

FINAL REPORT

**STREAMS CROSSINGS INVENTORY
GIS DATABASE (Version 2.0)**

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February 2000

Streams Crossings Inventory: Final Report
GIS Database
Feb. 2000
8-305-002

INTRODUCTION

The Stream Crossing Characterization and Inventory (SCCI) project is an ongoing collaborative project aimed at capturing new information on stream crossings found on forest access roads in insular Newfoundland. This information is used to compile a GIS database of crossings which allows for the integration of crossing information with other resource management and planning databases. During the 1997 and 1998 field seasons field technicians collected 3779 crossings throughout Western, Northern and Central Newfoundland. The data collected in 1997 (2104 crossings) were used to generate Version 1.0 of the Stream Crossing GIS database. The remaining 1675 crossings were captured in the 1998 field season.

The data collected through this project is a valuable resource to the various partner agencies for a multitude of reasons and hold great potential for future applications. For instance, the information has been assessed as beneficial and important in ongoing sustainable forest management certification documentation within the forest industry. For such reasons the complementary database developed through this project is to be integrated into the mainstream geographic information systems (GIS) currently in use by the partner agencies. To achieve this the SCCI had to be edited to harmonize the crossing locations with corresponding crossings found in two core resident databases in use amongst the project partnership: NF Forest Inventory (1:12,500) and NTS topographic maps (1:50,000).

The field crews were trained on the process to spatially edit their GPS crossing locations to align with crossing locations within the resident GIS production databases in use among the partners. During this process the master GIS database for 1998 was segmented into 58 corresponding 1:50000 NTS topographic map sections. The operators then edit the subset using reference data (streams and roads) extracted from the resident databases (forestry and NTS). Each crossing location on the assigned map sheet was moved to the appropriate stream crossing in the reference database resident in partner's GIS databases. This procedure is completed twice: once to produce a version of the crossing database which is harmonized with the forestry inventory database (FCROSS) and again to make a NTS harmonized version (TCROSS). A total of 58 subsets (map sheets) were edited during this process.

Following the spatial editing of each NTS map sheet section, the remaining work becomes the responsibility of the GIS Technical Coordinator. This stage of the project involves the compilation, quality checking, and processing of the data to produce the final GIS coverages for all crossings captured in 1998. Further to this the 1998 GIS and attribute databases had to be combined with the original database (version 1.0 produced in 1997) to produce a single inventory spanning both 1997 and 1998 field seasons. This newly combined database is referred to as Version 2.0. The production of version two was assigned to the GIS Technical Coordinator who had left the project prematurely to seek alternate employment out of the province. It is at this time that the Project Partners, through the Model Forest, contracted CFES to undertake the task of processing the data to create version 2.0. This work was necessary to bring closure to the semi-processed GIS database in preparation of the upcoming field season and the hiring of new staff. This report outlines the process used to: a) compile the 1998 data, and b) integrate the 1997 and 1998 field data to generate Stream Crossings GIS Database Version 2.0.

SUMMARY OF ACTIVITIES

GIS Spatial Data

Figure 1. on the next page illustrates the process undertaken to produce the GIS (spatial) component of version 2.0 of the stream crossing inventory database. It also indicates the stage of development which the project was at prior to CFES undertaking the project. This diagram outlines only the GIS database development process and it is not intended to describe the GPS data collection process. In addition to this process, a series of processing related to the attribute data which integrates with the spatial data was completed to produce the new stream crossing GIS database.

The following tasks were completed to produce version 2.0 of the Stream Crossing GIS Database:

Modifications to Version 1.0 (1997) Database

A quality control check conducted on version 1.0 (1997) data revealed that the spatial edits done by operator, Johnson, were not captured in the database. This resulted in the GIS Technical Coordinator having to redo the spatial edits for this operators files. Through the CFES contract to produce version 2.0 these newly modified files were integrated into version 1.0 of the database. Included in this reconstruction of Version 1.0 were all crossing located on NTS Map Sheets: MS032, MS050, MS060, MS061, MS082. This newly constructed of version 1.0 was used in the compilation of version 2.0; therefore, it was not necessary to circulate these updates to the partnership.

Compilation of Spatially Edited Files to form GIS Coverage for 1998

Upon completion of project field staff terms, the spatially edited 1998 GIS crossing data remained in a series of files and coverages corresponding with the operator assigned NTS map sheet number. To allow for integration of the 1998 data with the Version 1.0 these files has to be further processed and combined to produce a single GIS coverage (theme) for the 1998 season. In total 58 individual map sections coverages were appended using Arc\Info and ArcView to produce a single GIS coverage which has been spatially harmonized with the Newfoundland Forest Inventory (FCROSS).

This process was replicated to produce the NTS version (TCROSS) of the database for NTS users.

Editing of 1998 Attribute Database Files

The quality checking at this stage was conducted to ensure the same number of records and crossing ids were present in both versions of the GIS database. This is essential given that the GIS database (FCROSS & TCROSS) must link to the same single record in the attribute database file to obtain the detail crossing characteristics. The next stage of the process involves quality checking and processing to ensure a unique relationship between the GIS crossing database and the corresponding attribute database record. A one-to-one relationship was confirmed through this process. However, due to duplicate field data collection and removal of duplicates, through the GIS spatial editing process, there remained a greater number of attribute records in the database than there were in the GIS database. This observation resulted in the removal of the duplicate records in the attribute database which maintained a one-to-one record relationship between the spatial and attribute records for the 1998 data.

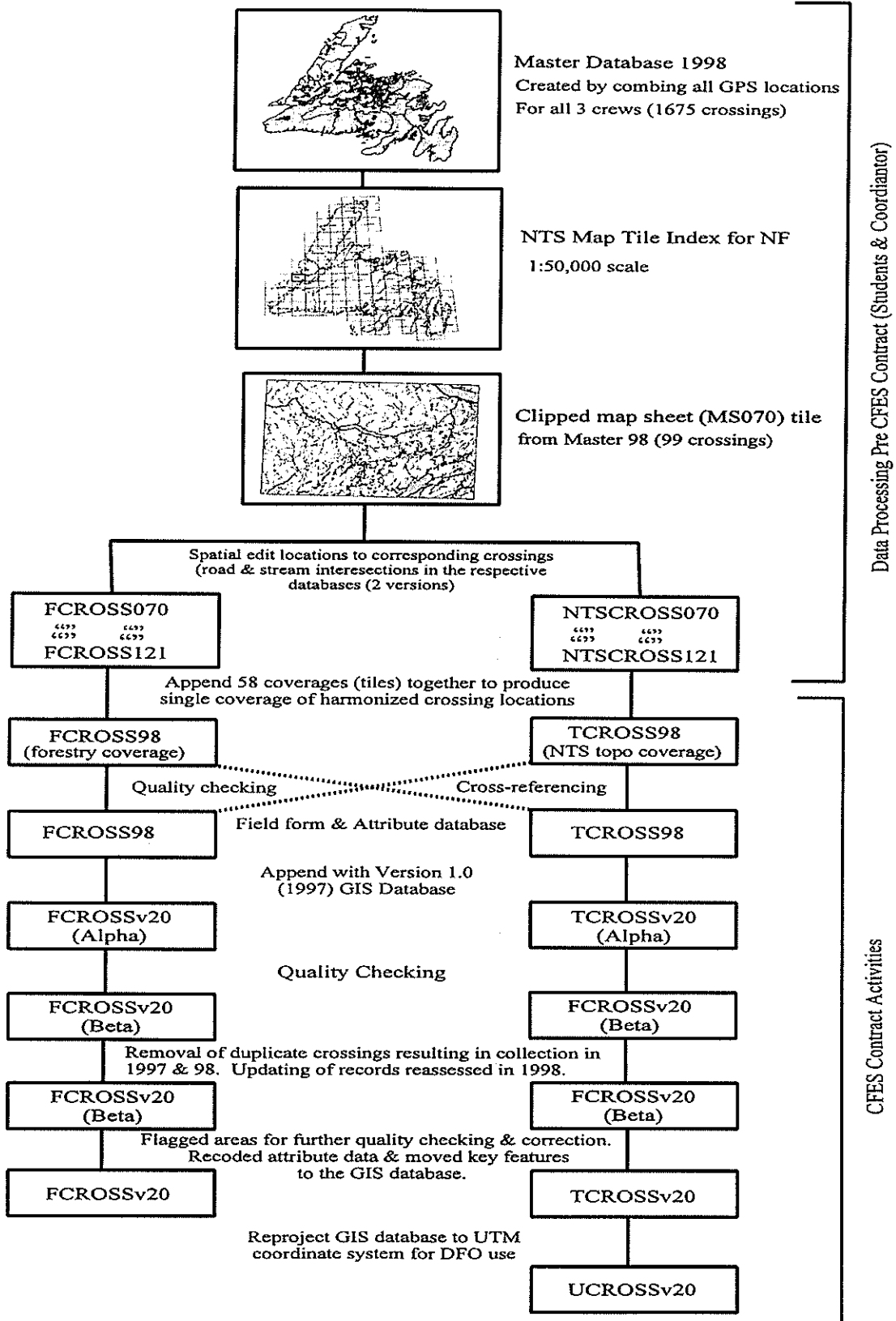


Figure 1. Spatial Data Processing - Stream Crossing Inventory Version 2.0

Production of Version 2.0 GIS database

This work entailed the appending of the newly revised Version 1.0 (1997) with the single 1998 GIS database, produced in the above step, to create version 2.0. This process was completed through the use of Arc\Info and ArcView. All processing was complete to ensure double precision of the position coordinate data. This new database contains 3779 crossings. Again the process was replicated to create both the harmonized forestry (FCROSS) and NTS (TCROSS) versions of the database.

A quality check procedure for crossing duplication in the newly created 1997 & 1998 data (version 2.0 alpha) was invoked to identify duplication and overlap of crossings between 1997 and 1998 field seasons. A total of 33 such crossings were identified. The duplicates were then removed from the GIS database and a note to remove the corresponding attribute record from the attribute database. The cleaning up of the attribute database was assigned to the new GIS Technical Coordinator for the 1999 project year.

Moving key attributes to the spatial database

To allow for easier data access by the partners a number of attribute features (items) were carried from the attribute data to the GIS database. These features include: structure type, field code, structure condition, and GPS file name. Using relational database techniques to link the spatial and descriptive databases the data was coded and moved over to the GIS database. Figure 3 illustrates the results of this process. This will make the commonly used information readily available to the users and eliminate the need to maintain permanent database links between the GIS database and the attribute database for routine inquiries. The following coding regiment was used to characterize the data in the GIS database.

Structure type:

STRUCTURE	CODE	DESCRIPTION
CULVERT	1	Crossing achieved via a culvert
BRIDGE	2	Crossing achieved via a bridge
MPARCH	3	Crossing achieved via multi-plate arch
CHUTE	4	Crossing achieved with old wood chute
WASHOUT	5	Crossing has been washed out
DAM	6	Crossing achieved via a dam structure
DECOMM	7	Crossing has been decommissioned
NONE	8	No structure in place - or undetermined structure

During the quality checking of this section it was recognized that a number of discrepancies in interpretation among field crews. All the 1998 data was cross referenced with the field forms to ensure that the crossing type was correct; however, the 1997 data required similar review, This review of the 1997 data was left to the GIS Technical Coordinator. In addition, 96 crossings were identified, belonging to Crew Z, as having no known structure type. These records were coded with a code "99" so that the GIS Technical Coordinator could locate and investigate as part of duties during the 1999 season. Such investigation is a time consuming exercise requiring cross-referencing database records with the field forms (paper copies).

GPS File

This item was populated with the corresponding GPS File name captured in the attribute data entry process. This file name can be used to confirm the crew collected, as well as the date and time collected.

Crossing Field Code

This item is an alphanumeric item assigned by the field crew during data capture. Generally the code is derived from the road network name abbreviation with a sequential numeric assignment for each successive crossing inventoried (ex. Lady Slipper Network crossing # 1 = LS1). This code was also used to sort the spatial database and check for duplicate records in the database.

Structure Condition

The condition of the structure was entered in the attribute database as a character string using the following codes: poor\fair\good\NA.. These values were quality checked and a number of discrepancies were observed. Many errors were a result of the data entry form not resetting to default value and a duplicate of the previous record condition being applied unless the operator made the change in the entry process. Rather than replicate these known problems into the GIS database the problem was flagged and passed along to the GIS technical Coordinator to conduct further quality checking and correction.

All quality checking was conducted individually on both the FCROSS and TCROSS GIS Databases. Then the two databases were cross referenced to ensure consistency in the number records and descriptions.

Attribute Database

The descriptive attribute data captured on the field form was entered into a database file through a custom data capture interface program. All six field technicians completed this task. Each technician was assigned approximately one-half of the crossings their crew collected during the 1998 season resulting in 6 individual database files. These files were appended to produce a single attribute database for all crossings captured in the 1998 season. This master attribute database contained 1866 records. Of this, 1675 represented new crossings. The remaining 191 records are either duplicate crossings captured during 1998 and 1997 seasons or re-assessed 1997 crossings, already captured in version 1.0 (initial crossings captured in 1997 were done using the original field form which did not capture all the necessary data-these were reassessed in 1998).

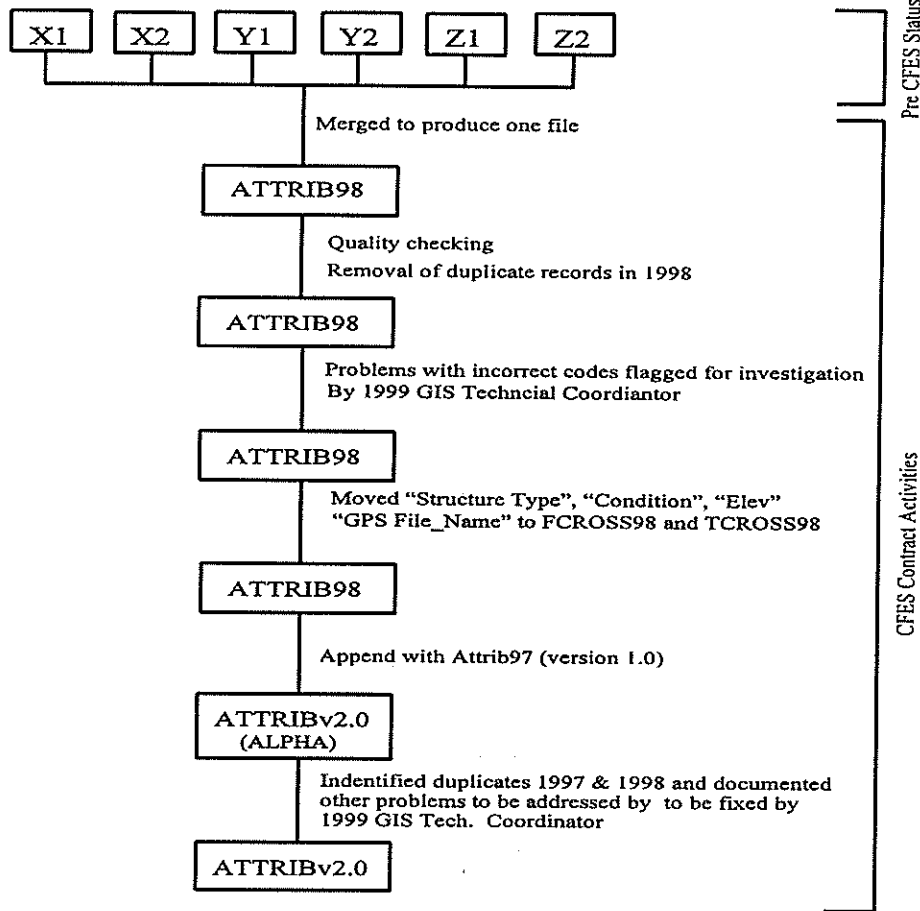


Figure 2. Attribute Data Processing - Stream Crossing Inventory (Version 2.0)

Figure 3. Outlines the data processing procedures and tasks undertaken to produce the attribute database for the stream crossing inventory (Version 2.0).

Before Processing						After Processing									
attrib98[alpha].dbf						attribv2.dbf									
Shape	Area	Perimeter	Cross	GPS File		Area	Perimeter	Cross	Cross ID	Elevation	Code	Structure	Condition	GPS File	
Point	0.000000	0.000000	1459	3563	Z100616A	0.000000	0.000000	1459	3563	129.4	GPR1		2	FAIR	Z100616A
Point	0.000000	0.000000	1460	3564	Z100616B	0.000000	0.000000	1460	3564	131.6	GPR2		1	GOOD	Z100616B
Point	0.000000	0.000000	1461	3565	Z100617A	0.000000	0.000000	1461	3565	33.1	HR1		1	GOOD	Z100617A
Point	0.000000	0.000000	1462	3566	Z100617B	0.000000	0.000000	1462	3566	40.7	HR2		1	FAIR	Z100617B
Point	0.000000	0.000000	1383	3487	Z093013A	0.000000	0.000000	1463	3567	178.4	PR1		5	POOR	Z100713A
Point	0.000000	0.000000	1384	3488	Z093013B	0.000000	0.000000	1464	3568	183.3	PR2		5	POOR	Z100713B
Point	0.000000	0.000000	1385	3489	Z093013C	0.000000	0.000000	1465	3569	204.7	PR3		5	POOR	Z100713C
Point	0.000000	0.000000	1386	3490	Z093014A	0.000000	0.000000	1466	3570	188.7	LR2		2	POOR	Z100715A
Point	0.000000	0.000000	1388	3492	Z093014C	0.000000	0.000000	1467	3571	191.0	LR1		2	POOR	Z100715B
Point	0.000000	0.000000	1389	3493	Z093015A	0.000000	0.000000	1468	3572	184.2	PLR3		5	POOR	Z100716A
Point	0.000000	0.000000	1390	3494	Z093015B	0.000000	0.000000	1469	3573	170.2	PLR4		5	POOR	Z100717A
Point	0.000000	0.000000	1391	3495	Z093015C	0.000000	0.000000	1470	3574	164.4	PLR5		5	POOR	Z100717B
Point	0.000000	0.000000	1392	3496	Z093015D	0.000000	0.000000	1471	3575	155.4	PLR6		2	POOR	Z100717C
Point	0.000000	0.000000	1393	3497	Z093016A	0.000000	0.000000	1472	3576	163.2	PLR7		2	POOR	Z100717D
Point	0.000000	0.000000	1399	3503	Z093019A	0.000000	0.000000	1473	3577	151.5	PLR8		5	POOR	Z100717E
Point	0.000000	0.000000	1400	3504	Z093019B	0.000000	0.000000	1474	3578	213.0	GGSR33		1	GOOD	Z100813A
Point	0.000000	0.000000	1401	3505	Z093019C	0.000000	0.000000	1475	3579	207.6	GGSR34		1	FAIR	Z100814A
Point	0.000000	0.000000	1402	3506	Z093020A	0.000000	0.000000	1476	3580	192.8	GGSR35		5	POOR	Z100814B
						0.000000	0.000000	1477	3581						Z100815A

Figure 3. Spatial attribute database before and after processing.

DELIVERABLES

The outlined activities were completed and a fully integrated (1997 & 1998) quality checked GIS database, known as version 2.0 was produced. The quality checking work conducted on the attribute database identified a number of unanticipated concerns. Some of the identified errors and omissions were completed; however, given the level of effort required to correct others were documented and passed along to the 1999 GIS Technical Coordinator for follow-up. It was suggested that the quality concerns in the attribute database be addressed prior to release of the complete package to the partners. These modifications and corrections in the attribute database would constitute version 2.1 of the stream crossing inventory database. This versioning would help clarify the history and development of the Stream Crossings database. Version 2.1 would not alter the newly prepared GIS (spatial) database produced by CFES, just the attribute records.

A complete copy of Version 2.0 both FCROSS and TCROSS was supplied to the GIS Technical Coordinator. The following items were delivered to the 1999 GIS Technical Coordinator during the employee orientation period: CD-ROM with all data files, databases associated with versions 1.0 and 2.0; working notes; field inventory sheets; and an overview of the database dictionary, coding regimes and descriptions. In addition, a one-day data overview and a list of instructions of what is necessary to complete all facets of version 2.1 were provided to the GIS Technical Coordinator.

CFES continued to support the GIS Technical Coordinator with the refinement and completion of version 2.1 throughout the 1999 field season. The correction of the attribute database in version 2.1 proved to require a considerable time commitment. This was, in part, due to the steep learning curve associate with a new individual having to fully grasp and understand the related databases and information sources.