# Cruise Plans 101

Northern Interior Cruising Committee
P.R. Smith, RPF, ATE
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# Introduction

- **Objective of the cruise is to make an <u>unbiased</u> estimate of volume and quality**
  - ✓ Unbiasedness starts with the Cruise Plan
  - ✓ Cruise Plans must be submitted to the Ministry BEFORE field cruise to provide this assurance

- **Cruise Plans are Professional Documents – treat them as such**
  - ✓ Appropriate supervision & accountability
  - ✓ Professional quality work (clear and free of errors)
  - ✓ Professional rationale for changes to the plan

# Agenda

- **Grids**
  - ✓ Sample Grid Interval
  - ✓ Sample Grid Systems
  - ✓ Sample Grid Patterns
  - ✓ Adding Plots
- **Timber Typing**
  - ✓ Stratification
  - ✓ Forest Types
- **Cruise Plans**
  - ✓ Cruise Manual Standards
  - ✓ Changes to the Cruise Plan

# Sample Grid Interval

- **Formula**

$$\text{Grid Interval (m)} = \sqrt{\frac{\text{Area}(m^2)}{\text{\# Plots}}}$$

  - ✓ Recommend rounding (down) to nearest 5m or 10m
  - ✓ Example:
    - ☞ Merch. Area = 123.4ha; # Plots = 89
    - ☞ GI = $\sqrt{1234000 m^2 / 89}$
      = 117.75m
      = 115m (~93 plots)

# Sample Grid Systems

- **GIS Grid**
  - ✓ Plot locations predetermined by GIS-generated grid
    - ☞ "Management Unit" scale
    - ☞ Easy to generate cruise plan maps electronically
    - ☞ Note that UTM & Albers projections are slightly off True North (See page A-169 of the Provincial Cruising Manual)
    - ☞ Be prepared to share the grid, including HOW it was derived, with the Ministry check cruiser
    - ☞ Using GPS for layout, potential to bias layout to include/exclude specific plot locations – now you know it, DO NOT exploit it

# Sample Grid Systems

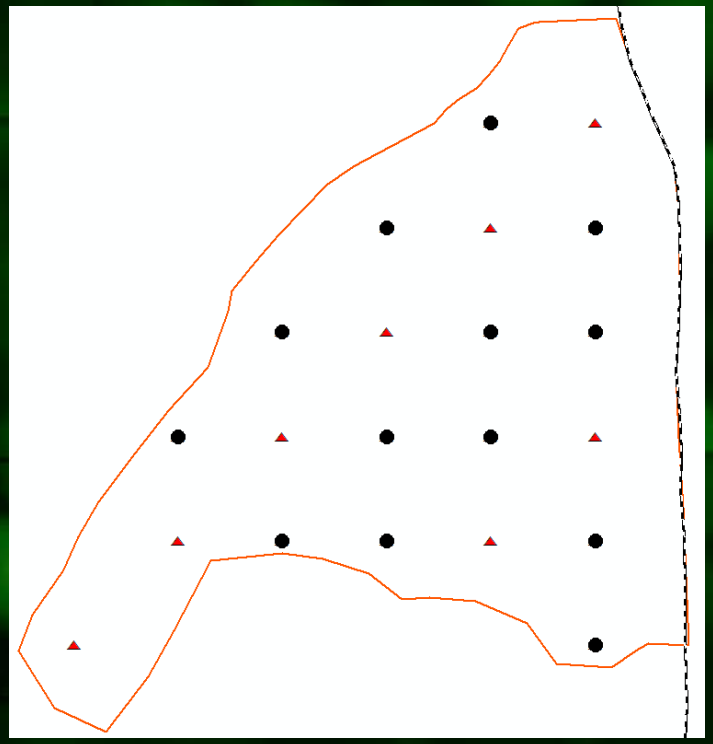
- **Local Grid**
  - ✓ Plot locations determined for each Forest Type based on the configuration of the type
    - ☞ Note the use of Merch. Area, not Block (new)
    - ☞ Locations of plots not (reasonably) predictable at layout
    - ☞ Selection bias (population within grid interval of southern-most and western-most points never sampled) – now you know it, DO NOT exploit it
- **Grid System must be consistent within a sample (cutting permit)**
    - ☞ See page 2-8 of the Provincial Cruising Manual

# Sample Grid Patterns

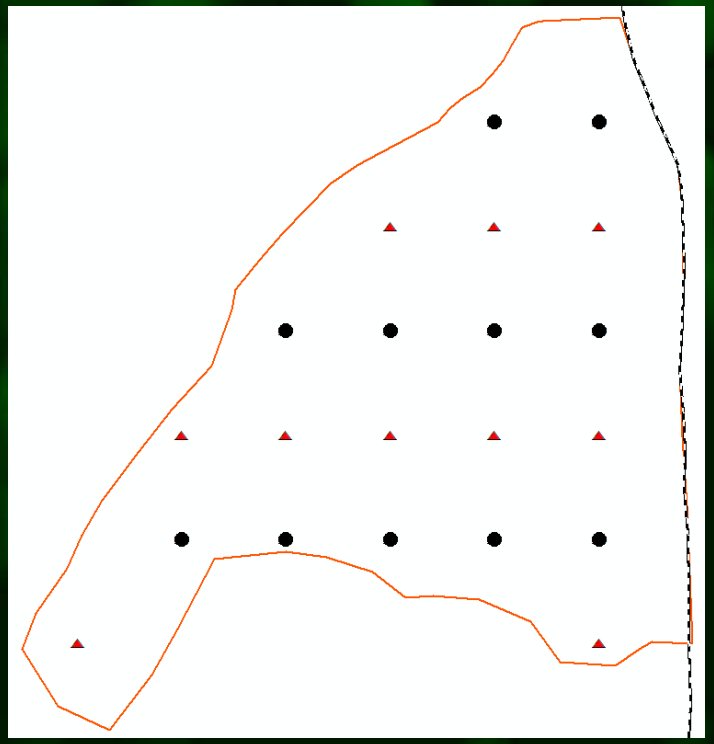
- **Distribution of Measure and Count Plots**
  - ✓ Must be systematic to avoid bias
  - ✓ Must be consistent within a sample (cutting permit)
  - ✓ Clarification of Section 2.4.1
    - ☞ "If count plots are used… the most westerly plot on the most southerly line… must be a measure plot."
    - ☞ AND is the start / anchor of the systematic pattern

# Sample Grid Patterns

- **Typical Patterns**
  - ✓Off-set (1:2)

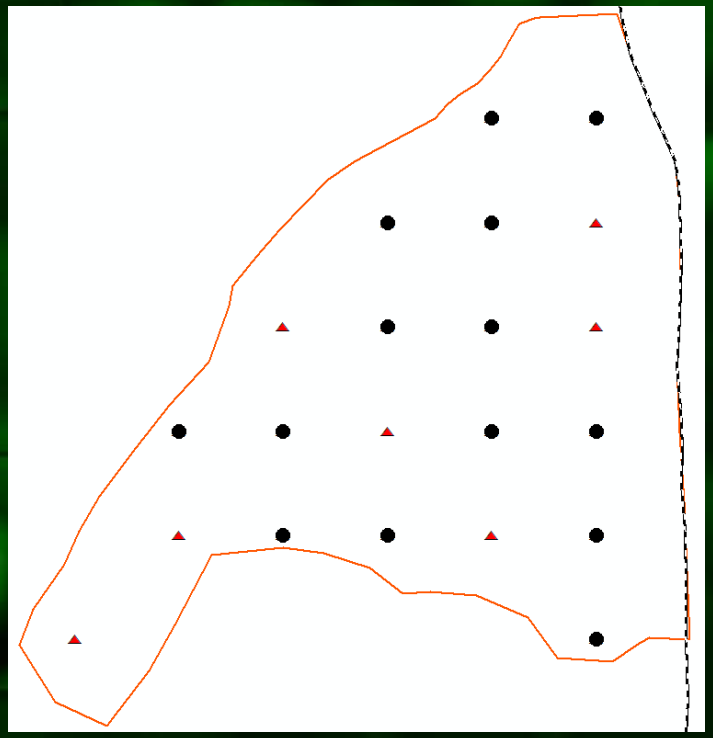


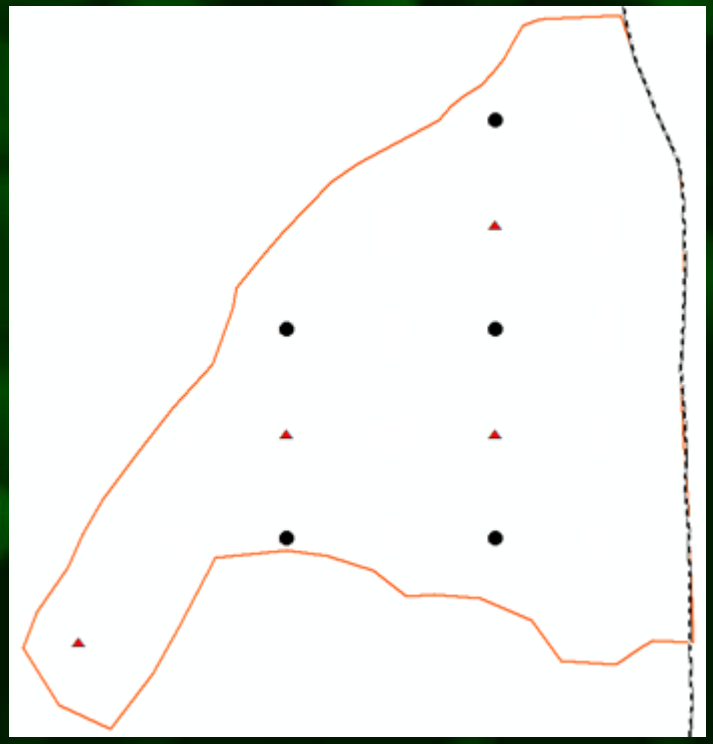
  - ✓Linear (1:1)



# Sample Grid Patterns

- **Typical Patterns**
  - ✓Sequential (1:2)
  - ✓Alternating (1:1)





# Adding Plots

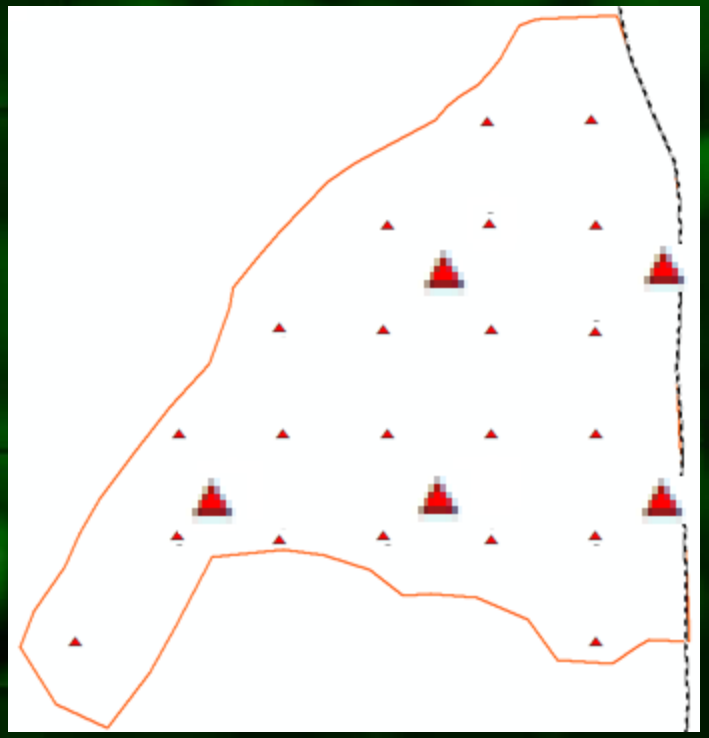
- **To meet Sampling Error requirements**
  (not because you don't like the first answer!)
- **Grid Interval**
  - ✓ Calculate total number of plots needed to meet SE
    (use CV from original plots)
  - ✓ Subtract original number of plots
  - ✓ Grid Interval of Add Plots (m) = $\sqrt{\frac{\text{Area}(m^2)}{\text{\# Add Plots}}}$
    - ☞ Merch. Area = 123.4ha; # Add Plots = 14
    - ☞ GI = $\sqrt{1234000 m^2 / 14}$
      = 296.89m
      = 295m

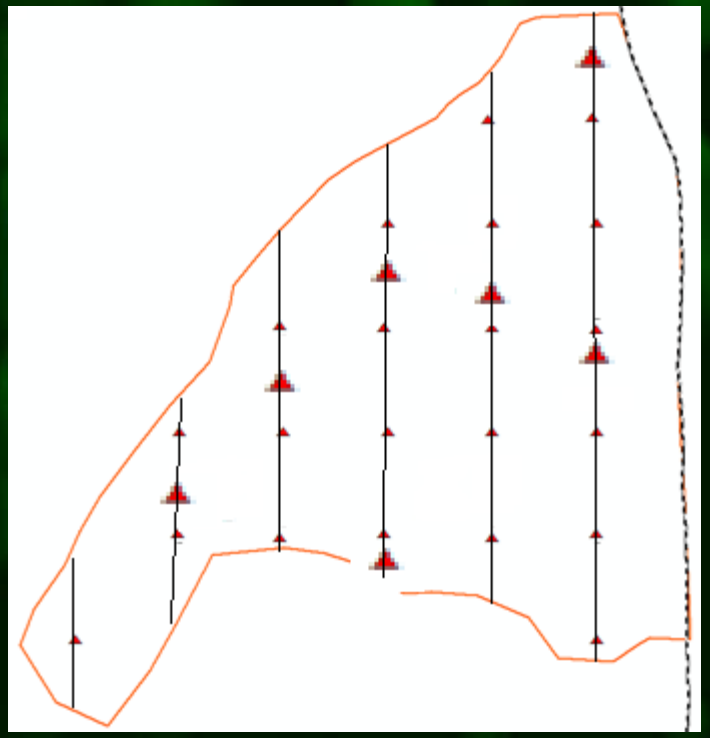
# Adding Plots

- **Grid Patterns**
  - ✓ New Grid
    - ☞ GIS Grid: position "first plot" of new grid over "first plot" of original GIS grid
    - ☞ Local Grid: project new grid from the start location of the original grid
  - ✓ Existing Grid
    - ☞ Add plots may be systematically located on the existing cruise strips
    - ☞ e.g. total strip length # Add Plots = distance between Add Plots
    - ☞ See page 2-10 of the Provincial Cruising Manual

# Adding Plots

- **Grid Patterns**
  - ✓New Grid (Local)
  - ✓Existing Grid





# Stratification

- **What**
  - ✓ Delineation and grouping of similar characteristics
- **When**
  - ✓ BEFORE field sampling to eliminate bias
    - ☞ See pages 2-3 and 2-18 of the Provincial Cruising Manual
- **Why**
  - ✓ To reduce overall variances in volume
  - ✓ To isolate a highly variable population
  - ✓ To sample at different intensities
  - ✓ To process differently post-sample
  - ✓ Stratify only if it gives a real sampling efficiency benefit

# Stratification

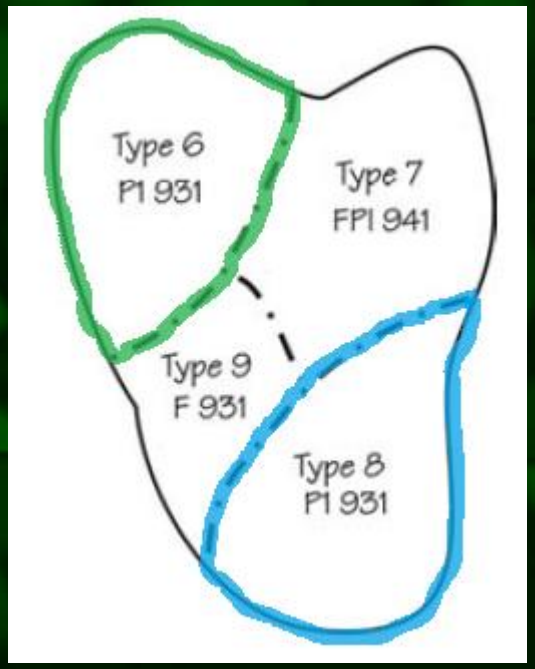
- **How**
  - ✓ Typically by (stereo)photo interpretation
  - ✓ Typically using stand characteristics such as height, crown closure, species (estimates of volume)
  - ✓ Could use VRI polygons – but this is a BAD idea
  - ✓ *Don't over-stratify*

# Forest Types

- **“Types”**
  - ✓ The Provincial Cruising Manual identifies four “Types”
    - ☞ Forest Types (merch. timber to be harvested – sampled)
    - ☞ Non-Forest Types (not merch. timber – not sampled)
    - ☞ Forest Reserves (merch. timber (or not) to be not harvested – not sampled)
    - ☞ Silviculture Treatment Units (areas of different silv. or harvest treatment – “overlap” Forest Types – sampled)
    - ☞ See page 2-18 of the Provincial Cruising Manual
- **Only the Forest Types** (and Silviculture Treatment Units) **are stratified**

# Forest Types

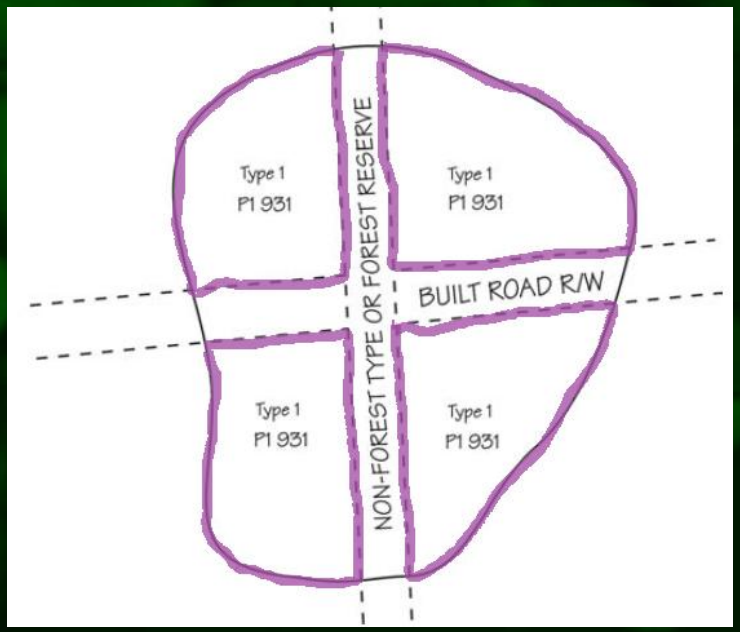
- **Stratification of Forest Types**
  - ✓ Forest Type polygons MUST be contiguous…




☞See pages 2-3 & 2-18 of the Provincial Cruising Manual

# Forest Types

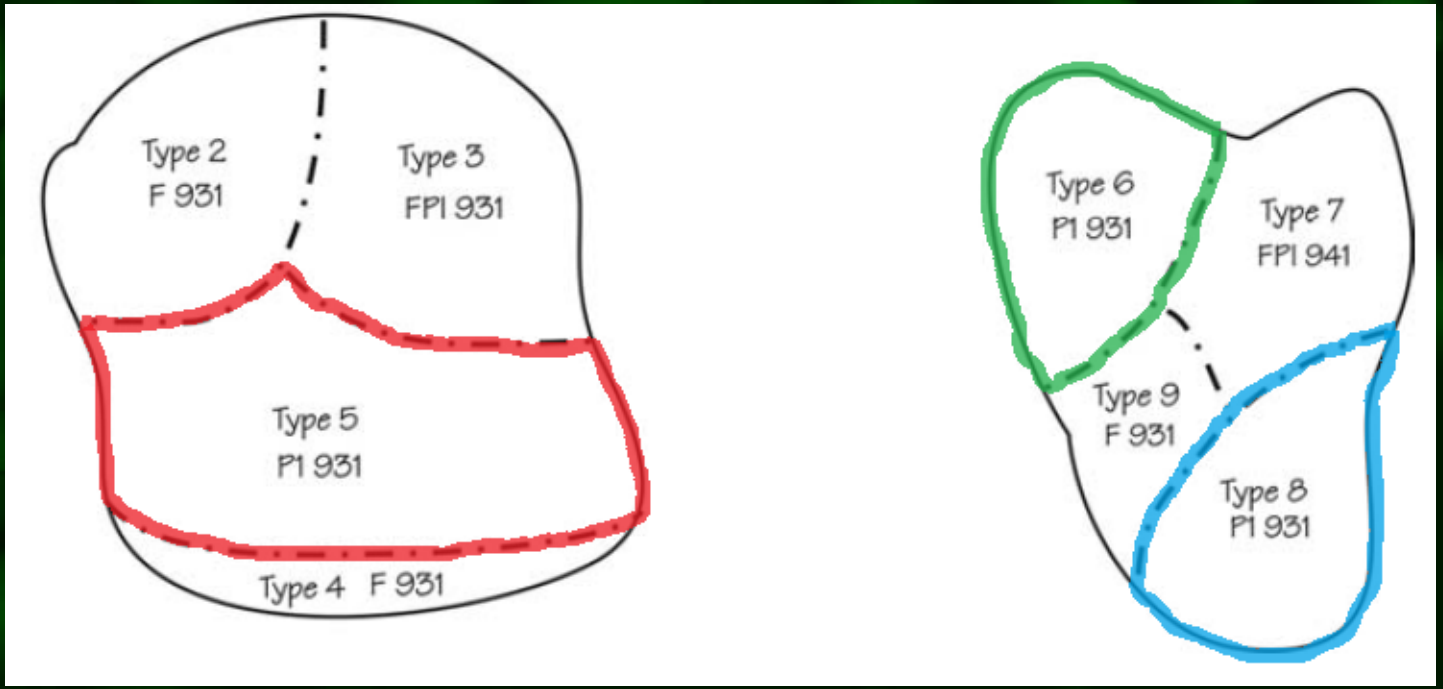
- **Stratification of Forest Types**
  - ✓ … except Forest Type polygons CAN be split by Non-Forest Types




☞See page 2-3 of the Provincial Cruising Manual

# Forest Types

- **Stratification of Forest Types**
  - ✓ Forest Type polygons must be unique to each cutblock




☞See pages 2-3 & 2-18 of the Provincial Cruising Manual

# Forest Types

- **Stratification of Non-Forest Types**
  - ✓ Typing of non-productive areas must be consistent
    - ☞ If a 0.3ha NP area is typed out, then ALL NP areas ≥0.3ha must be typed out
    - ☞ Upside: keeps Merch. Area "merch." and MAY improve Sampling Error
    - ☞ Downside: more opportunities for mistakes in data collection
    - ☞ In my experience, if it is worth excluding from the Merch. Area, it is worth ribboning out at layout (applies to all non-forest types)

    - ☞ See page 2-18 of the Provincial Cruising Manual

# Cruising Manual Standards

- **Minimum Plot Requirements**
  - ✓ CP <250ha:  200m grid or 1M Plot per 4.0ha
  - ✓ CP >250ha:  250m grid or 1M Plot per 6.25ha
  - ✓ Timber Type ≥1.0ha minimum 2M Plots
  - ✓ Timber Type <1.0ha minimum 1M Plot
  - ✓ All plots that can be established in the net merch. area must be cruised
    - ☞See pages 2-3, 2-5 & 2-8 of the Provincial Cruising Manual

# Cruising Manual Standards

- **Sampling Error Requirements**
  - ✓ Net Merch. Volume BEFORE reductions
  - ✓ Scale-Based:  15.0% (2SE) using M & C Plots
  - ✓ MPB Cruise-Based: 12.0% (2SE) using M & C Plots
  - ✓ Other Cruise-Based:  8.0% (2SE) using M & C Plots AND 12.0% using M Plots only
    - ☞See pages 2-5 to 2-7 of the Provincial Cruising Manual

# Cruising Manual Standards

- **Waiving Sampling Error Requirements**
  - ✓ Cutting Permits >20.0ha
    - ☞ 100mX100m Grid
    - ☞ Average ≥4.0 trees/plot
    - ☞ 1M:1C Plot ratio (based on *grid pattern of the cruise plan*, not actual numbers of plots planned or cruised)
  - ✓ Cutting Permits <20.0ha
    - ☞ 100mX100m Grid
    - ☞ Average ≥4.0 trees/plot
    - ☞ ALL M Plots

    - ☞ See page 2-6 of the Provincial Cruising Manual

# Cruising Manual Standards

- **The Important Map Content**
  - ✓ Timber Types:  define the population
    - ☞ Cutting boundaries
    - ☞ Forest and Non-Forest Type boundaries
    - ☞ Type Area Summary *
  - ✓ Plots
    - ☞ Grid Interval(s)* (especially if not using GPS)
    - ☞ Measure & Count Plots identified
    - ☞ Plots numbered
    - ☞ Recommend plot maturity if VRI-aging PI

* See Form FS693 notes

# Cruising Manual Standards

- **The Important Map Content**
  - ✓ Miscellaneous
    - ☞ Block Identification
    - ☞ Scale
    - ☞ Forest Reserve Types (and Silviculture Treatment Units) boundaries
    - ☞ VRI polygons & labels (for VRI-aging PI)
    - ☞ Existing (= Non-Forest Type) and proposed roads
    - ☞ See pages 3-3 to 3-5 of the Provincial Cruising Manual

# Cruising Manual Standards

- **Form FS693**
  - ✓ * If the required information is on the Cruise Plan Map, the info is not required on the form
  - ✓ The information may be provided in a format other than FS693
  - ✓ Some of the information on the form may not be available before cruising – don't sweat it
    - ☞ See pages A-39 & A-40 of the Provincial Cruising Manual

# Changes to the Cruise Plan

- **Changes before field cruise has started**
  - ✓ Re-submit the plan

# Changes to the Cruise Plan

- **Changes AFTER field cruise has started (or finished)**
  - ✓ ARE BIASED (that is a fact – get over it)
  - ✓ Should be RARE (for unforeseen – *and reasonably unforeseeable* – circumstances)
  - ✓ Must be submitted with a Professional Rationale
    - ☞ Reasons for the changes
    - ☞ Assessment of the impacts of the changes
    - ☞ Updated map

    ☞ See page 2-4 of the Provincial Cruising Manual

# The End

Any Questions?

Resources:

**Provincial Cruising Manual**

http://www.for.gov.bc.ca/hva/manuals/cruising.htm

**A Sampler of Inventory Topics**

Iles, Kim, 2003. Kim Iles & Associates Ltd.