



## **Watershed and Stream Classification**

### **for the Foothills Model Forest**

#### **Chisholm Fire Delivery and Data Set Description**



## Watershed and Stream Classification

### Chisholm / Dogrib Fires Research Initiative

#### Foothills Model Forest

##### *Delivery Data Set Description*

The intention of this document is to outline the deliverables and to provide a detailed description of coverage attribute tables created for the Foothills Model Forest client for Chisholm fire study area. The required activities and entities are outlined in the process documentation available as a separate document.

The Chisholm CDROM contains single line hydrography, hydrography polygons, watersheds and Digital Elevation Model (DEM) data as binary ARC/INFO coverages (line, polygon, and grid types) prepared within ARC/INFO 7.2 environment. An ArcView 3.2 project, for data overview, are also provided. The projection and datum is UTM Z11, NAD 83 with double precision accuracy maintained throughout all processes.

GISmo Solutions Ltd. completed this project using data provided by the Base Features Project, Resource Data Branch, Alberta Sustainable Resource Development.

The general information, including this data set description document, is located in the OVERVIEW sub-directory. This sub-directory also contains study area boundary, and an ArcView project file allowing for easy display of provided information.

#### **Chisholm CDROM**

The following directories and files are provided on the delivery CDROM:

**BF\_HYDRO, BF\_UPDATES, CHS\_ACCESS, CHS\_DEM, CHS\_HYDRO,  
CHS\_WORK\_COV, OVERVIEW**

#### **BF\_HYDRO**

This directory contains source hydrography data from the Base Features project. All data sets were provided as seamless coverages (E00) with unique BF-id identifiers

**Chs\_slnet** A seamless SDE extracted set of SLNET data from RDB Data Distribution.

**Chs\_hydpoly** Seamless SDE HYDROPOLYS data from Data Distribution.

**Chs\_hydpoint** Seamless HYDROPOINTS data from Data Distribution.

**info** ARC/INFO directory required for binary data structures.

**BF\_UPDATE**

This directory contains three coverages and a .dbf table that represent proposed changes to the Base Features information. The coverages contain elements that would be changed spatially (either added or modified arcs), while the table lists BF\_IDs corresponding to arcs that would be deleted (replaced with modified arcs), flipped or reassigned PS-flow.

<b>Chs_miscoded</b>	Coverage contains arcs that need corrections to ps-flow attribute.
<b>Chs_flipped</b>	Coverage contains arc that require flow directionality flipped. (original data incorrectly directed upstream).
<b>Chs_modif</b>	Coverage contains arc that require extension, trimming and possibl additional flow directionality flipped.
<b>Bf_edited.dbf</b>	Tables contains a list of BF_IDs that correspond at arcs requiring modifications (either change to ps-flow changed or directionality edit).
<b>info</b>	ARC/INFO directory required for binary data structures.

**CHS\_ACCESS**

This directory contains source access data from the Resource Data Data Distribution (Access Update project). All data sets were imported form provided export format coverages (E00).

Chs_cutlines	Cutlines data
Chs_facil	Facility points
Chs_hydcarto	Annotation
Chs_pipes	Pipelines
Chs_power	Transmission lines.
Chs_rails	Railways lines
Chs_roads	Roads.
Chs_acc_poly	Facility polygons.

**CHS\_DEM**

This directory contains seamless source DEM coverage and some processed terrain information. DEM gird coverages were created using *TOPOGRID* and *FILL* ARC/INFO processes. Included here are contour coverages created for Quality Control (QC) before and after the utilization of *TOPOGRID* and *FILL* processes.

Specific files are as follows:

**AFC\_TOPO** DEM for extended user study area. The extended area covers all 1:20K tiles (buffered by 300 M) overlapping study area processed through *TOPOGRID* and *FILL* to enforce a complete drainage. The required fill tolerance

was 6 M. Additional adjustment to Lesser Slave Lake was completed to enforce lake elevation at 577M. This DEM was used for watershed delineation. (AFC – Adjusted Filled Chisholm Topo)

**Flow\_ac\_lin** A flow accumulation lines grid indicating patterns of flow on **AFC\_topo** (used in the QC process for validation of hydro network). Grid has a 25 m resolution and 50 cells threshold.

**AFC\_hsh** A hillshade grid created from hydrologically adjusted surface with 35, 50 and 3 parameter values for sun location and vertical exaggeration.

**org\_in\_con\_5** A 5m contour for source data. This data set demonstrates source DEM data errors.

**org\_to\_con\_5** A 5m contour after initial *TOPOGRID* before adjusting streams directionality. This data set demonstrates some source hydro data errors.

**in\_con\_5** A 5m contour for corrected source data (after QC for proper terrain assembly).

**to\_con\_5** A 5m contour after *TOPOGRID* (QC for impact of stream network directional flows).

**Topo\_contour\_er.shp** A reference point for a location where stream flow needed to be adjusted (as org\_in contours and org\_to contours were significantly different)

**info** ARC/INFO directory required for binary data structures.

## **CHS\_HYDRO**

This directory contains a hydrography reaches and watersheds information requested by client. Both shape coverages: reachpoints and chs\_reaches contain attributes requested by client. Watershed coverage (chs\_wsd) corresponds to chs\_reaches .

Specific files are as follows:

**Chs\_segs** Flow segments designed for topological routes used for reaches aggregation. Individual gradients are compared and reaches are constructed by assigning an absreach attribute.

**Chs\_reaches.shp** Shape line coverage of reaches. Note: A unique reach is represented by a single arc and may not be split by an in-flowing tributary. In a few specific cases there are more than one arc per reach (when ArcInfo limitations for maximum number of vertices are exceeded).

**Reachpointshp** Shape point coverage of reach downstream terminating points. A unique

Reach is represented by a single point and there are two (or more) points at the confluence.

**Chs\_wsd\_gr** Watershed drainage polygon coverage. Areas associated with individual arcs are corrected and edited for slivers following ARC/INFO *GRID* processes. To improve cartographic representation raster artifacts are “smoothed” by a spline and node snap processes (when corresponding Chs\_wsd is created)

**Chs\_wsd** Final watershed drainage polygon coverage. In addition to individual “atomic” polygons an UPSTREAM region class stores aggregated regions. Additional region classes ORD1,ORD2 ... ORD8 represent subsets of regions corresponding to sub-basins of specific Strahler class.

**Info** ARC/INFO directory required for binary data structures.

### **CHS\_WORK\_COV**

This directory contains a classified single line stream network, identity coverage (after intersection with polygons) and some working files and coverages.

Specific files are as follows:

**Chs\_buf** Extended study area, where hydrological adjustment to DEM is completed.

**Csa\_slnet** Chisholm Study Area single line attributed hydrography network

**Cid\_slnet** Single line hydrography network intersected with polygon information (identity process)

**out\_chs** 1:20K mapsheet neatlines used to create extended study area border

**out\_chis** An initial clipping polygon for study area (replaced by mask\_500 derived out of watersheds later in the production).

**Chs\_lakes** Lakes polygon coverage for extended study area

**Primary\_forks.shp** Locations where a stream splits into two primary flows. Only one of these flows participates in drainage accumulation and region aggregation process.

**Strahler.avl** ArcView Colour legend table for displaying Strahler classification

**Topo\_brks.shp** Locations where a topological break was created by software at:  
Strahler class changes (Note: 1 into 3 inflow on the south edge does not create a break )  
Crossing any polygon feature  
At a confluence with a secondary flow of a higher order  
As indicated by Hydropoints

**info** ARC/INFO directory required for binary data structures

## OVERVIEW

This directory contains an outline of the study area, data documentation, and an ArcView 3.2 project for information display. The view comment fields (in view properties) provide additional information about the displayed data set.

Specific files are as follows:

**Mask\_500** A mask shape polygon coverage (created from watershed coverage with a 500m buffer)

**Visio** Directory containing Data / Process Model documentation in VISIO / WORD format.

**Chisholm\_data\_des.doc** Microsoft WORD file, data description document.

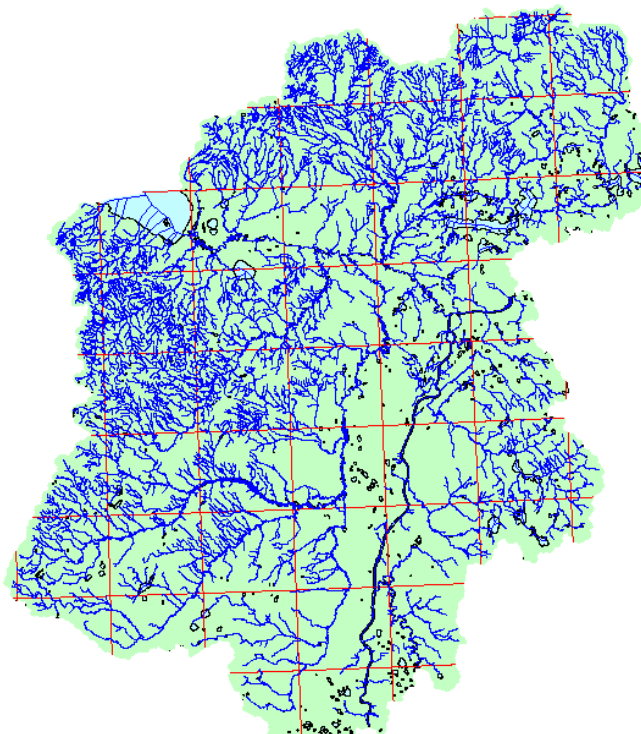
**Strahler.avl** ArcView Colour legend table for displaying Strahler classification

**Chisholm.apr** An ArcView 3.2 project providing data overview.

The following views are provided in the **Chisholm.apr** project for client's reference:

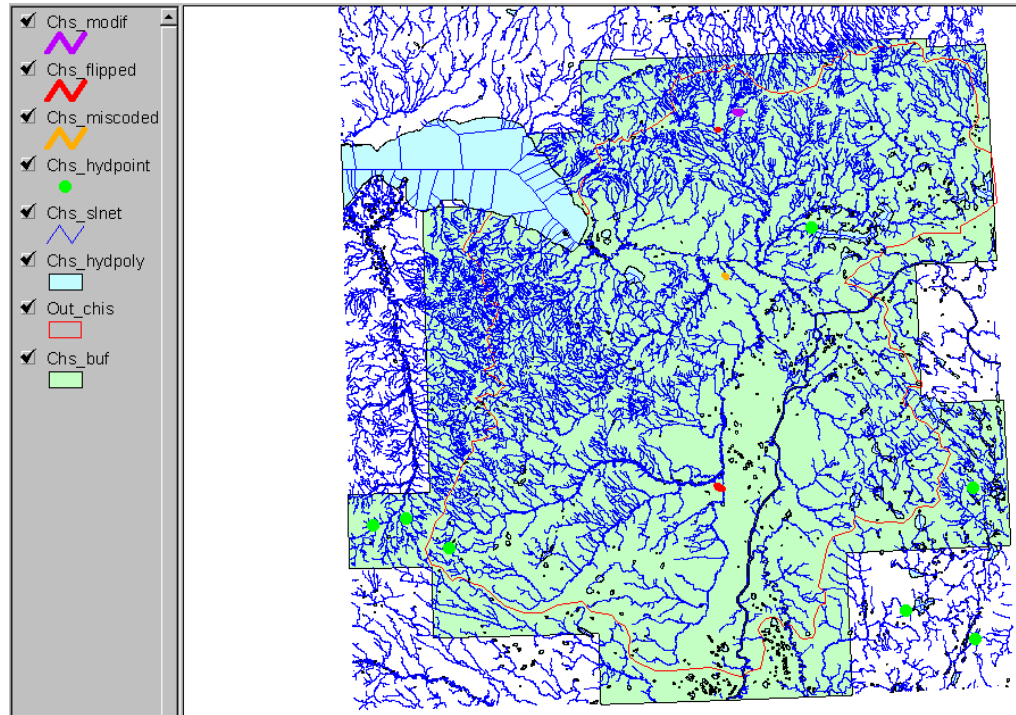
### 01 Overview.

Overview of Chisholm Fire study area.



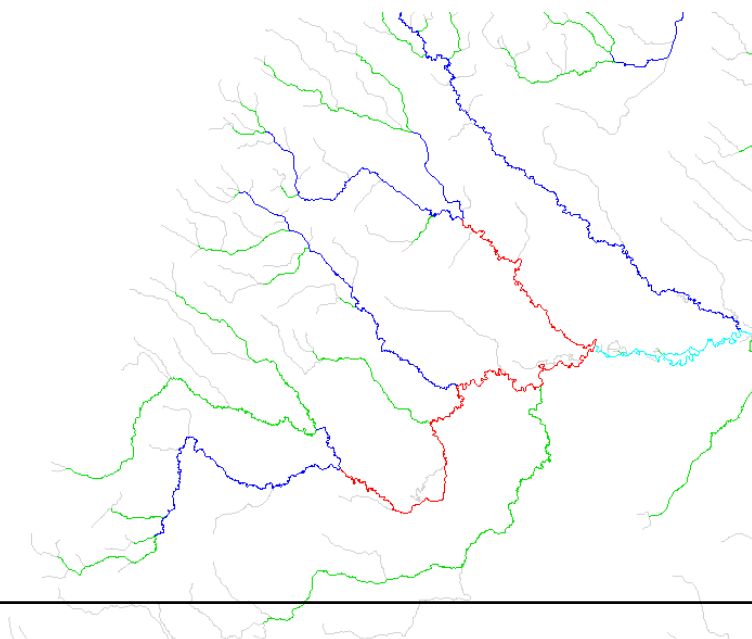
## 02 Source Data

Source hydrography data. Corrections to Base Features source data set are provided as additional separate coverages. The Chs\_buf polygon outlines the extent of corrections to the DEM.



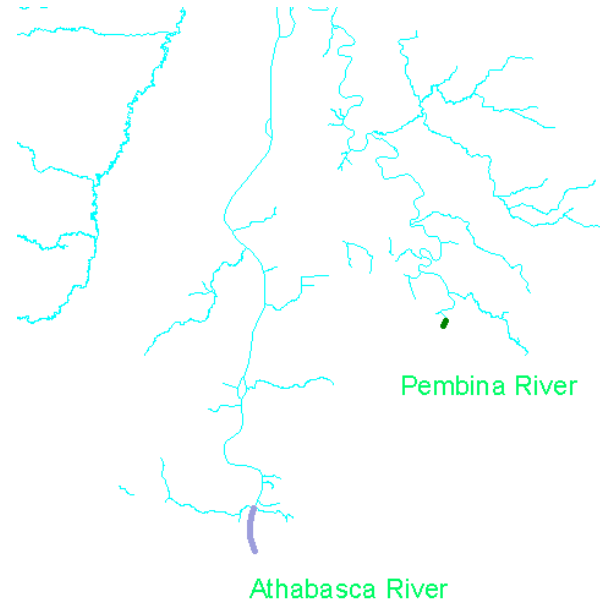
## 03 Strahler Classification

Strahler classification is applied to primary and secondary flows



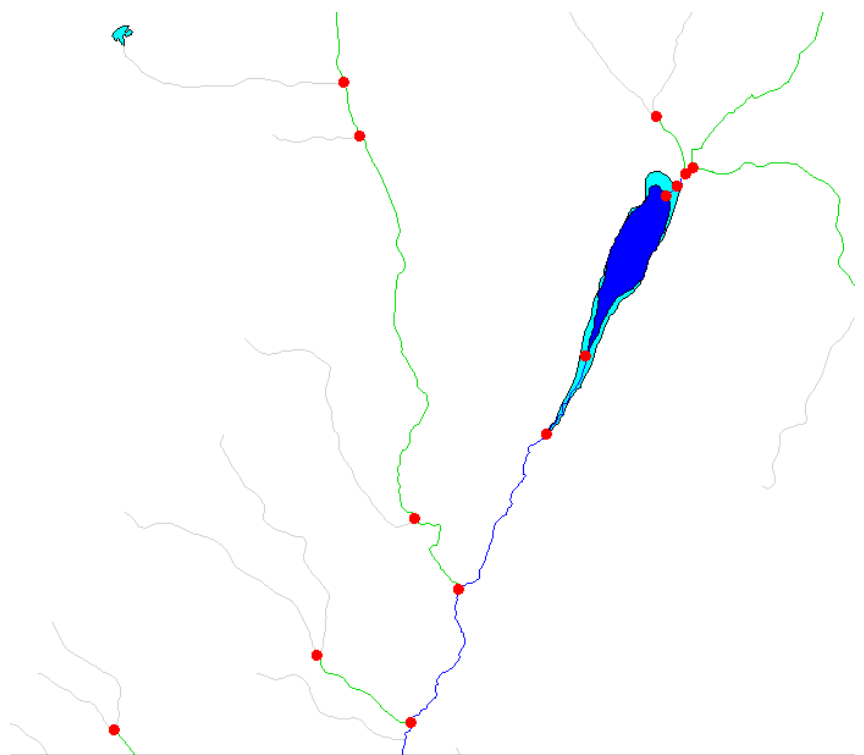
**04 Inflows**

A StartOrder attribute allows to initialize Pembina River inflow at Strahler Class 7 and Athabasca River at Class 8



**05 Topological breaks**

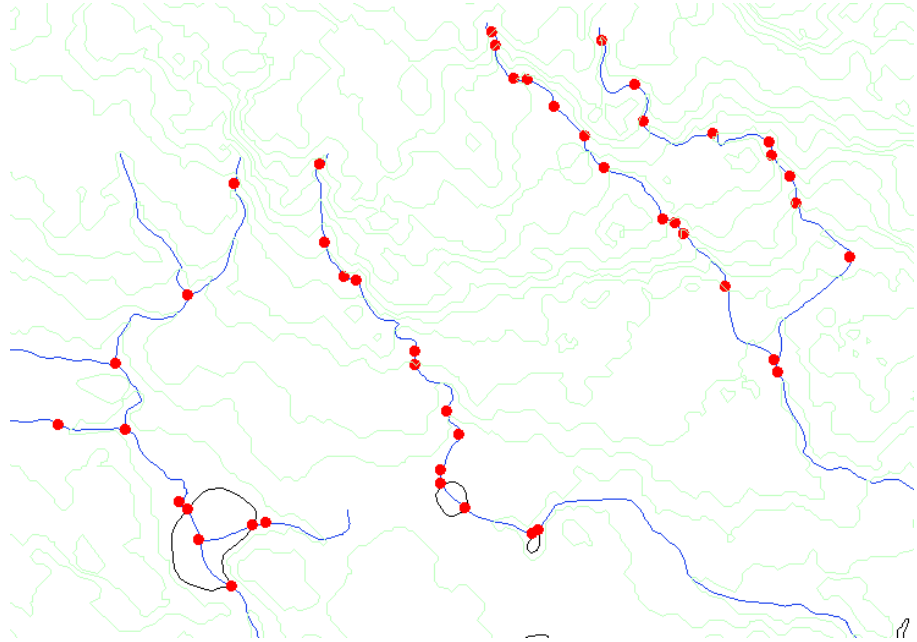
Topological breaks are created at:  
Strahler class changes (Note: 1 into 3 inflow on the south edge does not create a break )  
Crossing any polygon feature  
At a confluence with a secondary flow of a higher order  
As indicated by Hydropoints





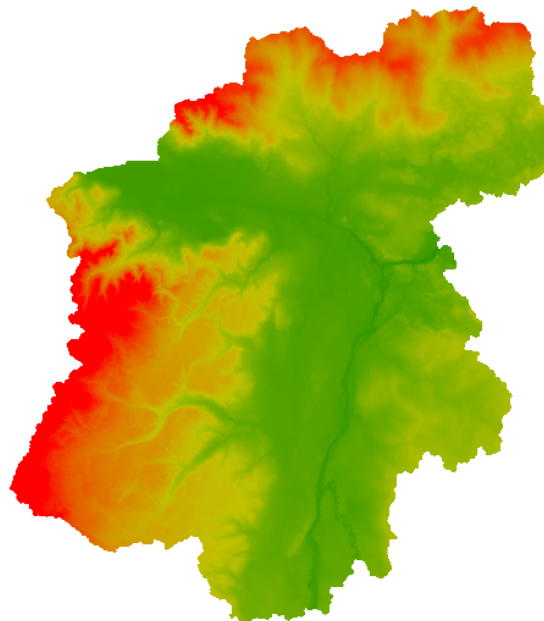
**06 Segments and Reaches**

Segments created on topological routes (primary flows only) are aggregated into reaches as per rules for gradient comparison. Topological break is never removed (Note: where a topological break is not present a full node topology is not enforced). Reachpoints with client attributes are created at a downstream node for every reach (so there are two of these at a confluence)



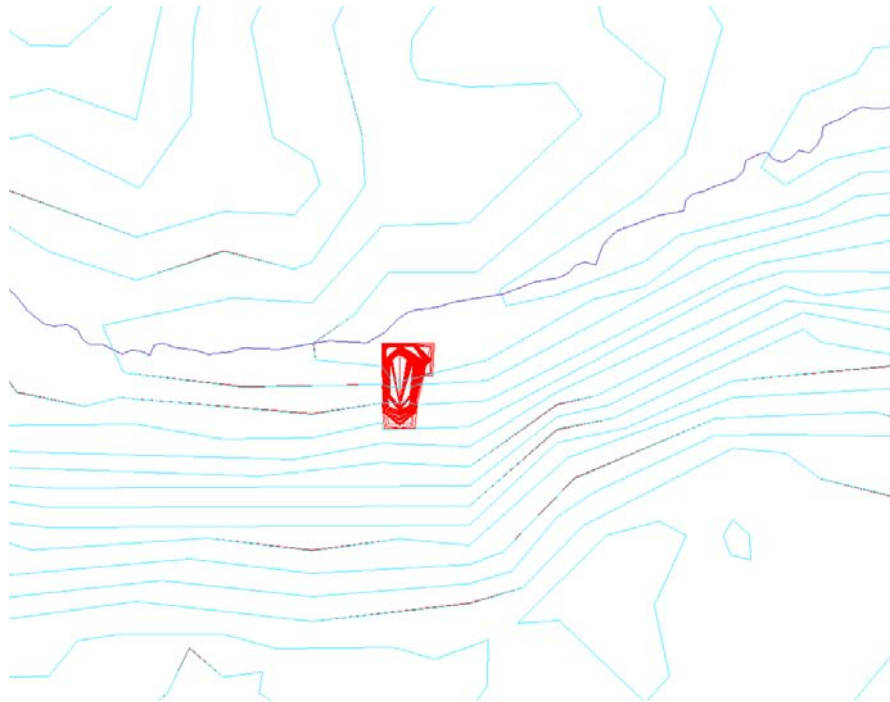
**07 DEM data set.**

View of the digital elevation model with mask.



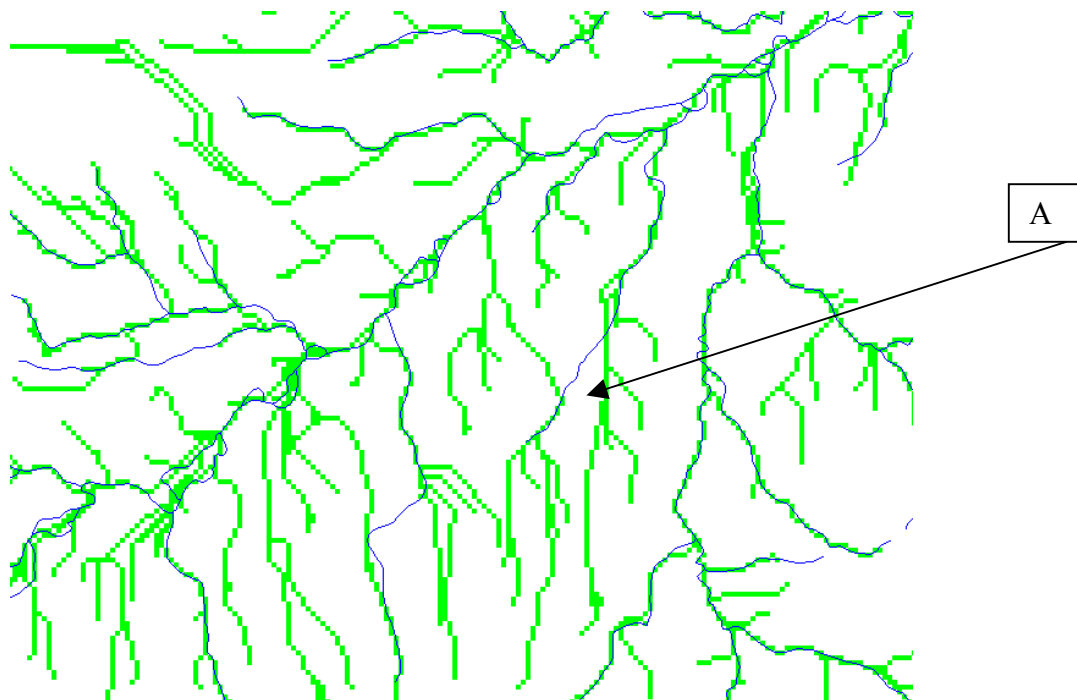
**Local modification to source DEM.**

Review of original contours allows to see locations where contours were modified before used in the process. Several spikes, ridges in lakes etc were removed



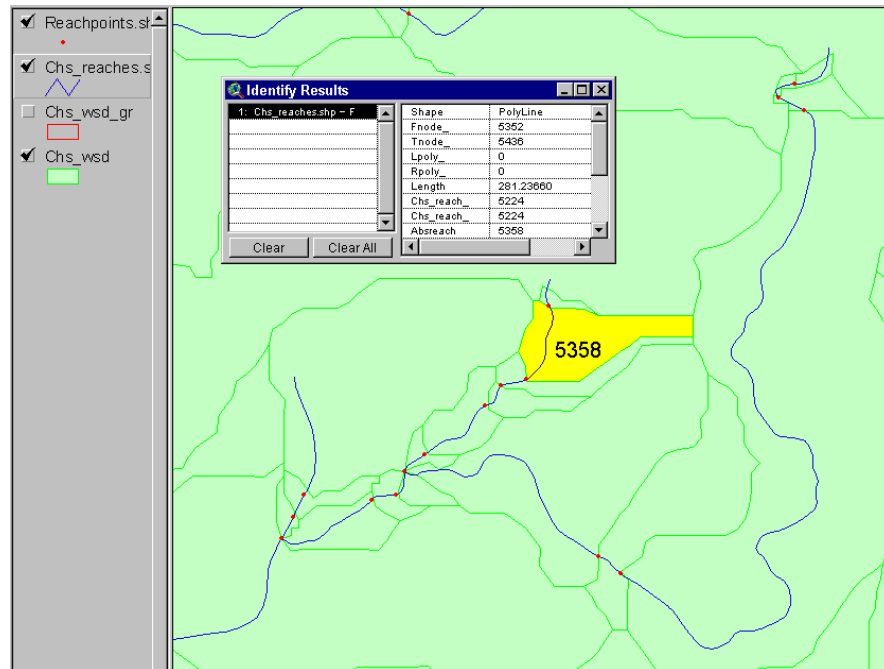
**08 Flow Lines**

There were no major discrepancies between flow accumulation lines and single line hydro flows. Minor cases as “A” are typical.



## 09 Reaches polygons and “Atomic”

Watershed polygons are created using ARC/INFO process that assigns a drainage area to individual arcs (reaches). The unique reach number “absreach” and the “grid-code” polygon attribute link the two data sets. Following the creation of watershed grids in raster domain, a corresponding polygon coverage is created and edited for accurate and pleasing cartographic representation. (Clean edited polygon cover with raster artifacts is provided as Chs\_wsd\_gr)

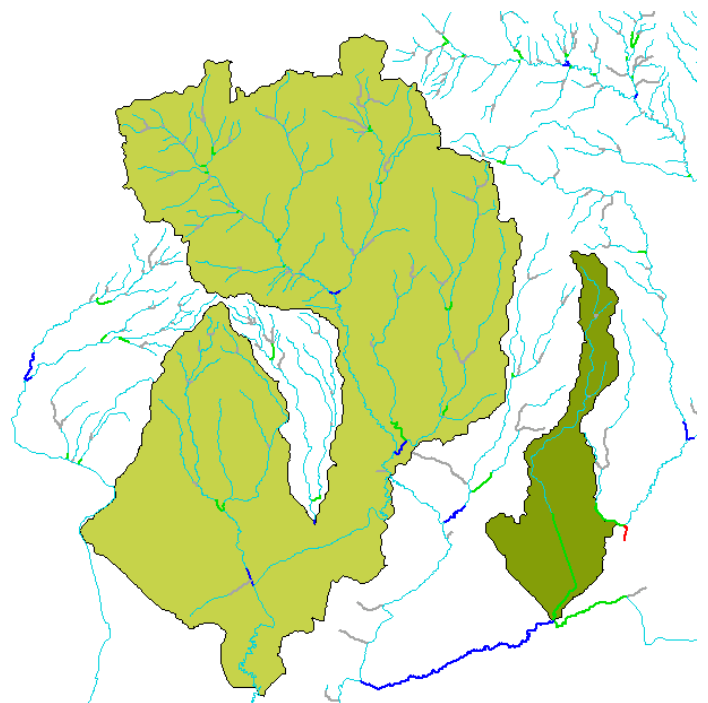


## 10 Watershed Upstream Regions

Region class Upstream in CHS\_WSD stores upstream drainage areas for all reaches.

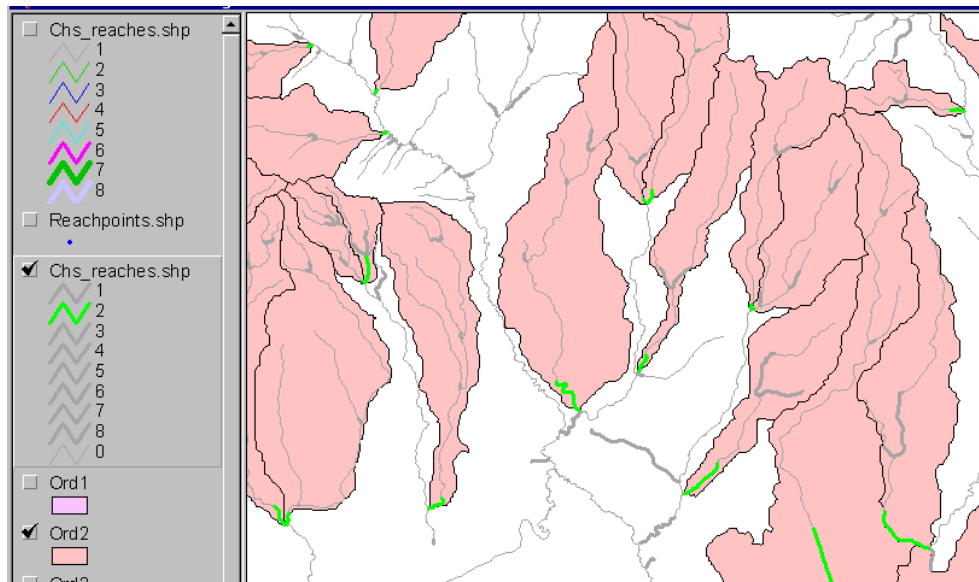
Attention: Do not query or display the upstream layer !!!

Use selection tool to pick a region for a desired absreach number and convert it to a separate theme  
There is only one upstream region per reach ( even for reaches with multiple segments) . Some regions may have "holes" if sub-areas are not connected to network.



### 11 Classification of regions for Strahler sub-basins

A “parent” attribute was added to reaches and regions to identify sub-basins of specific Strahler class. All regions of class 2 are available in the ORD2 region subclass.



## DETAILED DESCRIPTION OF COVERAGE ATTRIBUTE TABLES

The following tables show all attributes for the final coverages for the Chisholm area. ARC/INFO topological attributes, maintained Base Features attributes, and new attributes added in our processes are identified for three coverages (with four corresponding feature attribute tables).

Chs_hydpnt	Chs_hydpnt.pat	point attribute table
Chs_hydpoly	Chs_hydpoly.pat	polygon attribute table
Csa_slnet	Csa_slnet.aat	arc attribute table
Cid_slnet	Cid_slnet.aat	arc attribute table
Chs_segs	Chs_segs.aat	arc attribute table
Chs_reaches	Chs_reaches.dbf	shape arc attribute table
Reachpoints	Reachpoints.dbf	shape point attribute table
Chs_wsd	Chs_wsd.pat	polygon attribute table
Chswsd.upstream		UPSTREAM region class attribute table

### CHS\_HYDPOINT.PAT

NAME	ITEM DEFINITION	ITEM DESCRIPTION
AREA	8 18 F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8 18 F 5	Perimeter in coverage units. Set to 0 for point features.
CHS_HYDPOINT#	4 5 B	Polygon internal sequence number (record number).
CHS_HYDPOINT -ID	4 5 B	Polygon feature identification.
FEATURE-CODE	10 10 C	Base Features Project Attributes (BFA)
FEATURE-TYPE	30 30 C	BFA
NAME	80 80 C	BFA
SOURCE	6 6 C	BFA -  -
CAPTURE_DATE	8 10 D	BFA -  -
BF_ID		BFA

### CHS\_HYDPOLY.PAT

NAME	ITEM DEFINITION	ITEM DESCRIPTION
AREA	8 18 F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8 18 F 5	Perimeter in coverage units. Set to 0 for point features.
CHS_HYDPOLY#	4 5 B	Polygon internal sequence number (record number).
CHS_HYDPOLY-ID	4 5 B	Polygon feature identification.
FEATURE-CODE	10 10 C	Base Features Project Attributes (BFA)
FEATURE-TYPE	30 30 C	BFA
NAME	80 80 C	BFA
SBFLAG		
BF_ID		BFA

## CSA\_SLNET.AAT

NAME	ITEM DEFINITION	ITEM DESCRIPTION
FNODE#	4 5 B	From-node sequence number.
TNODE#	4 5 B	To-node sequence number.
LPOLY#	4 5 B	Left polygon sequence number.
RPOLY#	4 5 B	Right polygon sequence number.
LENGTH	8 18 F5	Length in coverage units.
CSA_SLNET#	4 5 B	Arc internal sequence number (record number).
CSA_SLNET-ID	4 5 B	Arc feature identification.
FEATURE_CODE	10 10 C	BFA !!! Features were unsplit based on whether or not it is a lake.
FEATURE_TYPE	30 30 C	BFA !!! These attributes represent lakes or one of the feature code / type attributes for unsplit streams.
NAME	80 80 C	BFA -  -
SOURCE	6 6 C	BFA -  -
CAPTURE_DATE	8 10 D	BFA -  -
PS-FLOW	1 1 C	BFA !! Even if <b>sln</b> has only primary flows (based on SEC_SEG) original P and S values exist here.
SEC_SEG	1 1 C	Secondary Segment flag "P", "S" . If BF data was not changed in the QC process it corresponds to PS-FLOW attribute
STARTORDER	2 6 B	Attribute controlling classification for external inflows
STRORDER	2 6 B	Strahler class (1 - 6 in this set).
BF_EDIT_FL	1 1 I	Flag from correction process values 1 - 8 as described below 1. Miscoded PS. 2. Connectivity (this flag indicated "pour" point). Some are left open, many were modified by snap nodes or added segments. 3. (Delete) does not exist on final set. 4. Flipped arc. 5. Added. These segments are broken at lake border, but not fully attributed. 6. (Added from DEM, client approved). 7. Gap created. 8. Dogleg (zinger corrected).
EDIT_DET	15 15 C	Edit detail – description corresponding to BF_EDIT_FL
ERRORS	20 20 C	Error messages from initial route creation (name and P/S errors)
STARTLENGTH	4 8 B	Attribute allows for adjusting route construction priority on inflowing streams
SEG_NO	4 6 B	Sequential upstream segment number (route design attribute)
HI_ORD	4 6 B	Highest Strahler order (route design attribute)
DOM_NU	4 6 B	Route ID (route design attribute)
DOM_ID	4 6 B	Route ID of corresponding primary route (route design att. on S flow)
NEWROUTFLAG	2 1 B	New Route required flag (route design attribute)

## CID\_SLNET.AAT

NAME	ITEM DEFINITION	ITEM DESCRIPTION
FNODE#	4 5 B	From-node sequence number.
TNODE#	4 5 B	To-node sequence number.
LPOLY#	4 5 B	Left polygon sequence number.

RPOLY#	4 5 B	Right polygon sequence number.
LENGTH	8 18 F5	Length in coverage units.
CID_SLNET#	4 5 B	Arc internal sequence number (record number).
CID_SLNET-ID	4 5 B	Arc feature identification.
CSA_SLNET#	4 5 B	?
CSA_SLNET-ID	4 5 B	?
FEATURE_CODE	10 10 C	BFA !!! Features were unsplit based on whether or not it is a lake.
FEATURE_TYPE	30 30 C	BFA !!! These attributes represent lakes or one of the feature code / type attributes for unsplit streams.
NAME	80 80 C	BFA -  -
SOURCE	6 6 C	BFA -  -
CAPTURE_DATE	8 10 D	BFA -  -
PS-FLOW	1 1 C	BFA !! Even if <b>sln</b> has only primary flows (based on SEC_SEG) original P and S values exist here.
SEC_SEG	1 1 C	Secondary Segment flag "P", "S" . If BF data was not changed in the QC process it corresponds to PS-FLOW attribute
STARTORDER	2 6 B	Attribute controlling classification for external inflows
STRORDER	2 6 B	Strahler class (1 - 6 in this set).
BF_EDIT_FL	1 1 I	Flag from correction process values 1 - 8 as described below 1. Miscoded PS. 2. Connectivity (this flag indicated "pour" point). Some are left open, many were modified by snap nodes or added segments. 3. (Delete) does not exist on final set. 4. Flipped arc. 5. Added. These segments are broken at lake border, but not fully attributed. 6. (Added from DEM, client approved). 7. Gap created. 8. Dogleg (zinger corrected).
EDIT_DET	15 15 C	Edit detail – description corresponding to BF_EDIT_FL
ERRORS	20 20 C	Error messages from initial route creation (name and P/S errors)
STARTLENGTH	4 8 B	Attribute allows for adjusting route construction priority on inflowing streams
SEG_NO	4 6 B	Sequential upstream segment number (route design attribute)
HI_ORD	4 6 B	Highest Strahler order (route design attribute)
DOM_NU	4 6 B	Route ID (route design attribute)
DOM_ID	4 6 B	Route ID of corresponding primary route (route design att. on S flow)
NEWROUTFLAG	2 1 B	New Route required flag (route design attribute)
CHS_HYDPOLYCP#	4 5 B	?
AREA	8 18 F5	?
PERIMETER	8 18 F5	?
CHS_HYDROPOLY CP-ID	4 5 B	?
SBFLAG	1 1 C	?
POLY_FEAT	25 25 C	?
RECNO	2 5 B	Temporary work attribute

**CHS\_SEGS.AAT**

NAME	ITEM DEFINITION	ITEM DESCRIPTION
FNODE#	4 5 B	From-node sequence number.
TNODE#	4 5 B	To-node sequence number.
LPOLY#	4 5 B	Left polygon sequence number.
RPOLY#	4 5 B	Right polygon sequence number.
LENGTH	4 12 F5	Length in coverage units.
CHS_SEGS#	4 5 B	Arc internal sequence number (record number).
CHS_SEGS -ID	4 5 B	Arc feature identification.
ROUID	4 4 B	Route ID identifier.
FROM	4 7 F4	Start point along the route.
TO	4 7 F4	Stop point along the route.
FR-SPOT	8 12 F3	Elevation reading at start point.
TO-SPOT	8 12 F3	Elevation reading at stop point.
GRAD-SG	8 12 F3	Gradient for the segment.
GRAD	8 12 F3	Gradient for the segment.
ABSREACH	2 5 B	Unique reach identifier.
CURREACH	2 5 B	Unique reach identifier with in unique route.
CLASS	2 2 B	Specifies class based on which aggregation was made.
FROMREACH	8 10 F3	Starting point along the route for the aggregated reach.
TOREACH	8 10 F3	Ending point along the route for the aggregated reach.
GRADREACH	8 10 F3	Gradient for the aggregated reach.

**CHS\_REACHES.DBF**

NAME	ITEM DEFINITION	ITEM DESCRIPTION
FNODE#	4 5 B	From-node sequence number.
TNODE#	4 5 B	To-node sequence number.
LPOLY#	4 5 B	Left polygon sequence number.
RPOLY#	4 5 B	Right polygon sequence number.
LENGTH	8 18 F5	Length in coverage units.
CHS_REACHES#	4 5 B	Arc internal sequence number (record number).
CHS_REACHES-ID	4 5 B	Arc feature identification.
ABSREACH	4 6 B	Unique reach identifier.
IGNORESEG	1 1 C	Flag to help identify last arc for the reach.
DOWNELEV	10 3 DOUBLE	Elevation at the downstream node.
UPELEV	10 3 DOUBLE	Elevation at the upstream node.
RISE	10 3 DOUBLE	Rise( Upstream Elevation – Downstream elevation).
STRLNDIST	10 3 DOUBLE	Strait line distance from beginning to end.
VALLEYSLP	10 3 DOUBLE	Valley Slope.
CHANLEN	10 3 DOUBLE	Length of the channel.
CHANSLP	10 3 DOUBLE	Channel Slope.
SINUOSITY	10 3 DOUBLE	Sinuosity.
LOCDRAINA	10 3 DOUBLE	Local drainage area.
TOTDRAINA	10 3 DOUBLE	Total drainage area.
PARENT	4 5 B	Flag calculated for reaches that are parent reaches for sub-basins of specific Strahler class. (1,2...8)



**REACHPOINTS.DBF**

NAME	ITEM DEFINITION	ITEM DESCRIPTION
ID	5 0 INTEGER	Unique point identifier.
DOWNELEV	10 3 DOUBLE	Elevation at the downstream node.
UPELEV	10 3 DOUBLE	Elevation at the upstream node.
RISE	10 3 DOUBLE	Rise( Upstream Elevation – Downstream elevation).
STRLNDIST	10 3 DOUBLE	Strait line distance from beginning to end.
VALLEYSLP	10 3 DOUBLE	Valley Slope.
CHANLEN	10 3 DOUBLE	Length of the channel.
CHANSLP	10 3 DOUBLE	Channel Slope.
SINUOSITY	10 3 DOUBLE	Sinuosity.
LOCDRAINA	10 3 DOUBLE	Local drainage area.
TOTDRAINA	10 3 DOUBLE	Total drainage area.

**CHS\_WSD.PAT**

NAME	ITEM DEFINITION	ITEM DESCRIPTION
AREA	8 18 F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8 18 F 5	Perimeter in coverage units. Set to 0 for point features.
CHS_WSD#	4 5 B	Polygon internal sequence number (record number).
CHS_WSD-ID	4 5 B	Polygon feature identification.
GRID-CODE	4 8 B	Corresponds to reaches ABSREACH attribute.

**CHS\_WSD.UPSTREAM**

NAME	ITEM DEFINITION	ITEM DESCRIPTION
AREA	8 18 F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8 18 F 5	Perimeter in coverage units. Set to 0 for point features.
UPSTREAM#	4 5 B	Polygon internal sequence number (record number).
UPSTREAM-ID	4 5 B	Polygon feature identification.
ABSREACH	4 6 B	Reach identifier
PARENT	4 5 B	Parent flag calculated for regions that correspond to parent reaches for sub-basins of specific strahler class.

### Information on reach aggregation for Chisholm area

Chisholm area used the aggregation rules option table 2 containing number of gradient classes (for segments), min max class segment gradient, % change parameter for aggregation.

#### Agg\_rule\_2.tab

9			Number of segment classes
-90	0	0	min, max class gradient , % change parameter
0	1	0.5	
1	2	1.0	
2	3	1.5	
3	4	1.5	
4	6	2.0	
6	10	3.0	
10	20	5.0	
20	90	10.0	

After reading the option table an Avenue script assigns abs\_reach (and reach\_grad) attribute as per rules.

Reach summary tool was applied to all reaches and to a selected group of reaches with length > 60m. An external ASCII summary option table 2 was used. Summary option table contains number of target reach classes, min max class reach gradient and class name attributes.

#### Summ\_par\_2.tab

10			Number of reach classes
-90.0	0.0	-1	min max Class
0.0	1.0	1	
1.0	2.0	2	
2.0	3.0	3	
3.0	4.0	4	
4.0	6.0	5	
6.0	10.0	6	
10.0	20.0	7	
20.0	40.0	8	
40.0	90.0	9	

An Avenue script applies reach classification and displays statistics ie. count, min, max, average length, average gradient for each reach class.

**Results****All Reaches**

Class	Count	Min Length	Max Length	Avg Length	Avg Grad
1	396	16.1	15023.4	459.4	-0.7
2	7127	0.6	52585.4	505.0	0.5
3	4651	4.5	31448.0	339.5	1.5
4	2892	6.4	27669.2	304.2	2.5
5	2553	6.8	4892.8	252.7	3.5
6	3097	6.5	8121.3	248.9	5.0
7	2188	6.9	2138.7	201.1	7.7
8	1024	8.1	3593.2	189.2	13.2
9	90	14.7	820.1	175.8	25.4
Total: 24018					

**Over 60m length**

Class	Count	Min Length	Max Length	Avg Length	Avg Grad
1	248	63.7	14991.1	406.5	-0.4
2	6529	60.0	52585.4	546.5	0.5
3	4523	60.0	31448.0	352.1	1.5
4	2831	60.2	27669.2	314.2	2.5
5	2511	60.0	4892.8	261.4	3.5
6	3058	60.1	8121.3	253.0	5.0
7	2157	60.0	6308.0	208.9	7.7
8	1019	63.3	3593.2	192.2	13.2
9	88	65.7	842.6	181.1	25.1
Total: 22964					

**Note:** The elevation data accuracy and the calculated slope attributes for the reaches shorter than 60m may be misleading. Such short reaches could have both start and end elevation assigned from either value and gradient / slope attribute set to 0. Most of these short reaches were created due to the topological constraints such as crossing a lake, or connecting network segment in the double line river, and even adjusted DEM will not support precise reading of elevation data for these.