to 10% are occasionally encountered. Figure 4 identifies those ecodistricts with the greatest amount of change between Time 1 and Time 2. The figure was assembled to show cross comparisons between the three sets of analyses, for example, the three largest ecodistrict change differentials for NPVI-GVI were the Del Bonita Plateau, Cypress Hills (technically part of the Montane) and the Milk River Upland; these are the blue bars in Figure 4. The red and green bars show the comparative results for the AAFCLU and PFRA-AAFCACI, respectively. Similarly, the largest ecodistrict change differential for the AAFCLU was the Lethbridge Plain (the red bar) and again the blue and green bars are added to provide comparative results with the other two sets of data.

Figure 4. Highest % Change for Grassland Region Ecodistricts for each Grasslands Dataset
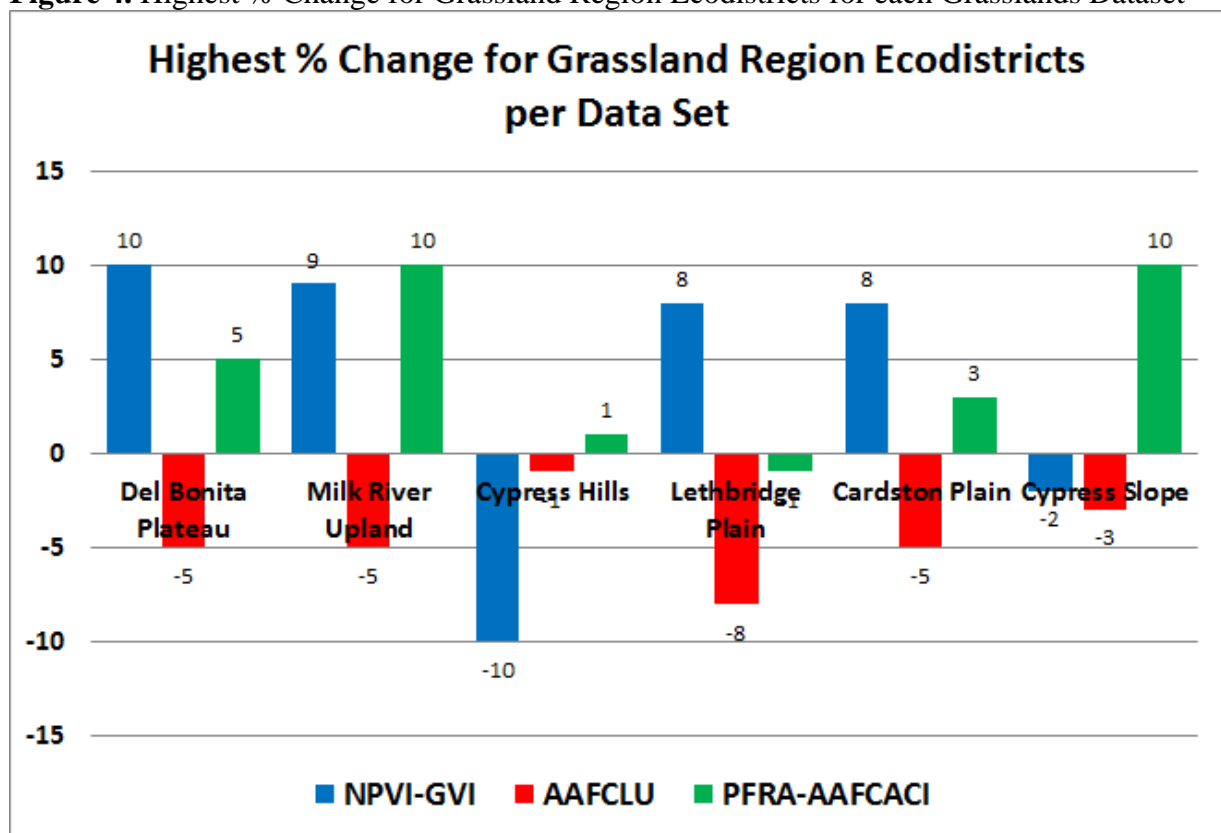
Figure 4 not only shows those ecodistricts that had the greatest change, it shows the magnitude of that change, and provides comparative insight into how similar and dissimilar the ecodistrict change is viewed through the different sets of analyses. Of note are the Lethbridge Plain ecodistrict where NPVI-GVI reports an *increase* of 8% in native cover while the AAFCLU shows a *decrease* of 8% in native cover; a spread of 16%. Similar spreads (15%) in the analyses can be seen in the Milk River Upland and Del Bonita Plateau.

It should be emphasized, however, that these five or six ecodistricts are the extremes of the change data, in perusing Appendix D Tables D1 to D3 it can be seen that for most of the 35 ecodistricts in the Grassland Natural Region the change is relatively small and consistent among the three analyses.

Figures 5, 6, and Map 4 show where most of the native cover still remains and where it is lowest. These are important not only because they show the highs and lows of native cover per ecodistrict but because as a Time 2 perspective they compare the satellite derived data analyses (AAFCLU and AAFCACI) with GVI. We see that the satellite derived analyses tend to be higher than the GVI (Figure 5) and in areas of low native cover the effect is inconclusive (Figure 6).

Figure 5. Grassland Ecodistricts with the Highest Native % for each Time 2 dataset (GVI, AAFCLU, and AAFCACI)
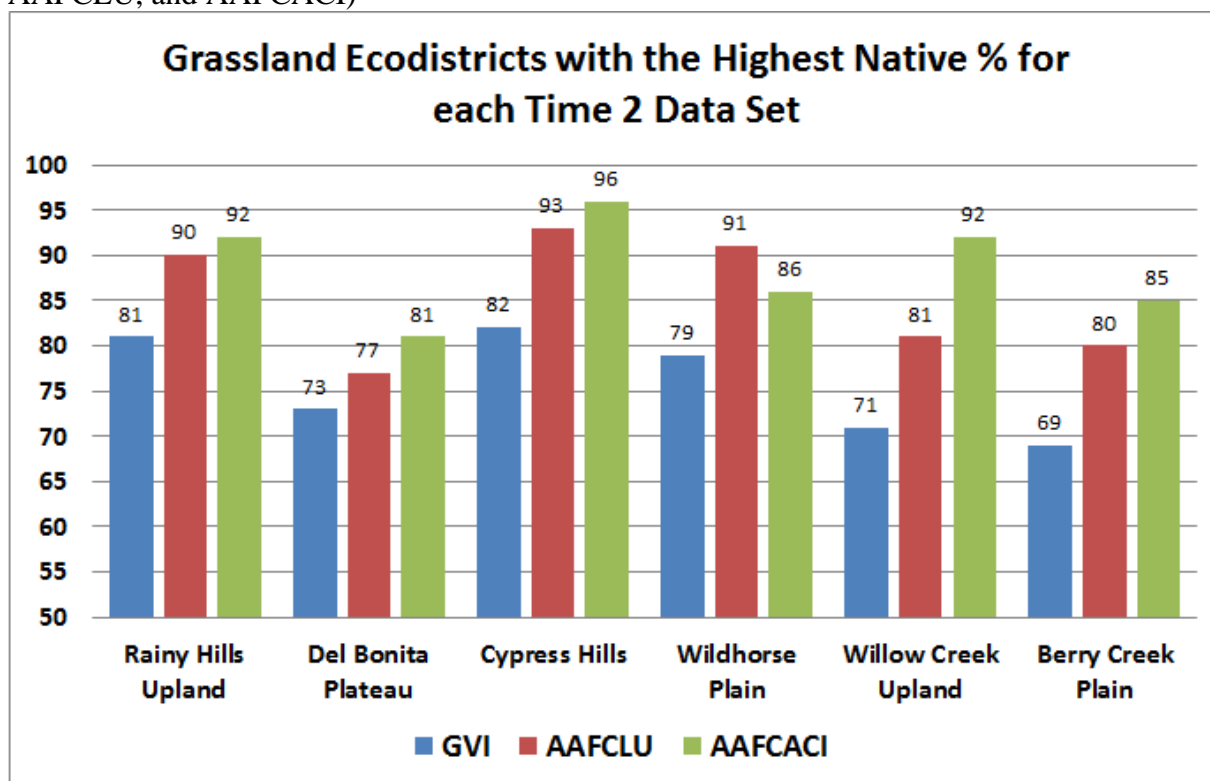
Figure 6. Grassland Ecodistricts with the Lowest Native % for each Time 2 dataset
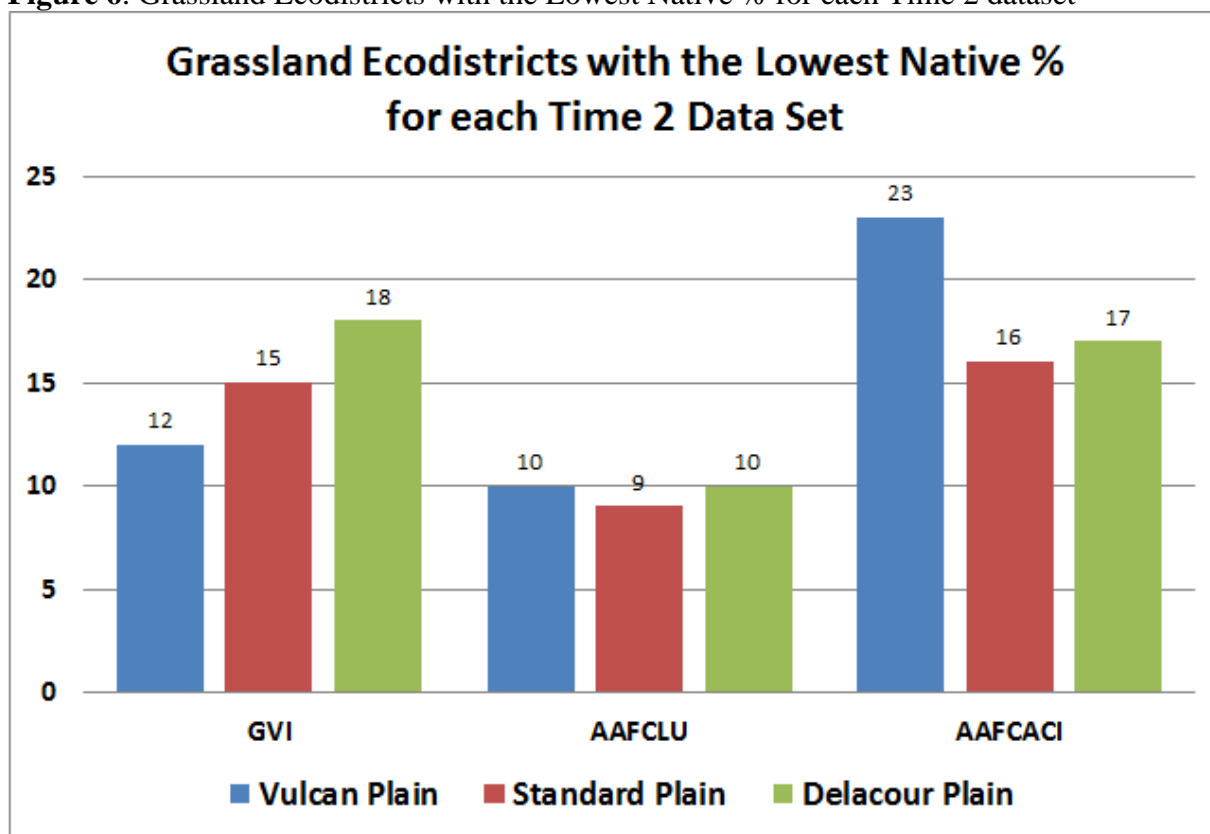
Map 4 Percent Native Cover Remaining for Grasslands Ecodistricts (based on AAFCLU2010 data)
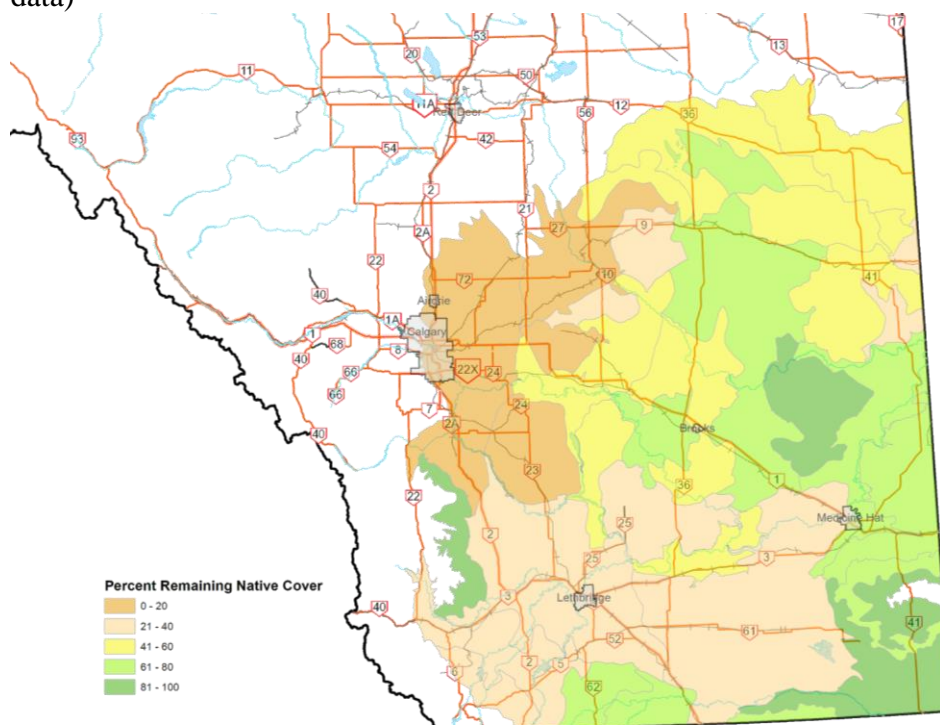
6.1.4 Results by cover type.

As with the no change within the margin for native cover for the overall Natural Region, the change values for each cover type are also not within the margin of error for (Figures 7, 8 and 9); the data is oscillating between 5% and -5%. The largest change in the NPVI-GVI analysis (Figure 7) is noted in the gramanoid cover for the Foothills Fescue (3%), While changes of note in the AAFCLU analysis (Figure 8) are observed in the Mixedgrass gramanoid cover (-5%). The PFRA-AAFCACI dataset (Figure 9) shows greatest change in the Northern Fescue for gramanoid and wetlands (-6% and +6%), respectively.

Which of these datasets is closest to portraying actual change in vegetation cover over the 20 or so year period? Likely some parts of all three, however, since the AAFCLU analysis (Figure 8) is the only data that is presented that reports significant change beyond the margin of error in the analysis. For this reason, it became the 'source of truth' compared to the other two analysis.

Figure 7. Percent NPVI-GVI Native Cover Change for the Grassland Natural Region
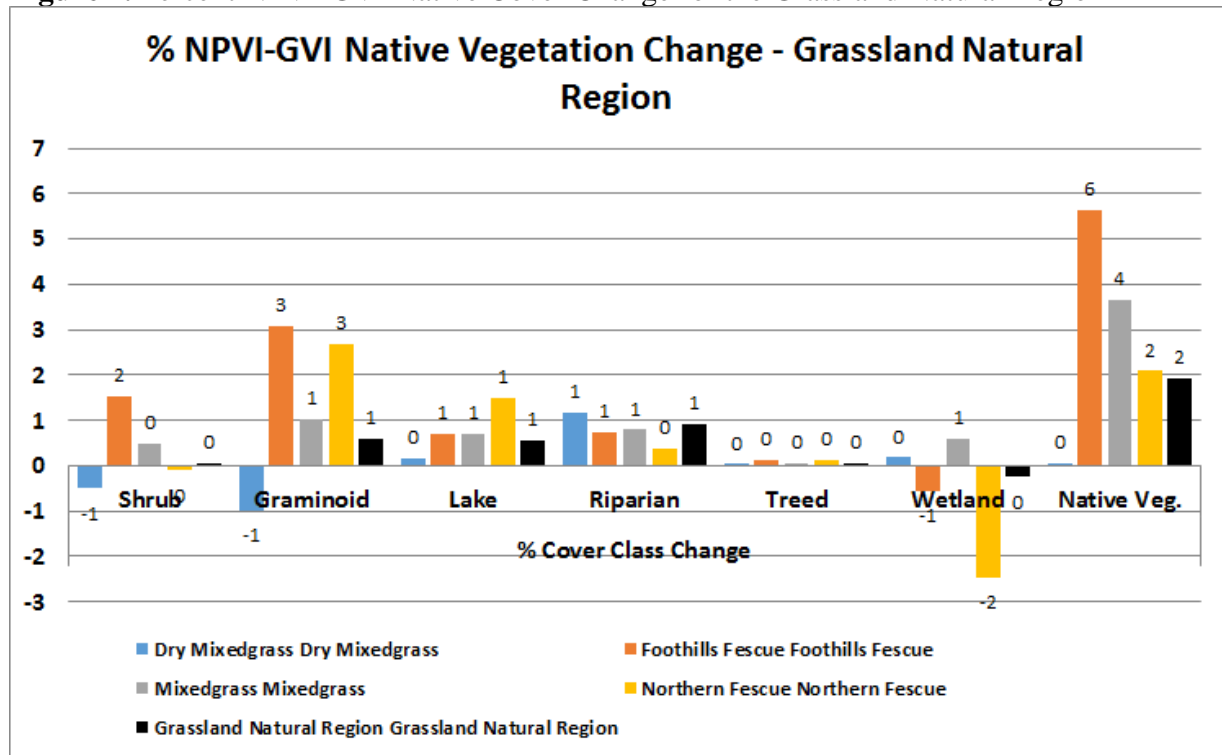
Figure 8. Percent Native Cover Class Change for the Grassland Region and Sub-Regions using the AAFCLU data
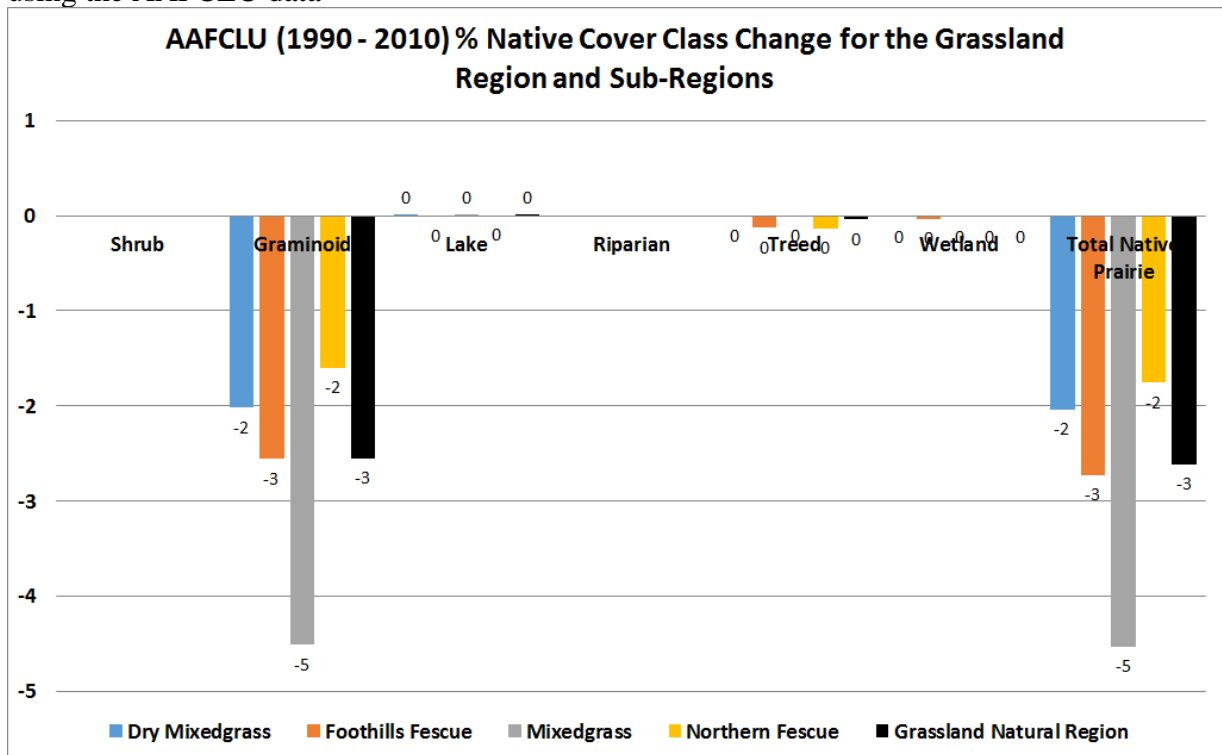
Figure 9. Percent Native Cover Class Change for the Grassland Natural Region using the PFRA-AAFCACI data
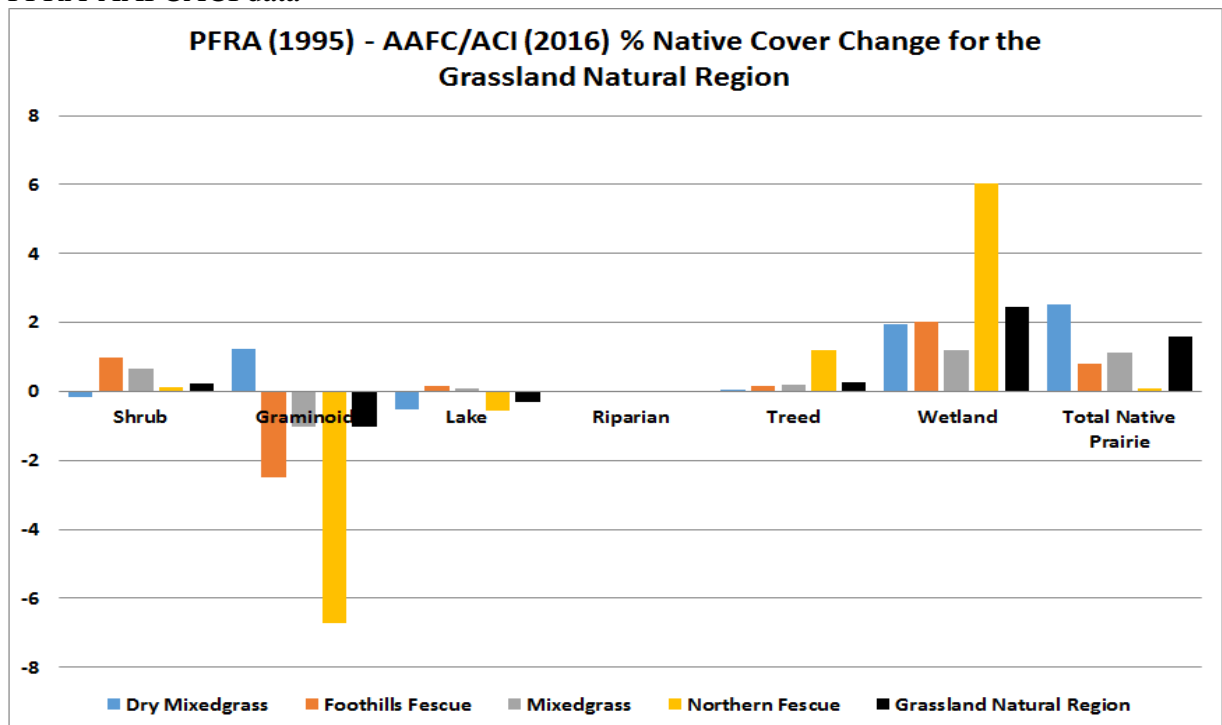
6.1.5 Results by Administrative Areas.

The change data for the administrative areas follows a pattern similar to the change information of the ecodistricts; more variability in the data but the change is still not discernible within the margins of error of the NPVI-GVI datasets and the PFRA-AAFCACI datasets. There may be a reportable change observed beyond the margins of error in the analysis using the AAFCLU datasets. Figures 10, 11, and 12 show that the range of change spans from 8% in Cardston County to -7% in MD of Ranchland No. 66 for the NPVI-GVI datasets. The PFRA-AAFCACI datasets show a similar range of about 7% to -6% but between the MD of Pincher Creek and Kneehill County. Once again, taking into account the margins of error in the analysis,the AAFCLU datasets may show consistent negative change. MDs and Counties with greater or equal to 15% Grassland Natural Region area show up in the Figure 10. . It is important to note that ONLY the Grassland Natural Region portion of those administrative areas straddling the Region boundary are being accounted, for example, for the County of Stettler, this represents only 25% of the County area. Generally, areas covering less than 25% may or may not show up in the figures; these include the MD of Ranchlands (2%), Mountain View County (11%) and the MD of Provost (13%). The percent change value form part of the administrative label for each bars within figure 12. See Appendix D Table D4 to D7 for details on the areas not shown in the figures.

Figure 10. Percent Native Cover Change for the Grassland Natural Region Administrative Areas using the NPVI-GVI data
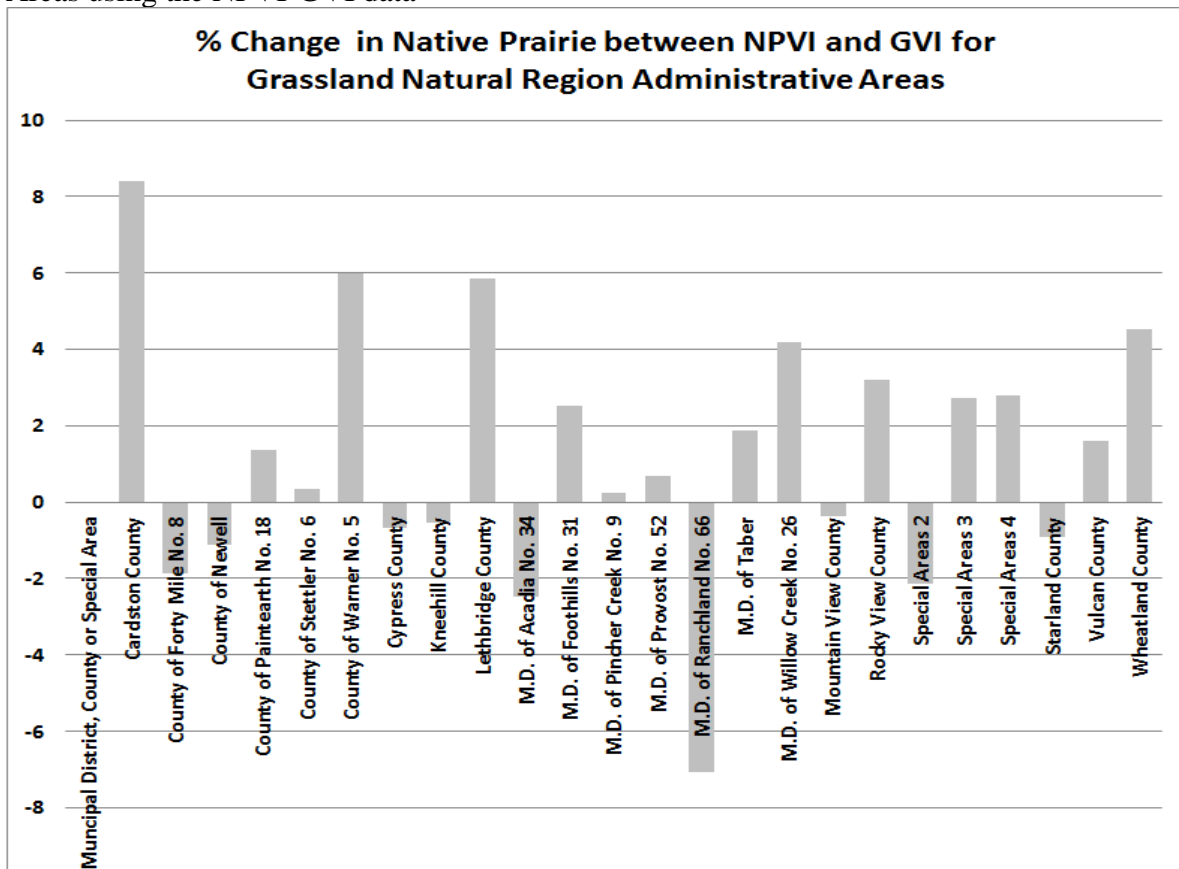
Figure 11. Percent Native Cover Change for Grassland Natural Region Administrative Areas using the PFRA-AAFCACI data
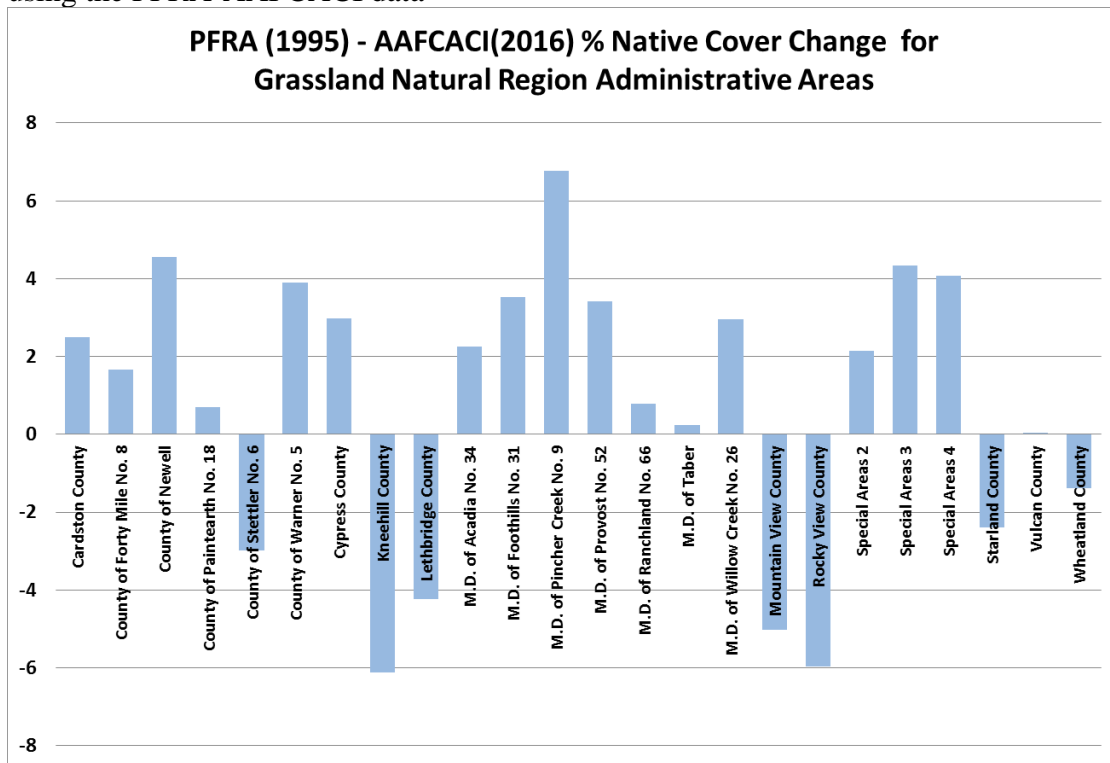
Figure 12. Percent Native Cover Change for the Grassland Natural Region Administrative Areas using the AAFCLU data.
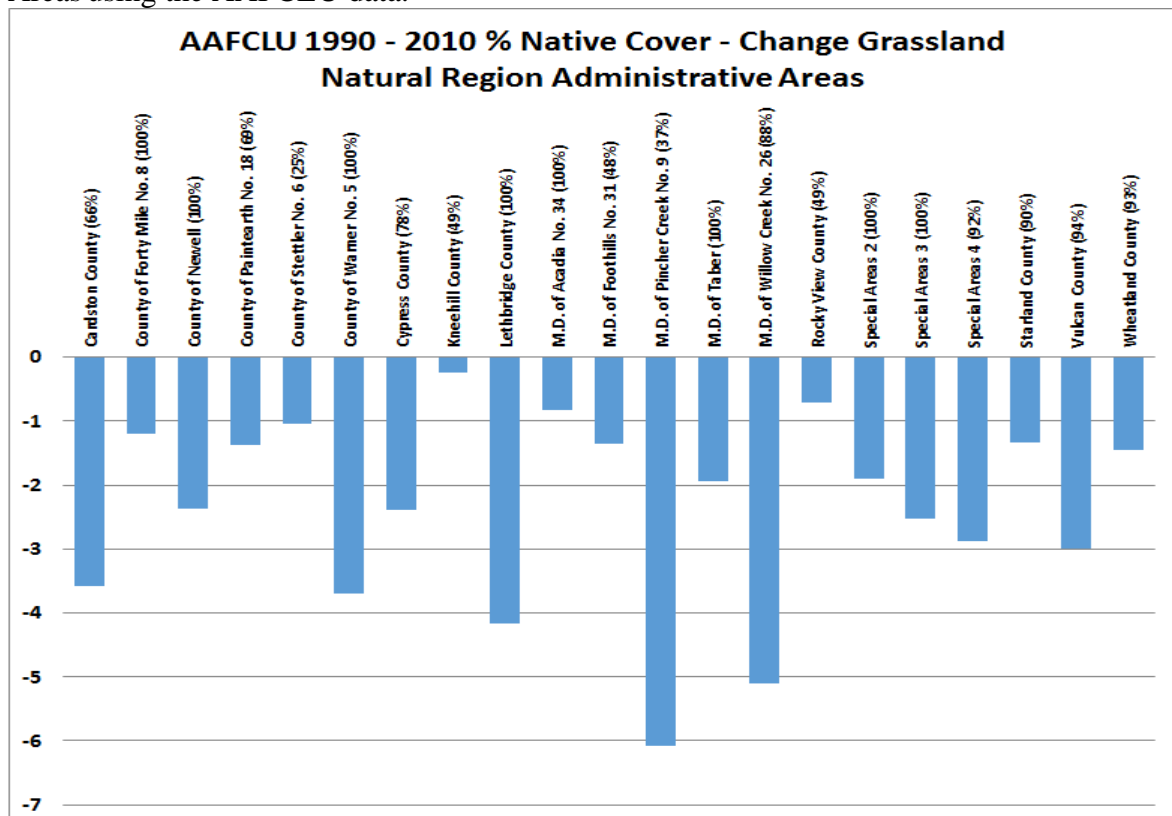
An interesting perspective of the data is obtained when looking at the administrative areas by the amount of native cover remaining. Figures 13, 14, and 15 show this view for the GVI, AAFCACI, AAFCLU, respectively Map 5 shows the spatial view using the AAFCLU2010 data. If we account for those Administrative Areas that are wholly encompassed in the Grassland Natural Region the greatest remaining native, amount is located in Special Area 2 and the least in Lethbridge County, this fact is borne out from all three datasets. Areas such as Cypress, Rocky View etc. have portions of their areas in other Natural Regions (see Figure 15 area labels for the percentages).

Figure 13. Percent Total Native Cover for the Grassland Natural Region Administrative Areas using the generalized GVI data
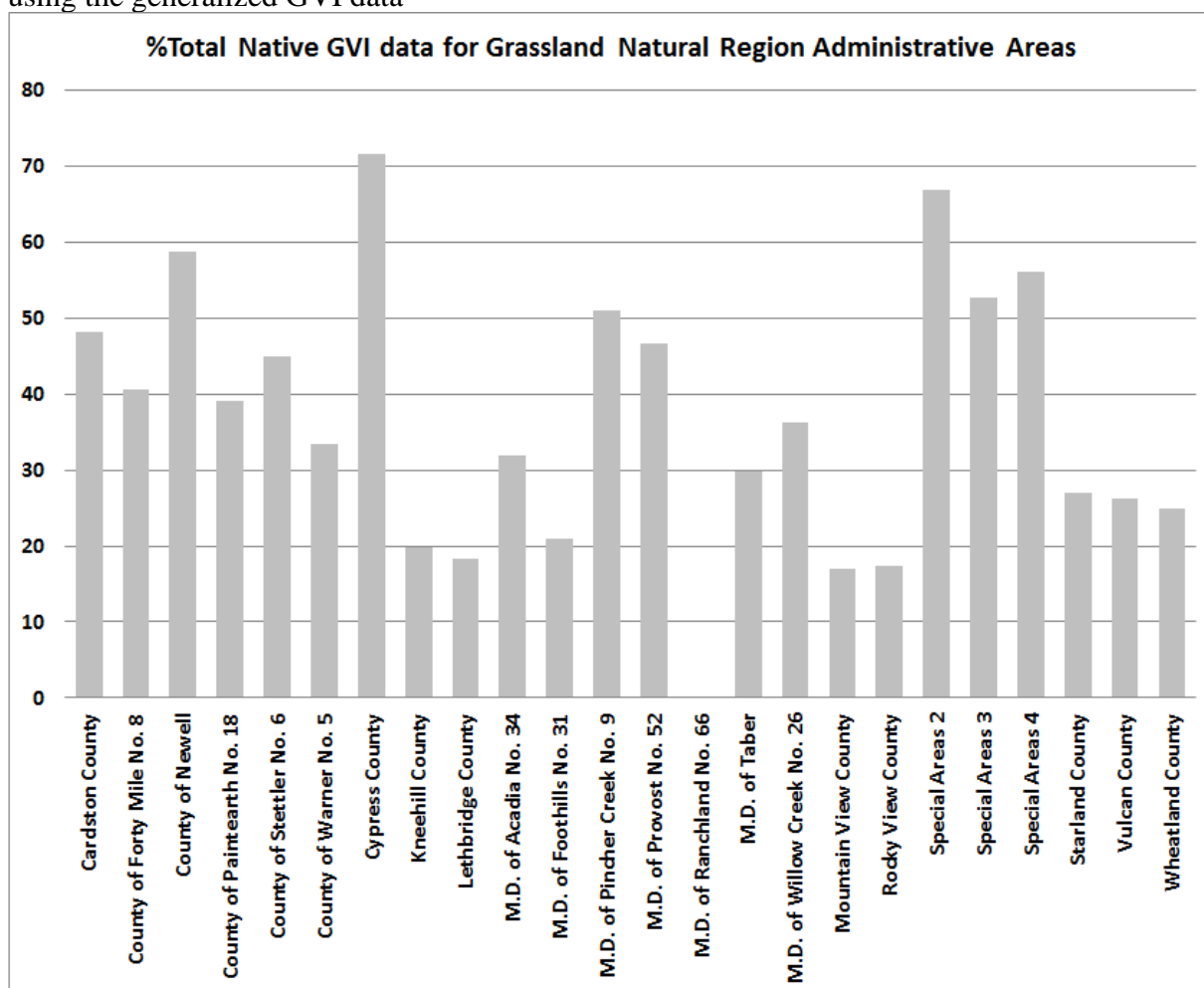
Figure 14. Percent Total Native Cover for the Grassland Natural Region Administrative Areas using the PFRA-AAFCACI data
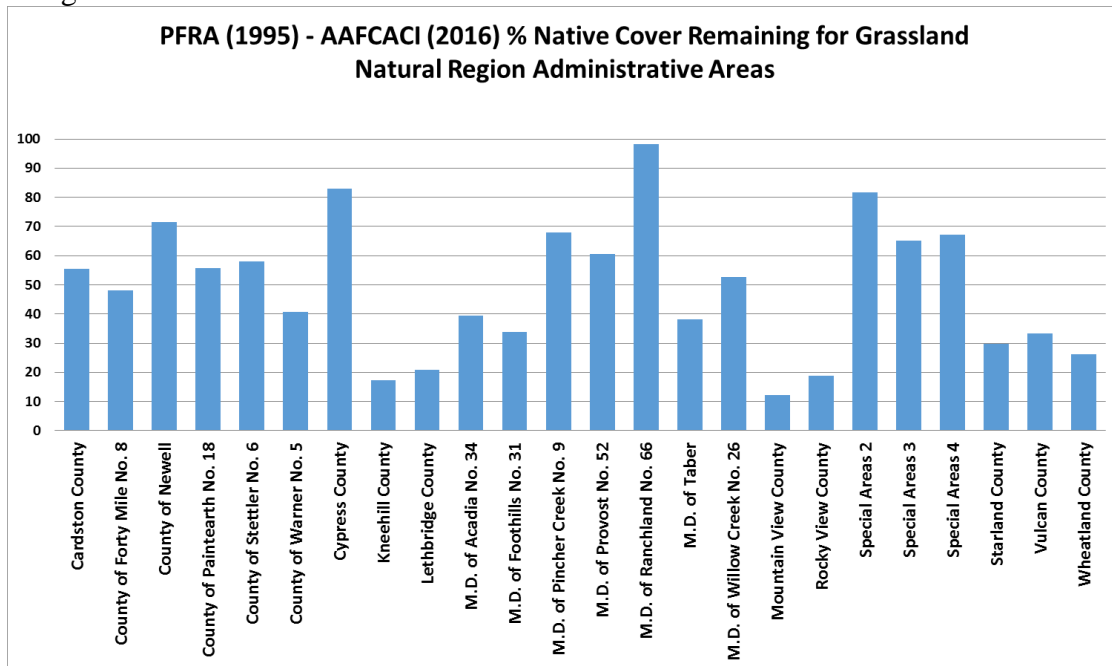
Figure 15. Percent Total Native Cover for the Grassland Natural Region Administrative Areas[1] using the AAFCLU2010 data
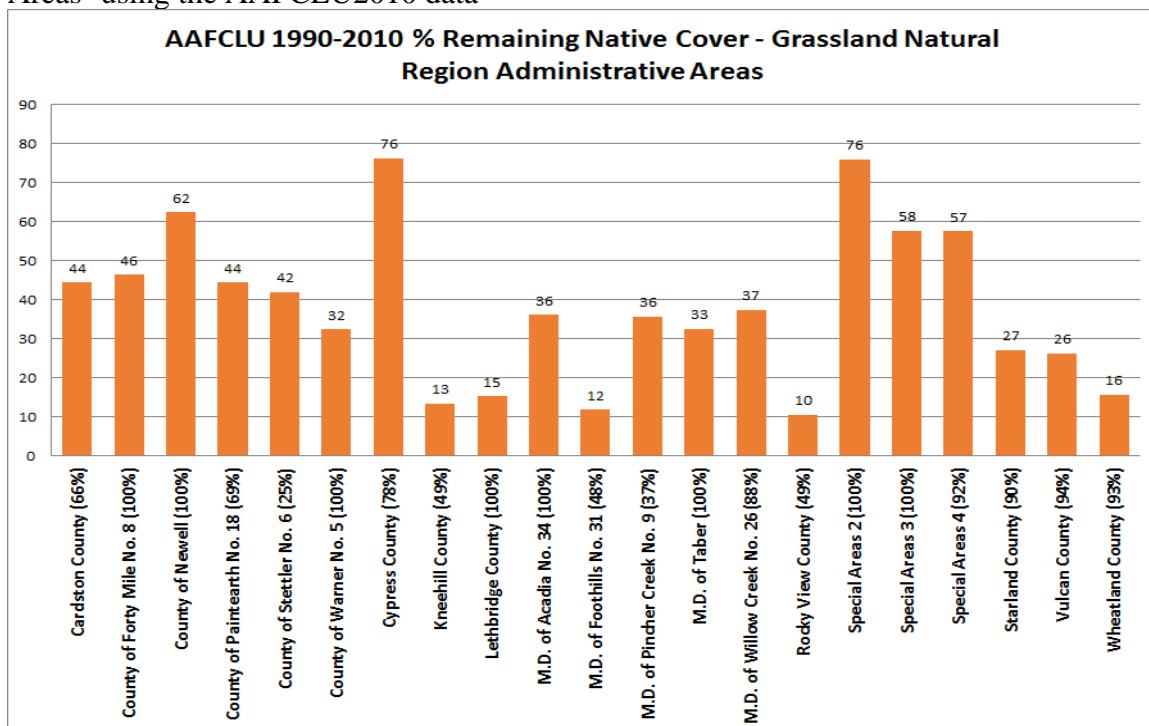
Map 5. Percent Remaining Native Cover for Grassland Region Administrative Areas using AAFCLU2010 data.
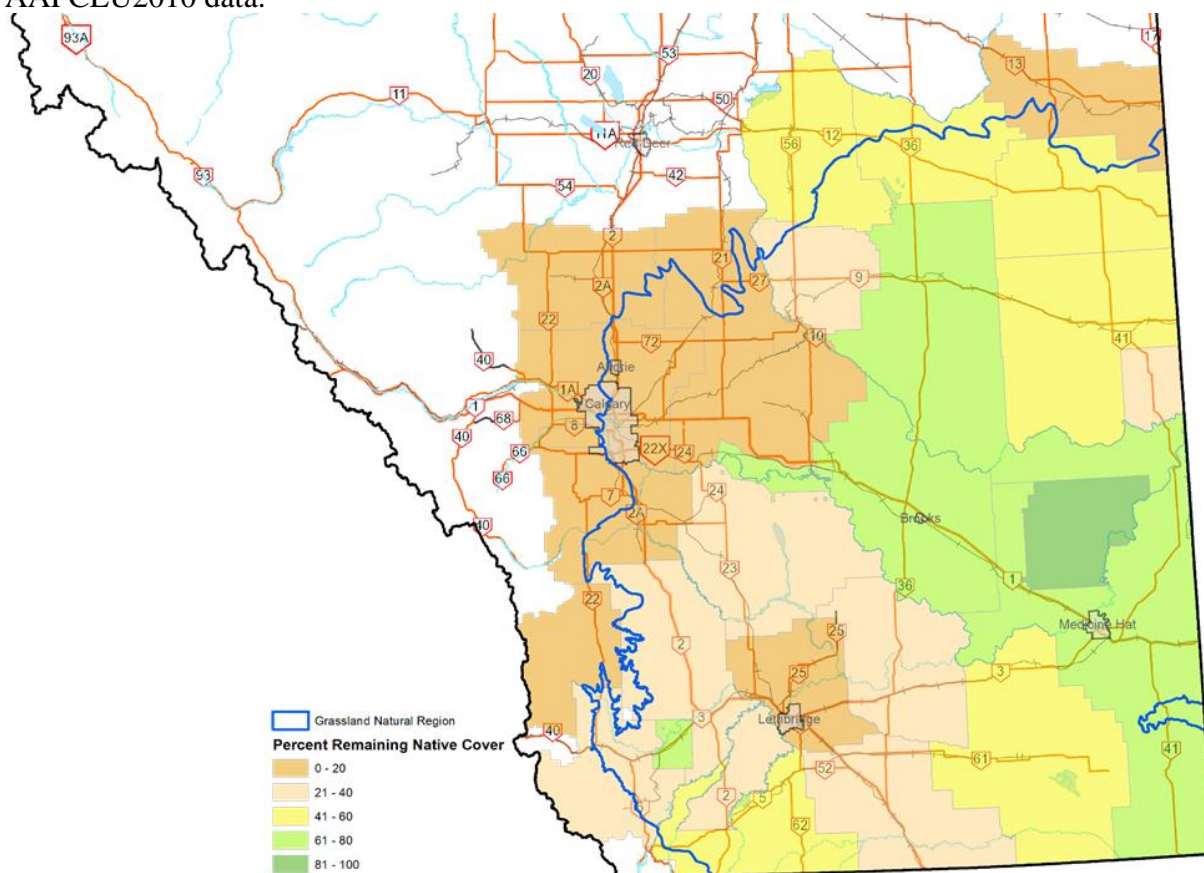
6.1.6 Results by First Nations and Military Base

The First Nations and the CFB Suffield military base have their own administrative jurisdiction and are presented apart from the Municipalities and Counties data. The Kainai and Piikani First Nations show s loss of native cover within the margins of error of the study (Figure 16) over the 20-year period covered by the AAFCLU data. Alternatively, CFB Suffield shows little, if any, loss during the same period and show the largest amount (98%) of remaining native cover (Figure 17).The Kainai First Nation shows the lowest amount of native cover at 34%, diminishing from 53% twenty years earlier, partly attributed to the Blood Tribe Irrigation Project (BTIP) of the 1990s.

Figure 16. Percent Native Cover Change for Grassland Natural Region First Nations and Military Base using AAFCLU data.
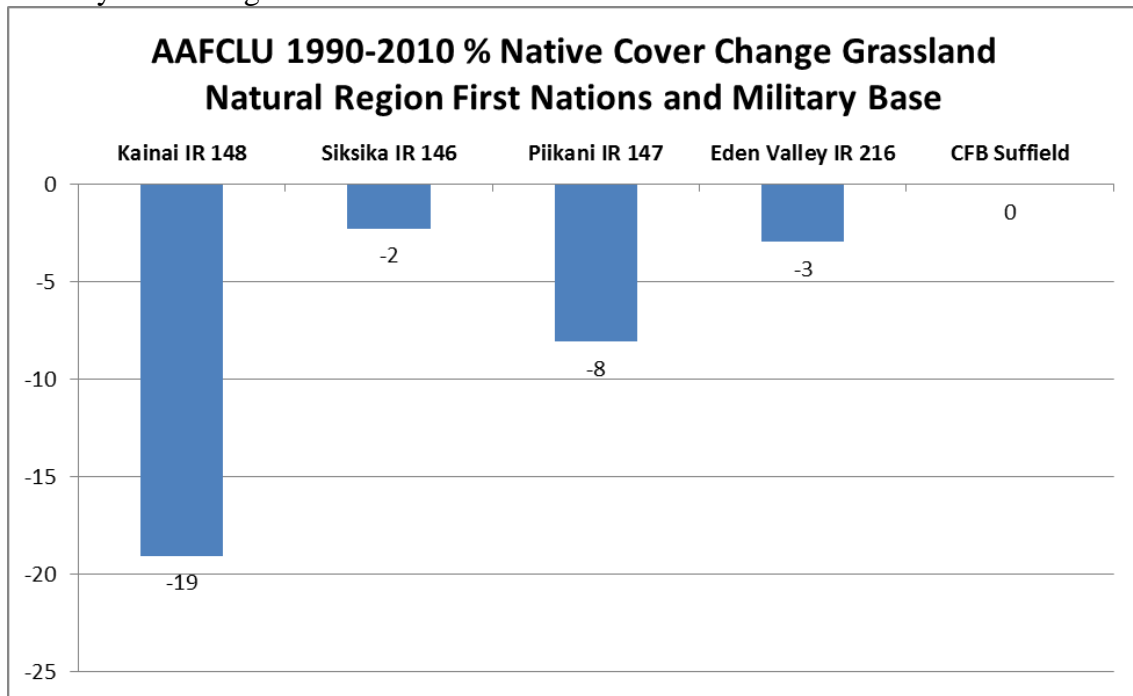
Figure 17. Percent Remaining Native Cover for Grassland Natural Region First Nations and Military Base using AAFCLU2010 data.
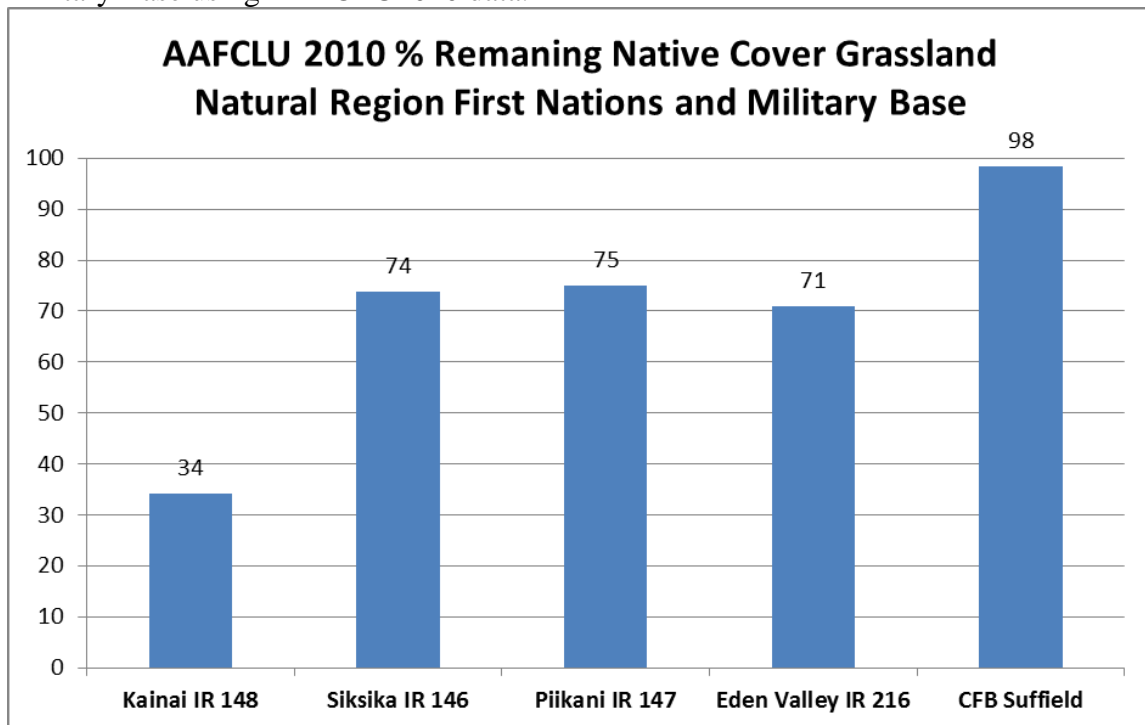
6.1.7 Public - Private (Crown - Deeded) Native Cover

The private vs. public change and remaining native cover analysis was performed with the AAFCLU data ie 1990-2010. The data reiterates the findings at the Natural Region and Sub-Region levels; no significant change in either public or private lands. Tables 2 and 3 show the overall amount of loss of native cover on crown land at about 2% and close to 3% on deeded lands. The figures are well within the error margins of the data. The data (Land Use 2010; Tables 2 and 3) also shows that the amounts of remaining native cover on publicly held lands is 87.5% while privately held lands are covered by 30.6% native cover. Another perspective of the data is that public lands hold about 27% of the total native in the Grassland Natural Region while the private lands hold 21%. These two figures added together provide the total native cover for the Grassland Natural Region, 48%, as reported earlier.

Table 2. Percent Native Cover Class Remaining and Change for **Public Lands** in the Grassland Natural Region using AAFCLU data.

Grassland Natural Region					
Cover Type	Area (ha)		% of Public Land in Native Cover		% Difference
	AAFCLU('90)	AAFCLU('10)	AAFCLU('90)	AAFCLU('10)	
Shrub					
Treed	29215	27643	1.0%	1.0%	-0.1%
Gaminoid	2391197	2336164	82.5%	80.6%	-1.9%
Lake	143651	143572	5.0%	5.0%	0.0%
Wetlands	28283	27813	1.0%	1.0%	0.0%
Total Native	**2592346**	**2535192**	**89.5%**	**87.5%**	**-2.0%**
Total Public Lands Area	**2897569**				
Total Natural Region Area	**9558049**				

Table 3. Percent Native Cover Class Remaining and Change for **Private Lands** in the Grassland Natural Region using AAFCLU data.

Grassland Natural Region					
Cover Type	Area (ha)		% of Private Land in Native Cover		% Difference
	AAFCLU('90)	AAFCLU('10)	AAFCLU('90)	AAFCLU('10)	
Shrub					
Treed	52380	49855	0.8%	0.7%	0.0%
Gaminoid	1946824	1757590	29.2%	26.4%	-2.8%
Lake	174309	174424	2.6%	2.6%	0.0%
Wetlands	58433	57222	0.9%	0.9%	0.0%
Total Native	**2231946**	**2039091**	**33.5%**	**30.6%**	**-2.9%**
Total Private Lands Area	**6660475**				
Total Natural Region Area	**9558049**				

Table 4 summarizes the ownership and native cover condition in the Grassland N.R.; it indicates that almost 70% of the Grassland Natural Region is deeded and on that deeded land about 2% of the total native cover was lost in the 20 year period. Public lands cover 30% of the Grassland Natural Region and on those lands about half a percent of the total native cover was lost over the same period.

Table 4. Percent Native Cover in Public and Private Lands in the Grassland Natural Region using the AAFCLU data.

Grassland Natural Region					
Tenure type	Area (ha)		% Area of the Grassland N.R.		% Difference
	AAFCLU('90)	AAFCLU('10)	AAFCLU('90)	AAFCLU('10)	
Private – Native	2231946	2039091	23.4	21.3	-2.1
Private - Total	6660475	6660475	69.7	69.7	0
Public – Native	2592347	2535192	27.1	26.5	-0.6
Public - Total	2897569	2897569	30.3	30.3	0
Grassland - Native	4824293	4574283	50.5	47.9	-2.6
Grassland - Total	9558044	9558044	100	100	0

6.2 Parkland

The Parkland data set used to characterize change and state was the AAFCLU 1990-2010; it was arrived at after a somewhat elusive path of using and checking a number of other datasets. Since GVI did not cover the Parkland Region, it was understood from the onset that some form of satellite sourced data would have to be used to assess the whole region. The first consideration was to be as consistent as possible with the Grassland Region; the dataset assessed was the PFRA-AAFCACI. Misclassification of too much native cover became noticeable quickly using this data set.; Almost half the Parkland presented as native. The next set of analyses looked at using some time iteration of the TimeScan data. Centred on 1997 for Time 1 and 2015 for Time 2, this analysis held some promise although it was showing some loss of native cover, in the order of 12%. This value seemed somewhat high and not out of line. This was the data that was presented, albeit prematurely, at the PCF meeting in Nanton on Sept. 20, 2018. The technical team continued its due diligence in validating both Time 1 and Time 2 versions of the data with other trustworthy data sources such as the PLVI (Primary Land Vegetation inventory) and found that the TimeScan 2015 dataset was indeed under reporting native cover, hence, the apparent losses observed beyond the margins of error in the study. Again, the technical team assessed more data sets: the ABMI footprint, the ABMI 3X7km photoplots, hybrids of the AAFCACI, TimeScan, and finally the AAFCLU. The

AAFCLU 2010 corresponded well with the PLVI standard (it covers only the eastern part of the Central Parkland), and, encouraged by the fact that the 1990 Time 1 version was assembled with the same rigor, the AAFCLU 1990 would likely be the best choice for this earlier period. Furthermore, AAFCLU 1990 easily ties in with the findings in the Grassland Natural Region where, as already noted, the AAFCLU correspond fairly well with the GVI standard. The Time 1 AAFCLU 1990 could use more validation with an independent data source such as with the Biota Consultants inventory of fescue grassland in the Parkland but this data was not available at the time of this writing. Therefore, unlike presenting more than one dataset for a comparative perspective as was done in the Grassland Region analysis, only the AAFCLU is available for the Parkland Region; it is the most credible source of data for the whole Natural Region. Discussion of data validation process occurs in more detail in Appendix C.

6.2.1 Region Results

The AAFCLU 1990 - 2010 data presents us with a scenario of change just beyond the margins of error for the study over this twenty-year period. There has been a general decrease of about 2% in native cover, primarily in the treed vegetative component (Table 5). As of 2010, approximately 20% of the Parkland Natural Region retains some type of native cover. Note that the AAFCLU combines the 'Shrubs' category into the treed category and the 'Riparian' class is similarly distributed into the Wetland, Treed, and Gramanoid categories).

Table 5. Native cover totals and change from 1990 to 2010 in the Parkland Natural Region using the AAFCLU data.

Cover Type	Area (ha)		% of Total Area		% Difference
	AAFCLU('90)	AAFCLU('10)	AAFCLU('90)	AAFCLU('10)	
Shrub					
Treed	570387	475048	9.9%	8.3%	-1.7%
Gaminoid	358536	327336	6.2%	5.7%	-0.5%
Lake	288106	287956	5.0%	5.0%	0.0%
Wetlands	55546	48697	1.0%	0.8%	-0.1%
Total Native	**1272575**	**1139036**	**22.2%**	**19.9%**	**-2.3%**
Total Natural Region Area		**5737005**			

A cursory view of the 1990 and 2010 native cover distribution maps (Map 6) visually re-affirms the relatively little change scenario, however, a closer look does show that loss of native cover is evident at a Sub-Regional/ecodistrict level, particularly in the areas west of Calgary. The maps also show that the remaining native cover is highly localized in the southeastern portions of the Central Parkland (from about Wainwright to Sounding Lake) and in the southern portion of the Foothills Parkland (from about Longview to the northern reaches of the Porcupine Hills west of Nanton). Other than the Rumsey area all other areas of native cover of the Parkland are sporadic and highly fragmented.

Map 6. Spatial distribution of native vegetation cover for AAFCLU1990 and AAFCLU2010 for the Parkland Natural Region.
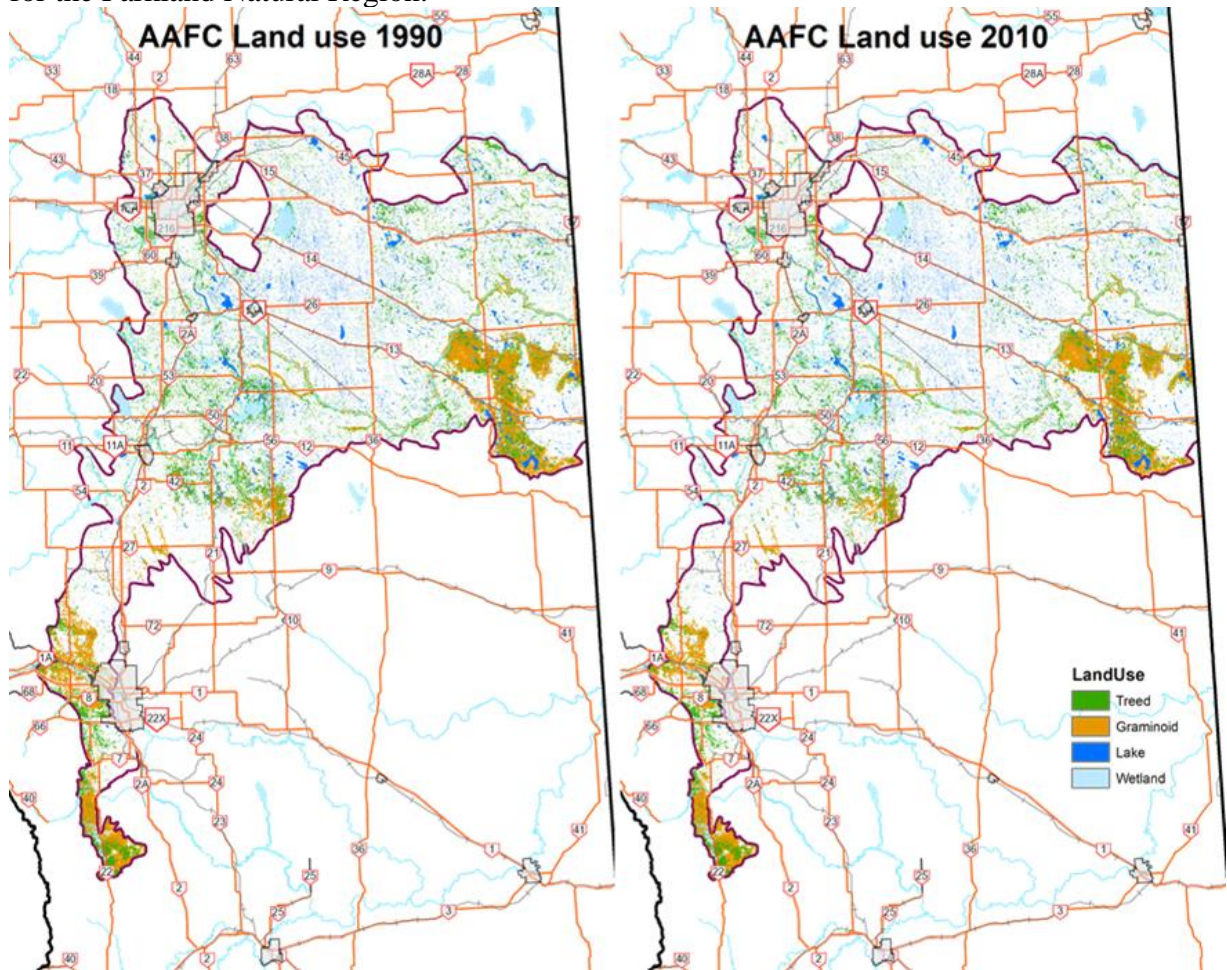
6.2.2 Sub-Region Results

The Parkland Natural Region contains two Sub-Regions, the Central and Foothills Parkland and as can be seen in Figure 18, the much larger Central Parkland trends dominate the overall Regional results. Although the percentage of remaining native is higher and well beyond the margins of error in the Foothills Parkland (49%) compared to the Central Parkland (18%) the aggregate native cover value for the Parkland Natural Region only decreases marginally to 20%.

The percent change for the two sub-regions show the Central Parkland decreasing by 2% from 1990 to 2010 while the Foothills Parkland decreases by 6% over the same period. With a greater percentage of native cover and much smaller areal extent, the Foothills Parkland is much more sensitive to % changes in the Sub-Region context. However, it should be noted that the actual loss in native cover is much greater in the Central Parkland (112,528 ha) than in the Foothills Parkland (21,007 ha; Appendix D,Table D4)

Figure 18. Percent Native Cover Remaining for the Parkland Natural Region and Sub-Regions using AAFCLU data
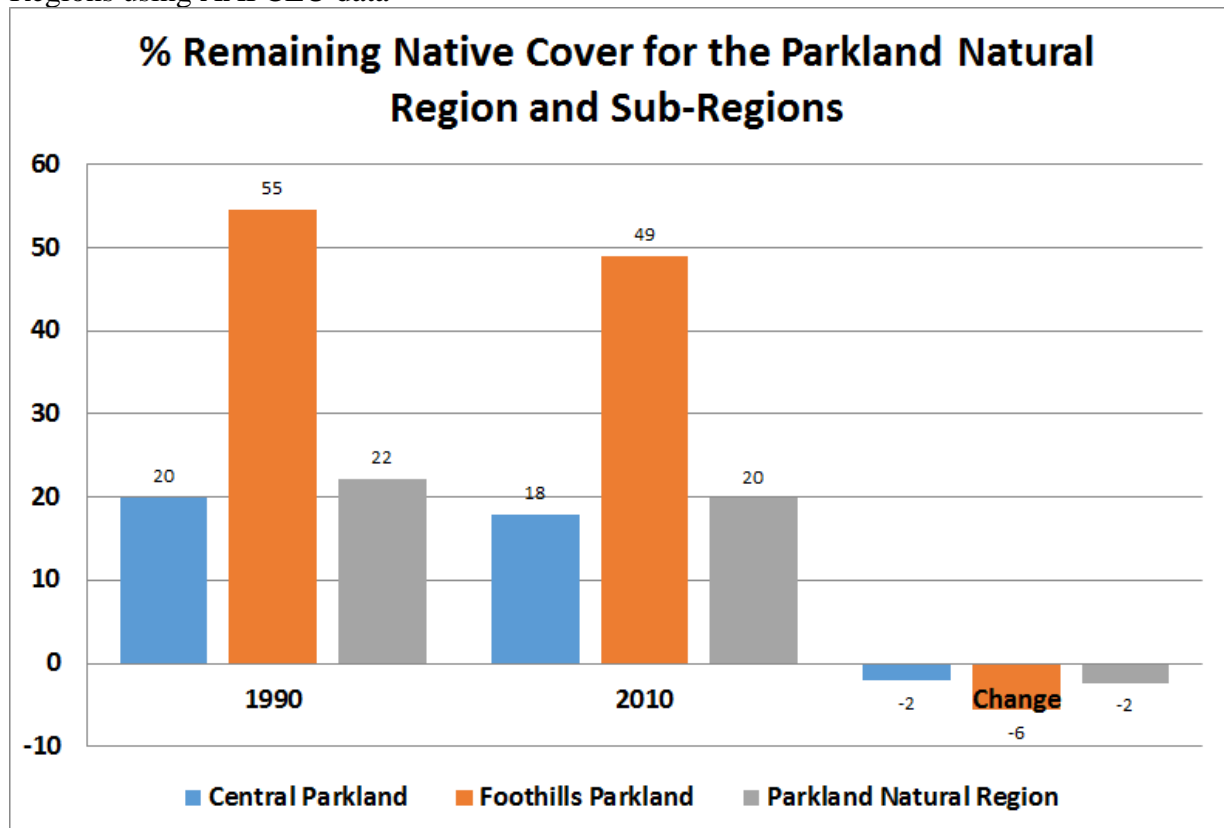
6.2.3 Ecodistrict Results

The ecodistricts results further magnify the extent of remaining native in the Parkland Natural Region. As was noted earlier, the little that is left of native cover in the Parkland Natural Region tends to be concentrated in three areas. At the ecodistrict stratification level, these areas are the Ribstone Plain (71%; it contains CFB Wainwright, Wainwright Dunes Natural Area/Ecological Reserve, sand/dune geomorphic constraints. Large tracts of Public Land), the Black Diamond Upland (49%; located southwest of Calgary with important ranching activity) and the Bashaw Upland (31%, contains the Rumsey Natural Area/Ecological Reserve and knob and kettle dominated topography). Most of the other ecodistricts (10 others) show about 10-15% native cover left, with the Olds Plain and Provost Plain at a dismal 7% and 8% respectively (Figure 19).

Figure 19. Percent Native Cover Remaining Remaining for the Parkland Natural Region Ecodistricts using AAFCLU2010 data
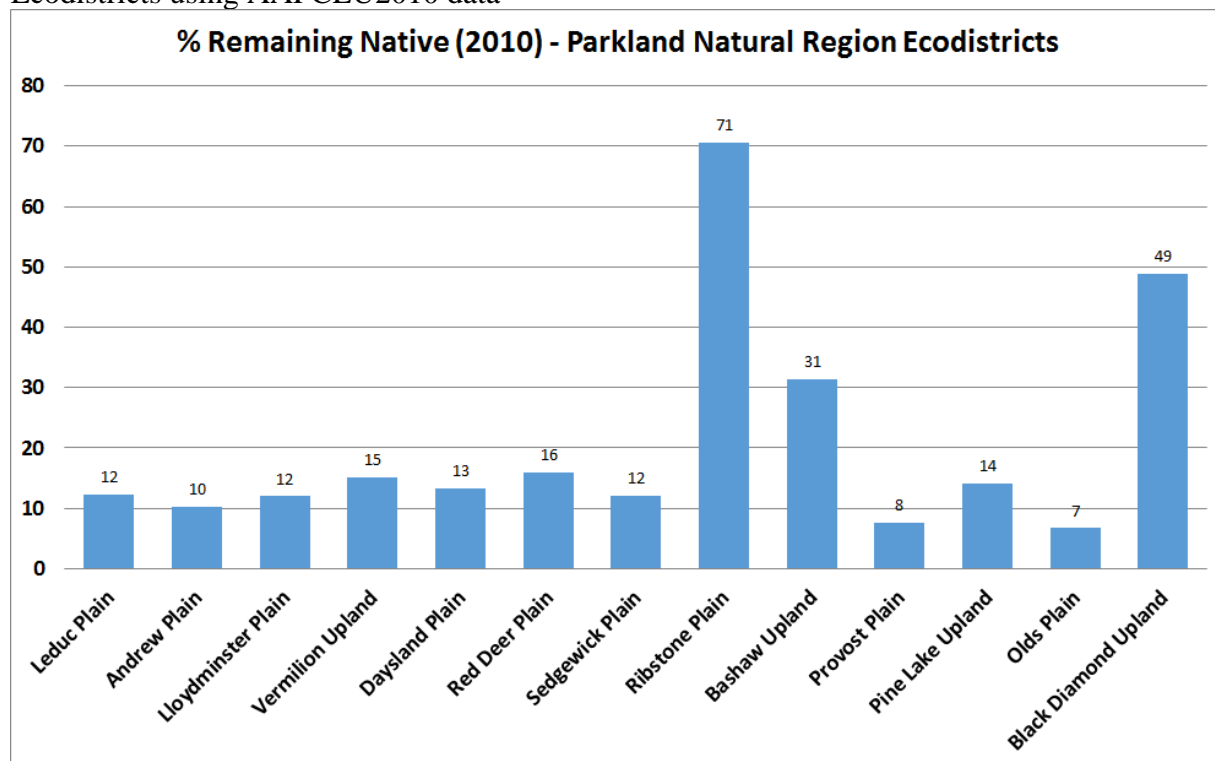
Map 7. Percent Native Cover remaining for Ecodistricts in the Parkland Natural Region using AAFCLU 2010 data.
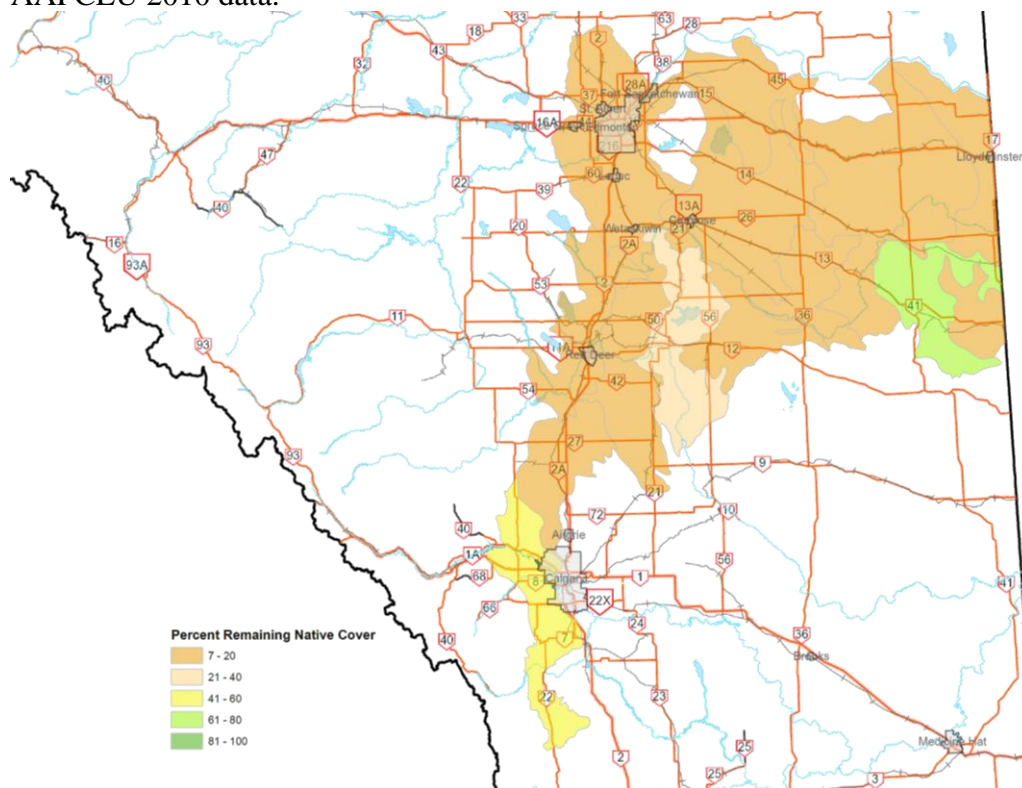
The change between 1990 and 2010, however, remains relatively low at about -2% for almost all of the ecodistricts (Black Diamond Upland being the outlier at -6%). Because there is so little native cover remaining the pressure of losing significant native cover is minimized in most ecodistricts. The exceptions being the Black Diamond and Bashaw Uplands and Ribstone Plain, the latter two being somewhat less impervious to loss because of the protected areas within them, the unsuitability of sandy dune/hardpan soils for commercial use, and the difficulty of farming in knob and kettle terrain.

6.2.4 Results by Cover Type

The native cover class change for the Parkland, aligns as expected with the results for change by the Region, Sub-Region, and Ecodistrict. Most of the marginal losses in the Central Parkland is in the 'Treed' category at about 1.8%; a figure on the edge of the error margin of the data. Most of the loss in the Foothills Parkland occurs in the gramanoid category (4.7%; Figure 20).

Figure 20. Percent Native Cover Class Change for the Parkland Natural Region using AAFCLU data
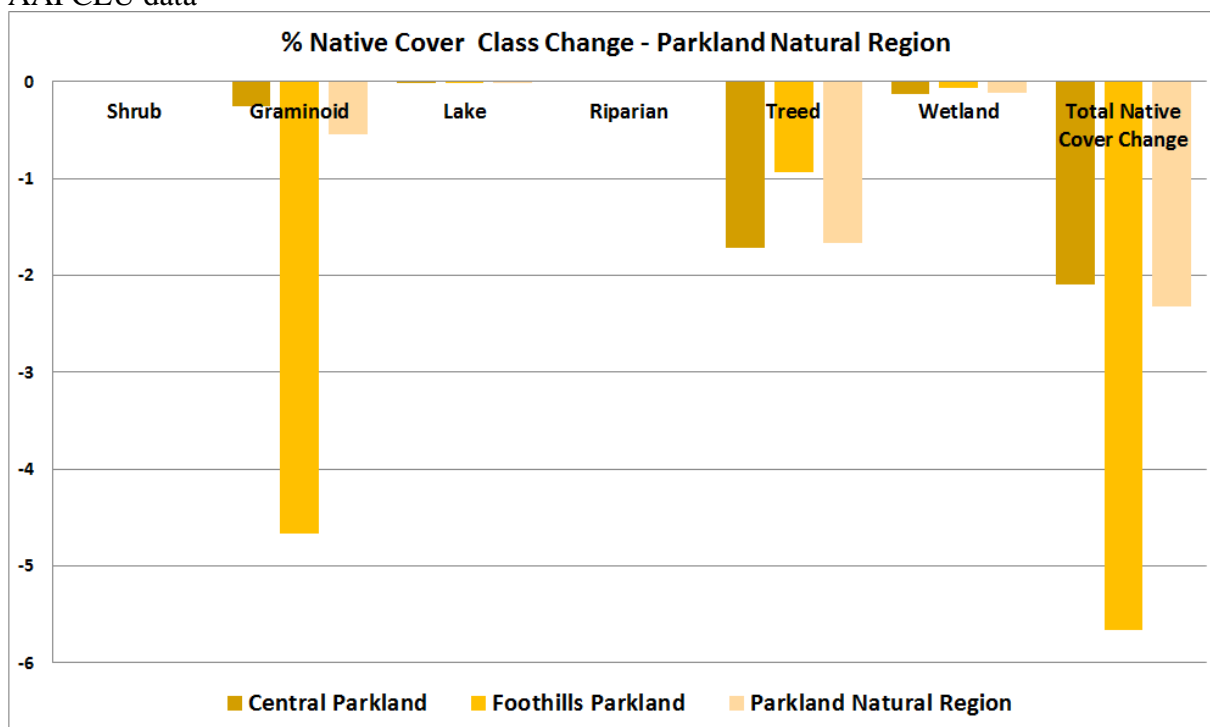
The loss categories are somewhat expected because those are the categories where the majority of native cover occurs. For example, the Central Parkland only contains 4% native gramanoid cover over the entire sub-region; not much left to lose. Treed area is double this figure and therefore more prone to loss/conversion (Figure 21).

Figure 21. Percent Native Cover Class Remaining for the Parkland Natural Region using AAFCLU data
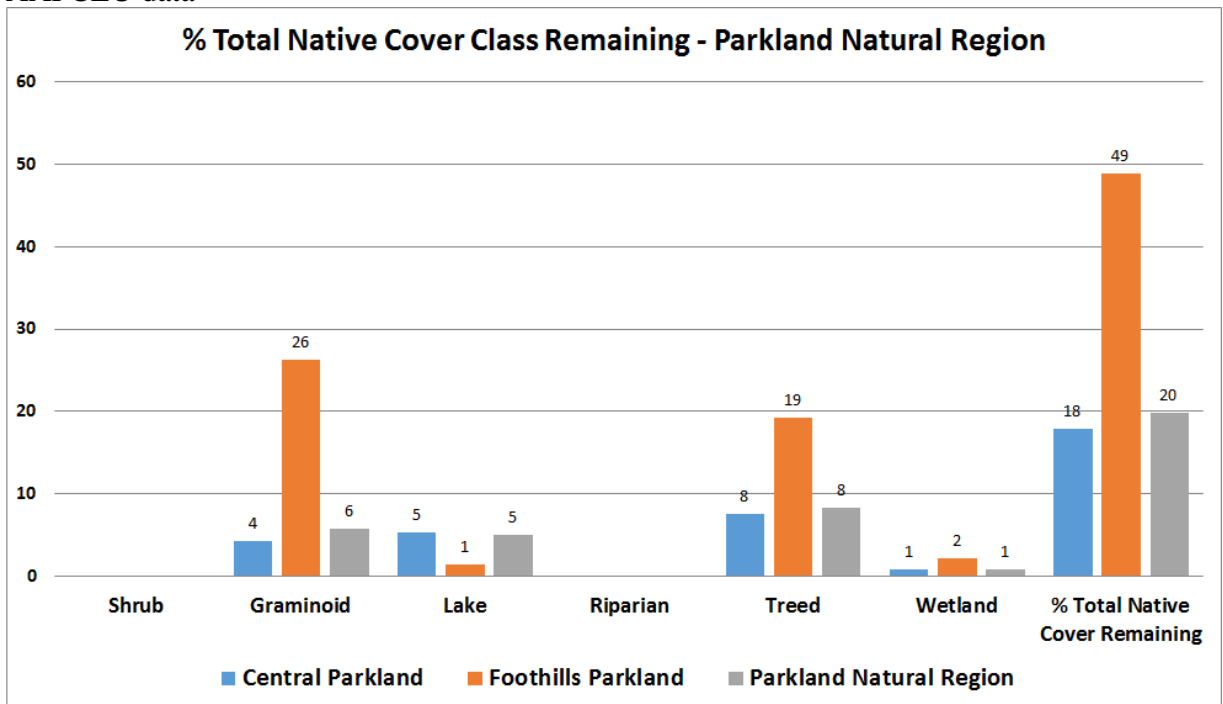
Viewing the loss condition from another perspective, Figure 22 provides the % of remaining native cover for the three ecodistricts where significant native cover still exists. It leads one to consider which of the remaining native cover types are most at risk in these ecodistricts where significant native cover remains. For example, of the 31% native cover that remains in the Bashaw Upland ecodistrict only 7% is gramanoid. Figure 22 also highlights the consequence of draining lakes and wetlands; in all three ecodistricts the combined value for both lakes and wetlands is no greater than 10%.

Figure 22. Percent Native Cover Class Remaining for the Parkland Natural Region Ecodistricts: Ribstone Plain, Bashaw Upland and Black Diamond Upland using AAFCLU data
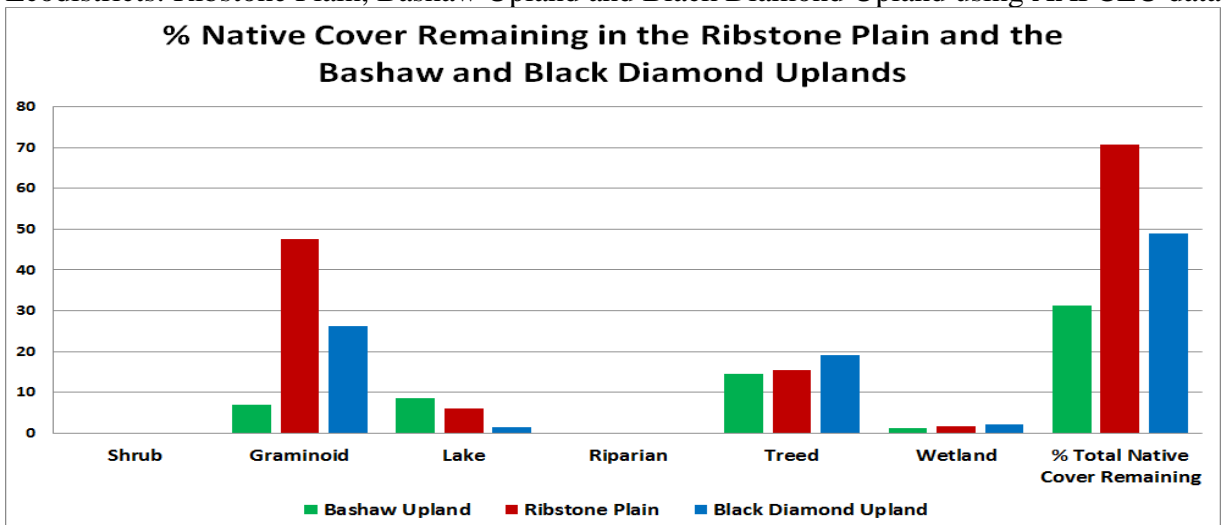
6.2.5 Results by Administrative Area

The general observation of no potential significant change noted at the Parkland Natural Region and Sub-Region applies to the Administrative Areas. In almost all cases, the change is less than the error level of the data (Figure 23). The only exception is Rocky View County where the change is noted at -8%; this change, however, applies only to 36% of the County, which is within the Parkland Natural Region the rest of the County is in the Grassland and Montane regions.

Figure 23. Percent Native Cover Change for the Parkland Natural Region Administrative Areas using AAFCLU data.
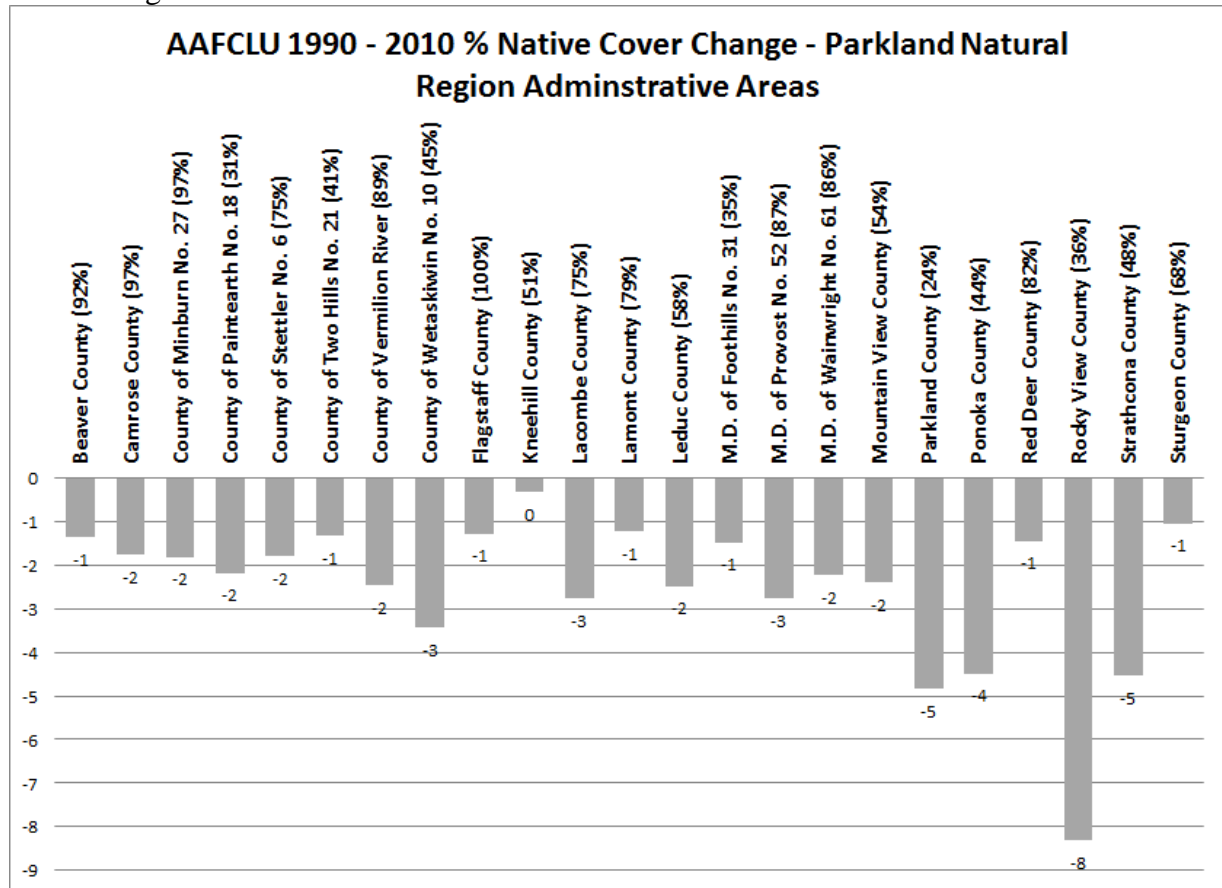
The percent of remaining native cover varies from a high of 37% for the MD of Foothills to a low of 7% for Kneehill County (Figure 24 and Map 8). Again, these values need to be viewed with the perspective that only a portion of these and other Areas are within the Parkland Natural Region. For the MD of Foothills and Kneehill County this portion amounts to 35% and 51%, respectively. The Parkland Natural Region only fully encompasses Flagstaff County.

Figure 24. Percent Native Cover Remaining for the Parkland Natural Region Administrative Areas using AAFCLU 2010 data.
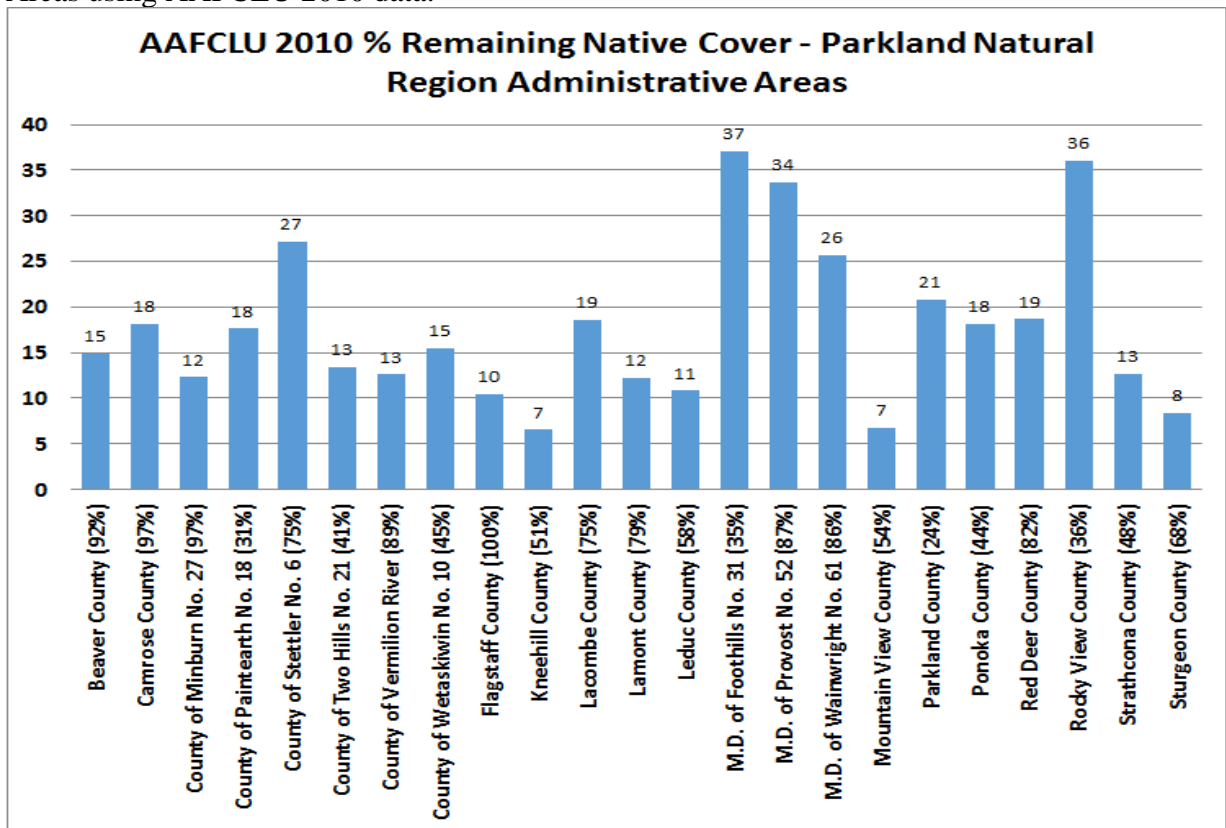
Map 8. Percent Native Cover Remaining for Parkland Natural Region Administrative Areas using AAFCLU data.
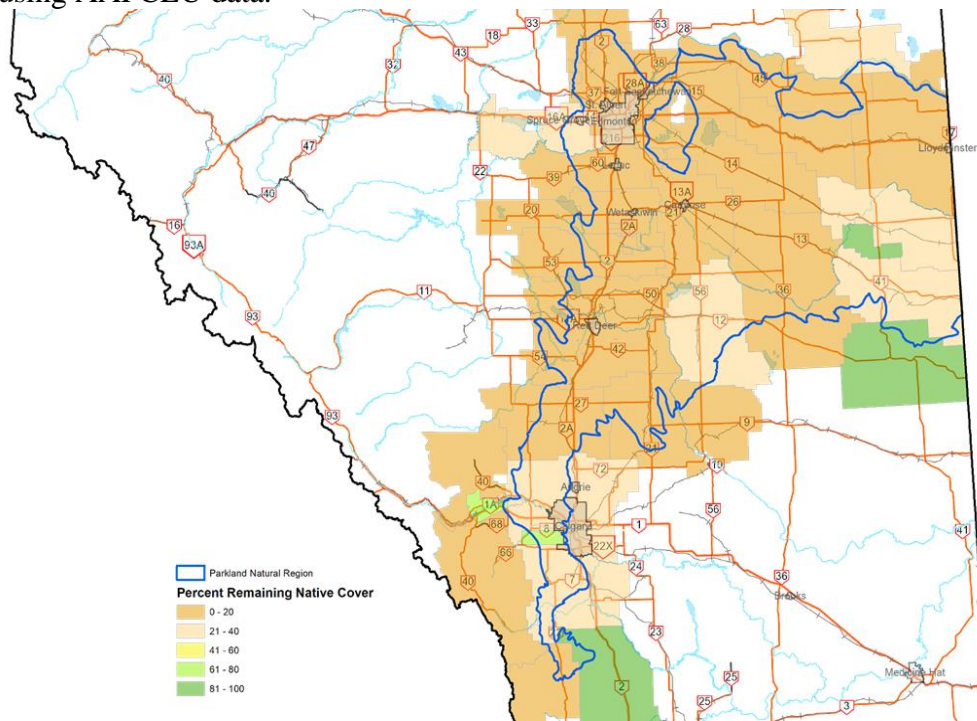
6.2.6 Results by First Nations and Military Base

No significant native cover change has occurred for most of the Parkland Natural Region First Nations and military bases. The exception is a 13% decrease in native cover observed for an amalgam of First Nations (Maskwicis) in the south central and western part of the Central Parkland Sub-Region (Figure 25) . They include Pigeon Lake IR 138A, Ermineskin IR 138, Louis Bull IR 138B, Samson IR 137, and Montana IR 139.

Figure 25. Percent Native Cover Change for the Parkland Natural Region First Nations and Military Bases using AAFCLU data
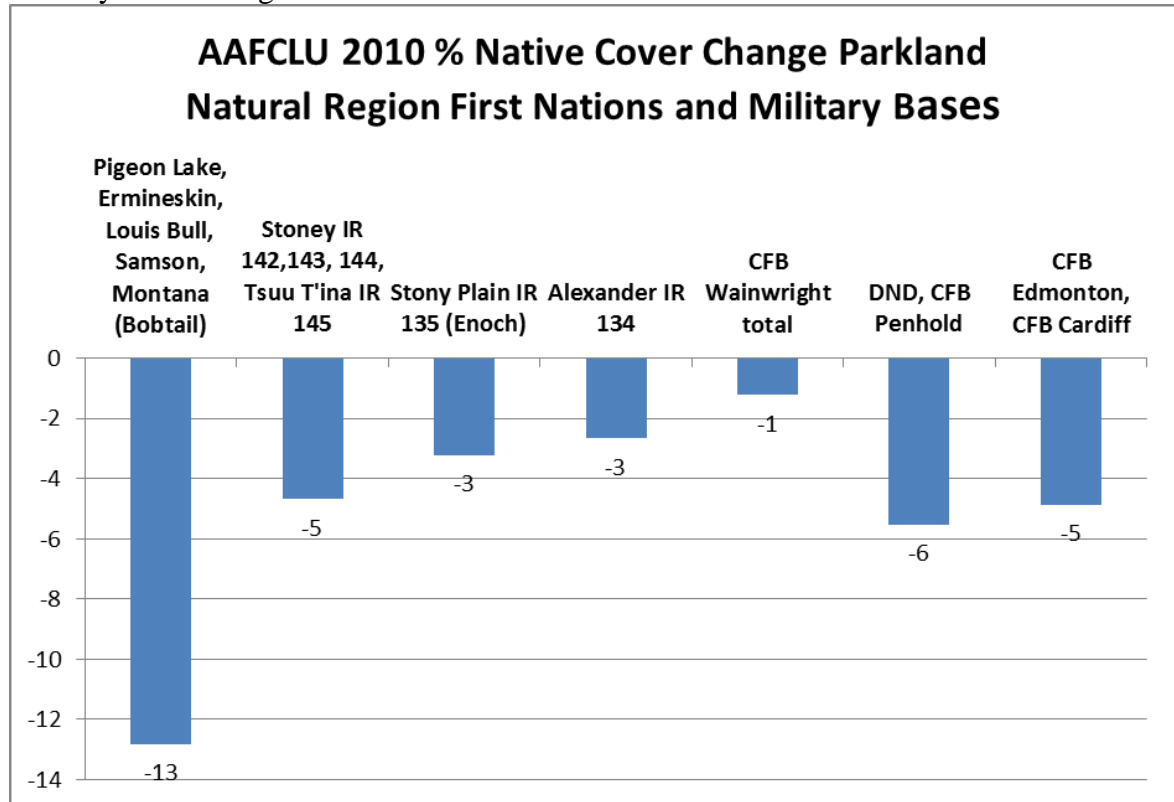
Remaining native cover also varies greatly for these First Nations and military bases. Most prominent is the large swath of native cover in CFB Wainwright (92%) (Figure 26). The amount of native cover remaining for the First Nations varies from a low of 26% at Enoch to a high of 76% for the Nakoda First Nation reserve. The total area of native cover of all the First Nations in the Parkland Region equates to about the total area existing in CFB Wainwright.

Figure 26. Percent Native Cover Remaining for the Parkland Natural Region First Nations and Military Bases using AAFCLU data

AAFCLU 2010 % Remaining Native Cover Parkland Natural Region First Nations and Miltary Bases
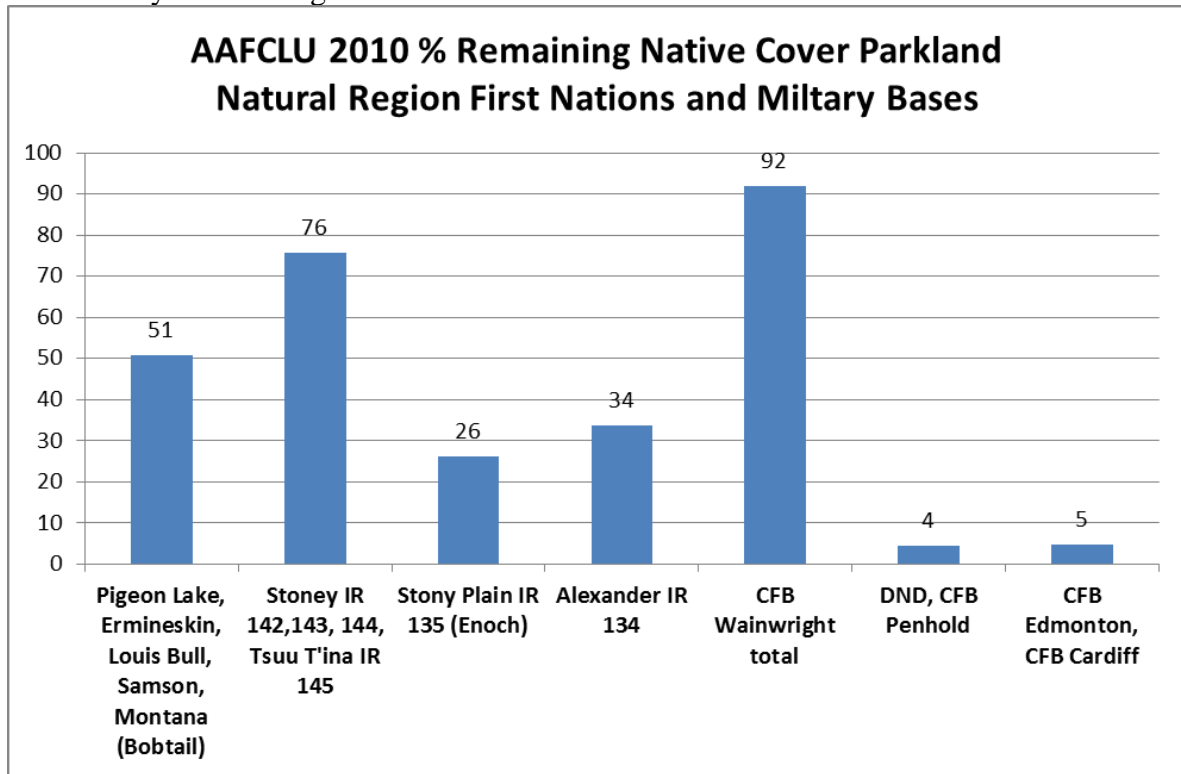
6.2.7 Results by Public - Private (Crown - Deeded) Native Cover

The private vs. public change and remaining native cover analysis was also performed with the AAFCLU data ie 1990-2010. The data basically mimics the findings at the Natural Region and Sub-Region levels; no significant change in either public or private lands. Tables 6 and 7 show that native cover comprises of about 54% of the public lands and 16% of private lands with losses of native cover of 3.3% on public land and 2.2% on private lands.

Table 6. Percent Native Cover Class Remaining and Change for **Public Lands** in the Parkland Natural Region using AAFCLU data

Parkland Natural Region					
Cover Type	Area (ha)		% of Public Land in Native Cover		% Difference
	AAFCLU('90)	AAFCLU('10)	AAFCLU('90)	AAFCLU('10)	
Shrub					
Treed	118230	103018	19.6%	17.1%	-2.5%
Gaminoid	121175	118459	20.1%	19.7%	-0.5%
Lake	91415	91424	15.2%	15.2%	0.0%
Wetlands	16420	14535	2.7%	2.4%	-0.3%
Total Native	**347241**	**327437**	**57.7%**	**54.4%**	**-3.3%**
Total Public Lands Area	602238				
Total Natural Region Area	5737005				

Table 7. Percent Native Cover Class Remaining and Change for **Private Lands** in the Parkland Natural Region using AAFCLU data

Cover Type	Area (ha)		% of Private Land in Native Cover		% Difference
	AAFCLU('90)	**AAFCLU('10)**	**AAFCLU('90)**	**AAFCLU('10)**	
Shrub					
Treed	452004	371875	8.8%	7.2%	-1.6%
Gaminoid	237276	208799	4.6%	4.1%	-0.6%
Lake	196665	196504	3.8%	3.8%	0.0%
Wetlands	39108	134144	0.8%	2.6%	1.9%
Total Native	**925053**	**811322**	**18.0%**	**15.8%**	**-2.2%**
Total Private Lands Area	**5134267**				
Total Natural Region Area	**5737005**				

Table 8 summarizes and adds further perspective of the trends that have been evident in the preceding results of the Parkland Natural Region. Almost 90% of this Region is in private ownership and this privately owned land only contains about 14% of the Region's native cover; public lands account for 10% of the Regions land area and of this 10% area 6% contains native cover. Together, private and public lands contain about 20% native cover as as noted elsewhere. Although the total loss in native cover between 1990 and 2010 was only 2% and statistically not significant, it still is a drop from a low 16% in 1990 to an even lower 14% in 2010. A couple of points deserve to be highlighted regarding the situation in the Parkland N.R., notwithstanding the fact that much of the Parkland Natural Region has been transformed into agricultural commodities, the native cover that remains is concentrated in the east and southwest and is relatively intact. Secondly, private lands contain almost triple the amount of native cover as do public lands; any conservation policy strategy should consider this fact in maintaining the native cover left in this Region.

Table 8. Percent Native Cover in Public and Private Lands in the Parkland Natural Region using the AAFCLU data.

Tenure type	Area (ha)		Percent Area		% Difference
	AAFCLU('90)	**AAFCLU('10)**	**AAFCLU ('90)**	**AAFCLU('10)**	
Private – Native	925053	811322	16.1	14.1	-2.0
Private - Total	5134267	5134267	89.5	89.5	0.0
Public – Native	347241	327437	6.1	5.7	-0.3
Public - Total	602238	602238	10.5	10.5	-0.0
Parkland - Native	1272294	1138759	22.2	19.8	-2.3
Parkland - Total	5737005	5737005	100	100	-0.0

7. Alberta Urban Municipalities.

Calgary and Edmonton are Alberta's two largest cities with significant footprint in the Grassland and Parkland Natural Regions; the smaller cities were not included in this analysis due to their relatively small footprint. A very general perspective of change and remaining native cover emerges using the AAFCLU datasets for 1990 and 2010. It should be noted that because of the modified nature of these landscapes the values presented should be used with discretion. The satellite sensors are generally not 'trained' for urban landscapes. For example, ornamental or introduced species or trees are classed simply as 'treed' in the urban setting. In any case, Figure 27 indicates a trend towards native cover loss for both Calgary and Edmonton with figures of approximately 5% and 8%, respectively. Total native cover for the two metropolitan areas are 11% for Calgary and 7% for Edmonton (Appendix C for the cities of Calgary and Edmonton). The data for the smaller urban centres such as Lethbridge and Medicine Hat are currently available within the GVI, and, with the city of Calgary soon to be compiled to GVI specifications, a more representative status of native landscapes in the Grassland Natural Region's urban municipalities will be possible in 2019. Short of obtaining, standardizing and analysing GIS data sets from the cities of Edmonton and Red Deer the Parkland Natural Region's lack of PLVI coverage in urban areas (Edmonton and Red Deer) restricts the urban profile of native cover to the current offering enabled by the AAFCLU2010 data,

Figure 27. Percent Native Cover Change and Remaining in Calgary and Edmonton using AAFCLU data
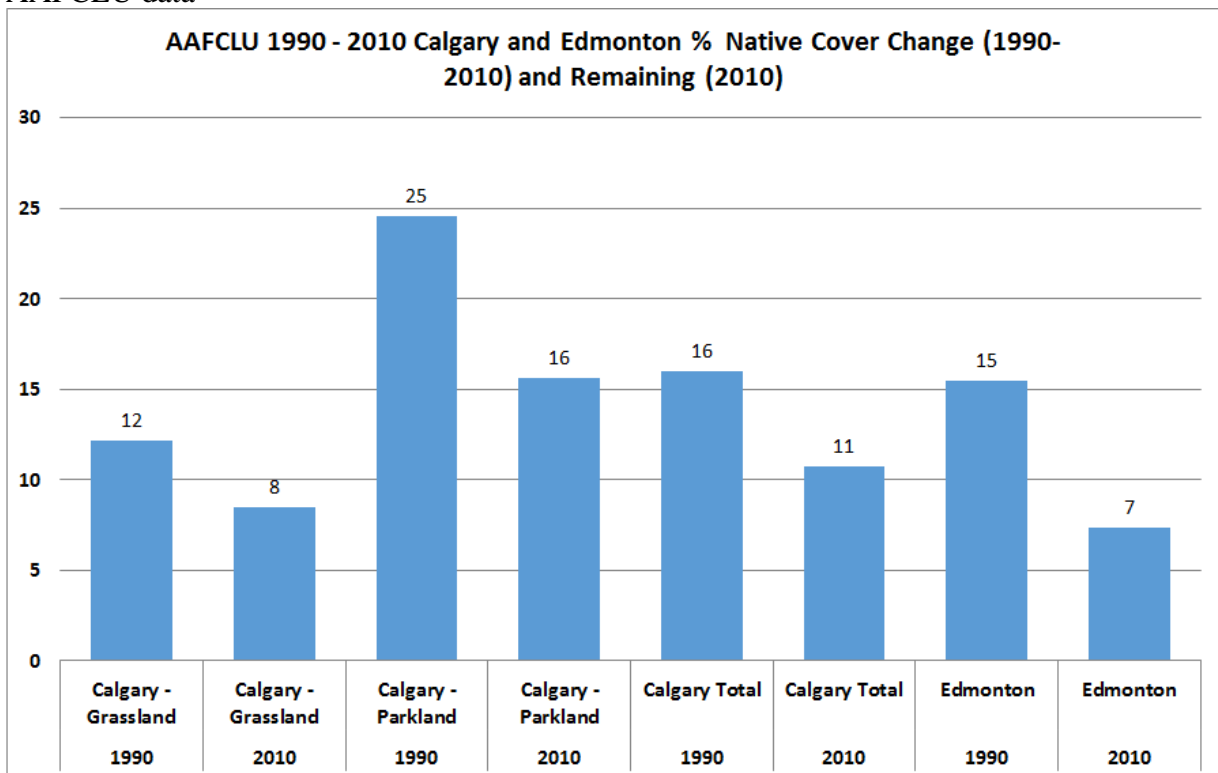
8. The Time Scan data sets: source, processing and results

8.1 Satellite/Raster Inventories - TimeScan Classification output

The TimeScan classified product were considered to be an experimental approach to be

validated by the more conventional reflectance based supervised and unsupervised classifications of satellite imagery. Members of the State of the Prairie technical working group saw value in this product product promised native cover and classifications faster and with higher reliability and less expense compared to current methods of native cover classification.

8.1.1 The Timescan (TS) Data Source Background
Timescan (TS) is a GeoService developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR). Its purpose is to provide a first impression of the main land cover characteristics and can support geospatial analysts and service providers to generate advanced land cover and land use classifications faster and with higher reliability. Based on historical Landsat- 5, 7, and 8 data. TimeScan examines the time series of all available datasets within the selected analysis period. It calculates the most significant spectral indices and calculates their statistics over time for each pixel.

AF staff from the State of the Prairie technical team attended a presentation of the potential applications of the TS GeoService at the University of Alberta. The presenter was a Canadian scientist attached to the Timescan Geoservice development project named Derek Rogge who was finishing a secondment opportunity with the DLR. Derek's presentation focused on the potential resource information extraction potential for the Timescan product particularly for soil property extraction, the State of the Prairie technical team staff saw potential for extracting native cover classes. There was enough interest and support for a TS GeoService pilot within the larger State of the Prairie analysis project undertaken by the state of the prairie technical committee. Maapera Analytics Inc.:

1. Extracted the ten, three-year intervals of Timescan input data between 1984 and 2016 from the DLR archive.
2. Performed a native cover classification based on training data collected from the GVI inventory that was completed in 2006,and
3. Provided and a documented the resulting native cover classifications for each of the ten, three year intervals of Timescan input data between 1984 and 2016.

Maapera Analytics Inc. completed and delivered the three items listed about in late October of 2017. The resulting native cover classification was one of the thirteen separate data sets that were evaluated to determine the best representation of the change and remaining native cover in both Grassland and Parkland Natural region, with ultimately, three of the thirteen data sources being used as Time 1 and Time 2 comparisons in the Parkland Grassland Natural regions of Alberta.

The representative data source for Timescan for Time 1 native cover comparisons was the supervised classification completed on the three year interval of Timescan data extracted between 1996 and 1998 this was known by the acronym TS1997. The representative data source for Time 2 was the supervised classification completed on the three year interval of Timescan data extracted between 2014 and 2016 this was known by the acronym TS2015.

8.1.1.1 The Grassland Natural Region
The change in native cover between TS1997 and TS2015 was observed as a significant decrease for Time 1 and Time 2 (-14.5%) compared to AAFCLU 1990 to AAFCLU 2010

Time 1 and Time 2 comparison (-2.6%) and NPVI and GVI Time1 and Time2 comparison (1.0%) (see Table 9). The observed significant decrease in Timescan data source was set aside as the other to sources showed a small decrease in the AAFCLU comparison and a small increase in the NPVI, GVI comparison. The observed decrease and increase in the latter two data sources were small enough to fall within the margin of error for the derivation of the two comparisons. The AAFCLU 1990, AAFCLU 2010 comparison being slightly below 0% change and the NPVI, GVI comparison being slightly above 0% change. In effect, there was no observed change in the latter two comparisons. Subject matter experts considered that latter two comparisons a better fit with their experience of what has gone on in the Grassland Natural region between Time 1 and Time 2. The choice to represent the picture of change with the AAFCLU rather than the authoritative NPVI to GVI comparison results as much from close agreement of the more authoritative NPVI to GVI comparison as it does from using a consistent data source for the Parkland Natural region authoritative comparison.
It also points to a credible and more streamlined strategy for repeating this native cover comparison for at the next iteration of the state of the prairie monitoring.

Table 9. Comparison of alternative Time 1 and Time 2 data sources in the Grassland Natural Region.

Cover types	Time Scan					AAFCLU					NPVI - GVI				
	1997		2015		% Diff.	1990		2010		% Diff.	1991-93		2006-16		% Diff.
	Area(ha)	%	Area(ha)	%		Area(ha)	%	Area(ha)	%		Area(ha)	%	Area(ha)	%	
Shrub											126982	1.3	132208	1.4	0.1
Treed	224285	2.4	125881	1.3	-1.0	81666	0.9	77576	0.8	0.1	27209	0.3	33283	0.3	0.1
Gram.	5321064	55.9	4060430	42.7	-13.3	4338372	45.4	4094117	42.8	-2.6	3297290	34.5	3350063	35	0.6
Lake	98427	1.0	164307	1.7	0.7	317972	3.3	318018	3.3	0.0	119210	1.2	203130	2.1	0.9
Riparian											81749	0.9	132555	1.4	0.5
Wetland	83522	0.9	1620	0.0	-0.9	86729	0.9	85049	0.9	0.0	386186	4.0	363943	3.8	-0.2
Native Total	**5727298**	**60.2**	**4352237**	**45.8**	**-14.5**	**4824747**	**50.5**	**4574761**	**47.9**	**-2.6**	**4038626**	**42.3**	**4215181**	**44.1**	**1.8**

8.1.1.2 The Parkland Natural Region

The Timescan native cover comparison TS2015 - TS1997 suggested a significant decrease in native cover (-11.6%) (Table 10) compared to the AAFCLU2010 - AAFCLU1990 which suggested that the loss was more modest (-2.3%). The Timescan comparison seem to over represent the amount of graminoid in Time 1 creating an inflated estimate of the amount of native cover present in the Parkland Natural region in Time 1. Timescan was again set aside. The AAFCLU comparison was chosen as the alternative that subject matter experts felt was the most representative of the Parkland Natural region.

Table 10. Comparison of alternative Time 1 and Time 2 data sources in Parkland Natural Region.

Cover types	Time Scan					AAFCLU				
	1997		2015		% Diff.	1990		2010		% Diff.
	Area(ha)	%	Area(ha)	%		Area(ha)	%	Area(ha)	%	
Treed	409458	7.0	183353	3.1	-3.8	570387	9.9	475048	8.3	-1.6
Gram.	678611	11.5	320884	5.5	-6.1	358536	6.2	327336	5.7	-0.5
Lake	119674	2.0	113764	1.9	-0.1	288106	5.0	287956	5.0	-0.0
Wetland	91139	1.6	233	0.0	-1.5	55546	1.0	48697	0.8	-0.2
Native Total	**1298882**	**22.1**	**618234**	**10.5**	**-11.6**	**1272575**	**22.1**	**1139036**	**19.9**	**-2.3**

There was some question as to the representativeness of 2006 GVI, available only in the Grassland Natural region as training data for running a supervised classification for the detection of native prairie in the parkland as well. There was also question as to the representativeness of GVI training data, gathered in 2006, being representative for all the

three-year intervals of Timescan input data, between 1984 and 2016, undergoing a supervised, native cover classification in either the Grassland or Parkland Natural Region.

It was felt that identifying better training data coinciding both geographically as well as historically the large discrepancy between TS and AAFCLU data sources would diminish.

The AAFCLU datasets was extensively ground truthed. One of the recommendations of this report is to redo the TS classification with more extensive and coincident ground truth from both a geographic and historical perspective. Potential sources include the AAFCLU classifications itself and the ABMI 3X7 photoplot data sets.

8.1.2 Pilot methodology

The Timescan input data for the pilot's supervised classification process consisted of the pixel statistics of remote sensing indices over a three year time intervals. Ten there intervals were considered between 1984 and 2016. The remote sensing indices originate from a 30 year Landsat archive maintained by the DLR. Each scene in the archive has the following indices generated for them:

- o A normalized difference built up index (NDBI)
- o A Modified normalized difference water or wet index (MNDWI)
- o A normalized difference vegetation index (NDVI)
- o A normalized difference index of Landsat Satellite bands 5 and 7 (ND57)
- o A normalized difference index of Landsat satellite bands 4 and 2 (ND42)
- o A normalized difference index of Landsat satellite bands 3 and 2 (ND32)

8.1.2.1 NDBI highlights-urban areas

These areas typically have a higher reflectance in the shortwave-infrared (SWIR) region, compared to the near infrared (NIR) region. Applications include watershed runoff predictions and land-use planning.

NDBI = (SWIR - NIR) / (SWIR + NIR)

The NDBI was originally developed for use with Landsat TM bands 5 and 4. However, it will work with any multispectral sensor with a SWIR band between 1.55-1.75 µm and a NIR band between 0.76-0.9 µm.

All statistics on NDBI are saved in TimeScan Professional with the following band IDs:

- Band__1: Max NDBI
- Band__2: Min NDBI
- Band__3: Mean NDBI
- Band__4: SD NDBI
- Band__5: MASD NDBI

8.1.2.2 MNDWI enhances open-water features

While suppressing noise from built-up land, vegetation, and soil. Xu reported that the MNDWI produced better results than the Normalized Difference Water Index in enhancing and extracting water from a background that is dominated by built-up land areas.

MNDWI = (Green - SWIR) / (Green + SWIR)

The MNDWI was originally developed for use with Landsat TM bands 2 and 5. However, it will work with any multispectral sensor with a green band between 0.5-0.6 µm and a SWIR band between 1.55-1.75 µm.

All statistics on MNDWI are saved in TimeScan Professional in the following band IDs:

- Band__6: Max MNDWI
- Band__7: Min MNDWI

- Band__8: Mean MNDWI
- Band__9: SD MNDWI
- Band_10: MASD MNDWI

8.1.2.3 NDVI is a measure of healthy green vegetation.
The combination of its normalized difference formulation and use of the highest absorption and reflectance regions of chlorophyll make it robust over a wide range of conditions. However, it can saturate in dense vegetation conditions when the leaf area index (LAI) becomes high.
NDVI = (NIR - Red) / (NIR + Red)
The value of this index ranges from -1 to 1. The common range for green vegetation is 0.2 to 0.8.4
All statistics on NDVI are saved in TimeScan Professional in the following band IDs:
- Band_11: Max NDVI
- Band_12: Min NDVI
- Band_13: Mean NDVI
- Band_14: SD NDVI
- Band_15: MASD NDVI

8.1.2.4 ND57 or NDMIR
This is the ratio of the Landsat-8 band 5 vs band 7.
(NDMIR) = (MIR1-MIR2)/(MIR1+MIR2)
All statistics on ND57 are saved in TimeScan Professional in the following band IDs:
- Band_16: Max ND57
- Band_17: Min ND57
- Band_18: Mean ND57
- Band_19: SD ND57
- Band_20: MASD ND57

8.1.2.5 ND42 or NDRB
This is the ratio of the Landsat-8 band 4 vs band 2.
(NDRB) = (Red-Blue)/(Red+Blue)
All statistics on ND42 are saved in TimeScan Professional in the following band IDs:
- Band_21: Max ND42
- Band_22: Min ND42
- Band_23: Mean ND42
- Band_24: SD ND42
- Band_25: MASD ND42

8.1.2.6 ND32 or NDGB
This is the ratio of the Landsat-8 band 3 vs band 2.
(NDGB) = (Green-Blue)/(Green+Blue)
All statistics on ND32 are saved in TimeScan Professional in following band IDs:
- Band_26: Max ND32
- Band_27: Min ND32
- Band_28: Mean ND32
- Band_29: SD ND32
- Band_30: MASD ND32

8.2 The Timescan Native Cover Classification

TimeScan data underwent a supervised classification by Mappera Analytics Inc. following the same cover class categories as that of NPVI using 2006 GVI as training datasets. Native cover assessment and comparison using these classified products have accuracy limitations. A discussion of the description of classification and output for comparison occurs in Section 8.1.

- Time Scan temporal statics based supervised land cover image classification of the three year interval between 1996 and 1998.
- Time Scan temporal statics based supervised land cover image classification of the three year interval between 2014 and 2016

  Training data used in the classification process made use of the available GVI class definitions and polygons. To reduce within-class variability only polygons >= 95 PCT_OF_POL (percent of polygon) were used. Six test tiles for the period 2005-2007, which best correlate with the GVI time frame, were used to build a set of training class libraries based on the original GVI classes. Using the mean profiles, a classification was performed using a spectral angle mapping approach (Price, 1994). The final product from the supervised classification was a 30-meter resolution raster in 12 classes as shown in Table 11.

Table 11. A summary of Timescan class description and map code(s) and their corresponding GVI code(s)

Class	TimeScan map codes	GVI codes
Wetland (temporary, seasonal, alkali and semi-permanent to permanent)	1	1-4, 10
Open Water	2	5-6
Woody vegetation (coniferous, deciduous and shrubs)	3	7-9
Native Upland (High vegetation cover)	4	11-18
Native Upland (Moderate vegetation cover)	5	21, 23
Native Upland (Low vegetation Cover)	6	19-20, 22
Bedrock, bare soils and impervious surfaces (low to no vegetation cover)	7	24
Crop (high variation between dense vegetative cover and semi-exposed or exposed soils, moderate to high moisture)	8	25
Crop (high variation between moderate vegetative cover and semi-exposed or exposed soils, moderate to low moisture)	9	26
Pasture (low variation between dense vegetative cover and semi-exposed or exposed soils, high to moderate moisture	10	27
Pasture (low variation between moderate vegetative cover and semi-exposed or exposed soils, moderate to low moisture	11	28
Mixed urban	12	31

No post classification processing like class smoothing, morphology etc were applied and additionally there were data limitations in late 1980s and early 1990s due to US government attempt to commercialize Landsat and reduced available archived data. Overall, the accuracies were measured to about 65% for the base 2006 (2005-2007) data.

Generation of detailed accuracy matrix for all time slices were not possible due to the lack of crossed referenced data at the same resolution as that of GVI. As noted, this is a pilot - experimental process incorporated into the State of the Prairie analyses to assess its viability for future inventories and change analyses.

8.3 Inventory Accuracy

The Landsat satellite revisited each scene location, some as much as 63 times over a three-year interval. As a result, it becomes possible to compute pixel-by-pixel statistics (mean, maximum, mean, mean slope, median) with some degree of confidence for each index in each scene in the DLR archive of Landsat images. These statistical layers were used as input to a supervised classification of native prairie cover types at a 30-meter resolution.

Each of the ten successive three-year intervals between 1984 and 2016 underwent classification. Training areas based on samples from GVI data calibrated the supervised classification of the Timescan data. Comparison of the TS2006 dataset with GVI occurred as follows:

1. GVI polygons which are at least 95% pure (single site type) were selected.
2. Maapera Analytics reclassified the GVI classification categories to match their TS classification categories.
3. Raster grids of pure GVI vector polygons of the same spatial resolution of the TS native cover grids (30 meters) were established.
4. An ESRI raster process called "Combine" assists the overlay of the TS grid with the GVI grid.

5. Transpositing the he results of the ESRI "Combine" process results in a confusion matrix compatible for further accuracy computation and analysis in Microsoft Excel.

The following results were reported:
- A full population of polygons
- A 50% random sample of polygons in 6 of the 12 tiles (Maapera's validation approach)
- 5 random samples of polygons covering at least 25% of each class in 6 of the 12 tiles (Maapera's training sites)

The accuracy evaluations were based on:
1. All classes individually and
2. Reducing the classes to "Native" and "Anthropogenic".

The user's accuracy for all classes generated was quite low at 30% and improve significantly to 78% when the classes were aggregated to a "Native" and "Anthropogenic" class. Results are similar to Maapera's validation approach.

If we look at validation of the training sites the user's accuracy is only about 25% for all of the training site samples and changes significantly to 78% if the classes were reduced to "Native" and "Anthropogenic". This indicates that the training sites are likely representative but also

indicates a problem with class separability.

One way of improving the classifier performance may be to reduce the amount of data using a Principal Components Analysis (PCA) to reduce the effect of band correlation. Another problem in the data is that on May 31, 2003, the Scan Line Corrector (SLC) on the LandSat 7 satellite failed. The SLC compensates for the forward motion of the satellite. The remote sensing community define this event, the failure of the Scan Line Corrector mechanism on the satellite as "SLC-off". Subsequent efforts to recover the SLC on the LandSat 7 satellite were not successful. The effect of SLC-off on Landsat 7 imagery was that it caused considerable striping in the LandSat imagery collected after May 31, 2003 and this carries over as striping in the TimeScan imagery product derived from LandSat 7 imagery as seen below.

Figure 28. Example of Stripping effect in the Timescan products derived from LandSAT 7 imagery,

Of the 22 bands used by Maapera only the 5 bands listed below were reasonable devoid of striping.

- Max NDBI
- Min MNDWI
- Max NDVI
- SD NDVI
- Mean ND42

Using a PCA reduced the input data set to 3 bands in which no visible striping could be seen and explained about 98% of the image variation.

Regardless of the approach taken, requires more work to improve the classification from the TimeScan imagery.

9. Discussion

9.1 The Data

The process of searching, evaluating, validating, checking, converting, and summarizing the various data products was the most challenging component of this work. Eleven data products (NPVI, AAFCLU, AAFCACI, GVI, ABMI, PLVI, PFRA, TimeScan, AFSC,CPVI, Hybrids) and twenty-five separate years were evaluated to develop a reasonable understanding of the actual state of the prairie (Grassland and Parkland) between the mid 1980s and the mid 2010s. All the data products differed, to some extent, in their characterization of native cover. The challenge was to find which of the 25 dataset/time combinations presented the true picture of Time 1 and Time 2.

The Time 2 candidates were easier to filter; they had to meet the standard presented by two cornerstone datasets: the GVI in the Grassland and the PLVI in the Parkland. The PLVI though accurate did not fully represent the Parkland condition because it only covered the eastern portions of the Central Parkland but it served its purpose in validating other candidate datasets that fully covered the Parkland. The GVI was a Grassland dataset in its own right and but generalizing it to the quarter section to enable a NPVI-GVI analysis lowered its accuracy slightly. Still, the raw GVI was the best representation of 'state' in the Grassland and helped validate the AAFCLU 2010 as a viable representation of Grassland condition.

The Time 1 dataset candidates presented more uncertainty. Anchoring datasets such as the PLVI and GVI did not exist for the Time 1 period and therefore the process of selecting and validating the true representation of native cover for this earlier period was not as robust. Early in the analysis period, the thought was that the NPVI was an adequate product for a Time 1 representation, however, its quarter-section construct, including some logical inconsistencies in the database led the Technical Team to look for alternatives. With the documented quality-checking rigor of the AAFCLU 2010 product and it also corresponding extremely well with the raw GVI, the Team chose the AAFCLU 1990 product was likely the best representative of native cover for Time 1.

A note worth remembering in this discussion is that the terms 'better product' and 'likely representative' etc. are all statistically irrelevant. The error margins of most of these data products are within 10-20%, as such the arguments made as to whether the change in native cover decreased by 2% or increased by 1% are being made within the noise parameters of the data. Nonetheless, a strong case is valid for maintaining consistency in data products between Time 1 and Time 2. With the AAFCLU 2010 emerging as a good proxy for GVI and PLVI in terms of native cover, its 1990 version for change analysis made sense. Furthermore, using the AAFCLU provided consistency of products and analysis between the Grassland and Parkland Natural Regions.

9.2 Results
The most relevant aspects of the results presented in section 6 is the statistically insignificant amount of loss in native cover occurring in both the Grassland and Parkland Natural Regions, Sub-Regions and to a large extent also the ecodistricts and administrative areas. When using the GVI and PLVI data set, PFRA, and AAFCACI dataset, the AAFCLU dataset accuracy made some comparisons statistically significant. There are some exceptions such as some of the First Nations and the areas closer to the province's large cities but for the most part, we observe a landscape showing little change in terms of native cover over the past 20-25 years. The general knowledge of native cover being more prominent in areas of unfavourable to agriculture stands out with the ecodistrict analysis; extreme topography and 'unproductive' soils equals greater native cover. If the analysis were driven down to the micro scale using high resolution DEMs the topographic limitations of viable agriculture would further reveal microsites of native cover. This particular analysis is sound and is worth repeating in the future in conjunction with a fragstats analysis to provide a thorough view of connectivity and fragmentation of native cover in both Natural Regions. Severely compromised native cover in the Parkland makes this particularly important in this region.

Stratification into its private versus public components provides an interesting twist to the perspective of the changes in native cover. As seen in sections 6.2.7 and 6.1.7 most of the public land is still native while most of the deeded land is not. Furthermore, most of the land in both the Grassland and Parkland Natural Regions is private. This is the interesting conundrum, most of the native cover in these two Natural Regions occurs not on public land but on private land. It makes sense that policy strategies needed to preserve native cover must meet the intrinsic interests of the private land owner, especially if one wants to reduce or eliminate the incremental loss observed over mostly private lands.

10. Conclusions
A number of observations and recommendations made throughout this Technical Report point to future action in assessing the state of native cover in the Grassland and Parkland Natural Regions. As already noted, obtaining reliable data was the main challenge in this exercise, a challenge that should be greatly diminished in future endeavors. Still, some needed improvements in the process will hasten a fuller appraisal of the 'State of the Prairie'. Some of these improvements and recommendations are simply continuing the validated process outlined in this document, others suggest bringing the analysis to the next level with more detailed and/or sophisticated analysis. Combining these technical recommendations with suggestions arising from a January 2019 PCF member workshop on ways in which the results and findings of this project may support prairie and parkland conservation and stewardship is the next step. The PCF will then determine what parties are in the best position to act on particular recommendations as well as determine PCF capacity based on overall priorities.

Concluding statements and recommendations of the Technical Team, dealing with project continuity and quality assurance and control are as follows:

1. Pursue the AAFCLU analysis with the 2020 dataset to get a further 30-year perspective. Building on the effort, template, and process used in this document it would be a relatively easy, low cost and straightforward way to create a supplemental follow-up. Regular evaluations of status are essential to inform ongoing prairie

conservation decision-making. An evaluation of native cover state and change by decade should be a PCF ongoing activity – preferably with the on-going support of the broader suite of collaborators that made this phase of the project possible. This will entail communicating to the federal level the robustness and effectiveness of the agricultural land use inventory as well as the importance of continuing it. There may also be opportunities to collaborate with Saskatchewan neighbours to get a more complete picture of state and change across the Canadian short grass prairies.

2. Consider a micro-scale analytical follow up using a high resolution DEM and the AAFCLU 2020 data (when available) to evaluate native cover with respect to connectivity and fragmentation which are not captured effectively by reconnaissance-level inventories. Both are current PCAP priorities where the PCF has invested resources to generate advisory reports: http://www.albertapcf.org/rsu_docs/jan27-abmi_grasslands_cb-2016-final_web_singles.pdf and http://www.albertapcf.org/rsu_docs/pcf_o2_connectivity_final_20170626a.pdf. The value of this analysis would be compounded if it could also include a site-level inventory component capturing data on tame grasses, invasive species and range condition. Past work on high value landscapes, connectivity and fragmentation are all linked to the State of the Prairie analysis and the possibility of connecting all the pieces and expanding the suite of future collaborators should be considered in taking all of this work to the next level.

3. Fix the NPVI. Logical inconsistencies in the database need to be addressed. For example, for some records percentages exceeded 100% for total native cover. This occurred in less than 1% of the records, but can and should be corrected by AEP. Issues of integrity of the photo-interpretation were also found. Occasionally, when the GVI and NPVI were compared the maps showed improbable conditions such as an increase or decrease in native cover when field personnel confirmed no change had occurred. This could be corrected by AEP comparing the NPVI with the AAFCLU 1990 database, which would highlight interpretation discrepancies and provide a basis for correcting anomalous values. The early inventories are invaluable for providing a base from which change can be assessed from current inventories. As such, they are not 'historical footnotes' but remain of considerable current value as a baseline for ongoing change analyses. Accordingly, identified errors in these baseline inventories can and should be fixed.

4. The classification outputs from TimeScan data evaluated in this project was based on a small spatial training dataset from one year (2006). This resulted in classification accuracy issues when applied to a larger extent and has also shown large variability in temporal classifications. TimeScan data does show potential and should be pursued with the appropriate classifications and ground truth applied. As with the NPVI, if the TimeScan process can be improved with the proper training data then some of the older satellite datasets can be used as even older base data for inventories.

5. Analyse the AAFCLU data at the section and quarter section level; where did significant micro losses occur? Cumulatively micro-losses are significant. Small scale maps of change analysis data only depict the larger landscapes on which significant

change is noticeable. Detailed analysis of microsite losses may yield valuable information on common characteristics of such sites that may be invaluable in helping public or private land managers, First Nations, municipalities of irrigation districts to target effective conservation measures.

6. Consider working with ABMI to reconcile the ABMI land cover product with the AAFCLU data; why are discrepancies observed? Develop a validating process using the 3X7km plots?

7. How interested is the PCF in urban areas state and change? With GVI soon to be available for the Grassland Natural Region's major urban centres, a characterization of the urban native state can easily be accomplished. Appropriate datasets to investigate Parkland urban centres need more investigation. Human activity impacts native ecosystems, but human values are essential for the conservation of ecosystems. Alberta is rapidly urbanizing. Most Albertans are urbanites and Alberta's major cities are in prairie and parkland Alberta (Calgary, Edmonton, Lethbridge, Red Deer, Medicine Hat). People are most exposed to Alberta's prairies and parkland where they live. This project has been tailored to the Grassland and Parkland Natural Regions, not the relatively small parts of those regions that are urban landscapes. A project tailored to better understanding the state and change of native ecosystems **within urban boundaries** and the implications of **expanding urban boundaries** on native ecosystems would yield important insights.

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Appendix A - Attribute remapping of data products to the NPVI cover class standard.

The six tables describe the how the field values in the datasets used for the analyses were evaluated and remapped to represent the six standard cover classes. The original codes are available from the links in the references following the tabulations

Table A1. Summary of required fields for all remapped databases (NPVI Standard)

Attribute	Description
SHRUB	Percent shrub cover
TREED	Percent tree cover
GRAMINOID	Percent herbaceous cover
LAKE	Percent lentic water cover including dammed water
RIPARIAN	Percent lotic cover including flowing water
WETLAND	Percent wetland (lentic systems)

Table A2. GVI Remapped Fields

Attribute	GVI source
SHRUB	Percent shrub cover for 1/4 sec. from GVI site types 11 – 24 (upland natural)
TREED	Percent tree cover for 1/4 sec. from GVI site types 11 – 24 (upland natural)
GRAMINOID	Percent grass cover for 1/4 sec. from GVI site types 11 – 24 (upland natural)
LAKE	Percent water cover for 1/4 sec. from GVI site type 5
RIPARIAN	Percent riparian cover for 1/4 sec. from GVI site type 6 - 10
WETLAND	Percent wetland cover for 1/4 sec. From GVI site type 1 - 4

Table A3. The City of Calgary Remapped Fields

Attribute	Natural Areas-Riparian Area-Hydrography source
SHRUB	Null - Not defined
TREED	Null – Not defined
GRAMINOID	Percent cover from the UNION coverage containing Natural Areas values 1 – 6, 8 Note: the Graminoid field is used as a general container for all upland natural area types. No distinction is made on vegetation types.
LAKE	Percent cover from the UNION coverage containing Hydrography Areas value 12
RIPARIAN	Percent cover from the UNION coverage containing Riparian Areas values 8 - 11
WETLAND	Percent cover from the UNION coverage containing Natural Areas value 7

Table A4. The Land Cover of the Prairies (PFRA 1995) Remapped Fields

Attribute	Land Cover of the Prairies (PFRA 1995)
SHRUB	Percent cover from Land Cover of the Prairies Re-mapped CODE - 4
TREED	Percent cover from Land Cover of the Prairies Re-mapped CODE - 5
GRAMINOID	Percent cover from Land Cover of the Prairies Re-mapped CODE - 3
LAKE	Percent cover from Land Cover of the Prairies Re-mapped CODE - 7
RIPARIAN	Null - Not defined
WETLAND	Percent cover from Land Cover of the Prairies Re-mapped CODE – 6 and 3

Table A5. AAFC Annual Crop Inventory (AAFCACI) 2016

Attribute	Natural Areas-Riparian Area-Hydrography
SHRUB	Percent cover from AAFC Annual Crop Inventory Re-mapped CODE - 50
TREED	Percent cover from AAFC Annual Crop Inventory Re-mapped CODE – 200 to 230
GRAMINOID	Percent cover from AAFC Annual Crop Inventory Re-mapped CODE - 110
LAKE	Percent cover from AAFC Annual Crop Inventory Re-mapped CODE - 20
RIPARIAN	Not defined
WETLAND	Percent cover from AAFC Annual Crop Inventory Re-mapped CODE - 80

Table A6. AAFC Land Use (AAFCLU) 1990, 2010

Attribute	Natural Areas-Riparian Area-
SHRUB	Not defined
TREED	Percent cover from AAFC Land Use Re-mapped CODE – 41, 45
GRAMINOID	Percent cover from AAFC Land Use Re-mapped CODE - 61, 62
LAKE	Percent cover from AAFC Land Use Re-mapped CODE - 31
RIPARIAN	Not defined
WETLAND	Percent cover from AAFC Land Use Re-mapped CODE - 41, 46, 73, 74

Table A7. The TimeScan Classification Remapped Fields

Attribute	TimeScan Classification outputs (1984-2016)
SHRUB	Not defined
TREED	Percent cover from TimeScan Classification Re-mapped CODE - 3
GRAMINOID	Percent cover from TimeScan Classification Re-mapped CODE - 4, 5 and 6
LAKE	Percent cover from TimeScan Classification Re-mapped CODE - 2
RIPARIAN	Null - Not defined
WETLAND	Percent cover from TimeScan Classification Re-mapped CODE – 1

Appendix B - Inventory map algebra and error propagation

Map algebra calculations are common when analysing raster type data. Standardizing all the inventories to the attribute and quarter section unit effectively provides the common raster unit to allow for map algebra calculations and comparisons. In essence, if all the inventories were stacked on top of each other, each quarter section or pixel would be spatially consistent and inter-relatable. With at least four types of compilation techniques used for the inventories, some judicial considerations needed to be applied. Separating air photo and satellite compiled inventories was a basic first step. This level of stratification enables a comparative analysis between these two approaches; an expensive and intensive manual compilation technique (air photo) and a more automated algorithm driven compilation process (satellite). This was one of the key desired outcomes of this project.

The main map algebra operation was simply to differentiate each quarter section attribute from a defined time 1 and time 2. That difference provided the basic change statistic for each quarter section/pixel and for each of the six standardized cover types. The significance of that change statistic needs some elaboration. Since each of the inventories had an intrinsic error associated with their compilation, that error would propagate through whatever map algebra calculations were applied to the inventory layers. For example, an NPVI (time 1) and GVI (time 2) differentiation would carry the 20% error inherent in the NPVI and the 10% error associated with the GVI through to the final result.

The general treatment of summing or subtracting the error component of a value was computed as follows:

If Q is some combination of sums and differences, i.e.

$$Q = a + b + ... + c - (x + y + ... + z); \text{then} \tag{1}$$

$$\delta Q = \sqrt{(\delta a)^2 + (\delta b)^2 + ... + (\delta c)^2 + (\delta x)^2 + (\delta y)^2 + ... + (\delta z)^2} \tag{2}$$

this means that the uncertainties add in quadrature.
In particular, if $Q = a + b$ or $a - b$, then

$$\delta Q = \sqrt{(\delta a)^2 + (\delta b)^2} \tag{3}$$

The NPVI-GVI analysis has an error of 20 and 10 percent for the NPVI and GVI, respectively, therefore the propagated error is:

$$\delta Q = \sqrt{(\delta 20)^2 + (\delta 10)^2} \tag{4}$$

$$\delta Q = \sqrt{400 + 100} \tag{5}$$

$$\delta Q = 22 \tag{6}$$

The value 22 represents the uncertainty in the difference found between the NPVI value and the GVI value.

The PFRA to AAFCACI analyses has an error of 40 percent, therefore the propagated error calculates to:

$$\delta Q = \sqrt{(\delta 40)^2 + (\delta 40)^2} \tag{7}$$

$$\delta Q = \sqrt{1600 + 1600} \tag{8}$$

$$\delta Q = 57 \tag{9}$$

The AAFCLU 1990 and 2010 analysis has an error of 11 and 5 percent respectively. The propagated error calculates to:

$$\delta Q = \sqrt{(\delta 11)^2 + (\delta 5)^2} \tag{10}$$

$$\delta Q = \sqrt{121 + 25} \tag{11}$$

$$\delta Q = 12 \tag{12}$$

Appendix C - Data Validation and Datasets Considered/Evaluated

Data validation was considered as an important process step in qualifying datasets for use. The key was to identify one dataset that had the highest level of reliability and accuracy and use that dataset either as the final dataset for analysis or use it to check the veracity of other datasets that were to be considered. The two most accurate and rigorously compiled datasets were the GVI in the Grassland Natural Region and the PLVI in the Parkland Natural Region. These datasets were developed using stereo photogrammetric techniques and were extensively audited and quality checked by Alberta government departments. The GVI was considered an ideal dataset covering all of the Grassland Natural Region and was considered the authoritative source for the Time 2 Grassland Natural Region analysis. PLVI only covered the

eastern portion of the Central Parkland Sub-Region and could not be used for the Parkland analyses, however, it could be used to validate other Time 2 datasets that covered the Parkland Natural Region completely.

Time 1 dataset validation was more problematic. No inventory compiled with the rigor of the GVI and PLVI existed for this period. The only datasets identified early in the process were the NPVI for the Grasslands Natural Region and the PFRA 1995 for both Grasslands and Parkland Natural Regions. The NPVI was limited as quarter-section inventory and had some issues with logical consistency. The PFRA 1995, although generally acceptable in the Grasslands, grossly overestimated native cover in the Parkland. A Timescan dataset centred on 1997 was found to be the best choice among the mediocre data lot.

The situation changed significantly when the Technical Team's Javed Iqbal came across the federal AAFC Land Use data. This dataset satisfied our 20-25 time interval requirement (informally set by the NPVI-GVI analysis), had high internal accuracy metrics, corresponded well with our Time 2 validating data sources (GVI and PLVI), and most importantly, contained a high level of internal process consistency between its Time 1 (1990) and Time 2 (2010) compilations. None of the other datasets had this very important characteristic. This was to be the definitive Time 1-2 dataset for the Parkland Natural Region and was also used comparatively with the NPVI-GVI and PFRA-AAFCACI datasets in the Grassland Natural Region.

Following are a number of datasets that were considered in the course of the data evaluations including brief commentary as to any issues encountered. Emphasis is placed on the Parkland Natural Region mostly because of the difficulties encountered in obtaining a dataset that accurately portrayed change and status for the complete Natural Region.

Table C1 shows the two initial datasets (Timescan 1997 and Timescan 2015) that were available to represent the Parkland Natural Region. With an almost 12% total native cover change between them, some informed decision needed to be made as to whether this change was real or an artifact of the data. Based on expert opinion, it was thought that the Timescan 2015 data representing some 11% native cover left in the Parkland was low but not improbable. It was prematurely used for the Nanton presentation to the PCF on Sept. 20th, 2018.

Table C1. Timescan data from 1997 and 2015

Cover types	Parkland				
	Time Scan '97		Time Scan '15		% Diff.
	Area(ha)	%	Area(ha)	%	
Treed	409458	7.0	183353	3.1	-3.8
Gram.	678611	11.5	320884	5.5	-6.1
Lake	119674	2.0	113764	1.9	-0.1
Wetland	91139	1.6	233	0.0	-1.5
Native Total	**1298882**	**22.1**	**618234**	**10.5**	**-11.6**

Proceeding to validate the data using the partial PLVI coverage for the eastern part of the Central Parkland exposed some serious issues. The higher values for native cover in the PLVI

were not being reflected in the Timescan 2015 dataset. The Timescan 2015 native cover for the PLVI area was 13% whereas the actual PLVI data showed a value of almost 36%. The Timescan 2015 version had to be replaced but with what? The Technical Team looked at various options, Table C2 outlines the values obtained for the AAFCACI (AAFC in the table)I 2015 to 2017, the Timescan (TS in the table) 2015, ABMI for the inverse of the Human Footprint Inventory (HFI Negative in the table) and the ABMI Land Cover for 2010. They are all compared to the reference PLVI 2016 data and are all clipped to PLVI area.

Table C2. Various datasets compared to the PLVI

Cover Types	AAFC 2015		AAFC 2016		AAFC 2017		Time Scan 2015		ABMI HFI Negative 2014		ABMI Land Cover 2010		PLVI 2016	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Shrub	180263	8.9	118370	5.8	179234	8.8					46562	2.3	113991	5.6
Treed	62319	3.1	80454	4.0	84962	4.2	50391	2.5			93133	4.6	221596	10.9
Gram.	280323	13.8	349270	17.2	366313	18	174506	8.6			316800	15.6	198153	9.7
Lake	38412	1.9	29838	1.5	47419	2.3	39791	2.0			71215	3.5	61928	3.0
Wetland	64711	3.2	117318	5.8	115966	5.7	95	0.0					131943	6.5
Total Native	626027	31	695251	34	793894	39	264783	13	501319	24.7	527710	26.0	727611	35.8

Generally, the AAFCACI datasets were relatively close in overall native cover to the PLVI reference dataset with the AAFCACI 2016 time slice closest (34% vs 35.8%). These datasets, however, tended to under report the Treed category and over report the Gramanoid category. The ABMI and Timescan data (as noted) under reported the total amount of native cover in the PLVI area. An adequate representation for the Parkland Natural Region was still missing.

The Technical Team, again, considered various combinations, including hybrids of the AAFCACI and Timescan to define a viable dataset, however, when the AAFCLU dataset was discovered and validated with both GVI and PLVI, the Timescan and AAFCACI hybrids were dismissed. The Team had found a consistent, accurate, and robust dataset to define the 'state of the prairie' for the Parkland Natural Region. Table C3 shows the AAFCLU datasets for both the Grassland and Parkland Regions compared to the initial Parkland datasets used (Timescan and AAFCACI hybrid) and also with the NPVI-GVI dataset.

Table C3. Left side shows data for the Parkland Natural Region, right side shows data for the Grassland Natural Region

	Parkland Natural Region					Grassland Natural Region				
Cover Type	Area (ha)		Percent		% Diff.	Area (ha)		Percent		% Diff.
	AAFCLU ('90)	AAFCLU ('10)	AAFCLU ('90)	AAFCLU ('10)		AAFCLU ('90)	AAFCLU ('10)	AAFCLU ('90)	AAFCLU ('10)	
Shrub										
Treed	570387	475048	9.9	8.3	-1.6	81666	77576	0.9	0.8	0.1
Gaminoid	358536	327336	6.2	5.7	-0.5	4338372	4094117	45.4	42.8	-2.6
Lake	288106	287956	5.0	5.0	-0.0	317972	318018	3.3	3.3	-0.0
Wetlands	55546	48697	1.0	0.8	-0.2	86729	85049	0.9	0.9	0.0
Total Native	1272575	1139036	22.1	19.9	-2.3	4824747	4574761	50.5	47.9	-2.6

	Parkland Natural Region					Grassland Natural Region				
Cover Type	Time Scan 1997		Hybrid (AAFC dom)		% Diff.	NPVI ('91-'93)		GVI ('06 -'16)		% Diff.
	Area (ha)	%	Area	%		Area (ha)	%	Area	%	
Shrub			247462	4.3	N/A	131168	1.4	136576	1.4	N/A
Treed	409494	7.1	303574	5.3	N/A	27694	0.3	33914	0.4	N/A
Gaminoid	678673	11.8	299716	5.2	N/A	3411515	35.7	3468001	36.3	N/A
Lake	119683	2.1	94464	1.6	N/A	84357	0.9	137284	1.4	N/A
Riparian					N/A	123421	1.3	210528	2.2	N/A
Wetlands	91136	1.6	294739	5.1	N/A	396827	4.2	372926	3.9	N/A
Total Native	1298985	22.6	1239956	22.0	N/A	4174981	45.6	4359230	45.6	N/A

As can be seen from the overall native cover figures, the AAFCLU data (denoted as Land use in Table C3) aligns relatively well with the original datasets that were considered. The only deviation of note being the NPVI and the AAFCLU 1990 where overall native cover varies by about 7% (43.7% vs 50.4%, respectively), and within these two datasets, the gramanoid cover varies by about 10%. (45.4% vs 35.7%, respectively).

The Central Parkland Vegetation Inventory (CPVI) Data.
This dataset was initially considered to be a prime candidate for characterizing Time one for the Parkland Natural Region. The CPVI was a fusion of satellite, air photo, and base features derived information and thought to be fairly accurate. Checking this dataset against the PLVI standard showed otherwise. Map C1 shows the visual verification check performed in the PLVI area and provides the rationale for dismissing this dataset as a Time 1 contender.

Map C1. The PLVI area of interest with CPVI on the left and PLVI data on the right.
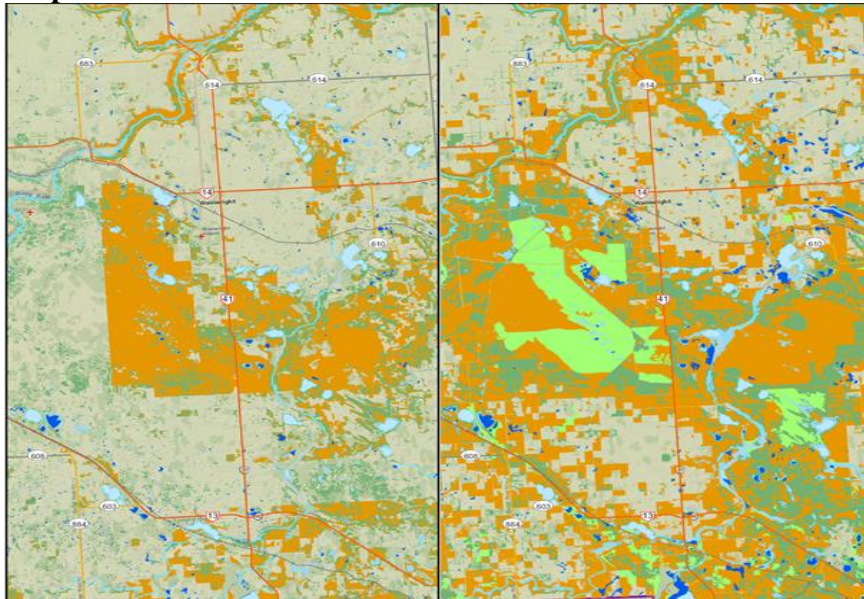
One key dataset that the Technical Team tried to obtain for validation purposes was a study/inventory of fescue grassland in the Central Parkland Sub-Region. This was work that was done by Biota Consultants for the Resource Data Division in the then department of Forestry, Lands, and Wildlife circa 1998. Inquiries were made in Edmonton and Red Deer regarding this data but unfortunately it was not found.
https://geodiscover.alberta.ca/geoportal/catalog/search/resource/fullMetadata.page?uuid=%7B351DD940-9110-4218-9CC9-CB159A9AC20A%7D

Primary Land Vegetation Inventory
The Primary Land and Vegetation Inventory (PLVI) is a photo-base digital inventory developed to identify the type, extent and conditions of vegetation in the forested and parkland areas of the province of Alberta.Ecological site phase (ecosite phase) is the main level of classification used in PLVI. PLVI captures range site only within the Central Parkland Natural Sub-Region. This dataset was critical to evaluate the feasibility (or non-feasibility) of a variety of Parkland Natural Region datasets as noted in Table C2 and Map C1. However, since it did

not cover the Parkland Natural Region completely its use was restricted to be used only as a validation dataset.
https://open.alberta.ca/opendata/plvi

The ABMI datasets.
In early 2012, the Alberta Biodiversity Monitoring Institute (ABMI) released 'Wall-to-Wall' inventories of human footprint and land cover. The land cover inventory provided polygon-based representations of provincial land cover for all of Alberta for 2000 and 2010. This inventory is based on the digital classification of 30 meter resolution Landsat satellite images, and enhanced using GIS datasets provided by the Government of Alberta. The land cover products contain approximately 1 million polygons, and comprise 11 classes, including water, shrubland, grassland, agriculture, exposed land. The Wall to Wall Human Footprint Inventory has evolved into the Alberta Human Footprint Monitoring Program (scale 1:15,000) with multiple partners. It provides a detailed and thorough biannual representation of provincial-scale anthropogenic footprint. Human footprint maps have been produced for 2007, 2010, 2012 and 2014. Metadata, data capture, delineation, orientation and accuracy are constantly improving. The 2014 map captures over 110 human footprint features:
http://www.abmi.ca/home/data-analytics/da-top/da-product-overview/GIS-Human-Footprint-Land-Cover-Data/HF-inventory.html?scroll=true

At the request and with the involvement of the PCF, in 2016 ABMI published The Status of biodiversity in the Grassland and Parkland Regions of Alberta. The report provides data on human footprint, the amount of native habitat and fragmentation as well as biodiversity and species intactness: http://ftp.public.abmi.ca//home/publications/documents/424-ABMI%202016_Status%20of%20Biodiversity%20in%20Prairie%20Region_FINAL%20REPORT.pdf

Both the the inverse of the Human Footprint (HFI) dataset ie. non-disturbed land and the Land Cover 2010 were considered as viable Time 2 datasets but ultimately replaced by the AAFCLU data particularly as they seemed to underestimate native cover in the PLVI validation area (~25% vs. 36% for HFI and 26% vs 36% for Land Cover 2010; Table C2)

The Three by Seven (3 X 7) km Photoplot Land Cover is also a very detailed and useful ABMI GIS data set that provides a comprehensive inventory characterizing moisture, management status, vegetation features, wetlands, land use, infrastructure, and land cover within the 1,656 ABMI 3 x 7-km sites that cover approximately 5% of Alberta. Over 800 out of 1,656 photoplot sites have been completed as of May 2018. This dataset was also considered as a high quality statistical representation of the Time 2 profile for the Parkland but as with the Human Footprint data but was deemed more appropriate as a potential validation dataset to be used alongside the PLVI, especially into the future.

Alberta Financial Services Corp. (AFSC Data).
The Agricultural Land Cover Classification (Agriculture Financial Services Corporation, AFSC), 2006 was similar to the PFRA land cover of the Prairies and was a dataset under consideration. In the end it was decided not to use this data set as it was conducted at a time that did not fit with the interval of time that native prairie vegetation condition in Alberta was being evaluated.

City of Calgary
As of 2016 the City of Calgary (CoC) was not inventoried by the GVI (as of the end of 2018) but is part of the satellite inventories for the Grassland and Parkland and is included in the NPVI. The City of Calgary did perform extensive assessments of their riparian and wetland resources. The data was partly used to validate/supplement the city component of the AAFCLU 2010. Personal communication with the O2 group (the dataset compilers) notes that information is current as of 2013 and was compiled primarily through LiDAR and DEM modelling with associated ground truthing. Classification was developed using spatial cost-analysis models. (Reference 3; see Appendix A, Table A3, for the CoC-to-NPVI remapped fields).

City of Edmonton
A land use data set was obtained for the City of Edmonton to attempt to validate the city AAFCLU satellite data. The data was evaluated but deemed too detailed to be reconciled with the AAFCLU data. Further investigation was determined to be outside the scope of the project; however, the final recommendations of this report do note that data to support urban change investigation is available if the PCF is interested. https://data.edmonton.ca/Thematic-Features/City-of-Edmonton-Land-Use/rezv-ns5t

Appendix D. Data Tables

Table D1. Native Prairie Vegetation Inventory (1991-93) and Grassland Vegetation Inventory (2006-16) Totals by Natural Region, Sub-region, and Ecodistrict.

Data Source	Natural Sub-Region	Ecodistricts	Cover Classes							Total Native Veg- No Bare Ground[1]	Non-Native Land	%Native Remaining Change
			Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Bare Ground			
NPVI	Dry Mixedgrass	804 - Sounding Creek Plain	6538	94190	204	749	34	16143		117858	108177	52
GVI			3043	103950	2791	5136	1398	14642	10802	130959	95077	58
Change			-3496	9760	2587	4387	1364	-1501	10802	13101	-13101	6
NPVI	Dry Mixedgrass	805 - Sibbald Plain	151	5949	0	0	0	1377		7477	21826	26
GVI			541	6970	94	289	167	2300	419	10360	18943	35
Change			390	1020	94	289	167	923	419	2883	-2883	9
NPVI	Dry Mixedgrass	806 - Berry Creek Plain	7017	477115	10377	3804	38	63879		562231	226971	71
GVI			7993	448592	12818	14617	249	58276	62130	542544	246658	69
Change			976	-28523	2441	10813	210	-5603	62130	-19687	19687	-2
NPVI	Dry Mixedgrass	809 - Oyen Upland	4167	130136	256	183	167	20802		155712	184829	46
GVI			4112	125476	2590	11560	321	21061	9189	165120	175422	48
Change			-56	-4660	2334	11377	154	259	9189	9408	-9408	2
NPVI	Dry Mixedgrass	811 - Acadia Valley Plain	433	12813	12	19	110	1469		14856	51218	22
GVI			230	11351	148	747	3	820	1188	13299	52776	20
Change			-203	-1462	136	728	-107	-649	1188	-1557	1557	-2
NPVI	Dry Mixedgrass	812 - Brooks Plain	5434	166848	8424	4850	534	16763		202854	162517	56
GVI			5047	171082	10986	6669	554	8556	18854	202895	162476	56
Change			-387	4234	2562	1818	20	-8207	18854	41	-41	0
NPVI	Dry Mixedgrass	814 - Rainy Hills Upland	7432	199500	554	1068	16	16628		225197	50465	82
GVI			1794	196440	1131	4939	17	18948	20161	223268	52394	81
Change			-5638	-3060	577	3870	1	2320	20161	-1929	1929	-1
NPVI	Dry Mixedgrass	815 - Bindloss Plain	14400	211881	4409	8306	684	10792		250472	106397	70
GVI			4738	213755	2036	16821	284	6086	32578	243720	113149	68
Change			-9662	1874	-2372	8515	-400	-4706	32578	-6752	6752	-2
NPVI	Dry Mixedgrass	818 - Bow City Plain	680	78233	3174	791	42	7404		90324	65934	58
GVI			824	80214	4064	2518	69	6719	10296	94408	61850	60
Change			145	1980	891	1727	27	-685	10296	4084	-4084	2
NPVI	Dry Mixedgrass	821 - Schuler	13691	140889	1303	7306	51	12855		176095	156537	53
GVI			3412	164409	1215	6270	19	12517	11524	187841	144791	56
Change			-10279	23519	-87	-1036	-32	-339	11524	11746	-11746	3
NPVI	Dry Mixedgrass	823 - Vauxhall Plain	843	62452	952	505	14	4757		69522	200742	26
GVI			372	61370	3424	2288	6	6010	4163	73470	196794	27

	Region	Subregion										
Change			-471	-1082	2472	1783	-8	1253	4163	3948	-3948	1
NPVI	Dry Mixedgrass	828 - Foremost Plain	5876	260828	15696	7131	74	15152		304757	734329	29
GVI			7446	241470	9805	15240	45	38902	22266	312907	726178	30
Change			1570	-19359	-5891	8109	-29	23750	22266	8151	-8151	1
NPVI	Dry Mixedgrass	829 - Purple Springs Plain	874	66226	457	1403	42	1672		70672	60363	54
GVI			1960	61345	1648	3621	16	3779	5126	72369	58666	55
			1087	-4881	1192	2218	-26	2107	5126	1697	-1697	1
NPVI	Dry Mixedgrass	833 - Wild Horse Plain	7021	244357	200	10707	21	9815		272120	42773	86
GVI			9430	218810	370	11516	19	9494	37024	249640	65253	79
Change			2410	-25547	171	809	-1	-322	37024	-22481	22481	-7
NPVI	**Dry Mixedgrass**	**Totals**	**74556**	**2151419**	**46018**	**46822**	**1826**	**199508**	**0**	**2520148**	**2173079**	**54**
GVI		**Totals**	**50942**	**2105233**	**53121**	**102228**	**3167**	**208109**	**245719**	**2522800**	**2170427**	**54**
Change		**Difference**	**-23614**	**-46186**	**7104**	**55406**	**1341**	**8601**	**245719**	**2652**	**-2652**	**0**
NPVI	Foothills Fescue	798 - Delacour Plain	2185	47989	3733	6715	1952	29849		92422	612339	13
GVI			5767	83718	7946	9126	3102	14757	7815	124416	580345	18
Change			3582	35729	4213	2411	1150	-15092	7815	31994	-31994	5
NPVI	Foothills Fescue	799 - Willow Creek Upland	2202	85905	36	1685	1704	376		91908	35081	72
GVI			11972	69435	742	5530	1975	528	10770	90181	36808	71
Change			9769	-16470	705	3845	271	152	10770	-1727	1727	-1
NPVI	Foothills Fescue	800 - Cardston Plain	2124	75130	5176	7458	956	2365		93209	204188	31
GVI			6908	87571	7421	7907	1446	5048	10805	116300	181097	39
Change			4784	12441	2245	449	490	2683	10805	23091	-23091	8
NPVI	Foothills Fescue	801 - Twin Butte Foothills	709	48401	79	2339	936	2429		54893	53533	51
GVI			3214	53523	1084	3349	846	3377	5453	65393	43033	60
Change			2505	5123	1005	1010	-90	948	5453	10500	-10500	9
NPVI	Foothills Fescue	802 - Del Bonita Plateau	1705	71336	4	2387	6	2965		78402	46215	63
GVI			1980	76357	1370	4884	0	6810	1707	91400	33217	73
Change			274	5021	1366	2497	-6	3845	1707	12998	-12998	10
NPVI	**Foothills Fescue**	**Totals**	**8925**	**328761**	**9028**	**20584**	**5554**	**37984**	**0**	**410835**	**951355**	**30**
GVI		**Totals**	**29840**	**370605**	**18562**	**30795**	**7369**	**30520**	**36550**	**487691**	**874499**	**36**
		Difference	**20915**	**41844**	**9534**	**10211**	**1815**	**-7464**	**36550**	**76856**	**-76856**	**6**
NPVI	Mixedgrass	787 - Majorville Upland	1045	61564	3305	325	0	3906		70145	75781	48
GVI			808	59888	3289	1704	3	5593	8327	71285	74641	49
Change			-237	-1676	-16	1379	3	1687	8327	1140	-1140	1
NPVI	Mixedgrass	788 - Standard Plain	49	2171	129	1044	8	5462		8863	85691	9
GVI			707	10589	1629	631	111	726	1332	14393	80161	15
			658	8418	1501	-413	103	-4736	1332	5530	-5530	6
NPVI	Mixedgrass	790 - Blackfoot Plain	2324	34309	6098	6909	1100	3598		54337	77650	41
GVI			2513	38992	7250	5972	1608	2262	3514	58597	73390	44
Change			189	4683	1153	-937	508	-1336	3514	4260	-4260	3
NPVI	Mixedgrass	791 - Vulcan Plain	577	16047	178	1383	23	3241		21448	236656	8

GVI			690	22252	2974	1616	69	3086	3301	30687	227417	12
Change			113	6206	2796	233	46	-156	3301	9239	-9239	4
NPVI	Mixedgrass	793 - Lethbridge Plain	2175	78869	6028	18584	292	5528		111476	661704	14
GVI			7482	114776	12291	21281	1560	16049	13276	173439	599741	22
Change			5307	35907	6263	2697	1268	10521	13276	61963	-61963	8
NPVI	Mixedgrass	797 - Milk River Upland	774	62250	5	2261	0	1477		66768	41809	61
GVI			1236	64724	419	3150	1	6036	1915	75567	33010	70
Change			462	2474	413	889	1	4559	1915	8799	-8799	9
NPVI	Mixedgrass	836 - Sweetgrass Upland	1425	22279	42	1447	0	673		25865	12332	68
GVI			1242	20497	81	2022	1	1441	1516	25284	12914	66
Change			-182	-1782	39	575	1	768	1516	-581	581	-2
NPVI	Mixedgrass	837 - Cypress Slope	3302	69475	172	3772	0	1797		78518	43801	64
GVI			1891	63943	392	6793	2	3365	7198	76386	45933	62
Change			-1411	-5531	220	3021	2	1568	7198	-2132	2132	-2
NPVI	Mixedgrass	838 - Cypress Hills	2482	105451	302	3380	982	3463		116060	10685	92
GVI			6213	82103	739	10339	302	4316	12937	104013	22732	82
Change			3731	-23347	438	6958	-680	853	12937	-12047	12047	-10
NPVI	Mixedgrass	9787 - Makepeace Plain	1439	78525	2854	1213	163	10622		94815	112527	46
GVI			2484	74021	3995	2771	230	8658	8738	92159	115183	44
Change			1045	-4504	1141	1559	67	-1964	8738	-2656	2656	-2
NPVI	**Mixedgrass**	**Totals**	**15593**	**530939**	**19112**	**40317**	**2567**	**39767**	**0**	**648295**	**1358636**	**32**
GVI		**Totals**	**25268**	**551785**	**33058**	**56278**	**3887**	**51532**	**62054**	**721809**	**1285123**	**36**
		Difference	**9675**	**20846**	**13946**	**15961**	**1320**	**11765**	**62054**	**73514**	**-73514**	**4**
NPVI	Northern Fescue	769 - Castor Plain	5194	83681	1309	2801	5543	47407		145935	209548	41
GVI			5162	94555	12047	6221	1855	32564	11326	152404	203079	43
Change			-32	10874	10738	3420	-3688	-14843	11326	6469	-6469	2
NPVI	Northern Fescue	771 - Neutral Hills	11590	132408	1884	5706	5803	29777		187168	180528	51
GVI			12138	144604	5660	7016	7898	26593	9328	203910	163786	55
			548	12196	3776	1310	2095	-3184	9328	16742	-16742	4
NPVI	Northern Fescue	777 - Kirkpatrick Lake Plain	4558	47920	789	849	1509	16126		71751	48087	60
GVI			1625	57767	3689	1345	1104	7652	3555	73182	46656	61
Change			-2933	9846	2900	497	-405	-8474	3555	1431	-1431	1
NPVI	Northern Fescue	779 - Endiang Upland	5125	32160	580	56	1388	11537		50846	53915	49
GVI			4120	38286	1883	38	3653	6830	1315	54811	49950	52
Change			-1005	6126	1303	-18	2266	-4707	1315	3965	-3965	3
NPVI	Northern Fescue	781 - Drumheller Plain	4097	47109	4282	5675	2168	7208		70540	266586	21
GVI			3756	47150	6212	4151	3151	4906	9508	69325	267801	21
Change			-341	41	1930	-1524	983	-2302	9508	-1214	1214	0
NPVI	Northern Fescue	786 - Wintering Hills	1529	57118	1355	611	1337	7513		69463	139081	33
GVI			3725	58017	3051	2455	1831	4220	3637	73298	135246	35
Change			2196	899	1696	1845	494	-3294	3637	3835	-3835	2

			Shrub	Graminoid	Lake	Riparian	Treed	Wetland				
NPVI	Northern Fescue	Totals	32094	400396	10199	15697	17748	119568	0	595703	897745	40
GVI		Totals	30526	440379	32542	21226	19492	82765	38668	626930	866518	42
		Difference	-1568	39982	22343	5529	1744	-36804	38668	31227	-31227	2
NPVI	Grassland Natural Region	Region Totals	131168	3411515	84357	123421	27694	396827	0	4174981	5380816	44
GVI		Region Totals	136576	3468001	137284	210528	33914	372926	382991	4359230	5196568	46
		Region Difference	5409	56486	52928	87108	6220	-23901	382991	184249	-184249	2

[1] GVI records bare ground as native cover. NPVI recorded bare ground as non-native cover. The bare ground component was removed from GVI native cover to make it compatible to the NPVI.

Table D2. AAFCLU (1990-2010) Totals by Natural Region, Sub-region, and Ecodistrict.

Year or Change Interval	Data Source	Natural Sub-Region	Ecodistricts	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Native Remaining	%Native Change
1990	AAFCLU	Dry Mixedgrass	804 - Sounding Creek Plain		126680	8515		418	6894	142507	83528	63	
2010	AAFCLU				120279	8478		424	6836	136018	90018	60	
Change					-6401	-38		6	-57	-6490	6490		-3
1990	AAFCLU	Dry Mixedgrass	805 - Sibbald Plain		8270	1678		11	199	10157	19468	34	
2010	AAFCLU				7456	1670		10	194	9331	20294	31	
Change					-813	-8		0	-4	-825	825		-3
1990	AAFCLU	Dry Mixedgrass	806 - Berry Creek Plain		597974	30267		1121	11171	640533	148669	81	
2010	AAFCLU				585599	30317		1111	11015	628043	161159	80	
Change					-12375	51		-10	-156	-12491	12491		-2
1990	AAFCLU	Dry Mixedgrass	809 - Oyen Upland		176118	10041		173	889	187221	153364	55	
2010	AAFCLU				168667	10075		181	848	179771	160814	53	
Change					-7452	35		8	-41	-7450	7450		-2
1990	AAFCLU	Dry Mixedgrass	811 - Acadia Valley Plain		15363	1403		18	133	16916	49191	26	
2010	AAFCLU				14822	1405		18	134	16379	49729	25	
Change					-540	2		-1	1	-537	537		-1
1990	AAFCLU	Dry Mixedgrass	812 - Brooks Plain		190430	16943		3413	7216	218002	147369	60	
2010	AAFCLU				183395	16955		3348	7026	210725	154646	58	
Change					-7035	12		-65	-190	-7277	7277		-2
1990	AAFCLU	Dry Mixedgrass	814 - Rainy Hills Upland		247129	3354		534	489	251506	24156	91	
2010	AAFCLU				244661	3320		543	485	249008	26654	90	

Year	Source	Sub-Region	Unit								
Change				-2468	-35	9	-5	-2498	2498		-1
1990	AAFCLU	Dry Mixedgrass	815 - Bindloss Plain	276007	9621	3122	2543	291293	65867	82	
2010	AAFCLU			268181	9580	3096	2425	283281	73878	79	
Change				-7826	-41	-26	-118	-8011	8011		-2
1990	AAFCLU	Dry Mixedgrass	818 - Bow City Plain	94799	9469	568	1953	106789	49469	68	
2010	AAFCLU			87959	9485	545	1925	99914	56344	64	
Change				-6840	16	-22	-29	-6875	6875		-4
1990	AAFCLU	Dry Mixedgrass	821 - Schuler	207232	7766	541	820	216359	116873	65	
2010	AAFCLU			196106	7783	541	818	205249	127983	62	
Change				-11125	17	0	-2	-11111	11111		-3
1990	AAFCLU	Dry Mixedgrass	823 - Vauxhall Plain	81456	6246	339	969	89009	181255	33	
2010	AAFCLU			76916	6236	324	973	84450	185815	31	
Change				-4539	-10	-15	4	-4560	4560		-2
1990	AAFCLU	Dry Mixedgrass	828 - Foremost Plain	332982	30271	434	3713	367401	671736	35	
2010	AAFCLU			311875	30301	427	3635	346237	692899	33	
Change				-21108	30	-7	-79	-21163	21163		-2
1990	AAFCLU	Dry Mixedgrass	829 - Purple Springs Plain	77918	3631	233	388	82171	48865	63	
2010	AAFCLU			73621	3647	221	380	77870	53166	59	
Change				-4297	16	-12	-8	-4301	4301		-3
1990	AAFCLU	Dry Mixedgrass	833 - Wild Horse Plain	283031	2846	757	1407	288042	27117	91	
2010	AAFCLU			280953	2835	753	1408	285949	29210	91	
Change				-2079	-12	-4	1	-2093	2093		-1
1990	**AAFCLU**	**Dry Mixedgrass**		**2715390**	**142051**	**11682**	**38784**	**2907907**	**1786926**	**62**	
2010	**AAFCLU**			**2620491**	**142088**	**11544**	**38102**	**2812225**	**1882608**	**60**	
Change		**Sub-Region**		**-94899**	**37**	**-138**	**-682**	**-95683**	**95683**		**-2**
1990	AAFCLU	Foothills Fescue	798 - Delacour Plain	39772	22247	8091	7096	77206	627555	11	
2010	AAFCLU			34065	22172	6327	6759	69324	635437	10	
Change				-5707	-75	-1764	-337	-7882	7882		-1
1990	AAFCLU	Foothills Fescue	799 - Willow Creek Upland	101041	304	6171	278	107793	19196	85	
2010	AAFCLU			96287	301	6204	267	103060	23929	81	
Change				-4753	-3	33	-11	-4733	4733		-4
1990	AAFCLU	Foothills Fescue	800 - Cardston Plain	80517	11106	4206	1112	96942	200468	33	
2010	AAFCLU			65417	11124	4171	1018	81730	215680	27	
Change				-15100	17	-34	-94	-15212	15212		-5
1990	AAFCLU	Foothills Fescue	801 - Twin Butte	36086	2097	3683	715	42581	65907	39	

			Foothills								
2010	AAFCLU			32993	2097	3669	699	39457	69031	36	
Change				-3093	0	-15	-16	-3124	3124		-3
1990	AAFCLU	Foothills Fescue	802 - Del Bonita Plateau	98382	2406	665	413	101865	22805	82	
2010	AAFCLU			92173	2430	669	411	95683	28987	77	
Change				-6209	25	4	-2	-6182	6182		-5
1990	**AAFCLU**	**Foothills Fescue**		**355798**	**38159**	**22816**	**9614**	**426387**	**935931**	**31**	
2010	**AAFCLU**			**320935**	**38124**	**21041**	**9154**	**389254**	**973064**	**29**	
Change		**Sub-Region**		**-34863**	**-35**	**-1775**	**-460**	**-37133**	**37133**		**-3**
1990	AAFCLU	Mixedgrass	787 - Majorville Upland	74788	5094	118	139	80139	65787	55	
2010	AAFCLU			73004	5119	118	137	78378	67549	54	
Change				-1784	25	-1	-2	-1762	1762		-1
1990	AAFCLU	Mixedgrass	788 - Standard Plain	6104	2453	318	1181	10056	84498	11	
2010	AAFCLU			4501	2466	323	1183	8473	86081	9	
Change				-1603	12	5	2	-1583	1583		-2
1990	AAFCLU	Mixedgrass	790 - Blackfoot Plain	45235	11365	3794	683	61077	70911	46	
2010	AAFCLU			42896	11341	3755	685	58676	73312	44	
Change				-2339	-24	-40	2	-2401	2401		-2
1990	AAFCLU	Mixedgrass	791 - Vulcan Plain	27296	4781	244	165	32487	225617	13	
2010	AAFCLU			21419	4813	248	79	26559	231545	10	
Change				-5877	32	3	-86	-5928	5928		-2
1990	AAFCLU	Mixedgrass	793 - Lethbridge Plain	199102	22728	4459	2557	228846	544334	30	
2010	AAFCLU			133769	22737	4347	2323	163176	610004	21	
Change				-65333	9	-112	-234	-65670	65670		-8
1990	AAFCLU	Mixedgrass	797 - Milk River Upland	80503	1930	50	369	82852	25830	76	
2010	AAFCLU			75930	1936	48	366	78280	30402	72	
Change				-4573	6	-2	-2	-4572	4572		-4
1990	AAFCLU	Mixedgrass	836 - Sweetgrass Upland	25215	149	802	85	26251	12082	68	
2010	AAFCLU			24145	149	806	82	25182	13151	66	
Change				-1070	0	4	-3	-1069	1069		-3
1990	AAFCLU	Mixedgrass	837 - Cypress Slope	89595	575	803	118	91091	31228	74	
2010	AAFCLU			86385	578	816	119	87898	34421	72	
Change				-3210	3	13	1	-3193	3193		-3
1990	AAFCLU	Mixedgrass	838 - Cypress Hills	113545	1004	3468	479	118496	8249	93	

Year	Type	Sub-Region	Plain								
2010	AAFCLU			112868	1011	3492	479	117851	8894	93	
Change				-676	7	24	0	-645	645		-1
1990	AAFCLU	Mixedgrass	9787 - Makepeace Plain	92353	8999	551	1569	103473	103869	50	
2010	AAFCLU			88235	8972	544	1559	99309	108033	48	
Change				-4118	-27	-7	-11	-4164	4164		-2
1990	**AAFCLU**	**Mixedgrass**		**753736**	**59078**	**14609**	**7345**	**834768**	**1172405**	**42**	
2010	**AAFCLU**			**663152**	**59122**	**14497**	**7012**	**743782**	**1263391**	**37**	
Change		**Sub-Region**		**-90584**	**44**	**-112**	**-334**	**-90986**	**90986**		**-5**
1990	AAFCLU	Northern Fescue	769 - Castor Plain	119360	33511	5545	11456	169872	185611	48	
2010	AAFCLU			114728	33504	4880	11377	164488	190994	46	
Change				-4632	-8	-665	-78	-5383	5383		-2
1990	AAFCLU	Northern Fescue	771 - Neutral Hills	169869	16415	17222	7011	210517	157455	57	
2010	AAFCLU			158473	16410	15872	6982	197737	170235	54	
Change				-11396	-5	-1350	-29	-12780	12780		-3
1990	AAFCLU	Northern Fescue	777 - Kirkpatrick Lake Plain	77733	7388	849	3870	89840	29999	75	
2010	AAFCLU			75757	7387	843	3857	87844	31995	73	
Change				-1975	-1	-6	-14	-1996	1996		-2
1990	AAFCLU	Northern Fescue	779 - Endiang Upland	42400	5169	1317	1572	50457	54304	48	
2010	AAFCLU			41517	5160	1307	1576	49560	55202	47	
Change				-883	-9	-10	4	-898	898		-1
1990	AAFCLU	Northern Fescue	781 - Drumheller Plain	39349	11045	4739	5175	60309	276817	18	
2010	AAFCLU			37320	11056	4701	5095	58172	278954	17	
Change				-2029	11	-39	-80	-2137	2137		-1
1990	AAFCLU	Northern Fescue	786 - Wintering Hills	64389	5144	2817	1889	74239	134306	36	
2010	AAFCLU			61384	5145	2815	1881	71225	137320	34	
Change				-3005	1	-2	-8	-3014	3014		-1
1990	**AAFCLU**	**Northern Fescue**		**513100**	**78672**	**32489**	**30973**	**655233**	**838492**	**44**	
2010	**AAFCLU**			**489179**	**78662**	**30416**	**30768**	**629025**	**864700**	**42**	
Change		**Sub-Region**		**-23921**	**-10**	**-2072**	**-205**	**-26208**	**26208**		**-2**
1990	**AAFCLU**	**Grassland Natural Region**		**4338024**	**317960**	**81596**	**86716**	**4824295**	**4733753**	**50**	
2010	**AAFCLU**			**4093757**	**317996**	**77497**	**85035**	**4574286**	**4983763**	**48**	
Change		**Region**		**-244267**	**36**	**-4098**	**-1681**	**-250010**	**250010**		**-3**

Table D3. PFRA (1995) and AAFCACI (2016) Totals by Natural Region, Sub-region, and Ecodistrict.

Data Source	Natural Sub-Region	Ecodistricts	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Native Remaining
PFRA	Dry Mixedgrass	804 - Sounding Creek Plain	1919	141279	3847		36	1374	148456	77580	65.7
AAFC-ACI			1631	137616	1794		1066	13885	155992	70044	69.0
Change			-288	-3663	-2053		1030	12510	7536	-7536	3.3
PFRA	Dry Mixedgrass	805 - Sibbald Plain	319	9067	727		12	112	10237	19056	34.9
AAFC-ACI			42	10366	192		14	1175	11789	17503	40.2
Change			-277	1299	-534		2	1062	1552	-1552	5.3
PFRA	Dry Mixedgrass	806 - Berry Creek Plain	2059	638722	14233		214	5003	660230	128972	83.7
AAFC-ACI			644	627331	9865		674	28147	666661	122541	84.5
Change			-1415	-11391	-4368		461	23145	6432	-6432	0.8
PFRA	Dry Mixedgrass	809 - Oyen Upland	888	182798	2103		16	588	186392	154151	54.7
AAFC-ACI			736	194857	1304		328	7886	205112	135431	60.2
Change			-152	12060	-799		313	7298	18720	-18720	5.5
PFRA	Dry Mixedgrass	811 - Acadia Valley Plain	126	15888	102		10	49	16175	49896	24.5
AAFC-ACI			42	16726	162		27	629	17586	48485	26.6
Change			-84	838	60		17	580	1411	-1411	2.1
PFRA	Dry Mixedgrass	812 - Brooks Plain	1358	214557	13645		1313	3226	234099	131272	64.1
AAFC-ACI			725	225444	11674		1897	18799	258540	106830	70.8
Change			-632	10888	-1971		584	15573	24441	-24441	6.7
PFRA	Dry Mixedgrass	814 - Rainy Hills Upland	286	248369	1785		62	733	251235	24427	91.1
AAFC-ACI			85	249078	1125		377	3053	253718	21944	92.0
Change			-201	709	-659		315	2320	2483	-2483	0.9
PFRA	Dry Mixedgrass	815 - Bindloss Plain	2964	266905	8475		2027	1066	281437	75422	78.9
AAFC-ACI			461	277350	6604		1746	6330	292491	64367	82.0
Change			-2503	10445	-1871		-281	5264	11055	-11055	3.1
PFRA	Dry Mixedgrass	818 - Bow City Plain	595	97082	7212		73	914	105877	50381	67.8
AAFC-ACI			53	100530	4917		52	7634	113185	43073	72.4
Change			-543	3447	-2295		-21	6720	7308	-7308	4.7
PFRA	Dry Mixedgrass	821 - Schuler	1068	186768	1976		276	1067	191155	141454	57.5
AAFC-ACI			693	215587	1786		247	3840	222152	110456	66.8
Change			-375	28819	-190		-29	2773	30998	-30998	9.3
PFRA	Dry Mixedgrass	823 - Vauxhall Plain	371	89907	4540		52	129	94999	175266	35.2
AAFC-ACI			84	89505	3404		43	3274	96310	173955	35.6
Change			-287	-402	-1136		-9	3145	1311	-1311	0.5
PFRA	Dry Mixedgrass	828 - Foremost	1148	331607	25656		530	1225	360167	678919	34.7

Source	Type	Region								
		Plain								
AAFC-ACI			527	357180	18673	166	8911	385456	653630	37.1
Change			-621	25572	-6983	-364	7685	25289	-25289	2.4
PFRA	Dry Mixedgrass	829 - Purple Springs Plain	1472	83560	3417		222	88671	42365	67.7
AAFC-ACI			72	80729	2788	79	1672	85340	45696	65.1
Change			-1400	-2831	-629	79	1450	-3331	3331	-2.5
PFRA	Dry Mixedgrass	833 - Wild Horse Plain	30	284025	2842	142	1270	288309	26613	91.5
AAFC-ACI			1702	265558	1171	88	2766	271285	43637	86.1
Change			1672	-18468	-1670	-54	1496	-17024	17024	-5.4
PFRA	**Dry Mixedgrass**		**14603**	**2790534**	**90557**	**4763**	**16980**	**2917437**	**1775773**	**62.2**
AAFC-ACI			**7496**	**2847857**	**65460**	**6806**	**108000**	**3035618**	**1657592**	**64.7**
Change			**-7106**	**57322**	**-25097**	**2043**	**91020**	**118181**	**-118181**	**2.5**
PFRA	Foothills Fescue	798 - Delacour Plain	2010	168810	6960	2533	143	180456	524305	25.6
AAFC-ACI			8432	118850	10251	5088	21969	164591	540170	23.4
Change			6422	-49959	3291	2555	21827	-15865	15865	-2.3
PFRA	Foothills Fescue	799 - Willow Creek Upland	6942	102549	197	1016		110704	16217	87.2
AAFC-ACI			6174	106359	418	1792	2164	116907	10013	92.1
Change			-768	3810	221	776	2164	6204	-6204	4.9
PFRA	Foothills Fescue	800 - Cardston Plain	378	126154	6357	1730	59	134677	162661	45.3
AAFC-ACI			4714	129711	5337	1802	2172	143735	153603	48.3
Change			4336	3557	-1019	71	2113	9058	-9058	3.0
PFRA	Foothills Fescue	801 - Twin Butte Foothills	1292	74262	1270	3137	469	80430	27967	74.2
AAFC-ACI			4120	77292	628	2544	916	85500	22897	78.9
Change			2827	3030	-641	-593	447	5070	-5070	4.7
PFRA	Foothills Fescue	802 - Del Bonita Plateau	125	91494	1056	961		93637	31006	75.1
AAFC-ACI			489	97306	1309	110	1089	100302	24340	80.5
Change			363	5812	253	-851	1089	6666	-6666	5.3
PFRA	**Foothills Fescue**		**10748**	**563270**	**15839**	**9377**	**670**	**599904**	**762155**	**44.0**
AAFC-ACI			**23929**	**529518**	**17944**	**11336**	**28310**	**611036**	**751023**	**44.9**
Change			**13181**	**-33751**	**2104**	**1958**	**27640**	**11132**	**-11132**	**0.8**
PFRA	Mixedgrass	787 - Majorville Upland	2	75492	2956	8	13	78470	67456	53.8
AAFC-ACI			77	75878	2955	47	1111	80068	65858	54.9
Change			75	386	0	39	1098	1598	-1598	1.1
PFRA	Mixedgrass	788 - Standard Plain	247	14442	247	59	1320	16315	78239	17.3
AAFC-ACI			321	9949	1586	154	2901	14912	79642	15.8
Change			74	-4493	1339	95	1581	-1404	1404	-1.5
PFRA	Mixedgrass	790 - Blackfoot Plain	1195	53144	8208	818	143	63508	68479	48.1
AAFC-ACI			4260	46392	8766	1710	3820	64949	67039	49.2
Change			3065	-6752	558	892	3678	1441	-1441	1.1

PFRA	Mixedgrass	791 - Vulcan Plain	23	42984	516	27	108	43659	214445	16.9
AAFC-ACI			923	39154	1343	494	1913	43826	214278	17.0
Change			899	-3830	827	468	1804	168	-168	0.1
PFRA	Mixedgrass	793 - Lethbridge Plain	752	222668	11997	478	121	236015	537164	30.5
AAFC-ACI			6109	202295	11157	1756	8103	229421	543759	29.7
Change			5357	-20373	-839	1278	7982	-6595	6595	-0.9
PFRA	Mixedgrass	797 - Milk River Upland	697	74098	934	116	6	75851	32766	69.8
AAFC-ACI			193	84864	608	41	632	86338	22279	79.5
Change			-504	10766	-325	-76	626	10487	-10487	9.7
PFRA	Mixedgrass	836 - Sweetgrass Upland	3	26905	136	38	12	27094	11147	70.9
AAFC-ACI			172	28043	36	13	120	28384	9857	74.2
Change			170	1137	-100	-26	108	1290	-1290	3.4
PFRA	Mixedgrass	837 - Cypress Slope	14	83848	382	31	26	84300	38010	68.9
AAFC-ACI			1085	94287	103	283	838	96596	25715	79.0
Change			1070	10439	-279	253	812	12295	-12295	10.1
PFRA	Mixedgrass	838 - Cypress Hills	97	118960	979	274	168	120478	6227	95.1
AAFC-ACI			2564	115753	427	936	1519	121200	5506	95.7
Change			2467	-3207	-551	662	1351	722	-722	0.6
PFRA	Mixedgrass	9787 - Makepeace Plain	128	99363	3481			829	103800	103542	50.1
AAFC-ACI			509	95037	4544	406	5961	106457	100885	51.3
Change			381	-4326	1063	406	5132	2657	-2657	1.3
PFRA	**Mixedgrass**		**3157**	**811903**	**29835**	**1849**	**2747**	**849491**	**1157476**	**42.3**
AAFC-ACI			**16212**	**791651**	**31526**	**5840**	**26919**	**872149**	**1134818**	**43.5**
Change			**13055**	**-20252**	**1691**	**3992**	**24172**	**22658**	**-22658**	**1.1**
PFRA	Northern Fescue	769 - Castor Plain	7064	169538	11722	1311	11898	201533	153950	56.7
AAFC-ACI			5953	145446	8977	3719	41624	205719	149764	57.9
Change			-1111	-24092	-2745	2409	29726	4186	-4186	1.2
PFRA	Northern Fescue	771 - Neutral Hills	15001	198753	8625	179	4226	226784	140895	61.7
AAFC-ACI			14829	181773	3469	11991	29239	241302	126377	65.6
Change			-172	-16980	-5156	11812	25013	14518	-14518	3.9
PFRA	Northern Fescue	777 - Kirkpatrick Lake Plain	3608	80225	5945	77	1511	91368	28471	76.2
AAFC-ACI			1762	78462	1469	1288	11883	94864	24975	79.2
Change			-1847	-1764	-4476	1210	10372	3496	-3496	2.9
PFRA	Northern Fescue	779 - Endiang Upland	378	59192	900	909	619	61998	42763	59.2
AAFC-ACI			6789	42565	1004	2332	8102	60792	43969	58.0
Change			6411	-16627	104	1423	7483	-1206	1206	-1.2
PFRA	Northern Fescue	781 - Drumheller Plain	5884	70568	4231	2877	4078	87638	249488	26.0

	Natural Sub-Region	Ecodistricts	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Remaining Native and Change
AAFC-ACI			2676	44589	6634		2766	14273	70938	266188	21.0
Change			-3208	-25979	2402		-110	10195	-16700	16700	-5.0
PFRA	Northern Fescue	786 - Wintering Hills	195	81761	1367		39	1206	84568	123976	40.6
AAFC-ACI			2092	66677	2711		1410	8544	81433	127112	39.0
Change			1897	-15085	1344		1370	7338	-3136	3136	-1.5
PFRA	Northern Fescue		32130	660038	32791		5392	23538	753889	739543	50.5
AAFC-ACI			34100	559512	24264		23507	113665	755047	738385	50.6
Change			1971	-100526	-8527		18114	90127	1159	-1159	0.1
PFRA	Grassland Natural Region		60637	4825746	169022		21381	43935	5120721	4434948	53.6
AAFC-ACI			81738	4728538	139193		47488	276894	5273850	4281818	55.2
Change			21100	-97208	-29829		26107	232959	153130	-153130	1.6

Table D4. AAFCLU (1990-2010) Totals by Natural Region, Sub-region, and Ecodistrict.

Year or Change Interval	Natural Sub-Region	Ecodistricts	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Remaining Native and Change
1990	Central Parkland	727 - Leduc Plain		0	27,829		79,838	6,507	114,174	620,446	16
2010				0	27,814		57,886	4,399	90,099	644,521	12
Change				0	-15		-21,952	-2,107	-24,075	24,075	-3
1990	Central Parkland	728 - Andrew Plain			17,969		15,939	2,086	35,995	282,696	11
2010					17,944		13,601	1,233	32,778	285,913	10
Change				0	-26		-2,338	-853	-3,217	3,217	-1
1990	Central Parkland	729 - Lloydminster Plain		1,844	7,883		26,567	2,088	38,382	236,646	14
2010				1,664	7,875		21,464	1,963	32,966	242,062	12
Change				-180	-8		-5,103	-125	-5,416	5,416	-2
1990	Central Parkland	730 - Vermilion Upland		16,802	51,262		93,504	6,471	168,038	783,194	18
2010				15,212	51,189		72,264	5,782	144,447	806,785	15
Change				-1,590	-73		-21,240	-688	-23,591	23,591	-2
1990	Central Parkland	731 - Daysland Plain		8,114	73,411		45,688	8,061	135,274	788,758	15
2010				7,234	73,388		35,988	6,823	123,434	800,599	13
Change				-879	-23		-9,701	-1,238	-11,840	11,840	-1
1990	Central Parkland	737 - Red Deer Plain		0	20,436		39,580	4,232	64,248	282,892	19
2010				0	20,400		31,252	3,407	55,059	292,081	16
Change				0	-36		-8,328	-825	-9,189	9,189	-3

Year	Natural Region	Subregion								
1990	Central Parkland	738 - Sedgewick Plain		5,298	10,605		16,113	1,317	33,333	214,196	13
2010				4,869	10,627		13,363	1,151	30,010	217,519	12
Change				-429	22		-2,750	-166	-3,323	3,323	-1
1990	Central Parkland	739 - Ribstone Plain		162,101	19,918		55,819	6,095	243,933	85,450	74
2010				156,303	19,885		50,542	5,940	232,671	96,712	71
Change				-5,797	-32		-5,278	-155	-11,262	11,262	-3
1990	Central Parkland	740 - Bashaw Upland		30,080	35,806		67,350	5,570	138,806	276,479	33
2010				29,117	35,846		59,898	5,425	130,287	284,999	31
Change				-963	40		-7,452	-145	-8,520	8,520	-2
1990	Central Parkland	743 - Provost Plain		1,435	5,555		4,652	789	12,431	137,151	8
2010				1,422	5,541		3,706	716	11,386	138,196	8
Change				-13	-15		-945	-72	-1,045	1,045	-1
1990	Central Parkland	744 - Pine Lake Upland		5,530	8,460		44,792	3,444	62,226	327,376	16
2010				5,057	8,468		38,347	3,284	55,156	334,447	14
Change				-473	8		-6,446	-160	-7,070	7,070	-2
1990	Central Parkland	746 - Olds Plain		12,453	3,940		5,747	855	22,995	260,734	8
2010				8,864	3,946		5,423	781	19,015	264,714	7
Change				-3,589	7		-324	-74	-3,980	3,980	-1
1990	**Central Parkland**			**243,656**	**283,075**		**495,590**	**47,514**	**1,069,835**	**4,296,019**	**20**
2010				**229,743**	**282,924**		**403,734**	**40,905**	**957,306**	**4,408,547**	**18**
Change				**-13,913**	**-151**		**-91,857**	**-6,608**	**-112,528**	**112,528**	**-2**
1990	Foothills Parkland	750 - Black Diamond Upland		114,795	5,002		74,618	8,014	202,429	168,334	55
2010				97,514	5,001		71,135	7,772	181,423	189,340	49
Change				-17,281	-1		-3,484	-241	-21,007	21,007	-6
1990	**Foothills Parkland**		**-**	**114,795**	**5,002**	**-**	**74,618**	**8,014**	**202,429**	**168,334**	**55**
2010			**-**	**97,514**	**5,001**	**-**	**71,135**	**7,772**	**181,423**	**189,340**	**49**
Change				**-17,281**	**-1**		**-3,484**	**-241**	**-21,007**	**21,007**	**-6**
1990	**Parkland Natural Region**		**-**	358,451	288,077	**-**	570,208	55,528	1,272,264	4,464,353	22
2010			**-**	327,258	287,925	**-**	474,868	48,678	1,138,729	4,597,888	20
Change				-31,193	-152		-95,340	-6,850	-133,535	133,535	-2

Table D5. Native Prairie Vegetation Inventory (1991-1993) and Grassland Vegetation Inventory (2006 –2016) Vegetation Cover Change for the Grassland Natural Region Administrative Areas.

Data Source	Municipal District, County or Special Area (% Grassland N.R. area if span on multiple Natural Regions)	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Bare Ground	Total Native Prairie Vegetation - No bare ground	Non-Native Land	% Remaining Native
NPVI	Cardston County (94.9%)	2623	156624	3567	14123	364	6201		183501	308666	39
GVI		7212	178645	6658	15958	1277	15150	12911	224900	267267	48
	Change	4589	22022	3092	1835	912	8949	12911	41399	-41399	
NPVI	County of Forty Mile No. 8	9778	266660	12935	11384	44	14456		315258	427060	42
GVI		9163	239849	5980	17252	66	28990	34665	301301	441017	41
	Change	-615	-26810	-6955	5868	22	14533	34665	-13958	13958	
NPVI	County of Newell	5474	319006	15836	3868	419	30560		375162	251131	60
GVI		6460	307890	19486	6867	614	26766	38750	368082	258211	59
	Change	987	-11116	3650	2999	195	-3794	38750	-7080	7080	
NPVI	County of Paintearth No. 18 (68.8%)	3420	46489	759	3407	5981	28466		88522	258300	37
GVI		4206	55119	9181	5513	1684	17604	6714	93307	253515	39
	Change	786	8630	8423	2106	-4297	-10862	6714	4785	-4785	
NPVI	County of Stettler No. 6 (24.8%)	2942	23594	908	182	2750	16449		46824	387146	43
GVI		2901	25351	4144	533	1681	13753	2460	48364	385607	45
	Change	-41	1757	3236	351	-1069	-2695	2460	1539	-1539	
NPVI	County of Warner No. 5	3007	108147	3106	7269	16	5357		126902	335563	27
GVI		5007	119683	5370	9183	6	15377	9788	154625	307841	33
		2000	11536	2264	1914	-11	10020	9788	27722	-27722	
NPVI	Cypress County (97.7%)	39684	844045	6652	21706	2117	50093		964297	399447	72
GVI		20853	828779	5269	38656	404	61314	95060	955275	408469	72
	Change	-18831	-15266	-1382	16950	-1713	11221	95060	-9022	9022	
NPVI	Kneehill County (48.6%)	1885	26209	567	2652	1691	1652		34656	306964	21
GVI		2169	24138	1461	1461	2264	1331	4271	32824	308796	20
	Change	284	-2071	894	-1192	573	-321	4271	-1832	1832	
NPVI	Lethbridge County	755	28902	3115	3212	66	1586		37637	265466	12
GVI		970	33608	5043	8217	46	7510	5543	55393	247710	18
	Change	215	4705	1928	5005	-20	5923	5543	17756	-17756	
NPVI	M.D. of Acadia No. 34	1289	32777	352	966	93	2593		38071	72905	34
GVI		943	28409	170	3964	13	1834	2445	35333	75642	32
	Change	-346	-4369	-183	2998	-80	-758	2445	-2737	2737	
NPVI	M.D. of Foothills No. 31 (48.4%)	1185	17924	314	3075	1288	6446		30231	282810	17
GVI		1235	24132	2140	5169	845	4602	3405	38122	274920	21
	Change	50	6208	1826	2094	-443	-1844	3405	7891	-7891	
NPVI	M.D. of Pincher Creek No. 9 (48.4%)	2771	78367	2961	6988	2170	1996		95252	298138	50

GVI		6498	75319	4014	7168	1696	1576	8572	96272	297119	51
	Change	3727	-3048	1054	180	-474	-419	8572	1020	-1020	
NPVI	M.D. of Provost No. 52 (12.5%)	930	13629	195	1670	1560	1333		19317	355531	41
GVI		1138	15091	814	621	1258	2965	852	21886	352961	47
	Change	208	1462	619	-1049	-302	1632	852	2570	-2570	
NPVI	M.D. of Ranchland No. 66 (1.8%)	142	5255	0	209	1390	52		7048	31889	??
GVI		463	3391	6	225	202	6	198	4293	34644	??
	Change	321	-1864	6	16	-1188	-46	198	-2755	2755	
NPVI	M.D. of Taber	1699	107443	2223	1950	37	6862		120214	308674	28
GVI		1906	106609	6095	5350	23	8278	9723	128261	300627	30
	Change	206	-834	3872	3401	-14	1416	9723	8047	-8047	
NPVI	M.D. of Willow Creek No. 26 (88.2%)	2584	114623	605	7500	2450	2773		130534	301632	32
GVI		15256	106477	6105	11502	2600	6750	14932	148691	283475	36
	Change	12672	-8146	5500	4002	150	3978	14932	18157	-18157	
NPVI	Mountain View County (11.0%)	81	6936	207	175	122	672		8193	242795	19
GVI		301	6009	136	178	240	368	349	7232	243756	17
	Change	220	-928	-71	3	118	-303	349	-961	961	
NPVI	Rocky View County (49.5%)	489	9177	1747	1318	243	12036		25010	377628	11
GVI		2029	24714	3161	1241	695	6109	1818	37950	364689	17
	Change	1540	15538	1414	-77	452	-5927	1818	12940	-12940	
NPVI	Special Areas 2	16630	559442	10023	9042	896	77233		673266	302887	69
GVI		13693	545128	17218	22427	1905	52163	60478	652534	323619	67
	Change	-2937	-14314	7195	13385	1009	-25070	60478	-20732	20732	
NPVI	Special Areas 3	10653	278191	1508	3402	370	47329		341455	340999	50
GVI		8358	275296	6447	24356	1205	44449	28391	360111	322343	53
	Change	-2295	-2895	4939	20954	834	-2881	28391	18656	-18656	
NPVI	Special Areas 4 (91.6%)	13366	160444	2200	3396	4114	38592		222112	235099	53
GVI		11449	172519	6009	7451	7815	29568	12349	234811	222400	56
	Change	-1917	12075	3809	4056	3701	-9024	12349	12699	-12699	
NPVI	Starland County (90.4%)	4153	47698	2380	1760	1189	9279		66458	195256	28
GVI		3714	46104	2766	2748	2908	5816	3823	64054	197660	27
	Change	-438	-1594	386	988	1719	-3464	3823	-2403	2403	
NPVI	Vulcan County	2650	119020	8004	5557	636	9644		145513	444444	25
GVI		3151	128440	5934	5934	720	10873	14459	155051	434905	26
	Change	501	9419	-2071	376	84	1229	14459	9539	-9539	
NPVI	Wheatland County	3685	59246	4260	8554	1450	25569		102765	399530	20
GVI		6867	91430	7351	7508	3436	8835	9016	125427	376869	25
	Change	3182	32183	3091	-1046	1985	-16733	9016	22661	-22661	

Table D6. PFRA (1995), AAFCACI (2016) Grassland Natural Region % Native Cover for Administrative Areas.

Data Source	Muncipal District, County or Special Area	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Native Remaining
PFRA	Calgary	363	13670	1074		646	33	15786	42557	27.1
AAFC-ACI		760	5817	1743		682	1480	10482	47860	18.0
Change		397	-7853	669		36	1447	-5303	5303	-9.1
PFRA	Cardston County	948	236274	6004		3320	488	247034	220092	52.9
AAFC-ACI		6139	240995	5103		2526	3927	258690	208435	55.4
Change		5190	4721	-900		-794	3440	11656	-11656	2.5
PFRA	County of Forty Mile No. 8	222	323556	18387		591	1179	343935	398432	46.3
AAFC-ACI		1679	333840	13543		244	6911	356216	386150	48.0
Change		1457	10283	-4844		-347	5732	12281	-12281	1.7
PFRA	County of Newell	1643	385738	26330		365	5553	419628	206665	67.0
AAFC-ACI		743	398028	20652		1380	27401	448203	178090	71.6
Change		-900	12290	-5677		1015	21848	28575	-28575	4.6
PFRA	County of Paintearth No. 18	6059	110069	9233		224	5734	131318	107410	55.0
AAFC-ACI		5733	90179	7167		4476	25439	132994	105734	55.7
Change		-326	-19890	-2065		4252	19705	1676	-1676	0.7
PFRA	County of Stettler No. 6	1814	55219	3589		1260	3951	65833	41957	61.1
AAFC-ACI		4038	39865	3068		1525	14113	62610	45179	58.1
Change		2224	-15354	-520		265	10162	-3223	3223	-3.0
PFRA	County of Warner No. 5	1162	160135	7673		697	14	169680	292800	36.7
AAFC-ACI		1066	178419	5261		156	2838	187739	274741	40.6
Change		-96	18284	-2412		-541	2823	18059	-18059	3.9
PFRA	Cypress County	3368	1043369	13428		779	4679	1065623	266709	80.0
AAFC-ACI		5097	1075435	8984		1783	13886	1105185	227147	83.0
Change		1729	32066	-4444		1004	9207	39562	-39562	3.0
PFRA	Drumheller	297	8331	353		176	33	9191	1929	82.6
AAFC-ACI		237	3855	338		187	691	5309	5811	47.7
Change		-60	-4477	-14		12	658	-3882	3882	-34.9
PFRA	Kneehill County	3265	33601	376		1609	11	38861	127116	23.4
AAFC-ACI		1521	18532	541		1812	6312	28718	137258	17.3
Change		-1744	-15068	165		203	6301	-10143	10143	-6.1
PFRA	Lethbridge County	352	69907	5852		7	71	76188	226915	25.1
AAFC-ACI		393	54126	5407		237	3162	63326	239777	20.9
Change		42	-15781	-445		230	3091	-12863	12863	-4.2
PFRA	M.D. of Acadia No. 34	233	39391	1004		442	71	41140	69821	37.1
AAFC-ACI		87	40601	822		503	1631	43643	67317	39.3
Change		-146	1210	-182		61	1560	2503	-2503	2.3
PFRA	M.D. of Foothills No. 31	343	51799	2255		671	64	55132	127155	30.2
AAFC-ACI		3790	50780	2168		1717	3107	61561	120726	33.8

Change		3448	-1020	-87	1046	3042	6429	-6429	3.5
PFRA	M.D. of Pincher Creek No. 9	1158	107479	4429	2456	30	115552	73410	61.2
AAFC-ACI		5699	114991	3669	2406	1601	128365	60597	67.9
Change		4541	7512	-760	-51	1570	12813	-12813	6.8
PFRA	M.D. of Provost No. 52	2457	22694	1013	28	604	26795	20155	57.1
AAFC-ACI		2296	19783	231	1472	4614	28397	18553	60.5
Change		-161	-2911	-782	1445	4010	1602	-1602	3.4
PFRA	M.D. of Ranchland No. 66	82	4313	22	140		4558	117	97.5
AAFC-ACI		253	3956	7	195	183	4594	80	98.3
Change		171	-357	-15	55	183	36	-36	0.8
PFRA	M.D. of Taber	2304	150420	8869	56	491	162139	266749	37.8
AAFC-ACI		185	150586	6547	110	5775	163201	265687	38.1
Change		-2120	166	-2322	54	5284	1062	-1062	0.2
PFRA	M.D. of Willow Creek No. 26	6884	192431	3048	907	46	203316	205691	49.7
AAFC-ACI		8938	195548	3269	2664	5019	215438	193569	52.7
Change		2054	3117	221	1757	4973	12122	-12122	3.0
PFRA	Mountain View County	283	6760	136	122		7300	35169	17.2
AAFC-ACI		152	3667	184	271	889	5164	37306	12.2
Change		-130	-3093	48	150	889	-2137	2137	-5.0
PFRA	Rocky View County	376	51028	2107	593	44	54148	165377	24.7
AAFC-ACI		1495	24632	4252	1236	9448	41062	178463	18.7
Change		1119	-26397	2145	642	9404	-13086	13086	-6.0
PFRA	Special Areas 2	5286	740817	17998	2055	10353	776510	199639	79.5
AAFC-ACI		2828	732267	14417	3193	44816	797522	178627	81.7
Change		-2458	-8550	-3581	1138	34463	21012	-21012	2.2
PFRA	Special Areas 3	3445	400041	8852	757	2632	415727	266712	60.9
AAFC-ACI		1836	411296	5406	1466	25361	445366	237073	65.3
Change		-1609	11255	-3445	709	22730	29639	-29639	4.3
PFRA	Special Areas 4	13290	237082	9345	239	3851	263807	154794	63.0
AAFC-ACI		13422	220384	3637	10800	32581	280824	137776	67.1
Change		132	-16698	-5708	10561	28730	17017	-17017	4.1
PFRA	Starland County	1597	69203	2370	1582	1239	75991	160845	32.1
AAFC-ACI		4563	49853	2705	1965	11248	70334	166501	29.7
Change		2967	-19350	335	383	10009	-5656	5656	-2.4
PFRA	Vulcan County	628	185429	9974	404	303	196739	393218	33.3
AAFC-ACI		3046	175175	10809	1521	6491	197042	392914	33.4
Change		2417	-10254	835	1116	6188	303	-303	0.1
PFRA	Wheatland County	2779	126991	5304	1256	2459	138789	363507	27.6
AAFC-ACI		5741	95929	9260	2963	17969	131861	370435	26.3
Change		2961	-31062	3956	1707	15510	-6928	6928	-1.4

Table D7. AAFCLU 1990-2010 Grassland Natural Region % Native Cover for Administrative Areas.

Year or Delta Interval	Muncipal District, County or Special Area	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	% Native
1990	Cardston County		139098	11511		4340	1415	156364	169961	48
2010			127477	11555		4288	1345	144665	181660	44
Delta			-11621	44		-52	-70	-11699	11699	4
1990	County of Forty Mile No. 8		328151	21000		1211	2557	352919	389504	48
2010			319260	20993		1215	2551	344019	398405	46
Delta			-8891	-7		3	-6	-8900	8900	1
1990	County of Newell		356862	33113		3503	9419	402898	219809	65
2010			342372	33137		3423	9194	388126	234581	62
Delta			-14490	24		-81	-225	-14771	14771	2
1990	County of Paintearth No. 18		74779	19419		6912	7885	108995	129734	46
2010			72511	19431		5945	7818	105704	133024	44
Delta			-2268	12		-967	-67	-3290	3290	1
1990	County of Stettler No. 6		28473	12510		1905	3469	46356	61433	43
2010			27444	12518		1802	3478	45242	62548	42
Delta			-1029	8		-103	9	-1115	1115	1
1990	County of Warner No. 5		151737	12009		1004	1752	166502	296120	36
2010			134682	12028		999	1704	149412	313209	32
Delta			-17055	19		-5	-49	-17089	17089	4
1990	Cypress County		807952	19810		5541	3449	836752	227983	79
2010			782820	19773		5533	3271	811397	253338	76
Delta			-25132	-37		-8	-178	-25355	25355	2
1990	Kneehill County		16145	1792		2753	1659	22349	143628	13
2010			15784	1765		2757	1654	21959	144018	13
Delta			-361	-27		3	-5	-390	390	0
1990	Lethbridge County		47649	9454		477	989	58569	244325	19
2010			35169	9462		411	925	45966	256927	15
Delta			-12480	8		-67	-64	-12602	12602	4
1990	M.D. of Acadia No. 34		36625	2951		599	686	40859	70116	37
2010			35691	2953		606	683	39933	71042	36
Delta			-934	2		8	-2	-926	926	1
1990	M.D. of Foothills No. 31		14765	5849		2934	244	23792	157968	13
2010			12432	5832		2856	211	21332	160428	12
Delta			-2333	-17		-78	-33	-2460	2460	1
1990	M.D. of Pincher Creek No. 9		52565	4200		3225	723	60712	85302	42
2010			43756	4190		3203	697	51845	94169	36
Delta			-8808	-10		-23	-26	-8867	8867	6

1990	M.D. of Provost No. 52	14206	2040	2629	864	19739	27225	42
2010		12833	2052	1896	862	17642	29321	38
Delta		-1373	12	-733	-2	-2097	2097	4
1990	M.D. of Ranchland No. 66	3692	27	708	77	4505	191	96
2010		3693	24	714	74	4505	190	96
Delta		2	-3	5	-3	1	-1	0
1990	M.D. of Taber	135362	10387	579	1561	147889	280999	34
2010		127016	10434	540	1552	139542	289346	33
Delta		-8347	48	-39	-9	-8347	8347	2
1990	M.D. of Willow Creek No. 26	158257	7616	6726	925	173525	235155	42
2010		137561	7588	6751	793	152693	255987	37
Delta		-20697	-28	25	-133	-20832	20832	5
1990	Mountain View County	3171	967	82	79	4300	38170	10
2010		2800	959	82	78	3919	38550	9
Delta		-371	-8	0	-1	-381	381	1
1990	Rocky View County	10809	8307	1286	4031	24433	195063	11
2010		9674	8264	1074	3882	22894	196602	10
Delta		-1135	-43	-213	-149	-1540	1540	1
1990	Special Areas 2	702109	40307	3456	13999	759872	216256	78
2010		683607	40315	3462	13861	741246	234883	76
Delta		-18502	8	6	-138	-18627	18627	2
1990	Special Areas 3	374202	24556	1658	9414	409830	272629	60
2010		357044	24550	1677	9318	392589	289870	58
Delta		-17158	-7	19	-95	-17241	17241	3
1990	Special Areas 4	212695	18213	13101	8538	252548	166074	60
2010		200918	18176	12880	8498	240472	178150	57
Delta		-11778	-37	-221	-40	-12076	12076	3
1990	Starland County	53555	6496	2258	4693	67002	169833	28
2010		50413	6499	2254	4660	63826	173010	27
Delta		-3143	3	-4	-33	-3177	3177	1
1990	Vulcan County	141838	17931	774	1052	161595	393535	29
2010		125283	17992	761	947	144984	410146	26
Delta		-16554	61	-12	-105	-16611	16611	3
1990	Wheatland County	54573	15022	4292	5551	79438	388742	17
2010		47916	15031	4213	5508	72669	395510	16
Delta		-6657	9	-78	-43	-6769	6769	1

Table D8. AAFCLU 1990 - 2010 Grassland Natural Region First Nations and Military Base Administrative Areas.

Year or Delta Interval	Muncipal District, County or Special Area	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	% Native
1990	Kainai IR 148 total		70441	1856		2849	379	75525	65999	53
2010	Kainai IR 148 total		43494	1861		2846	327	48528	92997	34
Delta			-26947	4		-3	-52	-26997	26997	-19
1990	Siksika IR 146 total		48444	3087		3420	202	55152	17376	76
2010	Siksika IR 146 total		46827	3074		3385	208	53494	19034	74
Delta			-1617	-13		-35	6	-1659	1659	-2
1990	Suffield total		259101	3925		88	438	263552	4310	98
2010	Suffield total		259030	3930		92	425	263477	4385	98
Delta			-71	5		4	-13	-75	75	0
1990	Eden Valley IR 216 total		383	1		6		390	137	74
2010	Eden Valley IR 216 total		369	1		5		374	153	71
Delta			-14	0		-1	0	-16	16	-3
1990	Piikani IR 147 total		34075	839		643	200	35756	7261	83
2010	Piikani IR 147 total		30591	846		646	202	32285	10733	75
Delta			-3484	7		3	2	-3471	3471	-8

Table D9. AAFCLU 1990 - 2010 Parkland Natural Region Administrative Areas.

Year or Change Interval	Data Source	Municipal District, County or Special Area	Cover Classes						Total Native Prairie Vegetation	Non-Native Land	% of total
			Shrub	Graminoid	Lake	Riparian	Treed	Wetland			
1990	AAFC Land-use	Beaver County			36169		14766	2801	53736	277746	92
2010	AAFC Land-use				36139		10794	2308	49241	282240	92
Change				0	-30		-3972	-493	-4494	4494	
1990	AAFC Land-use	Camrose County		5380	32422		31297	996	70095	282771	97
2010	AAFC Land-use			4620	32404		26148	680	63853	289012	97
Change				-760	-18		-5148	-316	-6242	6242	
1990	AAFC Land-use	County of Minburn No. 27			16459		22862	2184	41505	252366	97
2010	AAFC Land-use				16424		17800	1933	36157	257714	97
Change				0	-34		-5062	-251	-5348	5348	

Year	Source	County							
1990	AAFC Land-use	County of Paintearth No. 18	3960	3270	13247	923	21401	86693	31
2010	AAFC Land-use		3765	3235	11149	891	19040	89054	31
Change			-196	-35	-2098	-32	-2361	2361	
1990	AAFC Land-use	County of Stettler No. 6	22830	24662	41788	5016	94295	231886	75
2010	AAFC Land-use		22632	24705	36149	4947	88433	237748	75
Change			-197	43	-5638	-69	-5862	5862	
1990	AAFC Land-use	County of Two Hills No. 21	1	7929	7814	792	16536	95576	41
2010	AAFC Land-use			7905	6570	568	15043	97070	41
Change			-1	-24	-1244	-224	-1493	1493	
1990	AAFC Land-use	County of Vermilion River	4076	24092	46796	3201	78165	439768	89
2010	AAFC Land-use		3778	24058	34642	2869	65347	452585	89
Change			-298	-34	-12154	-332	-12818	12818	
1990	AAFC Land-use	County of Wetaskiwin No. 10	443	9687	18272	1359	29761	127674	45
2010	AAFC Land-use		116	9664	13702	870	24353	133082	45
Change			-327	-22	-4570	-489	-5408	5408	
1990	AAFC Land-use	Flagstaff County	5329	22534	19787	1675	49324	370393	100
2010	AAFC Land-use		4532	22618	15327	1488	43965	375752	100
Change			-797	84	-4460	-186	-5359	5359	
1990	AAFC Land-use	Kneehill County	5230	1239	3217	2407	12093	163551	51
2010	AAFC Land-use		4754	1239	3179	2348	11521	164123	51
Change			-475	0	-38	-59	-572	572	
1990	AAFC Land-use	Lacombe County	1122	13587	29417	3145	47271	173687	75
2010	AAFC Land-use		836	13556	23925	2859	41176	179783	75
Change			-286	-31	-5491	-286	-6095	6095	
1990	AAFC Land-use	Lamont County		10609	12940	3258	26808	172274	79
2010	AAFC Land-use			10614	11473	2271	24359	174723	79
Change			0	5	-1467	-987	-2449	2449	
1990	AAFC Land-use	Leduc County		4396	15948	844	21188	137934	58
2010	AAFC Land-use			4396	12304	543	17242	141880	58
Change			0	0	-3645	-301	-3946	3946	
1990	AAFC Land-use	M.D. of Foothills No. 31	23532	1951	20676	4243	50402	80345	35
2010	AAFC Land-use		22431	1948	19868	4212	48459	82288	35
Change			-1100	-4	-807	-31	-1943	1943	
1990	AAFC Land-use	M.D. of Provost No. 52	65583	15074	35439	3174	119270	208565	87
2010	AAFC Land-use		61610	14983	30622	2982	110197	217638	87
Change			-3972	-91	-4818	-192	-9073	9073	
1990	AAFC	M.D. of Wainwright	47162	15503	35977	3663	102305	264835	86

Year	Source	County							
	Land-use	No. 61							
2010	AAFC Land-use		45157	15525	29972	3484	94139	273002	86
Change			-2004	21	-6005	-179	-8167	8167	
1990	AAFC Land-use	Mountain View County	11027	2862	4594	570	19053	189465	54
2010	AAFC Land-use		6147	2854	4490	555	14046	194473	54
Change			-4880	-8	-104	-14	-5007	5007	
1990	AAFC Land-use	Parkland County		2894	13003	1321	17218	49885	24
2010	AAFC Land-use			2893	9982	1097	13971	53131	24
Change			0	-2	-3021	-224	-3247	3247	
1990	AAFC Land-use	Ponoka County		8091	20166	2093	30350	103602	44
2010	AAFC Land-use			8089	14516	1730	24335	109618	44
Change			0	-2	-5651	-363	-6016	6016	
1990	AAFC Land-use	Red Deer County	9533	14284	43724	2256	69797	277242	82
2010	AAFC Land-use		8732	14295	39915	1816	64759	282281	82
Change			-801	11	-3809	-440	-5039	5039	
1990	AAFC Land-use	Rocky View County	50390	2428	17173	504	70495	88393	36
2010	AAFC Land-use		38391	2428	16129	341	57290	101599	36
Change			-11999	0	-1044	-162	-13205	13205	
1990	AAFC Land-use	Strathcona County		1105	8987	263	10355	49736	48
2010	AAFC Land-use			1120	6387	116	7623	52469	48
Change			0	15	-2600	-147	-2732	2732	
1990	AAFC Land-use	Sturgeon County		3926	9646	791	14363	138421	68
2010	AAFC Land-use			3907	8296	571	12774	140010	68
Change			0	-19	-1350	-220	-1589	1589	

Table D10. AAFCLU 1990 - 2010 Parkland Natural Region First Nations and Military Bases

Year or Change Interval	Data Source	Muncipal District, County or Special Area	Shrub	Graminoid	Lake	Riparian	Treed	Wetland	Total Native Prairie Vegetation	Non-Native Land	%Remaining Native
1990	AAFC Land-use	County of Wetaskiwin No. 10 (Pigeon Lake, Ermineskin, Louis Bull, Samson)		390			3350	673	4413	11067	29
1990	AAFC Land-use	Ponoka County (Ermineskin, Samson, Montana (Bobtail))		934			3749	539	5221	9931	34
1990	AAFC Land-use	Pigeon Lake, Ermineskin, Louis Bull, Samson, Montana (Bobtail) total		1324			7098	1212	9635	20999	64
2010	AAFC Land-use	County of Wetaskiwin No. 10 (Pigeon Lake, Ermineskin, Louis Bull, Samson)		387			2578	556	3522	11959	23
2010	AAFC Land-use	Ponoka County (Ermineskin, Samson, Montana (Bobtail))		936			2855	381	4172	10981	28
2010	AAFC Land-use	Pigeon Lake, Ermineskin, Louis Bull, Samson, Montana (Bobtail) total	0	1323			5433	938	7694	22940	51
Change			0	-1			-894	-158	-1050	1050	-13
1990	AAFC Land-use	M.D. of Bighorn No. 8 (Stoney)		433	23		1262	2	1721	31	98
1990	AAFC Land-use	Rocky View County (Stoney, Sarcee)		6723	200		10728	94	17746	6479	73
1990	AAFC Land-use	Stoney, Sarcee total		7156	224		11991	97	19467	6510	80
2010	AAFC Land-use	M.D. of Bighorn No. 8 (Stoney)		438	23		1255	3	1718	33	98
2010	AAFC Land-use	Rocky View County (Stoney, Sarcee)		5796	203		10538	77	16615	7610	69
2010	AAFC Land-use	Stoney, Sarcee total		6235	226		11793	79	18333	7644	76
Change				-921	3		-190	-18	-1131	1131	-5
1990	AAFC Land-use	M.D. of Provost No. 52 (CFB Wainwright)		25	13		50	1	89	4	95
1990	AAFC Land-use	M.D. of Wainwright No. 61 (CFB Wainwright)		41420	1951		12025	1256	56652	4323	93
1990	AAFC Land-use	CFB Wainwright total		41445	1963		12075	1258	56741	4328	93
2010	AAFC Land-use	M.D. of Provost No. 52 (CFB Wainwright)		26	13		49	2	89	4	95
2010	AAFC Land-use	M.D. of Wainwright No. 61 (CFB Wainwright)		41403	1962		11298	1243	55907	5068	92
2010	AAFC Land-use	CFB Wainwright total		41429	1975		11347	1245	55997	5072	92
Change				-16	12		-728	-13	-745	745	-1
1990	AAFC Land-use	Parkland County (Stony Plain)			170		1251	127	1547	3716	29
2010	AAFC Land-use	Parkland County (Stony Plain)			171		1100	107	1378	3886	26
Change				0	1		-151	-20	-170	170	-3
1990	AAFC Land-use	Red Deer County (DND, CFB Penhold)			8		60	0	69	621	10
2010	AAFC Land-use	Red Deer County (DND, CFB Penhold)			8		22	0	31	659	4
Change				0	0		-38	0	-38	38	-6

Year	Data source	Area							
1990	AAFC Land-use	Sturgeon County (Alexander)		416	1093	104	1613	2826	36
2010	AAFC Land-use	Sturgeon County (Alexander)		413	996	85	1495	2944	34
Change			0	-3	-97	-18	-118	118	-3
1990	AAFC Land-use	Sturgeon County (CFB Edmonton, CFB Cardiff)		5	235	12	253	2388	10
2010	AAFC Land-use	Sturgeon County (CFB Edmonton, CFB Cardiff)		5	109	10	124	2516	5
Change			0	-1	-126	-2	-128	128	-5