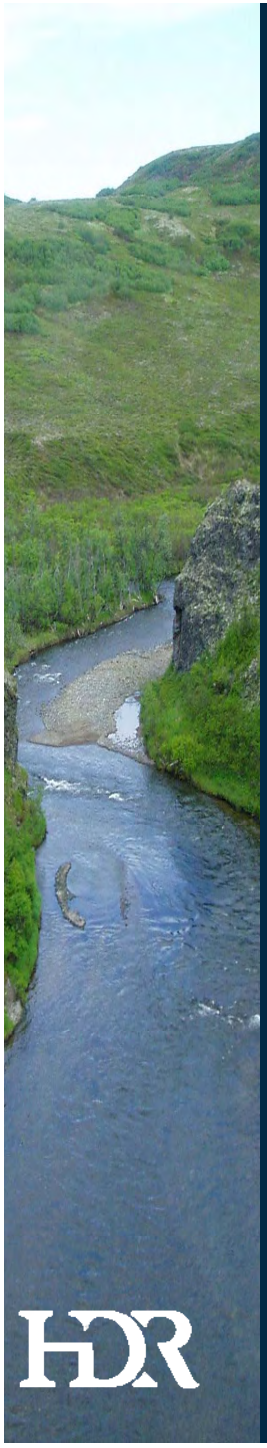
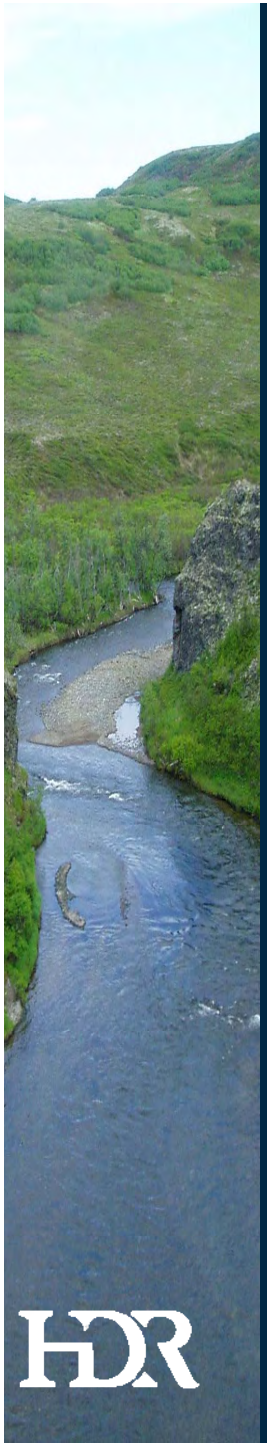


Pebble Project
Surface Water Hydrology – Mine

Shawn Florio, PE

Agency Meetings

November 28, 2007



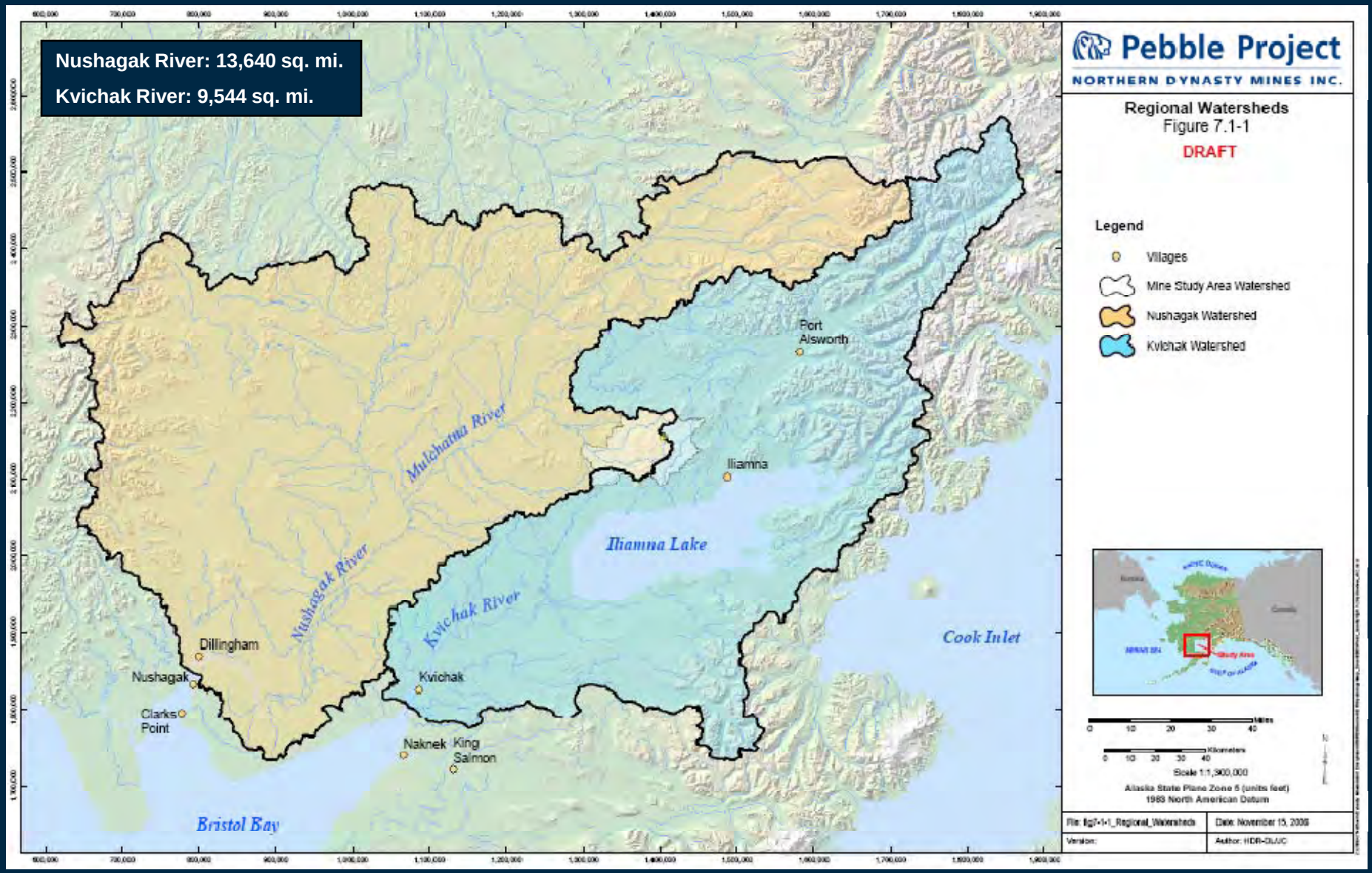
Discussion Topics

- Program Objectives
- Study Area
- Field Studies
- Results

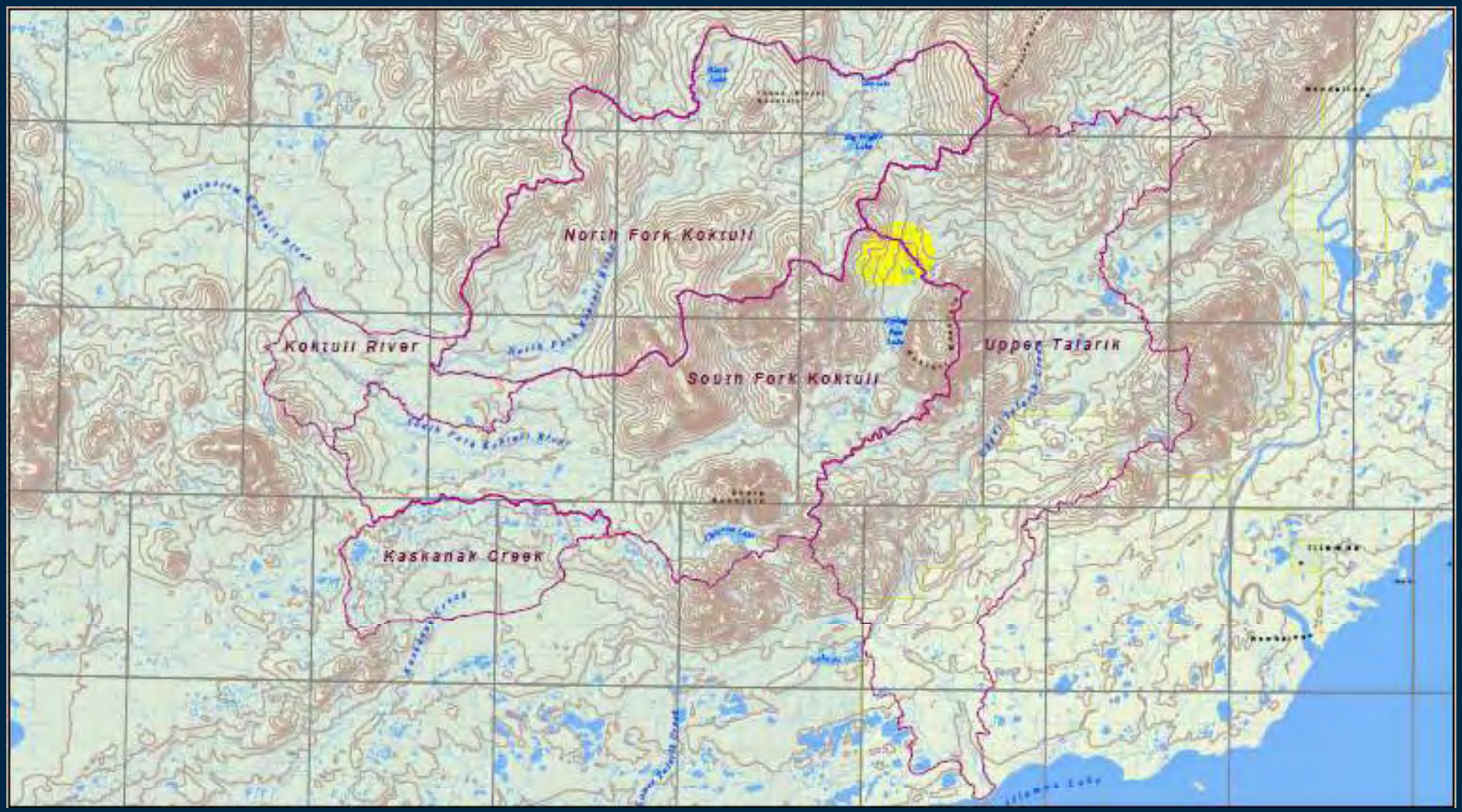
Program Objectives

- **Fulfill NEPA & CWA Needs (USEPA Hardrock Mining Handbook)**
  - Watershed Delineation
  - Stream Flows (Avg. Monthly, Baseflows, Flood Frequency)
  - Understand Gaining & Losing Reaches
  - Precipitation/Infiltration/Runoff Relationships
  - Channel Morphology & Sediment Transport
- **Provide Baseline Data**
  - Project Design
    - Water Balance
    - Alternatives Analysis
  - Project Permitting Process

Study Area
Regional Drainage Basins



Study Area Drainage Basins



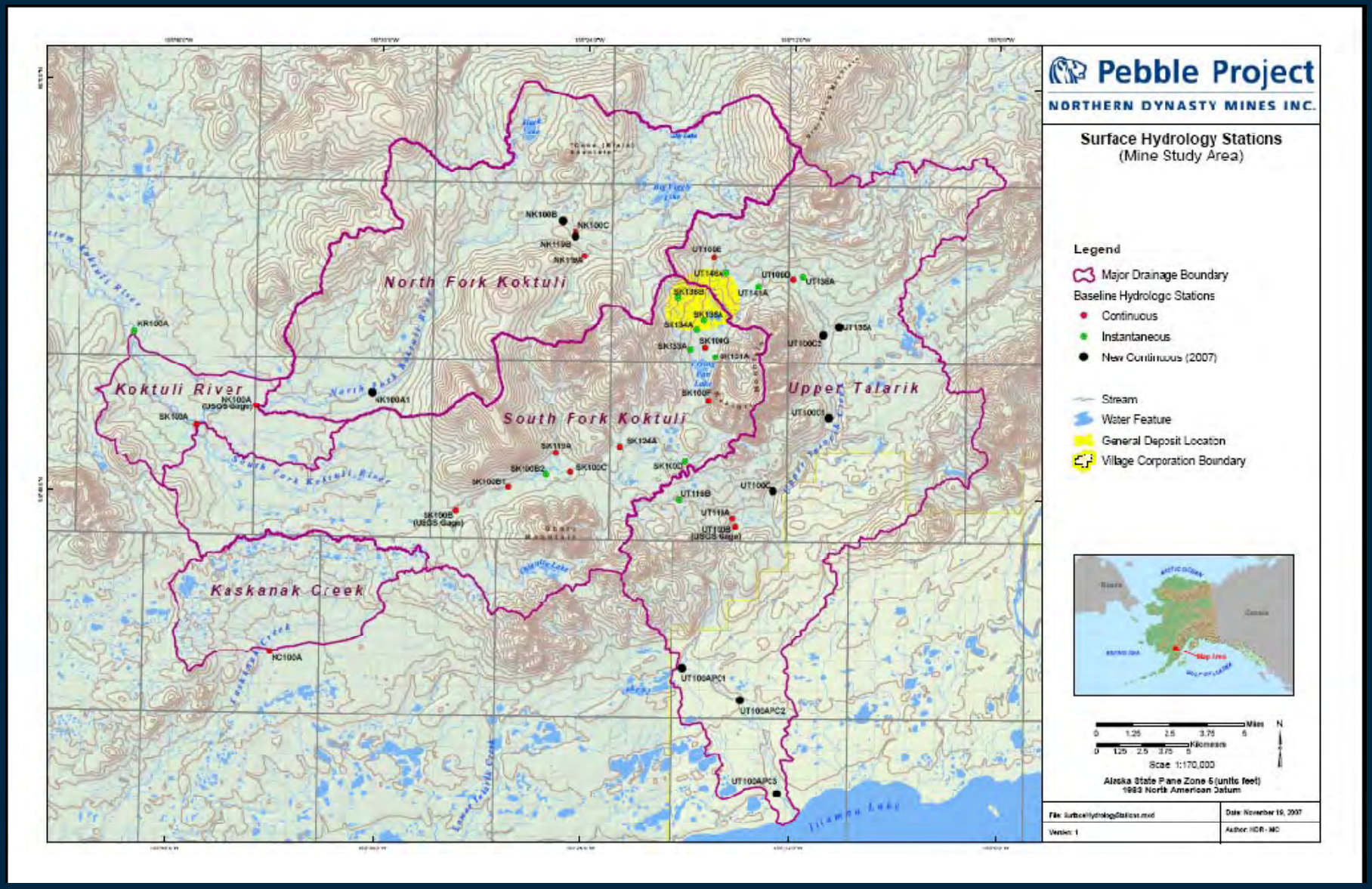
Field Studies

- Baseline Hydrology
- Low Flow (Baseflow)

Baseline Hydrology

- Monthly Field Visits
  - 38 Stations
  - 12 Measurements Per Year Per Station
  - Coincident with Water Quality Samples
- 12 Instantaneous (Only) Stations
  - Measurement Provided to Water Quality Team
- 26 Continuously Gaged
  - During Ice-Free Months
  - Winter Field Measurements
- Period of Record
  - 1991 to 1994 – Partial Record
  - 2004 to 2007 – Continuous Record
  - 2005 - 2 New Gages
  - 2007 - 10 New Gages
  - Data Through May 2006 Processed

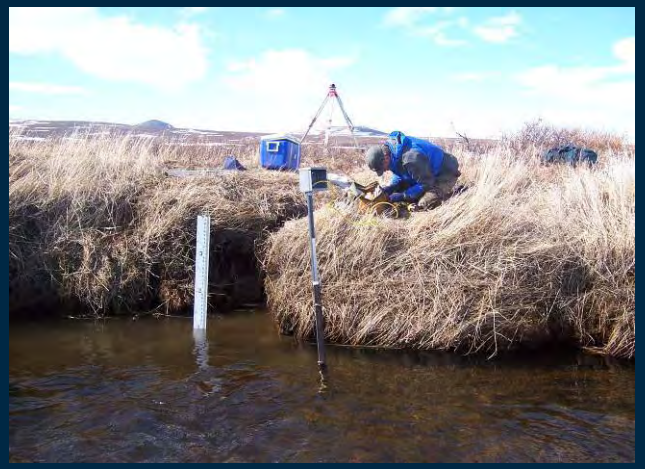
Baseline Station Locations



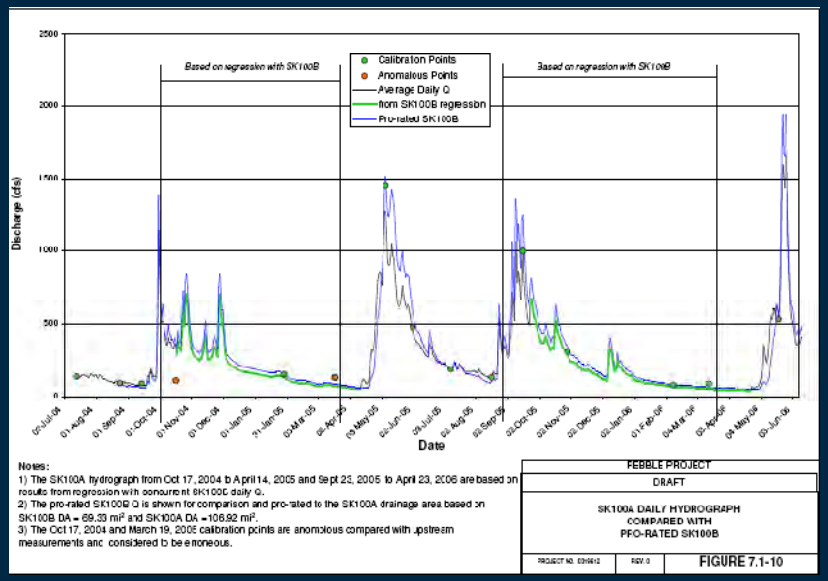
Discharge Measurement Methods

- **Standard USGS Discharge Methods**
  - **Velocity Meters**
  - **Salt-Dilution**

- **Surveyed Staff Gages & Data Loggers**



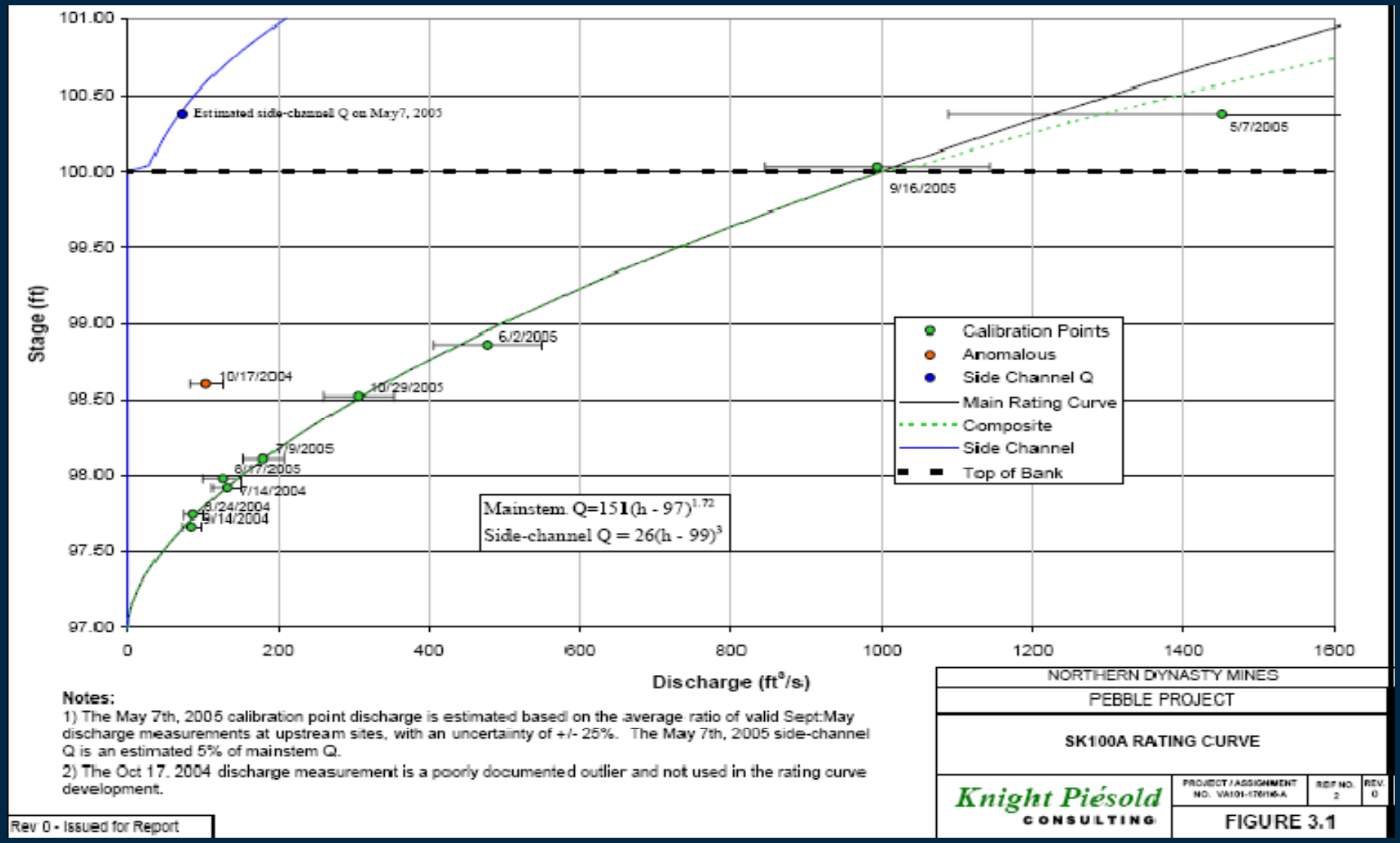
Results of Baseline Studies



Notes:
1) The SK100A hydrograph from Oct 17, 2004 to April 14, 2005 and Sept 23, 2005 to April 23, 2006 are based on results from regression with concurrent SK100B daily Q.
2) The pro-rated SK100B Q is shown for comparison and pro-rated to the SK100A drainage area based on SK100B DA = 69.33 mi² and SK100A DA = 106.92 mi².
3) The Oct 17, 2004 and March 19, 2005 calibration points are anomalous compared with upstream measurements and considered to be erroneous.

FEBBLE PROJECT
DRAFT
SK100A DAILY HYDROGRAPH COMPARED WITH PRO-RATED SK100B
PROJECT NO. 03481 | REV. 0 | FIGURE 7.1-10

Rating Curve Development



Notes:

1) The May 7th, 2005 calibration point discharge is estimated based on the average ratio of valid Sept:May discharge measurements at upstream sites, with an uncertainty of +/- 25%. The May 7th, 2005 side-channel Q is an estimated 5% of mainstem Q.

2) The Oct 17, 2004 discharge measurement is a poorly documented outlier and not used in the rating curve development.

Rev 0 - Issued for Report

NORTHERN DYNASTY MINES

PEBBLE PROJECT

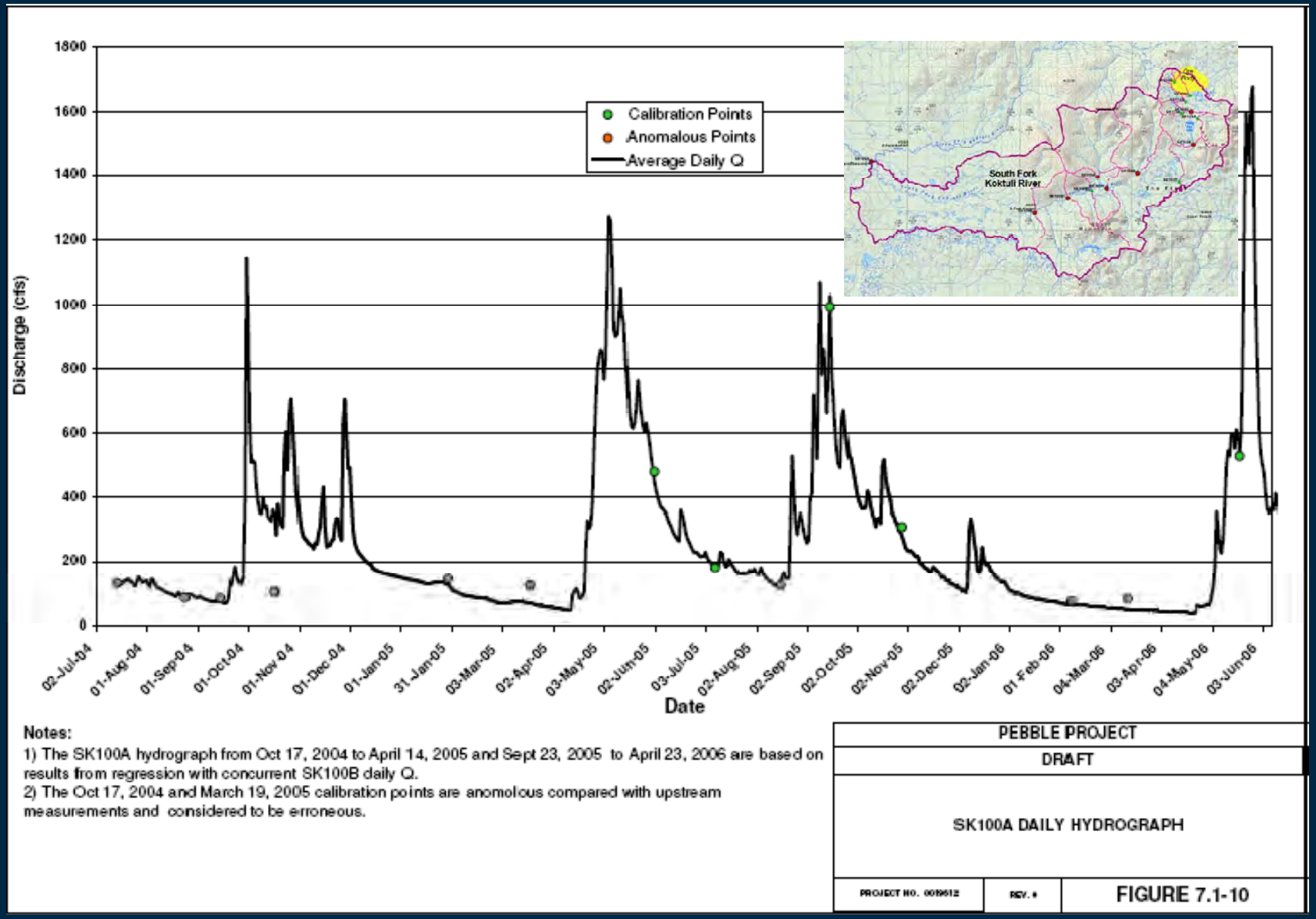
SK100A RATING CURVE

Knight Piésold CONSULTING

PROJECT / ASSIGNMENT NO. VA101-170/16-A | REF NO. 2 | REV. 0

FIGURE 3.1

Hydrographs
SK100A

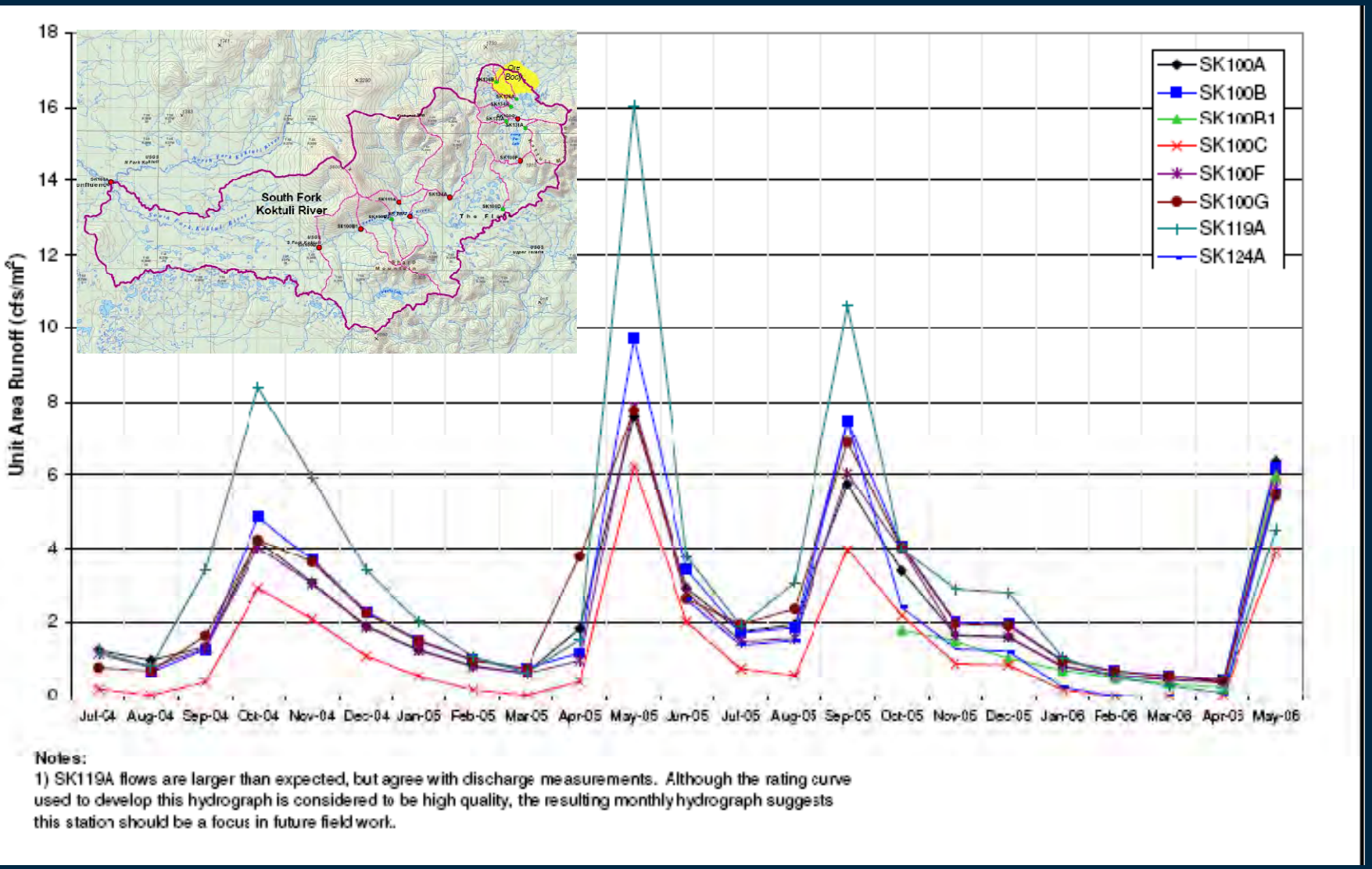


Notes:
1) The SK100A hydrograph from Oct 17, 2004 to April 14, 2005 and Sept 23, 2005 to April 23, 2006 are based on results from regression with concurrent SK100B daily Q.
2) The Oct 17, 2004 and March 19, 2005 calibration points are anomolous compared with upstream measurements and considered to be erroneous.

PEBBLE PROJECT		
DRAFT		
SK100A DAILY HYDROGRAPH		
PROJECT NO. 0019512	REV. 0	FIGURE 7.1-10

Unit Runoff Comparison

Monthly Means on South Fork

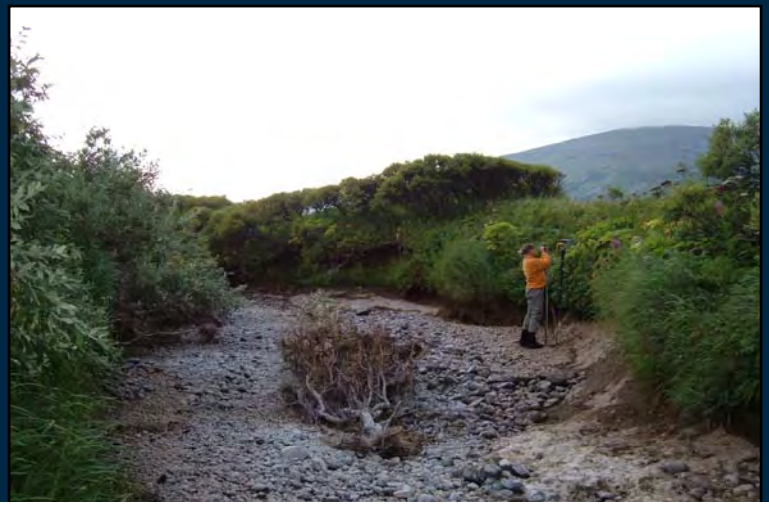


Notes:

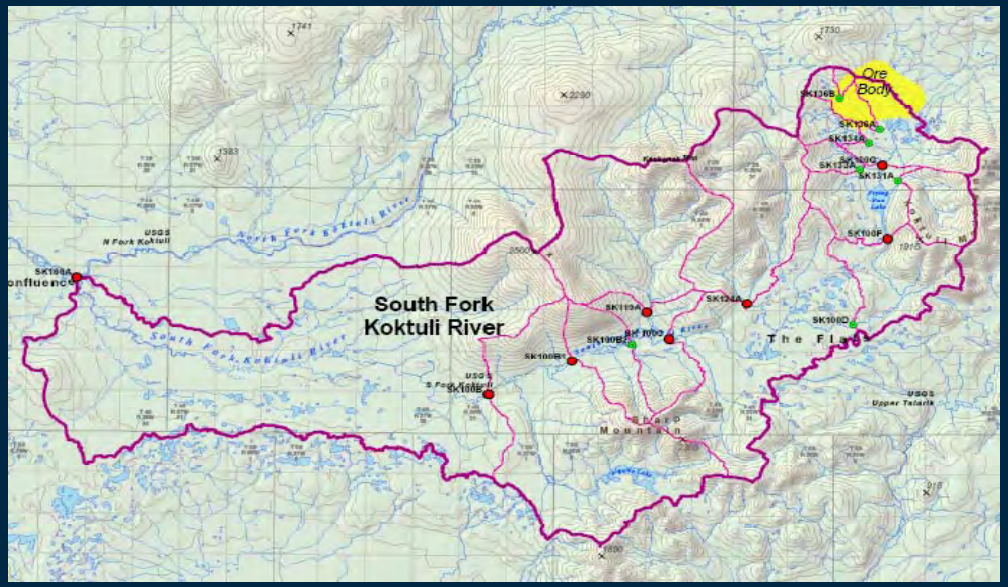
1) SK119A flows are larger than expected, but agree with discharge measurements. Although the rating curve used to develop this hydrograph is considered to be high quality, the resulting monthly hydrograph suggests this station should be a focus in future field work.

Intermittent Reach

SK100C - July 2005. Q = 22 cfs.

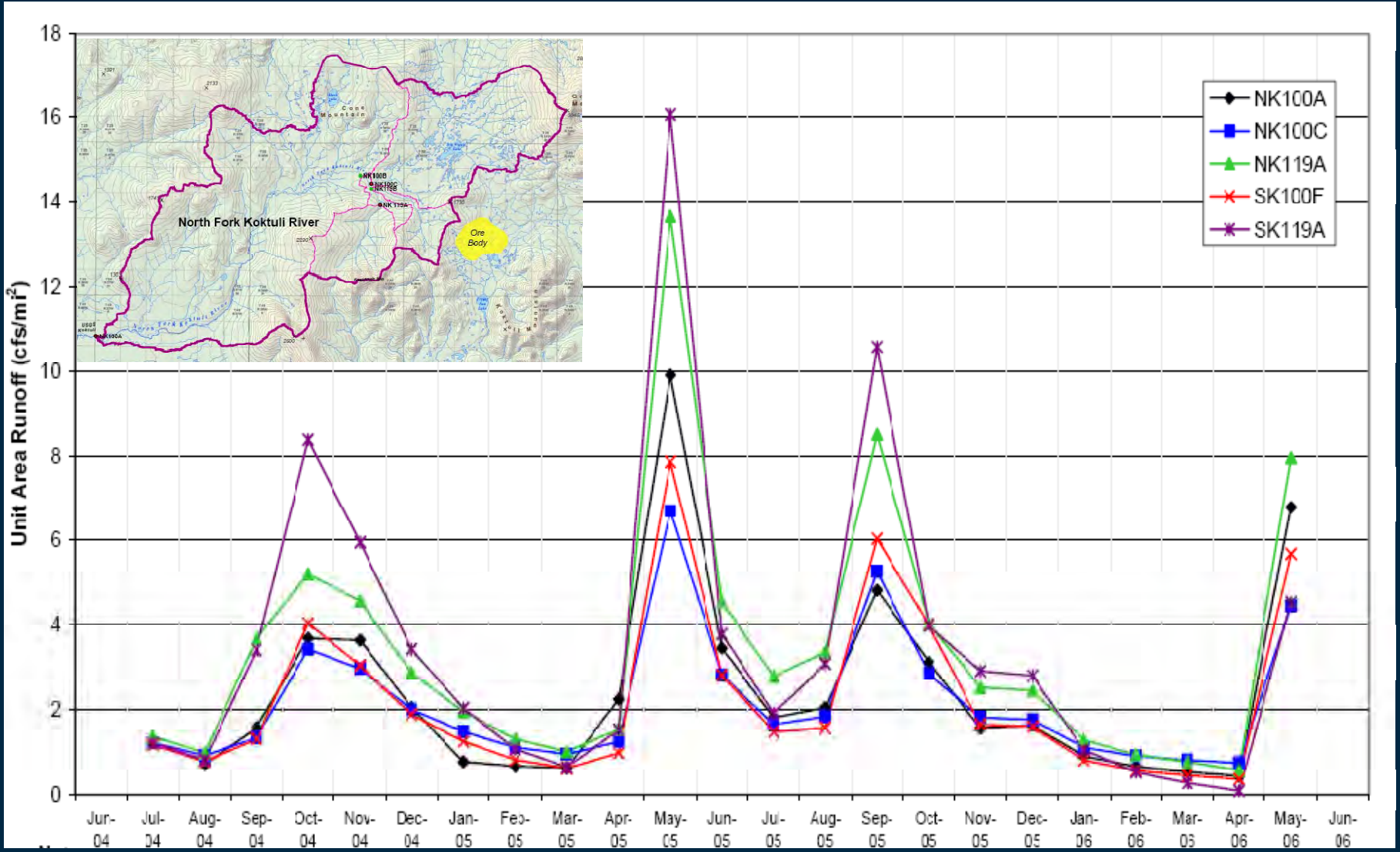


SK100C - August 2005. Q = 0 cfs.



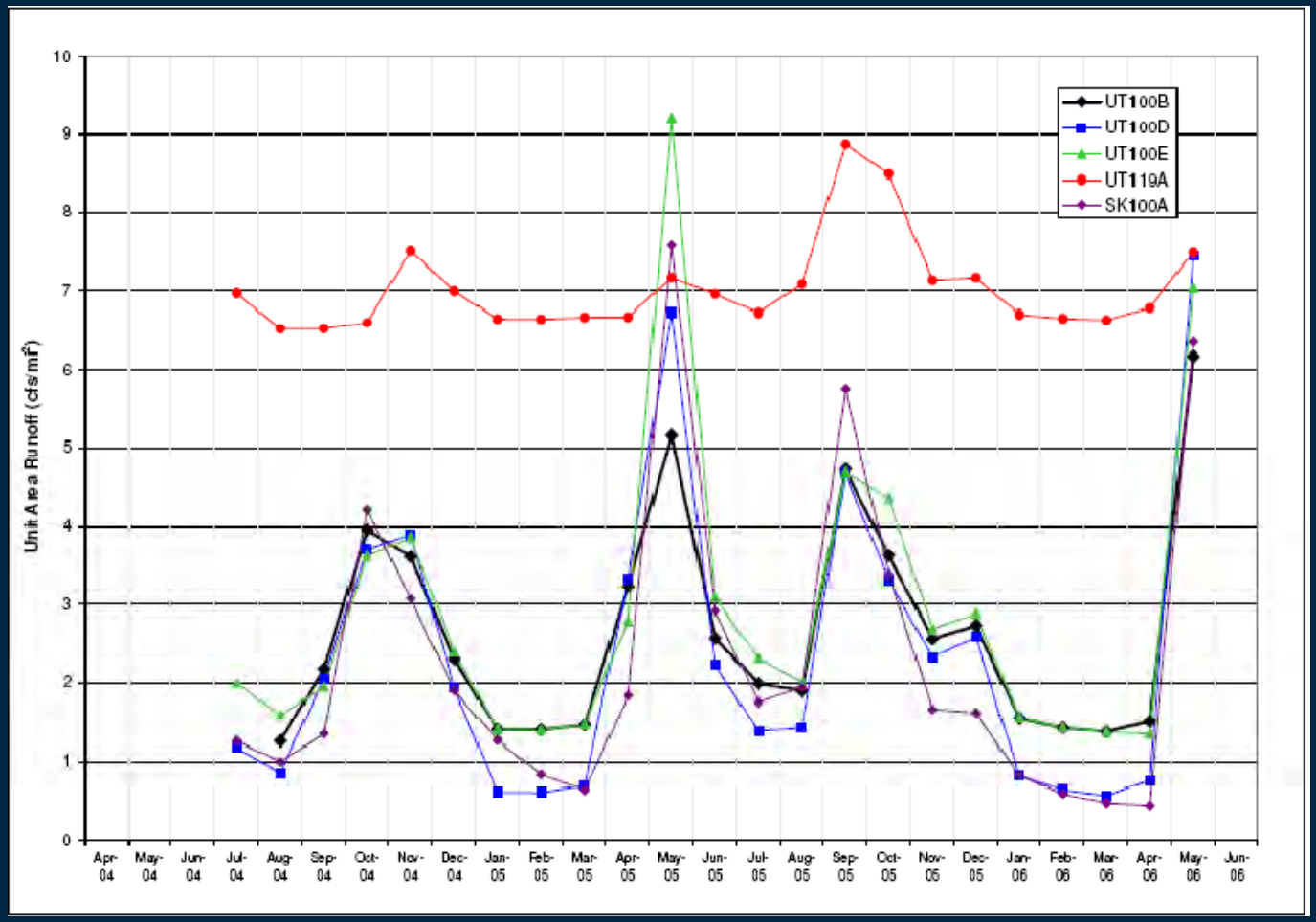
SK100F - August 2005. Q = 16 cfs.

Unit Runoff Comparison
Monthly Means - North Fork Koktuli

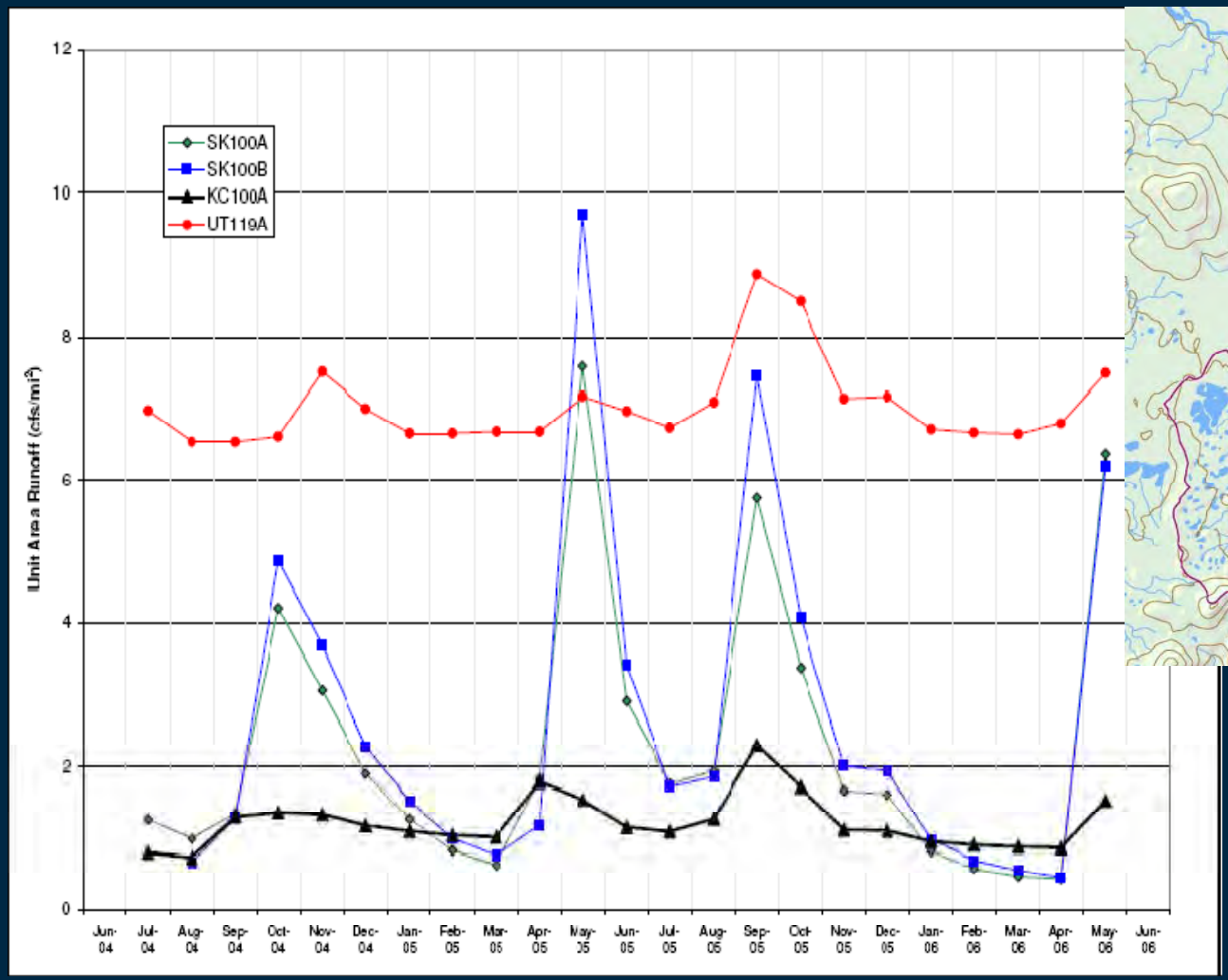


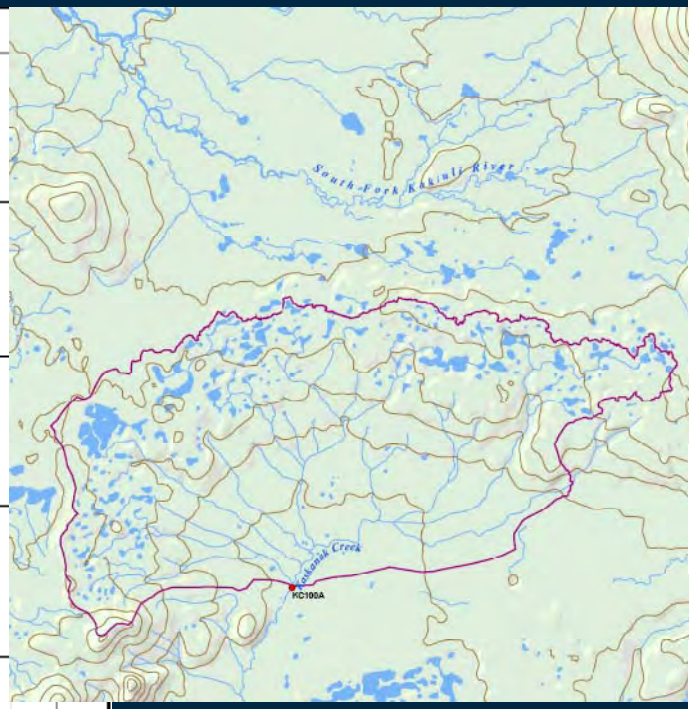
Unit Runoff Comparison

Monthly Means on Upper Talarik



Unit Runoff Comparison
Kaskanak Creek to SFK and UT



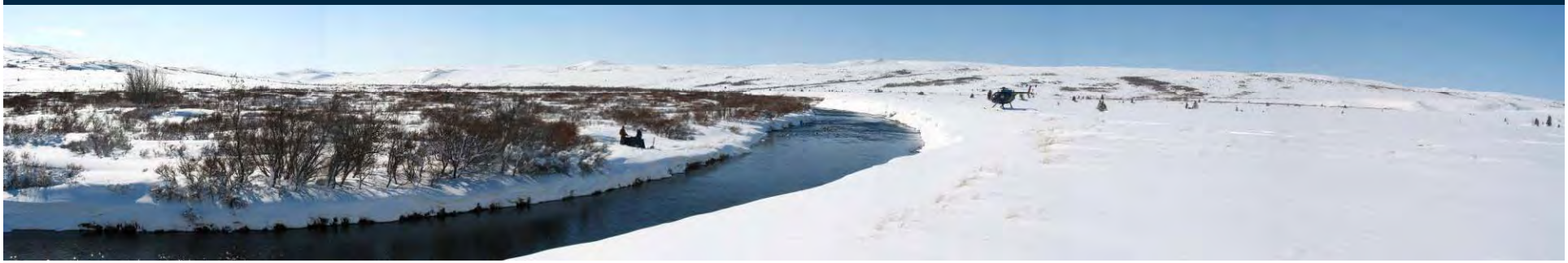


Baseflow (Low Flow) Analysis

Objectives:

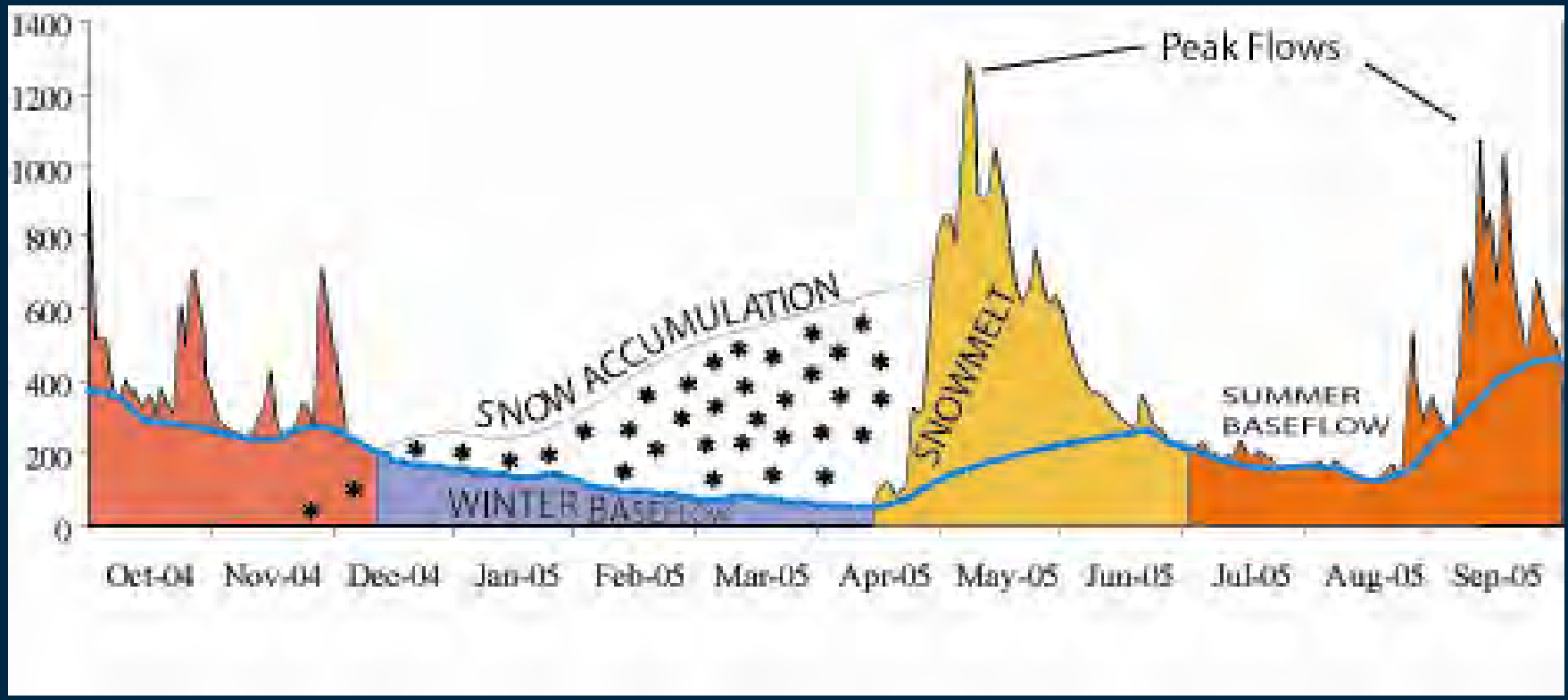
- Documenting Low Flow Conditions

- Understanding Gaining & Losing Reaches

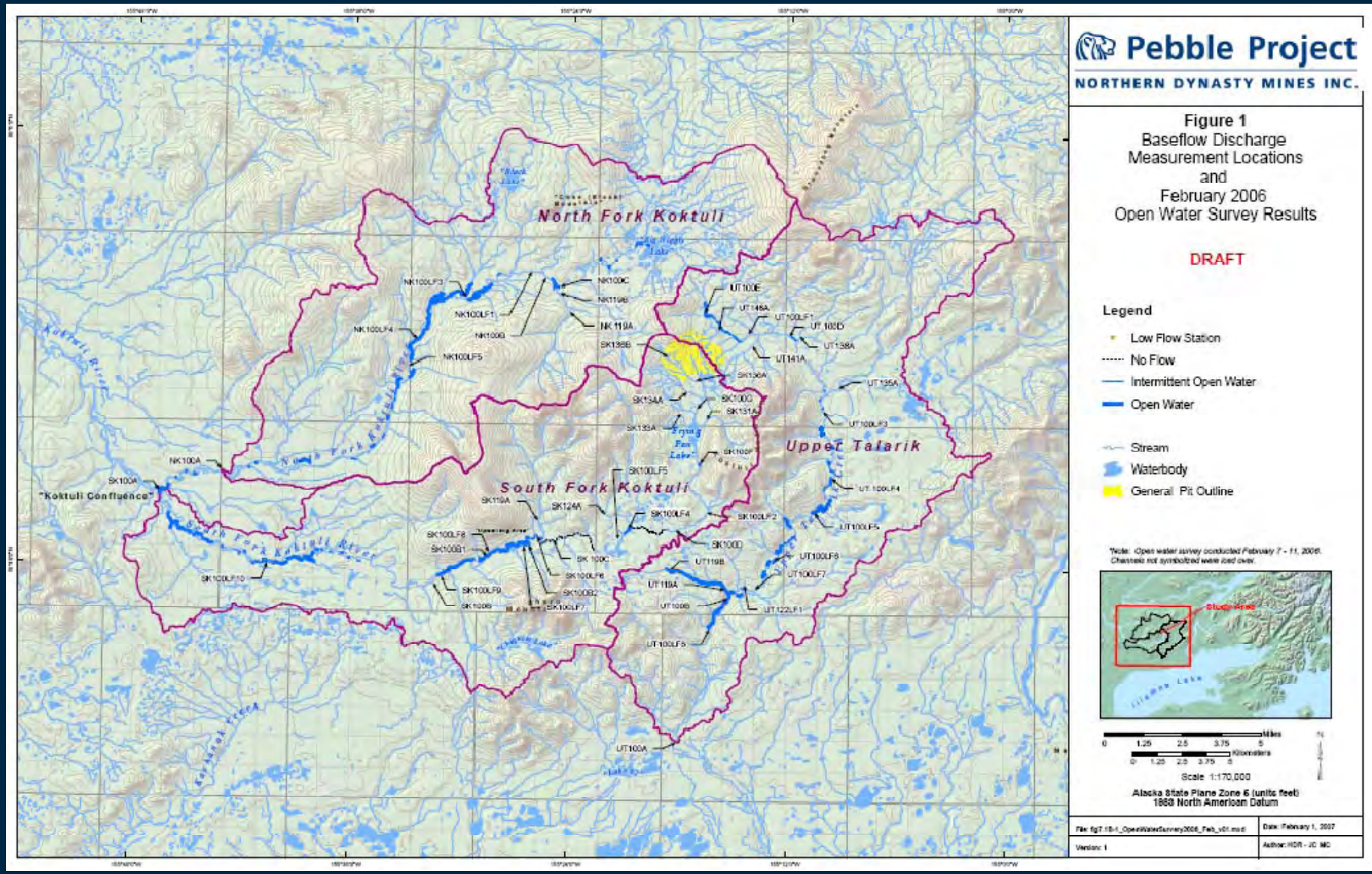


Baseflow Fieldwork

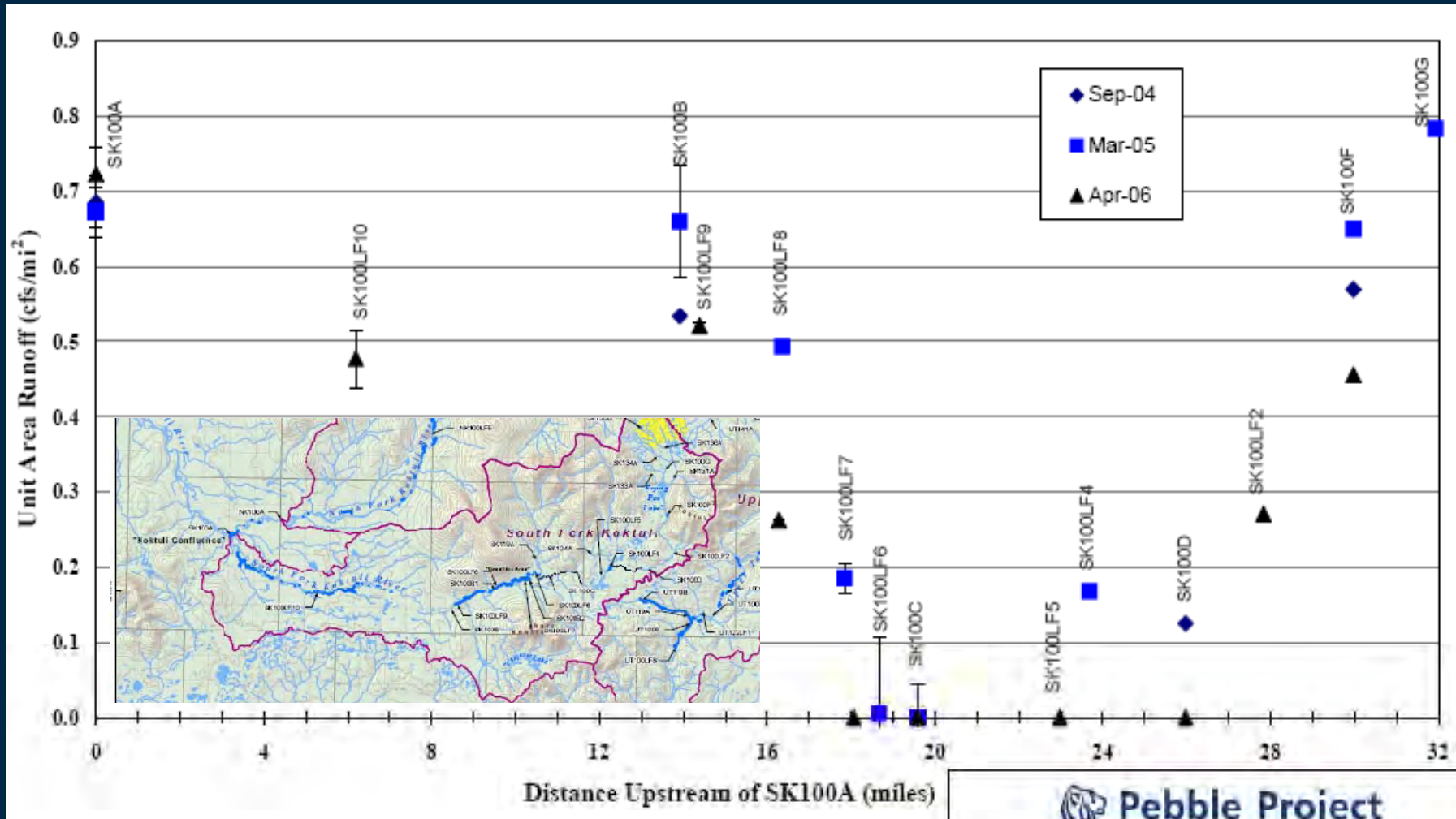
- 41 Stations
- Instantaneous Measurements
- Develop Profiles of Drainages



Baseflow Measurement Locations



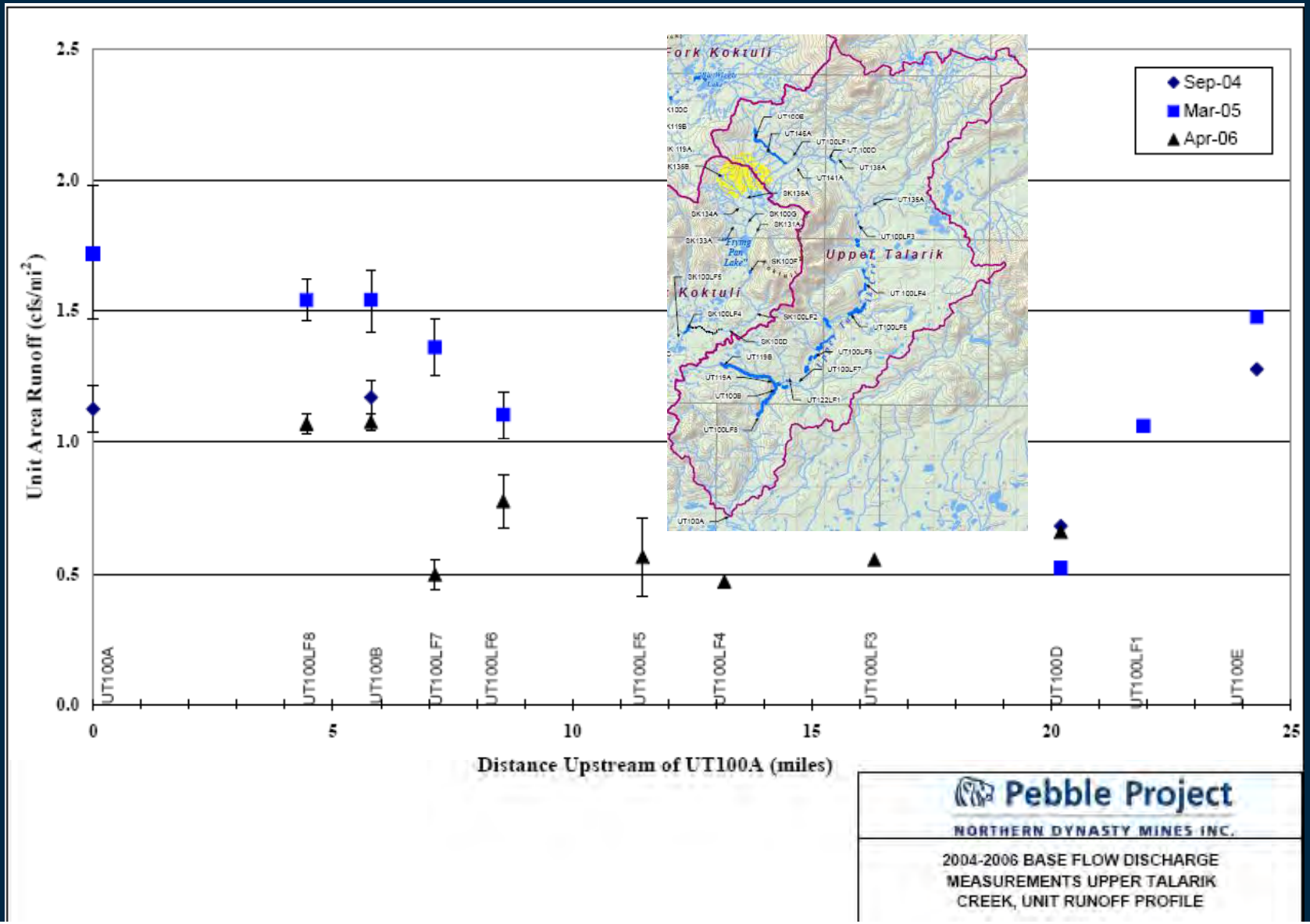
South Fork Koktuli Baseflow
Unit Area Runoff Profile



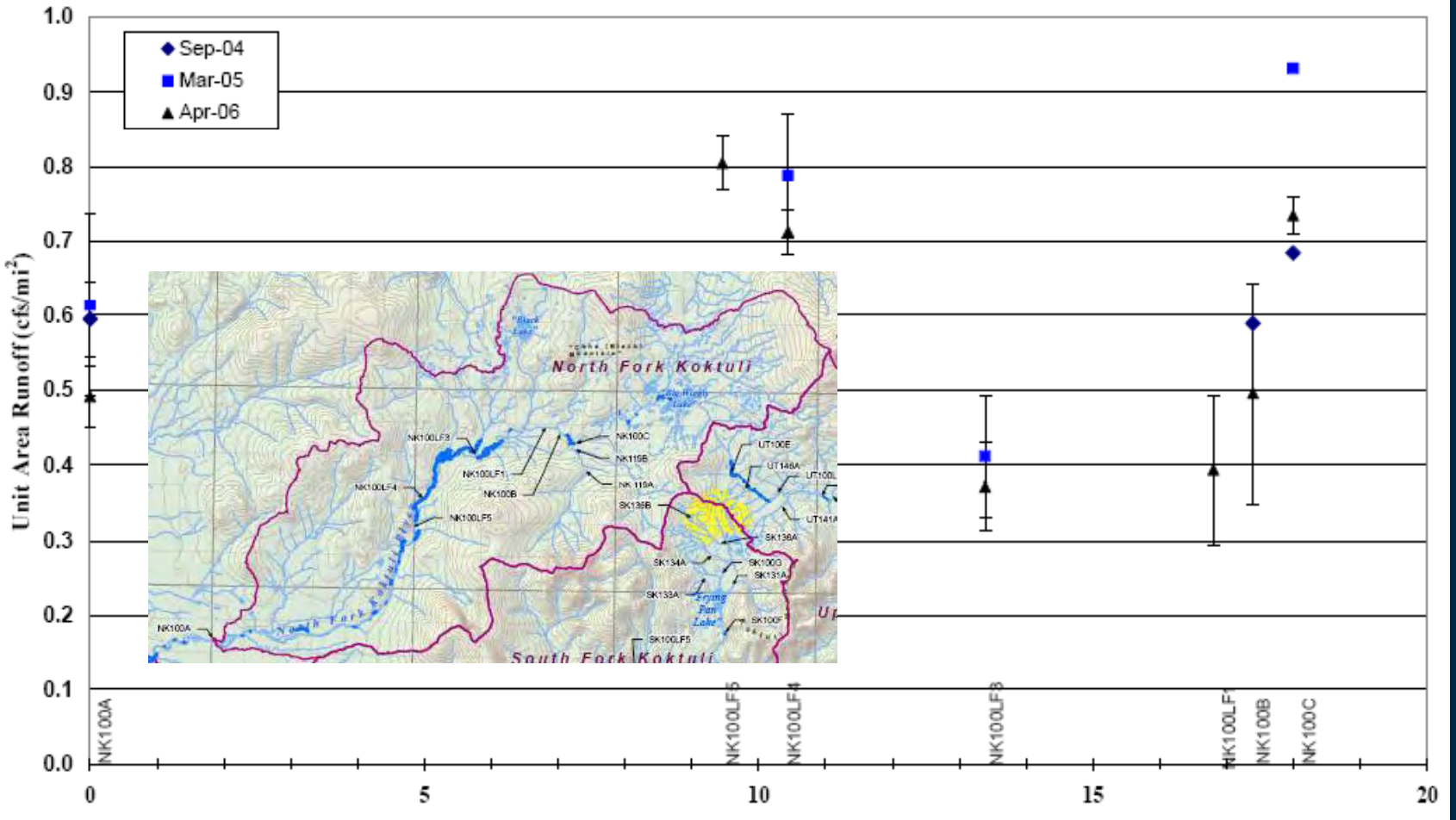
Pebble Project
NORTHERN DYNASTY MINES INC.

2004-2006 BASE FLOW DISCHARGE MEASUREMENTS SOUTH FORK KOKTULI RIVER, UNIT RUNOFF PROFILE

Upper Talarik Creek Baseflow
Unit Area Runoff Profile

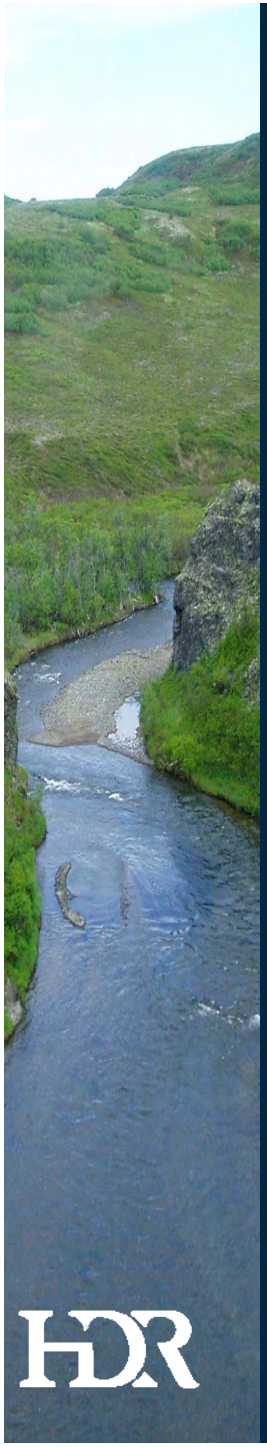


North Fork Koktuli Baseflow
Unit Area Runoff Profile



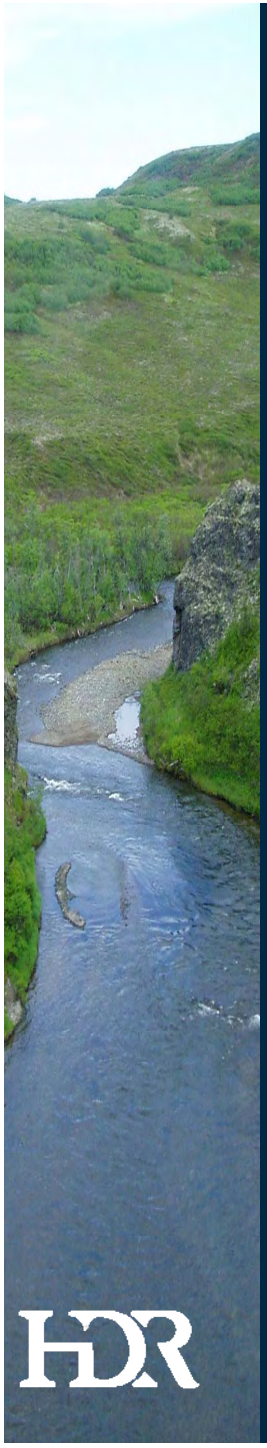
Pebble Project
NORTHERN DYNASTY MINES INC.

2004-2006 BASE FLOW DISCHARGE MEASUREMENTS NORTH FORK KOKTULI RIVER, UNIT RUNOFF PROFILE



Summary

- Seven New HDR-Operated Gages
- Three New APC-Operated Gages
- Increasing Period of Record
  - Continuous Baseline Hydrographs
  - Baseflow Measurements
- Mean Annual Runoff Consistent Between SK, NK & UT
  - Exception for Kaskanak Creek



Summary

- High Runoff in Steep Tributaries
  - SK119A
  - NK119A
  - High, Steep Drainages without Groundwater Storage
- Groundwater Interaction Important To SK, NK & UT
  - Controlled by Permeable Glacial Deposits
  - Losing Between Frying Pan Lake and SK100C
  - Gaining Reach Between SK100C and SK100B
  - Cross-Drainage Transfer to Upper Talarik