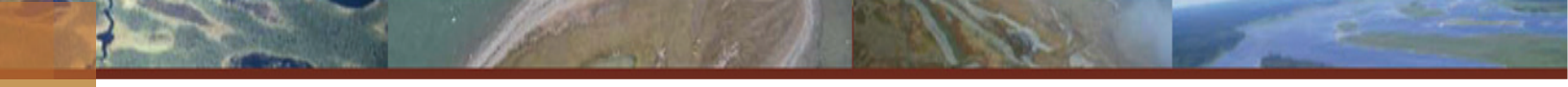
Provincial Satellite Derived Disturbance Mapping Data Specifications

April 2012



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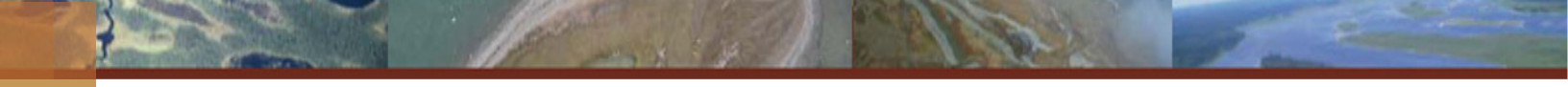

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1.0 Data Specifications Sheet

Date: April 2012

Section 1: Data Standard Information This section identifies the name, abbreviation, and extent of the Provincial Satellite Derived Disturbance Mapping and provides contact information for the producer and custodian of this data layer.	
Layer Name:	Provincial Satellite Derived Disturbance Mapping
Layer Abbreviation:	
Layer Description:	Represents vegetation disturbances which are identifiable in 30m Landsat change detection imagery.
References:	Far North Land Cover Data Specification
Production:	Science and Information Branch, Ministry of Natural Resources (MNR)
Product Contact:	Ian Smyth, Remote Sensing Specialist, Ontario Ministry of Natural Resources, Science & Information Branch, ian.smyth@ontario.ca
Extent:	Ontario north of approximately the 50th parallel. Includes all or parts of Ecozones 0E, 1E, 2E, 3E, 3S, 4S and 2W
Custodian:	Science and Information Branch, MNR

Section 2: GIS Data Layer Specifications This section identifies the geospatial criteria for this data layer.	
1. File Information	
File Type:	File Geodatabase - Feature Dataset
Projection File Name:	Contained within Geodatabase
Geometry Type	Polygon
2. Coordinate System	
Horizontal Coordinate System:	Universal Transverse Mercator
Datum:	GCS North American 1983

2.0 Disturbance Mapping Classification

2.1 Overview

The aim of creating a provincial disturbance map is to provide a consistent spatial inventory of natural and anthropogenic disturbances to meet regional and landscape level analysis needs (1:50,000 – 1:100,000). Disturbances to vegetation are constantly occurring, and the classification of medium resolution satellite imagery provides a cost effective and repeatable mechanism for mapping these changes.

Satellite derived disturbance mapping is being undertaken in conjunction with land cover mapping initiatives. Historically, provincial land cover mapping initiatives have been produced with 1990 and 2000 vintages. The most recent land cover initiative is for the Far North of Ontario (circa 2006-2009). As a result, the current undertaking of disturbance mapping is being geared towards these 3 time periods (1990, 2000, 2009). Currently, disturbances are being integrated into the Far North Land Cover in two broad classes: Disturbance – Non Woody and Sparse Woody and Disturbance – Treed and / or Shrub.

Through the analysis of vegetation change detection imagery, disturbances are classified as occurring prior to 1990, 1990-2000 or 2000-2009. These vintages are referred to as Time 0 (00), Time 1 (01) and Time 2 (02) in the data layer. This classification procedure is carried out in a series of overlapping sub-projects defined by Landsat track and frame boundaries and based upon 3 dates of images, Acquisition dates vary between Landsat tracks and as a result, each project is classified with a unique set of change detection composites. Consequently, matching events are captured in more than one project but with slightly different results. To avoid duplication, a procedure is undertaken to edge-match coincident disturbances.

Through the use of various contextual data layers along with the interpretation of historical imagery, the date ranges in which these disturbances occurred are further refined. At the same time, events are broken down into the type of disturbance, including: Burns, Cuts, Infrastructure, Pest/Disease, Weather and Unknown. The contextual information includes geospatial data layers which pertain to damaged forest mapping initiatives undertaken by provincial and federal programs (as outlined in section 2.3). These layers typically identify the source of the disturbance and the time period of the disturbance to varying degrees of precision. Additionally, a historical time series of available imagery is used for a manual interpretation of the disturbance events. These images include satellite imagery and aerial photography as far back as the mid-1980s and are in addition to the 3 Landsat images used in the classification procedure.

The following sections discuss considerations for the use of this data, provide descriptions of the disturbance classes and offer a data dictionary outlining the geospatial data products.

2.2 Considerations

2.2.1 Resolution and Minimum Mappable Unit (MMU)

- Medium resolution Landsat satellite imagery was used given its synoptic and temporal coverage. The Landsat sensor records data on a grid of approximately 30 m x 30 m cells or 'pixels'. This pixel size is ideal for regional or landscape level mapping since it is capable of mapping features as small as 0.5 hectares. The overall minimum mapping unit is approximately 1 hectare. Data users should be aware of this minimum mapping standard in reporting and analysing results.
- The disturbance data is being provided as a polygon vector layer with feature outlines that are consistent with the 30 metre resolution Landsat imagery used as source imagery. This disturbance information is being produced in connection with Ontario Land Cover initiatives which also use Landsat imagery with

a 30 metre resolution. This resolution is the standard for North American land cover mapping programs using Landsat imagery (*USGS, 2010*).

- Disturbance events represent "multi-part" features; a collection of isolated polygons that have the same attribute information and therefore have been grouped together as one spatial entity. This is done through satellite image interpretation. As a result, these multi-part features may actually include polygons that are as small as 0.5 ha.

2.2.2 Impact of Multi-date Satellite Imagery

- Since each sub-project area uses Landsat change imagery consisting of varying dates, there are instances where some recent disturbances may have hard edges along project area boundaries. This is due to the fact that the event was present in one project but not in the adjacent one due to the vintage of the images. The result is a feature that is incomplete but which will be updated as more recent imagery becomes available.

- The vintage of the disturbance mapping is dependent on the availability of cloud-free Landsat imagery. In order to reduce the impact of seasonal variations in vegetation response on the change detection process, care has been taken to match the seasonality of the three landsat images where possible. However, in order to meet this requirement, while at the same time minimizing the impact of cloud, there is some variation in the vintage of the disturbance mapping (2006-2009). An index feature class has been provided along with the disturbance feature class to identify these dates.

2.2.3 Mapping Completeness

- Through the manual interpretation stage of the process, disturbances are assigned a mapping completeness value of high, moderate or low. This value pertains to a qualitative assessment of the level of completeness of the classified disturbance feature in comparison to a visual interpretation of the imagery. As a general rule, the level of completeness is inversely proportional to the duration between the event and the image date used to classify it. In other words, the mapping completeness level of an event occurring within the same year as one of the images in the change sequence will be greater than an event occurring 5 years prior to any one of the images. This condition is less noticeable for disturbances occurring within time periods 01 and 02 due to the fact that the preceding image within the change stack acts as a benchmark. Conversely, disturbances occurring within time period 00 are impacted more significantly by this condition due to the lack of preceding imagery.

- A variance of the above condition includes instances in which burn disturbances within time period 00 or 01 are either very intense or occur over shallow soil / bedrock and the subsequent level of regeneration is not significant enough to allow for an adequate classification as disturbance. In these cases, the variability of the intensity of the disturbance or the patchy nature of exposed bedrock becomes evident in the pattern of classified features.

- Disturbances are assigned a qualitative level of confidence for both the existence of the feature as determined through the classification process (CONF_EXIST) and the type of disturbance as determined through the interpretation process (CONF_TYPE). This level of confidence for either field can be Low, Moderate, High or Confirmed. When the classified disturbance can be related to a feature in one of the contextual layers, the level of confidence is always "Confirmed". If the type of disturbance cannot be interpreted with an adequate level of confidence and the "DIST_TYPE" field is consequently assigned a value of "Unknown", the level of confidence in the type of disturbance (CONF_TYPE) is assigned a value of "Low".

2.3 Disturbance Mapping Classes

Disturbance Type	Code	Description	Contextual Sources	Possible Sources of Confusion
Burn	B	Vegetation loss due to fire. This class does not make a distinction between the causes of burns (natural – caused by lightning or anthropogenic – human influences); however, where available, contextual information has been related to these burn features which may indicate the cause of the disturbance.	Fire Disturbance Point Fire Disturbance Area NRCAN FireMars (2005-2008)	Smaller events (< 25 ha) can be confused with Pest Disease and Weather events or included in the unknown class where visual interpretation alone was inconclusive. The level of omission of a burn feature increases in relation to the lag time between the event and the acquisition date of the imagery being used for classification and interpretation.
Cut	C	Vegetation loss due to commercial forestry harvesting. This class does not make a distinction between the types of forestry harvesting activity.	Annual Report (AR) Depletion Forest Resources Inventory	Some inclusions of infrastructure (gravel roads, borrow pits) may occur at the point where these features converge with associated commercial forestry cut blocks. The majority of temporary access roads (vegetated/soil) occurring within cut blocks are contained within the Cut class. Exceptions to this are instances in which this road signature was captured in the change triplicate imagery in advance of the harvesting signature. In these instances, the road feature will be included in the Infrastructure class.

Disturbance Type	Code	Description	Contextual Sources	Possible Sources of Confusion
Infrastructure	I	Vegetation loss due to infrastructure development. This may include roads, railways, airports, utility corridors, borrow pits and buildings. This class does not make a distinction between the types of infrastructure development.	Annual Report (AR) Depletion	Some inclusions of commercial forestry cut blocks into the infrastructure class may occur at the point where these features converge with associated infrastructure, particularly gravel roads and borrow pits. The majority of temporary access roads (vegetated/soil) occurring within cut blocks are contained within the Cut class. Exceptions to this are instances in which the access road signature was captured in the change triplicate imagery in advance of the cut block signature. In these instances, the road feature will be included in the Infrastructure class.
Pest Disease	P	Vegetation loss due to insect or disease damage.	Western Fire Region Damaged Forest Layer (Insect) LIO Forest Insect Damage Event	Smaller events can be confused with stand mortality due to age or isolated pockets of blow-down. Fluctuations in vegetation signatures within small wetlands, due to phenological influences, can be confused with disturbance and may be interpreted as patches of insect or disease events.

Disturbance Type	Code	Description	Contextual Sources	Possible Sources of Confusion
Weather	W	Vegetation loss due to weather events. This class does not differentiate between the types of weather event. However, where available, contextual information has been related to these features which may indicate the type of weather event. These events can include light to moderate blow-down, severe blow-down (including tornados) and ice/snow events.	Western Fire Region Damaged Forest Layer (Weather) LIO Forest Abiotic Damage Event	Smaller events can be confused with stand mortality due to age or those caused by death due to pest / disease followed by blow-down. Large scale tornado events, with a continuous linear scar, are not typically confused with the pest disease class. Fluctuations in shoreline boundaries within the change imagery can be confused with blow-down events where a vegetation loss is detected. Efforts have been made to reduce this confusion by incorporating a water mask derived directly from the satellite imagery used for each of the 3 years in the change composite. Fluctuations in vegetation signatures within small wetlands, due to phenological influences, can be confused with disturbance and may be interpreted as patches of blow-down events.
Unknown	U	Vegetation loss that cannot be attributed to a specific type of disturbance with an adequate degree of confidence on the part of the interpreter.	LIO Misc Damage Event	

3.0 GeoDatabase Data Dictionary

The Provincial Satellite Derived Disturbance Mapping is provided as an ESRI ArcGIS File Geodatabase. Contained within this geodatabase are a series of Feature Datasets and Relationship classes that provide a connection between the final disturbance features and contextual information.

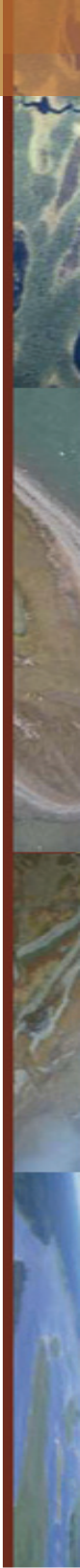
The following sections are provided as a data dictionary.

3.1 GeoDatabase Data Dictionary – Feature Datasets

Name	Entity	Description	Feature Type
Contextual_Layers_DD	Feature Dataset	Layers providing contextual information for disturbance mapping.	
Abiotdam	Feature Class	Forest Abiotic Damage Event . An event in which a non-biological event, such as wind or an ice storm, has damaged areas of forested land. OLID Metadata Record	Polygon
Firedspt	Feature Class	Fire Disturbance Point. Represents the estimated starting point of a forest fire for which the perimeter was not mapped. The fires are less than 40 hectares in size. OLID Metadata Record	Point
Firedstb	Feature Class	Fire Disturbance Area. Represents the mapped exterior perimeter of a forest fire. This database contains fire perimeters dating back to 1960. OLID Metadata Record	Polygon
Formisc	Feature Class	Forest Misc Damage Event. Includes forest damage events that cannot be singly attributed to a specific abiotic, insect or disease agent or event. These miscellaneous events are often the result of the cumulative effect of a combination of these aforementioned event types. OLID Metadata Record	Polygon

Name	Entity	Description	Feature Type
Insctdam	Feature Class	Forest Insect Damage Event. Represents a mapped event where forest insect pests have damaged trees by defoliation, foliage mining and wood boring, or contributed to tree mortality. Only the outer perimeter of the damage events are generally mapped e.g. there is no distinction between smaller areas within that were unaffected. In addition to infestations, forest mortality areas caused by these insect pests are mapped as separate events. OLID Metadata Record	Polygon
WFR_Insect_40_40_2010	Feature Class		Polygon
WFR_Wx_Damage_2010	Feature Class		Polygon
Disturbance_Mapping_{zone}	Feature Dataset		
Disturbance_Mapping_Vintages_{zone}	Feature Class	The change detection procedure used to create the disturbance mapping is conducted as a series of individual projects based upon Landsat track and frames. As a result, the data reflects the dates of Landsat imagery used in each project. This layer provides boundaries reflecting the most recent date of imagery used in the mapping and therefore provides context for the vintages of disturbances.	Polygon

Name	Entity	Description	Feature Type
DISTURBANCE_{zone}	Feature Class	This layer reflects the final disturbance layer, by UTM zone. This layer follows a procedure in which disturbances classified within the individual project areas (defined by Landsat scene) were merged together. During this process any matching disturbance events captured in overlapping scenes were dissolved into one feature.	Polygon



3.2 GeoDatabase Data Dictionary – Disturbance Attributes

DISTURBANCE_{zone}				
Field Name	**Alias**	**Description**	**Domain**	**Data Type**
MASTER_EVENT_ID	Master_Event_ID	Unique identifier for each disturbance. Where this disturbance is unique to a Landsat track-frame change detection project, Master_ Event_ID = Event_ID; however, where the disturbance event occurs in the overlapping region of multiple landsat scenes, and has been mapped in more than one of these scenes, Master_Event_ID = Event_ID for the scene with the most precise attribute information (i.e. narrowness of interpreted date range information).		Type: Long integer Length:9
TR_FR	Track Frame	Landsat TM track-frame scene identifier from which mapping was conducted		Type: Text Length:4
D_TYPE	Disturbance Type	Type of disturbance determined through contextual information and/ or image interpretation	B=Burn C=Cut I=Infrastructure P=Pest Disease W=Weather U=Unknown	Type: Text Length:50
MAPDATES	Mapped Date Range Start	Date of the earliest image used in the classification procedure for the given change detection time period in which the disturbance was mapped. For disturbances mapped in time period “00”, MAPDATES is NULL		Type: Date Length: 8

DISTURBANCE_{zone}				
Field Name	**Alias**	**Description**	**Domain**	**Data Type**
MAPDATEE	Mapped Date Range End	Date of the latest image used in the classification procedure for the given change detection time period in which the disturbance was mapped.		Type: Date Length: 8
SCANDATES	Image Scan Date Range Start	Date of the latest (most recent) image used for visual interpretation in which the disturbance IS NOT present.		Type: Date Length: 8
SCANDATEE	Image Scan Date Range End	Date of the earliest image used for visual interpretation in which the disturbance IS present.		Type: Date Length: 8
CONTDATES	Contextual Data Date Range Start	Earliest date that the disturbance could have occurred based upon contextual information. For contextual data sources that only specify a disturbance year, CONDATES is referenced as January 1 of that year.		Type: Date Length: 8
CONTDATEE	Contextual Data Date Range End	Latest date that the disturbance could have occurred based upon contextual information. For contextual data sources that only specify a disturbance year, CONDATEE is referenced as December 31st of that year.		Type: Date Length: 8

DISTURBANCE_{zone}				
Field Name	**Alias**	**Description**	**Domain**	**Data Type**
CONTSOURCE	Contextual Source	Data source from which contextual information was obtained	AFFM_FC = NRVIS Fire Disturbance Feature Class FIREMARS = NRCAN FireMars mapping WFRWxDamage = Western Fire Region Damaged Forest Layer AR_DEPLETION = NRVIS AR Depletion layer FOR_ABIOTIC = NRVIS Forest Abiotic Damage Event	Type: Text Length: 255
CONF_EXIST	Confidence Existence	Level of confidence in the actual existence of the disturbance that has been mapped through remote sensing means. If Contextual data was used to support the selection of a disturbance type, CONIF_TYPE = “Confirmed”.	C = Confirmed (Supported by contextual information) H = High M = Moderate L = Low	Type: Text Length: 50
CONF_TYPE	Confidence Type	Level of confidence that the producer has in the actual types of the disturbance that has been interpreted through remote sensing means. If the DIST_TYPE is “Unknown”, CONIF_TYPE = “Low”. If Contextual data was used to support the selection of a disturbance type, CONIF_TYPE = “Confirmed”.	C = Confirmed (Supported by contextual information) H = High M = Moderate L = Low	Type: Text Length: 50

DISTURBANCE_{zone}				
Field Name	**Alias**	**Description**	**Domain**	**Data Type**
SQM	Square Meters	Area of the disturbance in square meters		Type: Long Length: 4
HA	Hectares	Area of the disturbance in hectares		Type: Long Length: 4
CONT_ID	Contextual Identifier	Unique identifier for the contextual source feature		Type: Text Length: 25
DATES	Date Range Start	Earliest possible date t hat the disturbance could have occurred based upon the values of MAPDATES, SCANDATES and CONTDATES		Type: Date Length: 8
DATEE	Date Range End	Latest possible date that the disturbance could have occurred based upon the values of MAPDATEE, SCANDATEE and CONDATEE		Type: Date Length: 8
DIST_YEAR	Disturbance Year	Most precise date range of the disturbance occurrence expressed as a year(s) based upon the values of DATES and DATEE		Type: Text Length: 10
MAP_COMP	Mapping Completeness	Qualitative level of completeness of the mapped disturbance feature in comparison to a visual interpretation of the imagery.	H = High M = Moderate L = Low	Type: Text Length: 10

3.3 GeoDatabase Data Dictionary – Relationship Classes

Name	Description	Origin	Destination
Relationships Between Disturbance Features and Contextual Layers			
Disturbance_abiotdam_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: abiotdam Primary Key: Cont_ID Label: WeatherDamage
Disturbance_firedspt_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: firedspt Primary Key: Cont_ID Label: FireDamage
Disturbance_firedstb_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: firedstb Primary Key: Cont_ID Label: FireDamage
Disturbance_Insect_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: insctdam Primary Key: Cont_ID Label: InsectDamage
Disturbance_Misc_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: formisc Primary Key: Cont_ID Label: MiscDamage
Disturbance_WFRInsect_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: WFR_Insect_40_40_2010 Primary Key: Cont_ID Label: InsectDamage
Disturbance_WFRWeather_{Zone}	Type: Simple Cardinality: 1-1	F/C: Disturbance_{Zone} Foreign Key: Cont_ID Label: Disturbance	F/C: WFR_Wx_Damage_2010 Primary Key: Cont_ID Label: WeatherDamage

4.0 Acknowledgments

The disturbance mapping analysts would like to extend their gratitude to the Far North Branch and Aviation and Forest Fire Management for their continued support.

5.0 References

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Land Information Ontario Warehouse Data Class: Forest Abiotic Damage Event. Ontario Ministry of Natural Resources. http://www.mnr.gov.on.ca/en/Business/LIO/index.html

Land Information Ontario Warehouse Data Class: Forest Insect Damage Event. Ontario Ministry of Natural Resources. http://www.mnr.gov.on.ca/en/Business/LIO/index.html

Land Information Ontario Warehouse Data Class: Forest Misc Damage Event. Ontario Ministry of Natural Resources. http://www.mnr.gov.on.ca/en/Business/LIO/index.html

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