MCFN Technical Review – Hydrology Follow-up Meeting

February 26, 2010
1:00 pm to 4:30 pm
Golder Associates Calgary Office

Attendees:

Getu Biftu, Golder Associates
Stefan Kienzle, University of Lethbridge (on behalf of MCFN)
Bill Kovach, Shell
Wayne Speller, Golder Associates

Agenda:

1. Discussion of the HSPF Model:
   Question: How is the HSPF model set up to simulate pre-project and post-project water balances for all major landscapes with individual land cover-soil-climate conditions?
   - Include details as to the spatial delineation of simulated land units.

2. Prediction confidence of the HSPF model Discussion

3. Climate change on simulated post-project conditions Discussion:
   Question: How are the potential impacts of climate change on post-project conditions simulated for all major reclaimed landscapes with individual land cover-soil-climate conditions?
   - Include details on evapotranspiration, soil water balances, snow hydrology, and runoff.

Discussion Summary:

RESPONSES TO NOTED CONCERNS

Meeting commenced with Dr. Kienzle provide a review and clarification of concerns noted by MCFN in their review of the hydrology section of the EIA for the Jackpine Mine Expansion and Pierre River Mine Projects.

Once everyone in attendance was clear on the concerns of MCFN, Dr. Biftu started to explain how Golder, on behalf of Shell, constructed the HSPF model for the EIA (in response to the first two concerns noted in the agenda). Key points included:

Pre-Project Conditions

- The HSPF model is first calibrated against regional watercourses with robust monitoring data (e.g. Beaver River, Jackpine Creek, and Muskeg River).
- The model is then validated using data from other regional watersheds (Steepbank River and Joslyn Creek).
- Features (i.e. model parameters) associated with specific land segments are characterized into different topography and surficial geology (e.g. upland vs. lowland; surficial geological characteristics for each type [Clay, Sandy Loam, Sandy]).
- Model inputs are then assembled from existing available regional information (e.g. climate data, stream flow data, land cover data; surficial geology data, etc.). Using data collected from regional stations including Environment Canada climate stations, ASRD climate stations and RAMP stations, special and temporal variation of precipitation in the Oil Sand Region is reviewed. In addition, water yields from various stream flow gauging stations (i.e. that's how we discovered PRM rain shadow) are reviewed.

    - A point of concern for MCFN was the precipitation estimates used in the HSPF model. During the original MCFN Technical Review meeting, MCFN noted a discrepancy between the data Shell used for EIA assessment and "Prism data" that MCFN used for comparison.
    - To address this concern, Golder presented a comparison plot of special variation of rainfall data ("Prism data" vs. "local data used for EIA assessment"). The comparison showed that the two data sets are similar. Golder also explained that precipitation at PRM is relatively low due to the rain shadow effect of the Birch Mountains, as confirmed by monitoring information collected for the project from local climate stations.

ACTION: Shell to provide MCFN with a figure depicting regional climate monitoring stations and a summary of monitored precipitation values

Figure 2.2-1 and 2.9 depict the regional climate monitoring stations. A summary of the monitored precipitation values is located in Appendix A of the Environmental Settings Report (Shell 2007).

Fig. 2.9 Regional AES Climate.pdf Figure 2.2-1_Climate Station Location.pdf

- Relevant aspects of the know regional watercourses are then applied to the Project sites

    - Model outputs are validated against hydrological data collected specifically for the project sites

- As additional data becomes available over time, the HSPF model outputs are validated against the new data to confirm appropriateness of model outputs

Comment [f1]: A point of concern by the MCFN was the precipitation estimates used in the HSPF model. It was stated by Dr. Biftu that precipitation is quite low due to the rain shadow effect of Birch Mountain. According to Dr. Biftu, this was confirmed by the, so far, short monitoring of several climate stations.
Shell agreed to provide to MCFN a map with the location of those climate stations, and at least a summary of the monitored precipitation values. (COMMENTS FROM STEPHAN)

Effects of the Project

- For disturbed and reclaimed landscapes, Golder noted that there is more uncertainty, but the approach is rigorous and based on professional judgment as outlined in the 2003 Report Regional Surface Water Hydrology Study for Re-calibration of the HSPF Model (Golder, 2003)
    - This information is cited in the EIA but a summary is not provided which admittedly makes technical review by other parties more difficult.
    - The 2003 report provides anticipated hydrologic characteristics of various disturbed and reclaimed landforms.

- Evapotranspiration rates from the boreal forest are calculated by difference (i.e. water balance), as no available monitored data available.
    - A serious point of concern for MCFN was that actual (or areal) evapotranspiration rates do not appear to be estimated using the HSPF model, particularly for the estimation of streamflow and reclamation success under future reclaimed and climate change conditions. MCFN further noted that runoff coefficients were estimated in the Golder (2003) report for a variety of reclamation landscapes explaining that the problem is that the hydrological behaviour, following the HSPF approach, is backwards. Evaporation occurs first, and the remainder of the water becomes streamflow. Therefore, MCFN suggested that streamflow estimation for changed watershed conditions without the careful estimation of actual evapotranspiration is highly uncertain, highly questionable, and thus remains a major concern for the MCFN.
    - Shell clarified that actual evapotranspiration is calculated as part of hydrologic modeling depending on the potential evapotranspiration (which is an input to the model) and the status of available moisture in various storages (surface, sub-surface) at any given time. The method of using hydrologic model to estimate actual evapotranspiration is consistent with standard practice. Information presented in the Golder (2003) report are results of actual evapotranspiration simulated by the HSPF model and also results of various runoff components (surface runoff, Interflow and groundwater runoff) which was simulated by HSPF for various land cover types including reclaimed areas.

Comment [f2]: It is noted that actual (or areal) evapotranspiration rates are not estimated using the HSPF model.
This remains a serious point of concern, particularly for the estimation of streamflow and reclamation success under future reclaimed and climate change conditions. It is noted that runoff coefficients were estimated in the Golder (2003) report for a variety of reclamation landscapes.
The problem is that the hydrological behaviour, following the HSPF approach, is backwards. Evaporation occurs FIRST, and the remainder of the water becomes streamflow. Therefore, streamflow estimation for changed watershed conditions without the careful estimation of actual evapotranspiration is highly uncertain, highly questionable, and thus remains a major concern for the MCFN.

Model Uncertainty & Prediction Confidence

- Shell acknowledged that there is uncertainty in final reclaimed landform hydrologic characteristics, but asserted this is not related to the HSPF model.
    - At the conceptual level of the closure drainage plan for the projects, Golder suggested that the anticipated model outcomes are reasonable with high certainty. This assumes Shell will reclaim the project areas as described in the closure drainage plans.
    - MCFN suggested that because the closure plans are relatively coarse (i.e. large scale) for planning purposes, heterogeneity in various (actual) spatial aspects of reclamation like soil characteristics, actual depths placed, slope, aspect, etc. can be

expected such that the reclaimed landscape will not function exactly as anticipated in the conceptual closure drainage plans.
- Dr. Biftu acknowledged the uncertainty indicated by MCFN but indicated that most of this uncertainty in reclaimed area meso-topography has been taking into consideration through "uncertainty analysis" completed for hydrologic modeling.
- Dr. Biftu continued with discussions on how climate change models are used to assess potential effects to local hydrology.

Comment [f3]: A valid and important point. But it contradicts the previous bullet point, which states that model outcomes have a high certainty

Climate Change Predictions

- Hydrologic effects of climate change are calculated by extrapolating temperature trends for the local area forward and then comparing them to global climate models that align with the predictions.
  - One model is used for hotter, wetter conditions, and one for hotter, drier conditions

RECOMMENDATIONS BASED ON THE DISCUSSIONS

- Given concerns over approach and acknowledging that EIA reviewers of regulatory applications are often constrained by time and budget, MCFN requested that Shell:
  - Provide short but detailed discussions on conceptual approach to give reviewers more comfort in the approach taken (as opposed to having reference documents that are key to understanding the approach not included in the EIA package). Try to strike a balance that reduces the number of review questions (which have historically been quite similar) while keeping the EIA documentation at an appropriate length.
  - Undertake pre-application meetings with technical experts utilized by affected Aboriginal stakeholders to show them the technical approaches. The goal being to ultimately avoid miscommunication and reduce costs associated with misunderstandings in approach that manifest themselves in unnecessary technical review questions.
  - Provide data in useable format so reviewer can easily calculate anticipated results themselves.
- Given concerns regarding model certainty, MCFN requested that Shell:
  - Provide brief discussions on findings of validation testing against actual monitored data to confirm model predictions are appropriate
  - Consider another (perhaps more robust) approach to assessing climate change impacts on local hydrology – approach would have Shell look at a median case, a hotter, drier case, a hotter, wetter case, a cooler drier case, and a cooler wetter case.
  - Collect additional data to validate models and provide for better, refined EIA predictions (e.g. soil moisture from reclaimed soils, ongoing streamflow data)
  - Reconsider RSA boundaries for aquatics – considering the benefits of a collective regional dispersion study for the Athabasca River and providing spill response equipment to be used collectively and cooperatively on the Athabasca in case of adverse release.

Comment [f4]: This comment applies to the entire document.
All points are important as they would provide more transparency, which MCFN has requested since 2003. While MCFN welcomes these points, there is a clear lack of commitment by Shell when using the term "Consider" instead of "Will" or "Commit to".

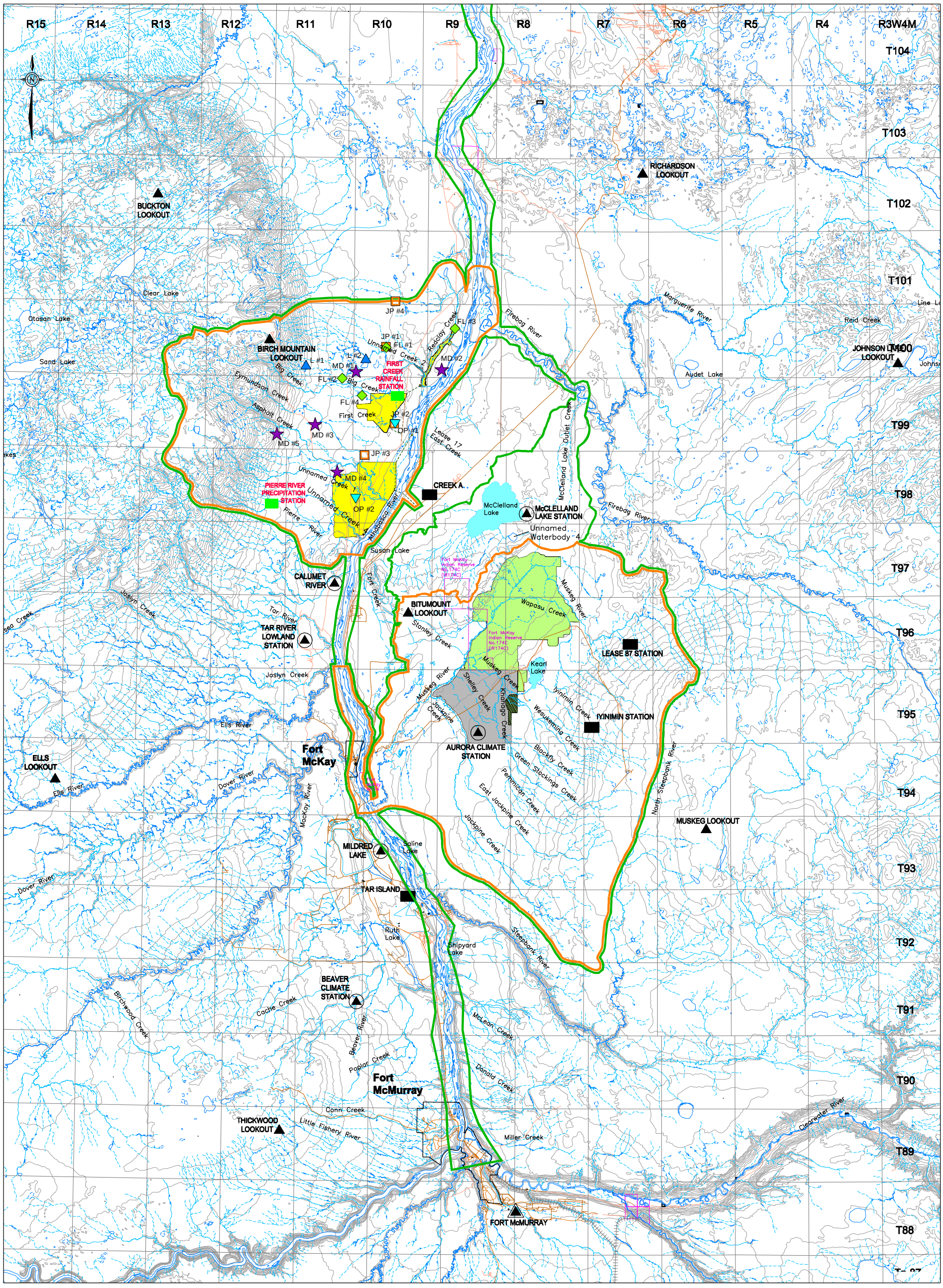
During the meeting, there appeared to be consensus that it would be welcome by both Shell and MCFN that mis- or under-communication will cost time and money, and must be, therefore, avoided wherever feasible.

Comment [f5]: As discussed, more information on how new experience based on reclaimed soils or continued streamflow monitoring (Shell or other oil sands companies) are integrated into new EIAs for refined, updated predictions is required. Shell stated that this was done to some extent, but it was not explained in any detail in the EIA.

Shell agreed that the inclusion of planned and on-going research should be reported to the stakeholders. This fosters transparency and informs the stakeholders of the positive activities Shell carries out.

In providing the foregoing general recommendations, MCFN highlighted their general concern that Shell does not appear prepared to commit to MCFN recommendations, but only to appease MCFN using terms like "will consider" instead of "will" or "will commit to". Shell responded that recommendations that improve communication and add transparency (such as discussion of planned and ongoing research) build trust, save time and money, and are therefore generally welcome. But Shell also reiterated that it is not prepared to make commitments during the technical review as these have implications beyond the persons in attendance. However, Shell confirmed that discussions and recommendations from the technical review would be considered in the development of Shell's project plans.

L:\2005\1344-OIL SANDS\05-1344-027-Shell Omnibus\6600\6650\Surface Water Hydrology Report\Fig 2.2-1 Locations of Regional and Local Climate Monitoring Stations.dwg Nov 22, 2007 - 3:00pm



LEGEND

- PIERRE RIVER MINING AREA
- JACKPINE EXPANSION MINING AREA
- JACKPINE MINE - PHASE 1
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- OIL SANDS INDUSTRY YEAR-ROUND CLIMATE MONITORING STATION
- ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT SEASONAL PRECIPITATION MONITORING STATION
- ENVIRONMENT CANADA ATMOSPHERIC MONITORING DIVISION YEAR-ROUND LONG-TERM PRECIPITATION MONITORING STATION
- LEASE SWAPPED TO SYNCRUDE
- OIL SANDS INDUSTRY SEASONAL PRECIPITATION MONITORING STATION
- PROJECT PRECIPITATION STATIONS
- MD #3 — MIXED DECIDUOUS SNOW COURSE SURVEY SITE
- L #1 — LAKE SNOW COURSE SURVEY SITE
- FL #4 — FLAT LOW LYING SNOW COURSE SURVEY SITE
- OP #1 — OPEN LAND SNOW COURSE SURVEY SITE
- JP #2 — JACKPINE SNOW COURSE SURVEY SITE

10 0 10
SCALE KILOMETRES

REFERENCE

ALBERTA DIGITAL DATA OBTAINED FROM ALTALIS LTD. (SEPTEMBER 2004.)
USED UNDER LICENSE. PROJECTION: TRANSVERSE MERCATOR
DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 12

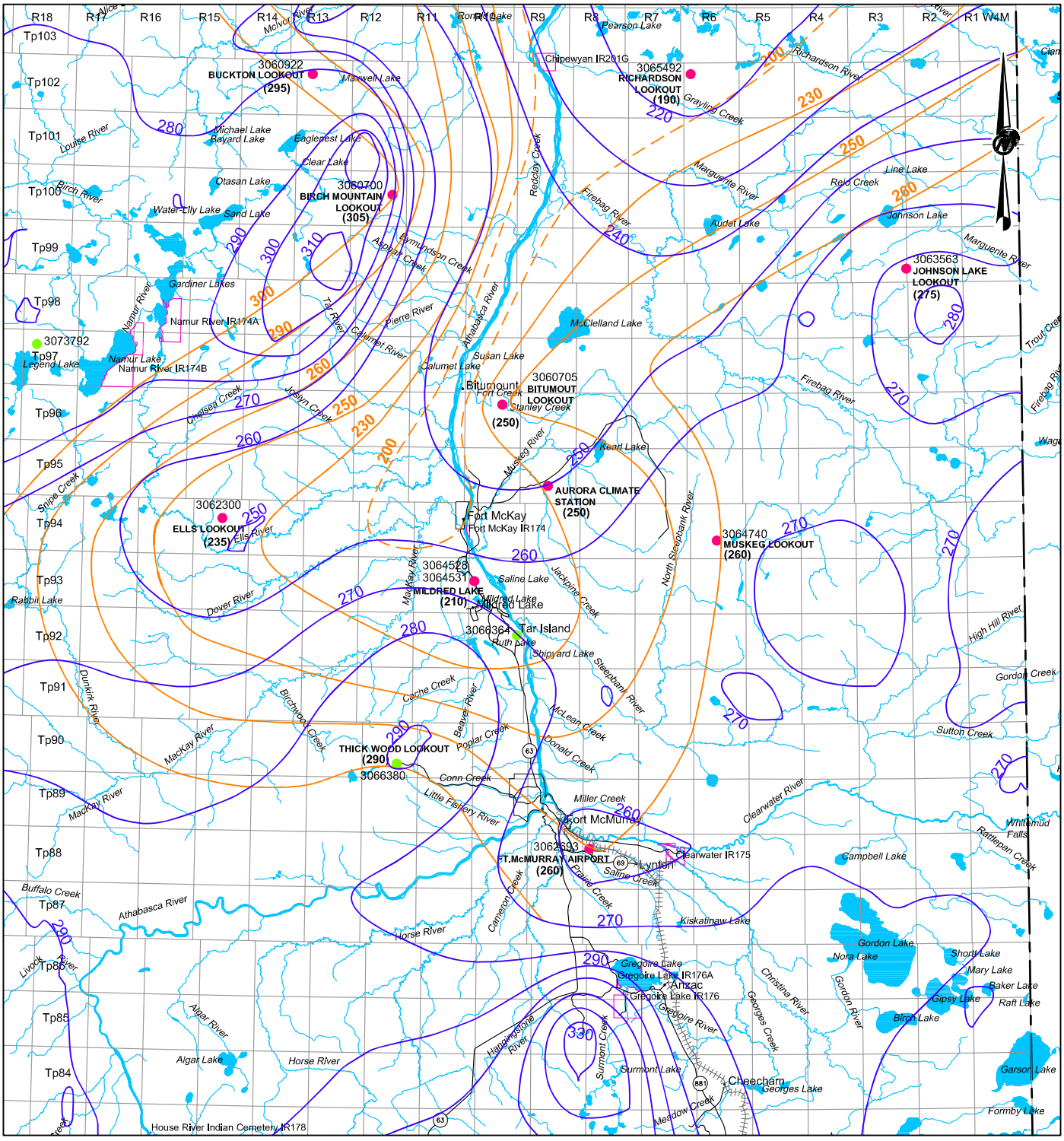
PROJECT
JACKPINE MINE EXPANSION &
PIERRE RIVER MINE PROJECT

TITLE
REGIONAL AND LOCAL CLIMATE MONITORING STATIONS AND PROJECT SNOW COURSE SURVEY SITES

Shell Canada Limited

PROJECT 05-1344-027.6650			FILE No.	Reg-Snow Course
DESIGN	CS	11/05/06	SCALE AS SHOWN	REV. 0
CADD	TY	18/11/07		
CHECK	KM	15/10/07		
REVIEW	WES/TC	20/11/07		

FIGURE: 2.2-1



LEGEND

- ACTIVE CLIMATE MONITORING STATION
- DISCONTINUED CLIMATE MONITORING STATION
- (260) MEAN SEASONAL TOTAL RAINFALL
- AIR WEAPONS RANGE
- INDIAN RESERVE
- OPEN WATER
- ROAD
- RAILWAY
- WATERCOURSE

20 0 20
SCALE KILOMETRES

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001.
SASKATCHEWAN NTDB DATA OBTAINED FROM ISC, AUGUST 2001.
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 12

PROJECT
cenovus ENERGY
NARROWS LAKE PROJECT

TITLE
ISOHYETAL MAP OF SEASONAL RAINFALL IN THE OIL SANDS REGION

Golder Associates
Calgary, Alberta

PROJECT 08.1346.0016.6600			FILE No. 08134600166600A001	
DESIGN	AA	27/01/10	SCALE AS SHOWN	REV. 0
CADD	GMF	28/01/10		
CHECK				
REVIEW				

FIGURE: 2.9

L:\2008\1346 Oil Sands\08-1346-0016 Cenovus Narrows Lk\6600\Report A (6630)\Fig. 2.9 08134600166600A001 REGIONAL_AES_CLIMATE.dwg Jan 28, 2010 - 12:20pm