

Image Analysis and GIS Processing
Land Cover DataBase 2
(LCDB2) Stage 4

Terralink International Ltd.

Prepared by: Seyed A. Miri
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1) Introduction:

Terralink International Ltd. (TIL) was contracted to produce the digital version of LCDB2 as the company has strong GIS and remote sensing capabilities. TIL was involved in the LCDB2 pilot project, and was contracted to complete work on the national database.

Landcare Research was responsible for the initial image classification and identification of temporal changes between LCDB1 and the new imagery. These changes are referred as “COOKIES” in this document. TIL was responsible for the validation of these cookies by using two key sources of imagery, Landsat7 ETM+ and SPOT (SPOT 2, 3 and 4). In addition TIL had access to other imagery sources such as orthophotos and high-resolution satellite images for some parts of the country, which considerably improved the quality of the database.

2) Methodology:

During the pilot project a number of different image classification and change detection techniques were evaluated and it was initially decided to carry out the cookie validation process in a raster environment. Although this was successful at the Pilot Study scale it was not the preferred approach for national scale work. The process raster approach was introducing errors into the database because of file corruption. Consequently, other techniques were investigated and it was decided to use a vector-based approach because it was more practical, efficient and quicker, while also producing a better cookie validation procedure.

2.1 Overall view of the production steps:

- **Preparation (imagery/cookies)**
- **LCDB 2 Pre-Field Editing**
- **LCDB 2 Post-Field Editing (Use of ground Data)**

- **Capturing Minor Shelterbelts**
- **MfE sign off**

LCDB 2 production work can be subdivided into the following main steps:

2.1.1 Preparation (imagery/cookies)

2.1.1.1 Image preparation

Pan sharpened landsat7 images supplied by Landcare Research were archived. The imagery was stored on DVDs and copied to the Terralink server. Images were stretched, if necessary.

2.1.1.2 Cookie preparation

A number of AML scripts (Arc Macro Language) had been written for this step. One of these AMLs assigned new codes to each vectorised cookie depending on its value based on the LCDB2 classification schema. During this step cookie polygons were assigned an additional 100 value to their code. For example, a polygon, which has a label value of 20 in LCDB 1 gets a LCDB 2 code of 40, subsequently 100 is added to produce the new polygon value of 140.

Additional AMLs merged adjacent polygons of the same value, LCDB1 and cookie images were merged and subsequently split according to area. The separated coverages contain areas greater than 0.58 ha (26 pixels) and less than 0.58 ha. This ensured that any polygons less than one hectare would be considered in the editing step. These two coverages are then clipped to NZ260 tile boundaries in preparation for editing.

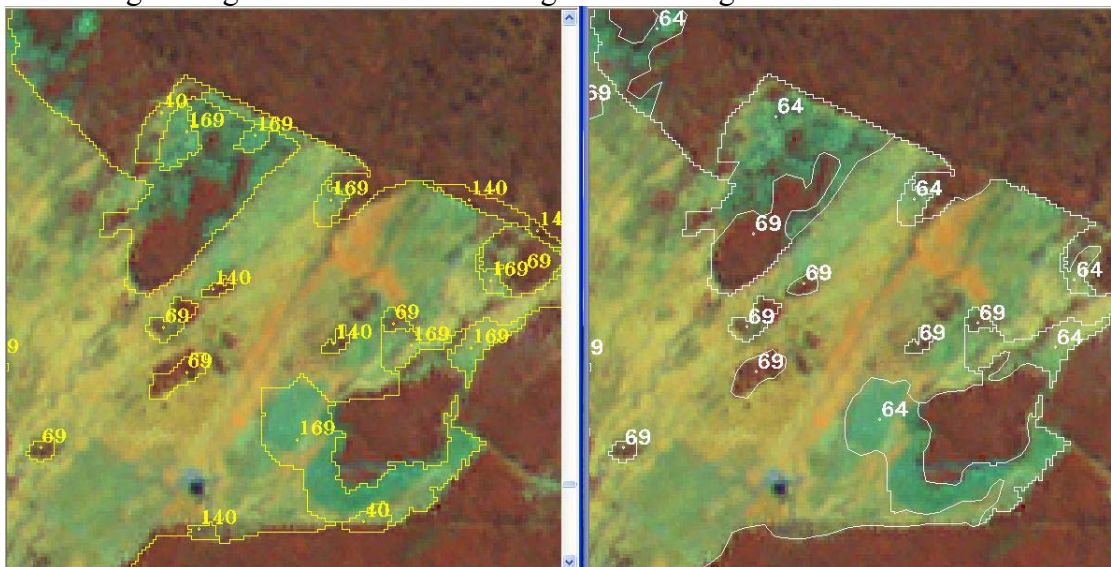
2.1.2 LCDB 2 Pre-Field Editing

The pre-field editing process sets out to achieve the following main objectives:

- Correction of LCDB1 line work
- Cookie verification and editing
- Identification of areas of temporal change
- Identify and fix areas of change where no cookie is available or were errors of omission or were coded incorrectly

Landsat 7 has improved spatial and spectral resolutions in comparison with SPOT 2, 3 and 4, thus allowing for more detailed analysis of land cover. Using Landsat 7 imagery, it was found that the boundaries of land cover parcels captured for LCDB1 can be better defined. The LCDB2 classification expands the LCDB1 classification hierarchically. Subdividing out these new classes comprised a major part of the editing process for LCDB2. Temporal change was identified by comparing the 2001/02 Landsat7 imagery with the 1996/97 SPOT imagery used for LCDB1. Reference was also made to other available data such as Orthophotos, AgriBase, Wetland classifications and Forest Company databases. Figure 1 demonstrates how pre-field editing is undertaken.

Figure 1) The left image shows cookies and LCDB1 boundaries before editing and the right image is the finalised coverage after editing.



The following attributes were populated for each polygon in the pre-field editing stage:

- LCDB1CLASS
- LCDB2CLASS
- ClassName

- FieldNotes (This is removed in the final version)

Table 1 below shows the code combinations that are used for polygon attributes.

LCDB2CLASS codes are used for the LCDB1CLASS attributes as well. These two fields are necessary for land use / land cover change analysis between LCDB1 and LCDB2. Improving the LCDB1 database will assist development of a 1990 land use description.

Table 1) Common code combinations, which were used for LCDB1CLASS and LCDB2CLASS. Note that the last digit of 3 digit numbers in this table represents ‘wetland’ areas eg. ‘681’ represents ‘Deciduous Hardwoods’ located in the Wetland areas.

LCDB1CLASS	LCDB2CLASS
1 or 40 or 41	1
2	2
3	3
4	4
5	5
10	10
11	11
12 or 69 or 40 or 41	12
13	13
14	14
15	15
20	20
21	21
22	22
30 or 40	30
31 or 40 or 30	31
32 or 40 or 41	32
40 or 41 or 4	40
41 or 64 or 52 or 51 or 54 or 12	41
42	42
43	43
44	44
45	45
46	46
47	47
50 or 41	50
51 or 64 or 11 or 41	51
52	52

53	53
54	54
55	55
56	56
57	57
60	60
61 or 40	61
40 or 41 or 51 or 52 or 54	62
40 or 41 or 51 or 52 or 54	63
66 or 67 or 69	64
63 or 64 or 65	65
65 or 66	66
67 or 40 or 51	67
68	68
69	69
681	681
471	471
511	511
431	431
521	521
571	571
691	691
501	501
551	551
541	541

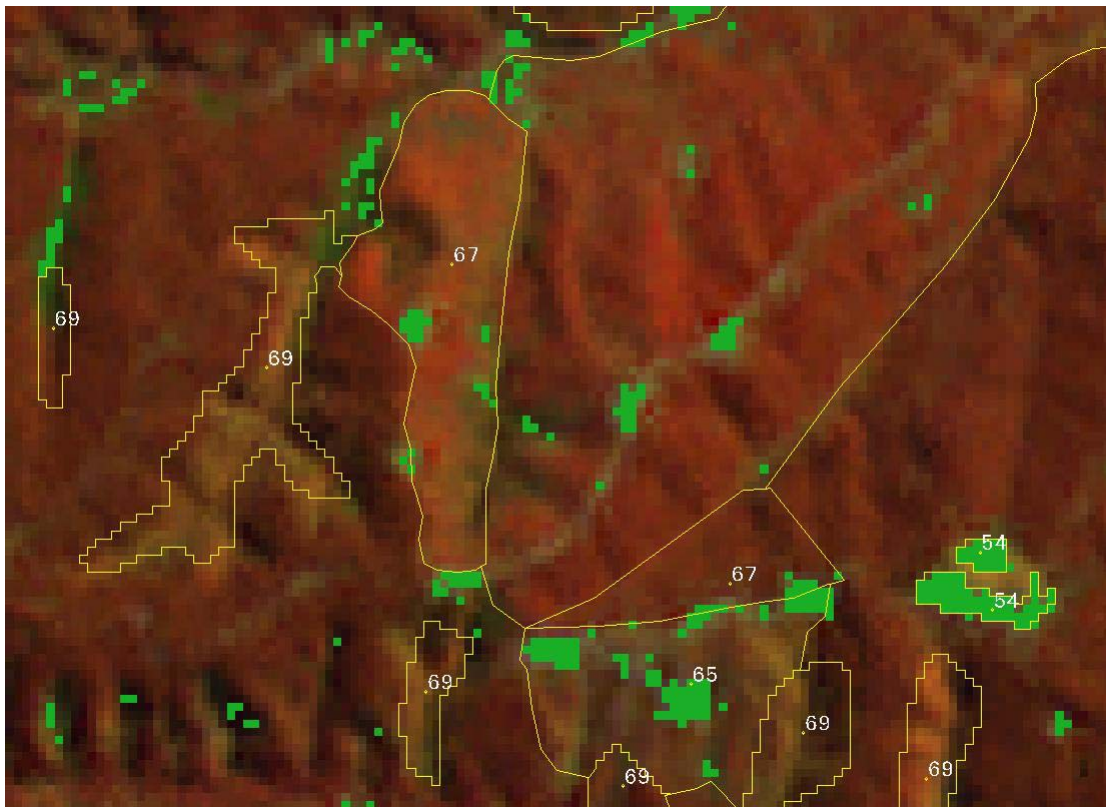
2.1.3 LCDB 2 Post-Field Editing (Use of ground Data)

Discrepancies in pre-field editing relate to the misclassification of land cover polygons incorrect class boundary definition or errors of omission. Once the initial classification was completed, a copy of the coverage was provided to the field checking teams. The coverages supplied by TIL were printed at 1 : 50 000 scale and taken to the field where errors were noted on the plot. Errors corrected included label changes, for example where the polygon outline was correct, but the land cover had been misclassified. This misclassification was updated by changing the polygon label to the correct class code. In some circumstances complete re editing of polygon boundaries was required, and TIL re-digitised the polygon to match the requested changes. There are certain classes and signatures that vary according to seasonal and spatial variations which were difficult to interpret from imagery alone, and rely on gathering extensive ground data.

Other changes were also requested. For example, class 62 (Afforestation not imaged) is a class that can only be identified from the field programme. TIL interpreted the outline of these polygons according to the boundary recorded by the field teams, as shown in figures 2 and 3. The field teams also noted land cover polygons missed in the draft classification.

There is a widely held expectation that broadly sampled ground data can be applied across a full Landsat scene however the project field checking procedures have demonstrated that restricting extrapolation of ground data to the area of a NZ260 tile (40km x 30km) is a more reliable sampling strategy.

Figure 2) Shows areas which are not covered by cookies (eg, class 67), or where the size of the cookies are too small (Out of LCDB2 specification, minimum polygon size is one hectare)



2.1.4 Capturing Minor Shelterbelts

Minor Shelterbelts were captured separately to produce a final coverage after the post-field editing stage was completed.

2.1.5 MfE sign off

Final coverages were sent to the MfE LCDB2 Project Manager (Steve Thompson), for final quality checks and sign off.. At the end of the post field work editing and capture of shelter belts was undertaken the tiles were archived. Once all tiles had been completed archived coverages were merged into the final seamless LCDB2 database.

2.2 Other Data (Use of ancillary data and archival imagery):

TIL has a vast store of ancillary data that was used in the Stage 4 process of the LCDB2 project. Ancillary data included aerial photography, scanned NZ260 topographical maps and reference materials including books and other technical documents . Additional information was also obtained from other organisations such as AgriQuality NZ, Department of Conservation, Regional Councils and Forestry Companies.

The AgriBase database was used to assist in defining the boundaries of class 30 (Short rotation crop land), Class 31 (Vineyards) and Class 32 (Orchards and other perennial crops). TIL clipped the AgriBase data to the desired extent, selecting out only the relevant farm types that meet LCDB2 specifications.

The clipped polygons were used as a guide for adding Class 30, 31 and 32 polygons to LCDB2.

If more than 60 percent of an Agribase 'ARA' farm type property was cultivated or had signatures typically describing cropping then the whole property was classed as 30. This recognised that for these farm types all the property had been cultivated over a 12 month period. The bulk of these properties are in mid Canterbury and south of Auckland. Figure 3 shows inclusion of polygons added to LCDB2, taking into consideration AgriBase boundaries.

- Polygon Adjacency errors
- Visual inspections
- Data conversion

4.0 Projection:

The database was produced in the NZMG map projection and then converted to the NZTM map projection. The database is available to users in both projections.

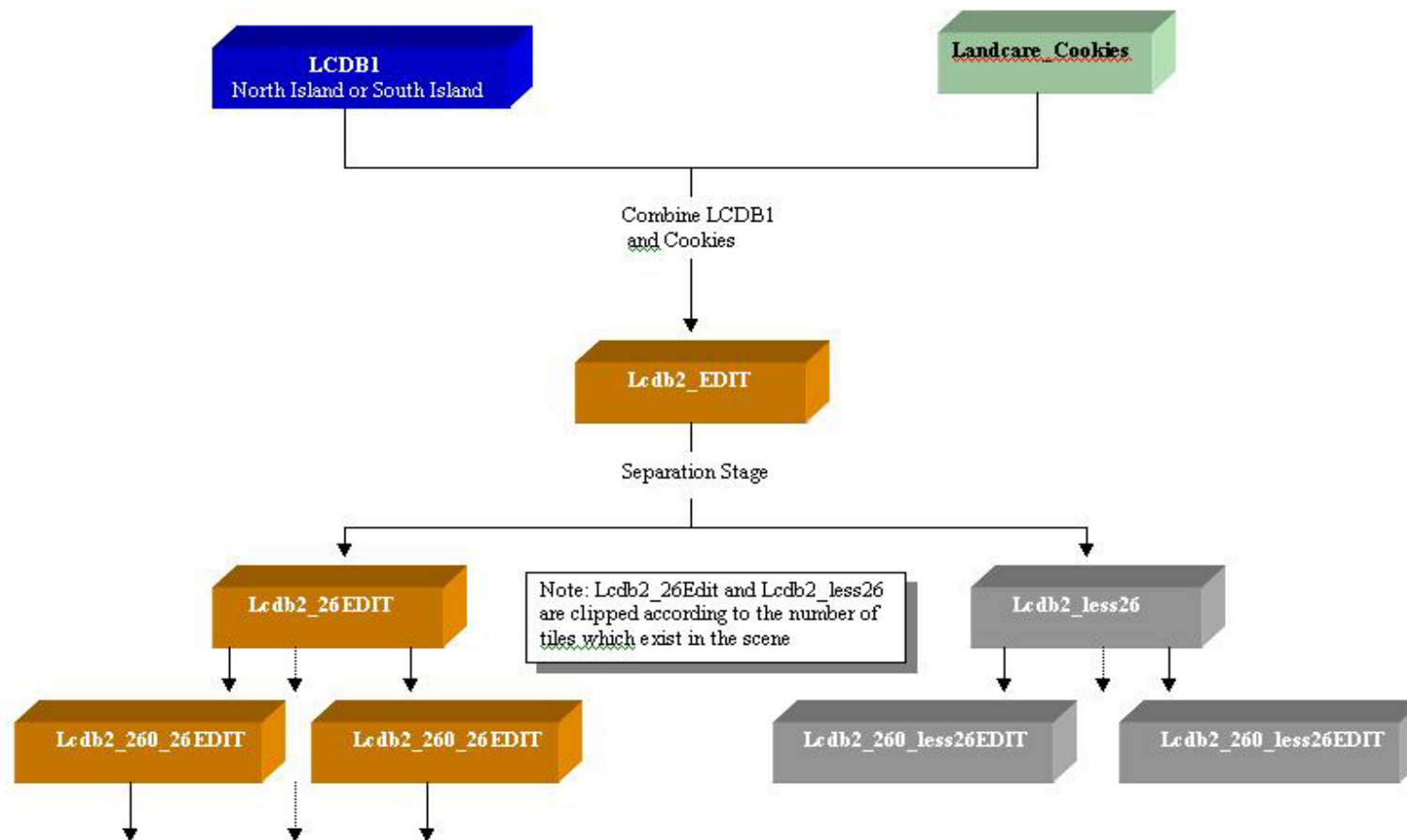
5.0 Hardware and software and data security:

A high spec server was dedicated to this project and all related data had been backed up each night. Field plots were archived in fireproof cabinets. ArcInfo and ERDAS Imagine were used to classify, edit and archive the data.

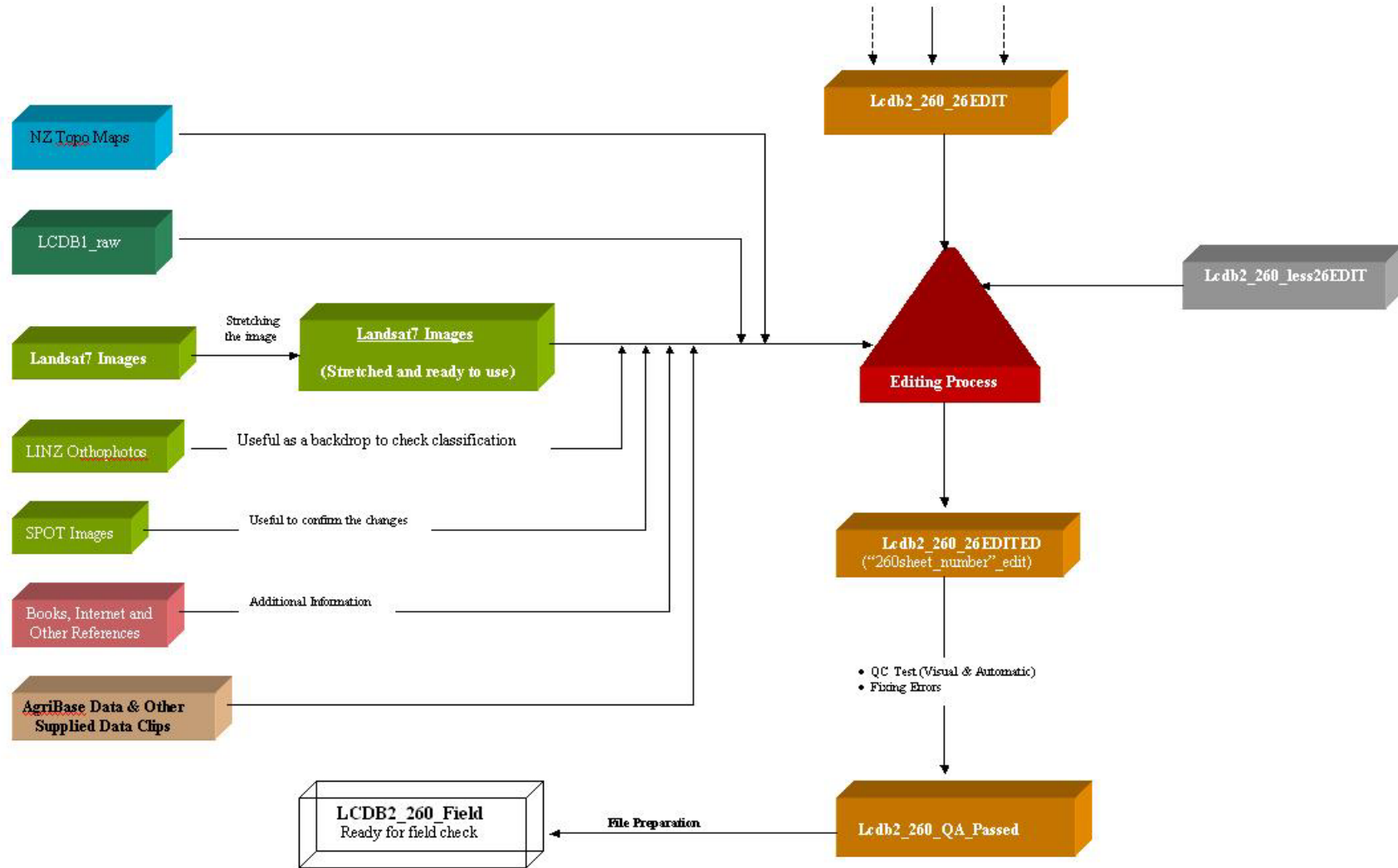
6.0 Appendix: Appendix 1 illustrates the LCDB2 production flowchart.

TIL LCDB2 Processes/Stage 4/a (Preparation)

Appendix 1)



TIL LCDB2 Processes/Stage 4/a (Editing)



TIL LCDB2 Processes/Stage 4/b (Post Field Editing & Final Preparation)

