BOREAS Experiment Plan



Chapter 4 Operations, Facilities, Schedules

May 1996

Version 2.0

BOREAS Executive Summary

This document is the Experiment Plan (EXPLAN-96) for BOREAS field operations to be conducted in 1996 (BOREAS-96). This work will consist primarily of a set of extended eddy correlation (H, LE CO₂) measurements at a number of tower flux sites from March through November 1996, supported by ecophysiological, hydrological, and biogeochemical observations. There will be a small winter campaign (FFC-W) to explore the physics of remote sensing over snow-covered forests, and three growing season field campaigns (thaw, midsummer, fall) in which the bulk of the in situ measurements and aircraft operations (airborne remote sensing and flux measurements will be concentrated.

Chapter 1 reviews the science issues and objectives of BOREAS; the overall design of the field observation component of BOREAS; the field operations and some preliminary results from BOREAS-94; and the shortcomings of the BOREAS-94 data set. The last item provides the motivation for the return to the field; i.e. for BOREAS-96.

Chapter 2 reviews the analyses and planning activities that took place in the period 1994-1995. These resulted in three white papers which are summarized in the text.

Chapter 3 describes the field operations planned for BOREAS-96. These are based directly on the requirements from the white papers summarized in Chapter 2. Chapter 3 is divided into six sections: overview; monitoring; NSA growing season studies; SSA growing season studies; and AFM and RSS growing season activities.

Chapter 4 describes operations procedures; the facilities to be made available by the project; and the schedules for site support.

Chapter 5 describes the aircraft operations. Complete summaries of all the mission plans for all the BOREAS-96 aircraft are included.

Chapter 6 provides a "quick look" summary of field campaign objectives, including tables showing which teams and aircraft will be present during IFC's.

Chapter 7 describes emergency procedures in case of accidents in the field.

Appendices A-H contain further details on investigator contact information; shipping and customs; data documentation; references; satellite overpass schedules; team activity write-ups; directions to BOREAS auxiliary sites, and an acronym list.

BOREAS Experiment Plan 1996

Table of Contents

Exect	utive S	ummai	ry				
1.0	Intro	troduction					
	1.1	Background Science Issues and Objectives of BOREAS					
	1.2	Experiment Design					
	1.3	Field Operations in BOREAS-94					
	1.4	Prelir	Preliminary Science Results from BOREAS-94				
	1.5	Short	comings of	the 1994 Data Set and Open Issues	1-14		
2.0	Analysis and Planning Activities: 1994-1995						
	2.1 White papers and workshops						
	2.2	Objec	ctives of BO	REAS-96	2-1		
		2.2.1	Fluxes and	d Processes at the Stand Level	2-1		
		2.2.2	Surface ar	d Atmospheric Boundary Layer Studies	2-3		
		2.2.3	Remote Se	ensing Science	2-5		
3.0	BOREAS-96 Field Activities						
	3.1	Overview					
	3.2	Monitoring					
		3.2.1	Automatio	c Meteorological Stations (AMS)	3-1		
		3.2.2	Hydrolog	ical Measurements	3-6		
		3.2.3	Satellite C	bservations	3-6		
	3.3	Winte	Winter RSS Campaign				
		3.3.1	Airborne	Data Acquisition	3-9		
		3.3.2	Surface M	easurements	3-11		
	3.4	NSA	Growing Se	eason Studies	3-12		
		3.4.1	Overview	, Rationale	3-12		
		3.4.2	Measurem	nent Tasks	3-12		
		3.4.3	Team Tas	k Summary	3-14		
		3.4.4	Operation	al Considerations	3-16		
			3.4.4.1	TF Operations for NSA in 1996	3-16		
			3.4.4.2	Transition Season Observations	3-18		
			3.4.4.3	Wetland Ecosystems	3-19		
				3.4.4.3.1 Fens	3-19		
				3.4.4.3.2 Beaver Ponds	3-20		
	3.5	SSA (Growing Sea	ason Studies	3-20		
		3.5.1	Overview	, Rationale	3-20		
		3.5.2	Measurem	nent Tasks	3-21		
			3.5.2.1	Stand Scale Processes	3-21		

			3.5.2.2	Canopy Pro	cesses	3-21
			3.5.2.3	Understory		3-24
			3.5.2.4	Moss/Soil P	rocesses	3-25
				3.5.2.4.1	Contribution of the Moss/	
					Soil system to Total	
					Fluxes	3-25
				3.5.2.4.2	Contribution of Moss	
					Respiration to Moss/Soil	
					Respiration CO_2 Fluxes	3-26
			3.5.2.5	Stable Isotop	bes of CO_2	3-27
		3.5.3	Team Task S	Summary		3-27
	3.6	Grow	ing Season RS	5S and ÅFM a	ctivities	3-29
		3.6.1	ĂFM Activit	ties		3-29
		3.6.2	RSS Growin	g Season Acti	vities	3-32
4.0	Oper	ations,	Facilities, Sci	hedules		
	4.1	Mana	gement of Ex	periment Ope	erations	4-1
		4.1.1	Overview			4-1
		4.1.2	Decision Ma	iking		4-4
		4.1.3	Operations I	Management	Roles and Responsibilities	4-5
			4.1.3.1	BOREAS Mi	ssion Manager (MM)	4-5
			4.1.3.2	Study Area	Manager (SĂM)	4-5
			4.1.3.3	Team Chairs	s/Representatives	4-7
			4.1.3.4	TF Site Capt	ains	4-8
			4.1.3.5	Field Liaisor	n and Site Managers/	
				Contacts		4-9
			4.1.3.6	Laboratory (Chiefs	4-9
			4.1.3.7	Aircraft Mar	nagers	4-9
			4.1.3.8	Investigators	s	4-10
			4.1.3.9	Meteorologi	cal Forecaster/Briefer	4-12
		4.1.4	Meeting Sch	edules and Fo	ormats	4-12
		4.1.5	Aircraft Ope	erations Plann	ing	4-17
		4.1.6	Communica	tions		4-18
			4.1.6.1	Aircraft Rad	io Net	4-18
			4.1.6.2	Ground Rad	io Net	4-18
			4.1.6.3	Telephones/	'Faxes	4-21
		4.1.7	Safety			4-22
			4.1.7.1	Fire and Acc	cident	4-22
			4.1.7.2	Safety on sit	e	4-22
	4.2	Facili	ties			4-23
		4.2.1	Study Area	Layout; Site L	ocations	4-25
		4.2.2	Ops Center,	Labs, Radio n	iets, Telephones	4-25
		4.2.3	Field resour	ces: huts, gene	erators, transport	4-26

5.0 Aircraft Operations

5.1	Overv	riew of Schedu	ile and Operations	5-1
	5.1.1	Overview of	Field Campaign Tasks	5-1
	5.1.2	Operations N	lanagement: roles and Responsibilities	5-1
		5.1.2.1	Phone Calls	5-1
		5.1.2.2	Radio Calls	5-3
	5.1.3	Flight Hours	and basing	5-8
	5.1.4	Mission Allo	cation Strategies	5-9
5.2	Missic	on Plans	0	5-10
	5.2.1	C-130 (RC)		5-14
		5.2.1.1	RC-SN and RC-SS: Snow Missions in	5 1/
		5010	PC TN and PC TC: ASAS Mission	5-14
		5.2.1.2	Otrow TE Sites	E 1E
		E O 1 O	De DT. Decional Transact: ASAS	5-15 E 1E
	500	DC g (PD)	RC-RT. Regional Italiseci. ASAS	5-15
	5.2.2	DC-0(RD)	DD MC. CCA Madalina Crid Massia	5-21
		5.2.2.1	RD-MS: 55A Modeling Grid Mossic	5-22
		5.2.2.2	RD-WIN. INSA Woueling Griu Wosaic RD RT: Regional Transact	5 22
		5.2.2.5	PD BS: Baseline Padar Manning SSA	5 23
		5.2.2.4	PD ES: 'Eiro' linos SSA	5 23
		5226	RD RN: Basolino Radar Manning NSA	5 23
		5.2.2.0	D IS: Multiangle radar pages SSA	5 22
		5.2.2.7	RD DS: Prodawn radar manning SSA	5 23
	572	5.2.2.0	KD-D3. Theuawit fauar mapping, 35A	5 27
	5.2.5	ER-2(RE)	PE MS: Manning of SSA	5 27
		5.2.3.1	RE-MS. Mapping of SSA RE-MN_RT: Mapping of NSA Transact	5 27
		5.2.3.2	RE-MIN, KT. Mapping of NOA, Hansett RE SS: Snow Over Elights of SSA During)-27 m
		0.2.0.0	Single Pass AVIDIS	5 5 0 7
	521	Chioftain (RE	O(1)	5 31
	J.2. 1	5 2 <i>A</i> 1	PP TS. Tower / Auviliary Sites SSA	5 32
		5.2.4.1	PD TN: Tower / Auxiliary Sites, SSA	5 33
		5.2.4.2	RP PT: Coverage of Pagional Transact	5 33
	525	Flight Plane f	for Flux Aircraft Operations	5 33
	5.2.5	5 2 5 1	Ev CS: Candle Lake Runs	5 35
		5252	Fx-C3. Callule Lake Kulls Fx-TS Fx-TN: Site-Specific Short	5-55
		0.2.0.2	Passes	5-35
		5253	Fx-RT Regional Transects	5-41
		5254	Fx-LS Fx-LN: Mini-/Meso-Scale	0 11
		0.2.0.1	Transects and L-Shaped Patterns	5-41
		5255	Fx-GS Fx-GN [·] Grid and Stack	5-44
		5256	Fx-PS Fx-PN: Budget Box Patterns	5-45
		5.2.5.7	Fx-HS. Fx-HN: Stacks and Tees	5-52
		5.2.5.8	Fx-FS, Fx-FN: Flights-of-Two	5-52
		5.2.5.9	Fx-LS: SSA: Low-Level Route	5-54
		5.2.5.10	Fx-VS, N: CO ₂ Profiles	5-54
			,	

5.2.5.11	FB-ES, N: Site recce, forward air	
	traffic/birddog	5-54

6.0 Field Campaign Summaries 6.1 FFC-W: Winter Campaign 2/27-3/15/96 6-3 6.2 IFC-1: Thaw/Post-Thaw Campaign 4/2-28/96 6-7 6.3 IFC-2: Mid-Growing Season 7/9-8/9/96 6-11 6.4 IFC-3: Fall Campaign 10/1-20/96 6-15

7.0 Emergency Procedures

7.1	Northern Study Area (NSA)	7-1
7.2	Southern Study Area (SSA)	7-4

Appendices A-H

Appendix A	Investigator Contact List				
Appendix B	Shipping Information; Customs and Immigration				
Appendix C	BOREAS Data Documentation Outline				
Appendix D	References				
Appendix E	Satellite Overpass Schedule				
Appendix F	Team Science Activities for BOREAS-96 AFM TF TE TGB HYD RSS				
Appendix G	BOREAS Auxiliary Site Directions				
Appendix H	Acronyms List				

4.0 **OPERATIONS, FACILITIES, SCHEDULES**

This chapter describes operations management, project resources and schedules for BOREAS-96. Basically, BOREAS-96 will be managed as a down-scaled version of BOREAS-94. The key components are as follows:

<u>Operations HQs</u>: SSA Ops will be manned during FFC-W. Both NSA and SSA Ops will be manned during IFC-1, IFC-2 and IFC-3. Also, there will be a BOREAS staffer at each study area prior to IFC-1, to assist the TF crews and others in getting installed. The Ops centers will be equipped with ground and air radio networks, telephones, faxes, etc., see 4.2.2.

Laboratories: Lab space will be available in the NSA and SSA, see 4.2.2.

<u>Mission Management</u>: A mission manager (MM) should be present during all periods of active airborne operations. The MM will work with the investigators to draw up mission schedules, work with local air traffic and assess weather over the study areas, see 4.1.

Details on BOREAS-96 operations are addressed in the subsections in this chapter.

Field investigators must be at least familiar with reporting procedures in Section 4.1.3.8, safety information in Section 4.1.7, and emergency procedures in Chapter 7.

4.1 <u>Management of Experiment Operations</u>

4.1.1 Overview

The day-to-day management of BOREAS is overseen and implemented by the BOREAS Operations Group (BOG) which consists of agency representatives (BOREAS Executive or BEX) and science team representatives (science steering group or SSG). BOG members are listed in Table 4.1.1.

During field campaigns, experiment operations will be managed from two Study Area Headquarters (SAHQ); one in the Snodrifters Lodge in Candle Lake (SSA) and one at Manitoba Provincial hangar (next to RCMP hangar) in Thompson Airport (NSA), see Section 4.2. Contact telephone numbers and radio frequencies are given in Section 4.1.6. Each SAHQ will be manned during most of the day by a Study Area Manager (SAM) plus backup, who will coordinate activities among investigators and staff, work logistics problems and receive and transmit reports on the status of activities within the study area. The SAM will usually be assisted by one other person and will be in radio contact with the TF site captains and others within the study area and in telephone contact with the other SAHQ.

	ВС	DG Members			
BEX Membership SSG Membership					
Name	Agency	Name	Science Team		
Sellers	NASA	MacPherson	AFM		
Hall	NASA	Black	TF		
Newcomer	NASA	Berry	TE		
Cihlar	CCRS	Crill	TGB		
Halliwell	CFS	Lettenmaier	HYD		
Goodison	AES	Ranson	RSS		

Table 4.1.1.BOREAS Operations Group Membership

The BOG is supported by staff scientists from the participating agencies who help with logistics, operations management and BORIS. The staff organization is shown in figure 4.1.1. Note that the underlined people are first points of contact.

At any one time, one study area may be the focus of more aircraft and/or specialized ground-based activities than the other. The Mission Manager (MM) will be based at this 'hot' study area, and will coordinate all BOREAS aircraft activities from the 'hot' SAHQ, including those at the 'cool' study area. Sometimes, the MM may choose to delegate oversight of some local flight activities at the cool study area (SA) to the SAM there.

During active periods, the MM will hold nightly meetings of the BOREAS Operations Group (BOG) to organize the next day's activities in detail and follow-on activities (two or three days) in broad strokes, see Section 4.1.4.

The next few subsections cover:

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•	Decision Making	4.1.2
•	Operations management roles and responsibilities	4.1.3
•	Meeting schedules and formats	4.1.4
•	Aircraft operations planning	4.1.5
•	Communications	4.1.6
•	Safety	4.1.7



Figure 4.1.1 BOREAS Staff Organization: Underlined names denote first points of contact. 'Data H' denotes Data Handling; 'Image P' denotes Image Processing; 'Dbase' denotes Database Design and Development; 'Docn' denotes Documentation Oversight.

4.1.2 Decision Making

There are three principal authorities for making decisions that affect BOREAS field operations and prioritization of follow-on analyses by staff. These are:

(i) <u>The Experiment Plan</u>: This document (EXPLAN-96) sets out the strategic framework for the experiment and will be taken as the basis for decision making by the BOREAS Operations Group (BOG = BEX + SSG) and mission managers. Procedures documented in this chapter have precedence over procedures documented elsewhere.

(ii) <u>BOREAS Meetings</u>: BOREAS workshops, science team meetings and workshops, and BOG meetings will be tasked with refining the experiment design and modifying and ratifying the experiment plan. In general, the outcome of any of these meetings should be a written brief to be transmitted to the BOG. This is absolutely essential if the Experiment Plan is to be modified. Any scientist wishing to modify some aspect of the plan is strongly encouraged to air the proposal with his or her group, if time allows, or at least with their group chair prior to bringing it to BOG.

During field campaigns, there will be a nightly BOG meeting to which all participating scientists and staff are encouraged to attend. This meeting will be chaired by the mission manager who will solicit reports from those managing equipment essential to the mission, e.g. group chairs, TF site captains, aircraft managers, etc. For brevity, these reports and a weather briefing will follow a set format. During FFC-W and IFC-2, the briefing will include a presentation of proposed aircraft mission options and fallbacks for the next day and an outline of possible missions for the next three days. This proposal will be discussed and modified by those present and the coordination of the next days activities will be subsequently arranged.

The final schedule of aircraft missions and planned ground activities will be posted at each SAHQ and at the laboratory of each study area. Additionally, the proposed flight schedules will be faxed to participating aircraft base airfields on request. Aircraft Managers should either be present or be represented at the BOG meetings, or make arrangements to otherwise receive the flight planning information.

(iii) <u>Mission Manager</u>: The Mission Manager (MM) will be on duty from the beginning of one BOG meeting to the next, i.e. a 24-hour cycle. The MM will be a BEX member with some experience of coordinating field and aircraft operations. Roles and responsibilities of the MM and other operations staff are laid out in Section 4.1.3.

The MM will use this experiment plan and the missions plus fallbacks proposed by the BOG meeting to guide the management of experiment operations over the next 24-hour duty cycle. All decisions to launch, cancel or modify airborne missions or significant ground operations (i.e. involving a substantial commitment of project personnel or project resources) must be routed through the MM who will be located near the most active Study Area with communication links to the aircraft, key investigators and staff. If, because of changing conditions, the MM thinks it is necessary to drastically diverge from the BOG plan, he/she will attempt to consult with the BOG or the affected investigator or, if time or communications do not allow for this, he/she will go ahead and implement the action. The action will be discussed with the BOG and affected scientists as soon as possible thereafter.

4.1.3 **Operations Management Roles and Responsibilities**

4.1.3.1 BOREAS Mission Manager (MM)

The MM will be a BEX member who has overall responsibility for coordinating all BOREAS activities during a 24-hour duty cycle within the FFC or IFC. Specifically, the MM is responsible for:

- Chairing the nightly BOG meeting and allocating subsequent action items;
- Oversight of aircraft mission planning, coordination and execution;
- Resolution of disagreements among investigators beyond what cannot be handled by the SAM (see below).
- At the end of the duty cycle, the MM must modify the mission plans prepared for that day to record the missions and activities actually completed. These records (see Figures 4.1.4.b and c) must be filed at the SAHQ and returned to the BOREAS US Project Office at NASA/GSFC at the end of the IFC/FFC.
- Turning on and turning off the intensive Upper Air Sounding Program (AFM-5).
- Approving significant expenditures of project reserve funds.

Generally, an MM will be on duty continuously for a 24-hour cycle, from the beginning of one BOG meeting to the next. Handover to the next MM must be accompanied by a comprehensive briefing. The MM will work out of (or be in direct contact with) the SAHQ alongside or in place of the SAM.

4.1.3.2 <u>Study Area Manager (SAM)</u>

The SAM will be a BOREAS staff member who will manage day-to-day ground operations at a study area. He/she will be assisted by one other person. The responsibilities of the SAM are:

- Be aware of activities ongoing at the SA.
- Maintain communications between investigators and with the MM and the other SAM.

- Elicit reports from site captains, team representatives and staff in the study area. These reports are to summarize the status of activities within the study area and state special requests, e.g. specific aircraft missions. These reports are to be documented in the team chart (see Figure 4.1.4.c) and passed on to the MM and the other SAM by 2300Z (1700 local in SSA and 1800 in NSA (summer.)
- Ensure collection and filing of investigator activity reports, see figure 4.1.3.8. Chase up delinquent investigators.
- Document events in the mission log. The events should be logged as a separate file for each day with exact local times; e.g.,

'1300 : FT calls site entry into SSA. Ground teams informed by radio.
1303 : FT calls start on first flight line'

Aircraft take-off, site entry, site exit and landing times must be logged.

- Follow the progress and supervision of tasks handled by local labor, liaising with Dan Hodkinson and the site manager as necessary.
- Participate in the nightly BOG meetings, either in person, if at the hot SA, or by speaker phone, if at the cool SA. The SAM at the cool SA is encouraged to have other key BOREAS people participate in these meetings or at least have their reports at hand.
- The SAM at the cool SA is encouraged to convene meetings or otherwise communicate with the investigators to plan future activities or to discuss the requests to be sent to the MM in more detail. If investigator teams or other groups wish to hold large meetings, the SAM should be informed and provide assistance as necessary.
- Inform investigators and staff of the next days plan as finalized by the BOG. This plan, and associated action items, may be broadcast over the radio net when the SAHQ opens for business the next day.
- Ensure that the required sun photometry measurements are being made on clear days at the time of satellite overpasses or remote sensing aircraft flights.
- Induct and brief arriving investigators. Provide them with the briefing handouts and issue radios, etc. Debrief investigators leaving the area; recover loaned equipment.
- Maintain a file on investigator movements and plans. Before setting out for the field, investigators should contact the SAHQ with their intentions for the day -- sites to be visited, activities planned, and expected time of return. The SAM will maintain a file in the format provided, see Figure 4.1.4.c.

If the investigator is more than three hours late, the SAM will initiate a search. The SAM may initiate a search before this time on his/her own initiative.

The provisional schedule for SAMs and MMs is shown in Table 4.1.3.2.

	Dates	NSA-SAM	SSA-SAM	MM
FFC-W	2/27-3/15		Knapp/Morell	Sellers/Hall/
				Irons
Pre-Thaw	3/10-4/02	Hodkinson/Nelson	Hodkinson/Nelson	
IFC-1	4/02-4/28	McCowan/Landis	Huemmrich/Twine/Curd	Sellers/Hall
IFC-2	7/09-8/09	Newcomer/Kaminsky/ Nickeson/Herring	McCowan/Morell/ Huemmrich/Young	Sellers/Hall
IFC-3	10/01-10/22	Curd/Twine/Mitchell	Nickeson/Herring/ Kaminsky	Sellers/Hall

Table 4.1.3.2SAM and MM Schedule

4.1.3.3 <u>Team Chairs/Representatives</u>

Each study area will have a set of nominated science team representatives to represent each of the science teams working there. The group chairs will ensure that a team representative is present or will show up themselves unless otherwise arranged with the SAM or MM. The exception is the AFM team who only need report to the MM or the SAM at the hot site. If no team representative has been nominated by the beginning of the IFC, the SAM or MM will work with team members in the field to identify a nominee. At the cool site, representatives are responsible for giving team reports for that SA to the SAM by 2100Z. This report and associated requests should be brief and may be given to the SAM verbally over the radio net.

The team representatives' report should cover the following:

- Team activities carried out that day, particularly changes from the scheduled activities discussed at the previous nights BOG meeting.
- Team activities planned for the next day.
- Needs or requests, particularly any requests for special aircraft flights for the next day.

Team representatives may be given action items by the MM following the BOG.

4.1.3.4 <u>TF Site Captains</u>

The TF principal investigators at each TF site or their nominees are the TF site captains. These site captains are responsible for maintaining the quality of their sites, for overseeing the use of resources and for overseeing safety-related procedures on-site. Specifically, the site captains are responsible for:

- Delineating go- or no-go areas around each site. Normally, the TF site WABs will be no-go areas.
- Approving the use of site power for other investigators, likewise the use of huts and other facilities.
- Ensuring continuous radio contact between the TF site and SAHQ.
- Informing the SAHQ when balloons are to be deployed with as long advance notice as possible; and then re-informing SAHQ when actual deployment and take down occurs.
- Checking the presence and serviceability of essential equipment on site: medical kits, fire extinguishers, radio gear, tower climbing gear; informing Ops immediately of shortfalls in essential equipment.
- Reporting on the status of the TF site to SAHQ by 2100Z each day.
- Ensuring that investigators who wish to ascend the tower are properly equipped, trained and briefed.
- Ensuring that investigators working near the tower are wearing hard hats.
- Maintaining the site log. All the TF sites must keep a site log. This is a log book plus a chart with experiment site locations marked in degrees / distance from a reference point (generally the tower base). The aim is to (i) document investigator experiment locations and (ii) prevent interference between experiments. Logs and formats are available from BORIS (Dave Knapp), see also figures 4.2.1.

Any investigator who wishes to work on or close to a TF site must first consult with the site captain or his/her representative. The site captain may deny access to certain parts of the site. If necessary, a potentially aggrieved investigator or site captain can appeal to the SAM or MM if there is a conflict that cannot be easily resolved.

N	SA	SSA		
TF Sites	TF Captains	TF Sites	TE Captains	
OBS	Wofsy/Goulden	OBS	Jarvis	
OJP	Fitzjarrald	OA	Black	
Fen	Jelinski			
YJP	McCaughey			

Table 4.1.3.4 TF site Captains

4.1.3.5 Field Liaison and Site Managers/Contacts

Dan Hodkinson (US) is the first point of contact for investigators who wish to get some significant infrastructure task completed. He will work with the PANP Site Manager or Paula Pacholek (SSA), Carl Spence (NSA) and others as necessary to get approved work done. Investigators should not attempt to task any of the site support staff without contacting Dan Hodkinson or the SAM/MM on duty.

4.1.3.6 Laboratory Chiefs

Betsy Middleton (SSA) and Patrick Crill (NSA), or their nominees, will oversee the allocation of space and other resources at the Paddockwood School (SSA), and Heritage Museum facility (NSA), respectively. Betsy Middleton will pull the calibration gas requirements together for all BOREAS-96 teams. CCRS (Gill Traynor) and NASA (Dan Hodkinson) will arrange for purchase and study area distribution of cal gas cylinders.

4.1.3.7 <u>Aircraft Managers</u>

All proposed aircraft missions must be approved by the MM. Aircraft managers are responsible for maintaining and executing the flight operations planned by their PI's or requested by the BOG through the MM. The aircraft manager or the associated aircraft PI should report to the MM by 2100Z each day with the following information.

- Intentions/requests for the next day's operation, including details of flight plans and statement of necessary decision times (e.g. aircraft prep times, etc.).
- Remaining research hours
- Status of aircraft and crew readiness; e.g. '30 hours remaining for the IFC; 10 hours before an inspection; two days before a mandatory crew rest day.'

The aircraft management/PI should attend the BOG if based near the hot site, sit in on the BOG by speakerphone with the SAM at the cool site or arrange immediate contact with the AFM representative or MM after the BOG. It is essential that the aircraft manager be aware of the BOG plans during or immediately after the BOG: he/she should get hold of a copy of the next days mission schedule by fax if all else fails. The aircraft manager/PI is then responsible for:

- Scheduling the aircraft preparation and launch.
- Briefing the aircrew on the plans, including the flight activities of other BOREAS aircraft.
- Contacting (or ensuring that the pilot contact) the MM at the target SAHQ by telephone or radio at the following times/events:

- -- prior to setting out to the airport to prepare the aircraft
- -- prior to engine start
- -- 'wheels up' (if in radio range)
- -- 'site approach', when within radio range of the SAHQ, giving aircraft position, altitude, intentions and ETA on-site. (The MM or SAM will respond with information on relevant aircraft and surface activities).
- -- 'start of work' in the study area
- -- movement from one surface target to another
- -- 'site exit'
- -- 'down safe'
- The 'down safe' call should include information on:
 - -- flight take-off time, landing time
 - -- mission type
 - -- accomplishments / problems
 - -- readiness for repeat mission

Aircraft managers and pilots must also be familiar with sections 4.1.6.1 and 5.1.2.

4.1.3.8 <u>Investigators</u>

All investigators must:

- (i) Check in by telephone or in person with the SAHQ when arriving in a study area for an IFC and when leaving for home. On arrival, field investigators will get an update briefing, radios, contact materials, etc.
- (ii) Tell their group representative their plans for the next day, also special needs or requests, by noon of each day. (Sometimes SAM'S will collect these reports directly from investigators on behalf of the group representative.) Be sure to notify SSA-SAHQ the day before you intend to visit sites in PANP.
- (iii) Be familiar with the emergency procedures, see Section 4.1.7.
- (iv) When entering the field, notify the SAHQ; keep the radio ON all day; and when leaving the field notify the SAHQ. Be familiar with the radio procedures described in 4.1.6.2.
- (v) Contact the TF site captain when visiting a TF site, especially if you intend to set up an experiment nearby or want to use the tower.
- (vi) Investigators must fill in the activity log sheet, see figure 4.1.3.8 for example, and give a copy to the SAM prior to leaving the study area. There should be at least one entry per day.

Group:	Team Members:
PI:	

Date	Site	Start Time	End Time	Measurements	Notes

Figure 4.1.3.8: Investigator Log. Investigators should collect blank forms from Ops and complete at least one line per day in the field (even if no work was done). Completed sheets must be handed in to the SAM prior to leaving the study area.

4.1.3.9 <u>Meteorological Forecaster/Briefer</u>

There will be three sources of meteorological forcast support for BOREAS.

<u>ECMWF</u>: ECMWF have agreed to fax forcast materials to the SSA-Ops once a day during FFC's and IFC's. They will provide time-line forcasts for gridpoints representative of the NSA and SSA.

<u>National Meteorological Center</u>: NMC will supply forcast materials to the SSA-Ops once a day during most FFC and IFC days.

<u>Saskatoon Regional Center</u>: Saskatoon Center provides the operational aviation forcast for the province. AES has arranged for them to provide support and to fax SSA-Ops the briefing materials. The best times to contact Saskatoon for verbal briefings and updates are:

am:	0600-0615 LT 0830-0900 LT

pm: 1800-1815 LT 1900-1915 LT

Contact phone numbers are in section 4.1.6.3.

The gridpoint forecasts will be in a form similar to an aviation forecast (FT). Current and 24-hour forecast conditions will be provided for points:

WIN	55° 40'N,	98° 40'W (Center of NSA)
WIP	53° 40'N,	106° 15'W (PANP in SSA)

4.1.4 Meeting Schedules and Formats

During FFC-W and IFC-2 there will be a BOG meeting every night. During IFC-1 and IFC-3 BOG meetings may be held at less frequent intervals, in which case the SAMs and MM should catch up on the project documentation for the preceding period at that time. The radio net will be used to advertise meetings.

The BOG meetings will start at 0200Z (2000-SSA; 2100-NSA) chaired by the MM from the hot study area. All BOREAS team members are encouraged to attend, but the following must be represented:

Mission Manager (chair) Outgoing Mission Manager Forcaster or representative Team representatives, unless released by arrangement with the MM Key aircraft representatives The steps leading up to the BOG meeting are shown in Figure 4.1.4.a.

The format of the meeting will be as follows:

•	Weather forecast: 24-hour prog, 3-day outlook	(5 minutes)
•	Outgoing mission manager report	(5 minutes)
	 Aircraft missions completed 	
	- Other significant events	
•	Study area manager reports/updates (2)	(2 minutes each)
•	Team representative reports/requests (6)	(2 minutes each)
•	Aircraft status and plans	(5 minutes)
•	Incoming mission manager mission proposals	(5 minutes)
•	Discussion	(5 minutes)
•	Finalization of plans for next day, distribution of	
	of action items	<u>(5 minutes)</u>
	TOTAL	46 minutes

These BOG meetings will start promptly at 0200Z at: 2000 LT: Snodrifters Lodge, Candle Lake (SSA) 2100 LT: Inco Training Center or TBD site (NSA)

There will be a telephone tie-in to the Marlboro Inn in Prince Albert so as to include C-130 crews and PA-based investigators.

The formal BOG business may be followed by a variety of follow-up science or operations meetings.

Figures 4.1.4b and c show examples of mission summary charts.



Figure 4.1.4a Steps leading up to the BOG meeting showing flow of reports from SAHQ's to the MM.

				BO	REAS	Airc	raft/	'Satel	lite S	Sched	ule					
Date	: 8/1	3/93	;	Mission Manager: Sellers NSA SAM: Evans Hot Site: NSA SAM: Nevc								s comer	-			
ент	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	100	200	300	400
NSA.	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
SAT		N-12 V 41, 64							N-11 ⊽ 44, 48							
AC		DC-8	⊳ YÆ	 		PD- HH		 	_⊲ YÆ	26000'	 		 			

Satellite Legend

Ν	=	NOAA AVHRR	N-12	Satellite type - number
L	=	Landsat	∇	
S	=	Spot	41,45	

Symbol ' ∇ ' at top of row denotes NSA, near base denotes SSA.

Aircraft Legend



Figure 4.1.4b Aircraft/Satellite mission summary chart. Legend explains abbreviations. These charts will be prepared and presented at the BOG meeting to brief BOREAS participants on the next day's activities. At the next BOG, a version of the chart reflecting the actual activities completed for that day will be finalized and filed.

BOREAS Daily Team Participation Form

					Mi	ssio	tion Manager: Sellers					NSA SAM: Evans											
DATI	<u>E: (</u>	<u>)8-1</u>	<u>3-9</u>	13	Ho	<u>t Si</u>	ite: 1	<u> </u>				SSA	<u>s s</u>	<u>M</u>	: N	ewco	mer						
Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0.FM					P P none *																		
ATIVI	-	<u> </u>	-			-		*		*	P		-	-	-								_
TF								W OJP AD		W YJP Fen AD	Fen AD *												
	\vdash	P			P			w	*	P		Р											
TE		OA AD *			PW AD *			OA OBS AD *	P BS AD	FW AD *		FW AD *											
TGB					* W leaf rapid AD																		
HYD									nhrj AD *														
RSS				Р ҮЛР AD *			* W OJP OBS AD				* ? flin flon	W CL visit AD *				W YA OBS AD *	₩ ОА ҮЛР РМ *		W ?WX AD *				
					*]]		.NSA	A site	9	*				.SS	A Sit	ce						
		Ĩ	Ι	Loca	tion		e.g. SSA - OA																
		1	Activ	vity		W = working, P = preparation																	
				Tin	ne				ĉ	ım =	mor	ning	д, А	D =	= all	l day	7						

Figure 4.1.4c Investigator activity summary. Legend explains abbreviations. These will be prepared and presented at the BOG meeting to brief BOREAS participants on the next day's activities. At the next BOG, a version of the chart reflecting the actual activities completed for that day will be finalized and filed.

The people listed at the beginning of this section must be represented at BOG meetings unless specific arrangements have been made with the MM or SAM. While all investigators are encouraged to attend any BOG meeting, every few days there will be a call for investigators to show up and participate on a particular evening. These bigger meetings are intended to open up communication between investigators; refreshments (beer, snacks, etc.) should be available.

4.1.5 <u>Aircraft Operations Planning</u>

The following procedures for the submission and approval of aircraft mission plans, monitoring of flight operations and communications have been set up to ensure flight safety and efficient coordination in BOREAS.

Proposed aircraft missions must be communicated to the MM in time for their incorporation into the evening BOG briefing held the day before the mission is executed. It is preferred that each aircraft have a representative (P.I., aircraft manager or pilot) at the BOG meeting. Any changes to the missions as described in Chapter 5 must be communicated to the MM as soon as practicable.

The MM will formally approve proposed mission plans at the BOG meeting in which the schedule for the next days missions will be set out in the Ops chart (Satellite/Aircraft) as shown in figure 4.1.4.b; copies will be made available and/or faxed to aircrews on request. For safety reasons, the following protocols have been established:

- Aircraft missions will be separated by time and/or altitude. The exceptions will be some combined flux missions in which case aircrews will confer with each other beforehand. The Aircraft Ops chart will show aircraft missions by altitude from top to bottom.
- Any departure from mission profiles (take-off times, site-entry times, altitudes, etc.) must be communicated to the MM as soon as possible.
- The SSA flux aircraft low-level routes are one-way only at any given time. The direction and clearance to enter these routes will be handled by BOREAS Ops.
- All BOREAS aircraft will communicate with BOREAS-Ops and each other on 122.7. Some calls are mandatory, see 4.1.6.1 and 5.1.2.
- Flight plans must be filed for each flight.
- Significant BOREAS/aircraft activity will be NOTAM'd by the MM.

If, for some reason, an aircraft team wishes to execute an unscheduled mission at short notice (i.e., not advertised at the previous BOG meeting) they must first contact the MM or his/her representative for approval. At this time, the MM will bring the team up to date with respect to other aircraft operations.

More details on aircraft operations management may be found in Section 5.1.2.

4.1.6 Communications

4.1.6.1 <u>Aircraft Radio Net</u>

The BOREAS-96 aviation radio frequency is 122.7. The NSA and SSA Ops Centers are equipped with aviation radio base stations which are FM-linked to booster-repeaters to enhance communication with low-flying aircraft in the study areas. Aircraft on the ground at Thompson Airport can reach Ops directly; aircraft at Prince Albert Airport generally need to be at ~ 200' altitude to make contact, so a 'wheels-up' call is requested.

Low-flying BOREAS aircraft should monitor Thompson radio (118.8) and Prince Albert radio (122.3) when operating in the NSA and SSA, respectively.

Radio calls should be made to the Ops Centers following the protocols outlined in 5.1.2.2. On first contact, Ops will advise of local conditions, traffic, tethered balloon operations and any other significant news. Ops will be the only groundto-air contact point between BOREAS investigators and BOREAS aircraft. Any requests for information between the two groups should therefore be channeled through Ops, who have both air and ground radio sets.

The call-signs are 'BOREAS-Ops' for the study area headquarters and 'Eyeball' for the support aircraft (FB) used for weather reconnaissance/birddogging.

4.1.6.2 Ground Radio Net

Ground radio nets will be in place in both the NSA and SSA. These will allow conversations between the SAHQ, TF Site Captains, TE Site Captains and other key investigators. It is desirable that ground radio communication follow normal radiocommunications format:

• On the first transmission / contact, say:

-- Person or place to be contacted

-- Name of person, team number and position of person transmitting

e.g. 'BOREAS Ops; this is Joe Bloggs, TF-20 at the Young palmtree site.'

- Keep transmissions as short as possible, i.e. no rambling, no long lists or monologues. If you have a list of items to transmit; break it up into messages of 15 seconds or less. This gives someone else a chance to cut in if necessary.
- At the end of the conversation say: -- Name of person transmitting - clear

e.g. 'Joe Bloggs, clear'.

- At the end of transmission, ensure that the radio is not still transmitting; i.e. no stuck button. Otherwise, no one else can hear anything anywhere.
- TF site captains in particular, but everyone in general, keep your radios ON. TF site Captains perform a radio check with the SAHQ when turning the radio on in the morning and prior to turning off in the evening. When driving in a vehicle, ensure that the radio is not lying on its transmit button; i.e. is not jammed on.
- Radios can be drawn from the SAM in each study area; these sets must be returned when the investigator leaves the study area (even if he/she is moving to the other study area). Investigators can rent their own radios for the season from the supplier; contact Gill Traynor for details.
- Investigators should get a briefing on channels to use, etc., when picking up their sets; see below for a summary. They should also be familiar with the emergency procedures listed in Chapter 7.
- If investigators want to use their radios in 'local' mode for on-site crew-to-crew conversations, they should advise Ops before switching to 'local', and also when they come back onto the BOREAS frequency.

The FM radios issued to BOREAS participants have channel selectors. In the NSA, channel 10 is used on-site while channel 09 can be used to contact BOREAS Operations or the Lab from town or on the stretch of Route 391 leading out to the study area from the airport or for local crew-to-crew conversations. In the SSA, users should select the channel denoted by the repeater number (e.g. RPT 4 for the PANP area) as shown in Figure 4.1.6.2. The radios can be used to contact BOREAS Operations from Prince Albert Airport from the Athabaska tower (Channel 02). For on-site crew-to-crew converstaions, users should select the channels marked 'local' for each location as marked on figure 4.1.6.2, (e.g. LOC 5 for the Whiteswan area). The radios have a complete list of channel numbers taped onto their backs; remove the radio from its sleeve to see this.





4.1.6.3 <u>Telephone/Faxes</u>

The following telephone numbers are useful.

Southern Study Area

SSAHQ - , Candle Lake Snodrifters Lodge	(Voice)	306-929-2214
	(Dataline)	306-929-2213
	$(E\Delta X)$	306-929-2217
Spacestle Ladge Candle Lake	(Voico)	306 929 217/
Shine Lantorn, Candle Lake	(Voice)	306 020 4555
PANP Park HO (also supplication)	(Voice)	306 663 5322
SDC (AMS Notwork)	(Voice)	206 022 5427
Paddaskuraad School	(voice)	306 989 1118
	$(\mathbf{E} \mathbf{\Lambda} \mathbf{Y})$	306 989 4448
Drings Albert Airport Weather Services	$(\Gamma A \Lambda)$	206 052 8640
Prince Albert Mosther Office (taped message)		206 052 2114
Prince Albert Weather Office (laped message)	(Voice)	206 052 8625
La Dance Elight Comming Station	(Voice)	300-955-8625
Lakonge, Flight Service Station	(Voice)	306-425-2368
Saskatoon, Flight Service Station	(Voice)	306-242-8227
Prince Albert Aviation (Eyeball)	(Voice)	306-764-4077
Prince Albert Airport ASAS Room (C-130/Ops)	(Voice)	306-922-3775
Prince Albert Airport, Athabaska Airways	(Voice)	306-922-3775
	(FAX)	
Prince Albert Inn	(Voice)	306-922-5000
Marlboro Inn	(Voice)	306-763-2643
	(FAX)	306-763-6336
Comfort Inn	(Voice)	306-703-4466
Northern Study Area		
NSAHQ - Provincial Hangar, Thompson Airport	(Voice)	204-677-4619
	(Speaker)	204-677-4633
	(FAX)	204-677-6414
	(Dataline)	204-677-4693
Inco Meeting Room	(Voice)	204-778-6230
0	(FAX)	204-778-6261
Inco Plant Laboratory	(Voice)	204-677-6450
Thompson Airport Flight Services	(Voice)	204-677-4043
Thompson Airport Weather Office (tape	d message)	204-677-6900
Keewatin Community College	(Voice)	204-677-6450
5 0	(Payphone)	204-778-6119
Heritage North Museum	(Voice)	204-677-4431
0	(FAX)	204-677-4462
Jo Lutley (Sunphotometer)	(Voice)	204-778-7669
Burntwood Hotel	(Voice)	204-677-4551

Meridian Hotel Country Inn Mystery Lake Hotel AES Radiosonde Network-Thompson Zoo (AES Observer)	(Voice) (Voice) (Voice) (Voice) (Voice)	204-778-8387 204-778-8879 204-778-8331 204-677-7078 204-677-7982
Weather Forecast	Support	
ECWMF (Brian Norris)	(switchboard) (direct) (fax)	44 1734 499000 44 1734 499423 44 1734 869450
Saskatoon Wx Briefer	(Voice) (Fax)	306-975-6699 306-975-6516
Joe Eley	(Voice) (Voice)	306-975-6912 306-975-5685
NMC (Hua-Lu Pan or Ken Mitchell)	(Voice) (Fax)	301-763-8301 301-763-8545

4.1.7 <u>Safety</u>

Chapter 7 describes procedures for getting emergency medical and/or fire assistance. This section describes what is available on site and routine safety procedures.

4.1.7.1 <u>Fire and Accident</u>

<u>Fire</u>: There are fire extinguishers at each TF hut. Additionally, in the NSA, there are fire extinguishers at each generator hut. In case of fire at the TF site, call for assistance by radio immediately. If you see a fire out in the bush, call in its location immediately - you may be the first to see it.

<u>Accident</u>: There are first aid kits in each TF site hut. Call SAHQ to arrange medevac, if necessary. The ground net radio can also be used to place an emergency phone call (see Chapter 7). All TF sites are close to potential medevac helicopter landing sites. (In the case of the OA-SSA, the two clearings back down the trail are adequate for this). More details on medevac procedures can be found in the last section in Chapter 7; all investigators should read this prior to entering the field for the first time.

4.1.7.2 Safety on site

<u>Investigator plans for the day</u>: Investigators must tell SAHQ where they will be on any given day. This is especially important for 'roving' investigators in TE, TGB and HYD teams. On leaving for the field, call in to SAHQ with a brief message of where you are going and expected time of return (ETR). The SAM will maintain a file on your plans. This information should also be given to your team representative. If you do not report back in (by radio, phone or in person), the SAM will initiate a search no later than three hours after your ETR. TF teams should contact the SAHQ by radio each morning upon entering their site and also prior to leaving. Investigator teams are also advised to have a copy of the EXPLAN with them in the field.

<u>Tower climbing</u>: All tower climbing must be cleared by the TF or TE site captains or his/her representative. Caution should be used when climbing the scaffold towers - under some conditions the steps and walkways can be slippery. The Rohn Towers should not be climbed without a tower training course, safety harness, and at least one other person present on the ground. If only one other person is present, he/she <u>must</u> have a radio. If two or more others are there, a radio is still strongly advisable. Tower climbers and backups must be familiar with the basics of climbing and rescue techniques, i.e., lowering an injured person from the top of the towers. Hard hats must be worn in the vicinity of the TE and TF towers.

- 1. TF towers (scaffold and Rohn): Site Captains control access and work on their towers. They are responsible for the placement of safety equipment, and (especially in case of Rohn towers) for ensuring that people who are to climb the tower have received the necessary training.
- 2. TE Canopy Access towers: Site Captains control access and work on their towers. They are responsible for the availability of safety equipment and for checking that people who are to climb the tower have received the necessary training. There will be training courses held close to the beginning of IFC-1 which will be arranged by Dan Hodkinson (US Staff 301-286-3621). Dan Hodkinson will arrange subsequent training as necessary. Anyone wishing to use a TE tower should contact Joe Berry or Dan Hodkinson.
- 3. SRC (AFM-7) Meteorological towers: Only SRC personnel or their nominees are to climb these towers.

<u>Insurance</u>: Investigators are responsible for their own insurance while working on the project. This should cover medical expenses, third party injury, etc.

4.2 <u>Facilities</u>

Figure 4.2 shows the schedule of facilities availability in BOREAS-96.

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	NSA
NSA-OBS	
4/16 MSA-OJP	11/30
NSA-Fen	11/30
Field Support 4/10 4/20	
NSA Ops 4/16 4/28	7/98/9 10/110/20
2/15 (Shipping) NSA Lab	11/30
	SSA
SSA-OA	11/30
SSA-OBS	11/30
Field Support 3/20 4/4	
SSA Ops 2/25 3/15 4/2 4/15	7/7 8/9 10/1 10/22
SSA Lab 2/1	11/30
Feb Mar Apr May	/ Jun Jul Aug Sep Oct Nov

Figure 4.2 Schedule of BOREAS Facilities. Note that labs will be continuously available from their start dates onwards, but Ops centers will not.

4.2.1 Study Area Layout; Site Locations

Figure 5.1.2.2 shows the SSA and NSA with the aviation NAVAID grid overlaid. Figures 4.2.1 show the TF sites layouts individually, together with a (true) bearing and range grid overlaid on each one, with the point of origin being the TF tower base. This reference grid should be used to identify experiment locations around TF site.

Table 4.2.1 lists site locations as of the GPS field reconnaissance of BOREAS-94.

4.2.2 Ops Centers, Labs, Radio Nets, Telephones

The Ops Centers in the SSA (Snodrifters Lodge in Candle Lake) and NSA (Provincial Hangar, Thompson Airport) will be manned during the field campaigns. Each Ops Center is equipped with ground and air radio equipment and telephones (see 4.1.6).

Some limited laboratory facilities will be provided by the project, to permit analyses of samples that need to be performed within a few hours of sample collection or which would be impractical to perform at investigators home institutions. These facilities will be operated during the BOREAS-96 IFC's, and at a reduced level during the Winter campaign (FFC-W) and between IFC's. The labs will also be used for equipment receiving and storage between IFC's. The project will be providing space, power, running water, and a few items of equipment for shared use, as well as helping to coordinate investigator access to consumables such as gas cylinders. The project will not directly purchase expensive laboratory instruments or other capital equipment which are expected to have a useful life well beyond the duration of the BOREAS experiment. It is vital that investigator teams and groups who require such equipment arrange for it to be available and shared as appropriate. Each lab will be equipped with telephones and faxes, enabled for local calls only (i.e. you must have a phone card to make a long distance call).

NSA Lab: Heritage North Museum

Part of this Museum will be modified to meet the lab space requirements of all investigators in the NSA, see figure 4.2.2a. The size of the lab space has been greatly scaled down from 1994 because of fewer participants in 1996. One high precision balance and one high capacity balance will be provided by the project. The project will also provide a drying oven, a refrigerator and an upright freezer. In addition to the main lab area, there is a storage area in the museum annex. Currently this storage area is not heated, but that may change before the IFC's. Benches and tables will be added for sample preparation, computer stations, and work space. The building will be rewired with ample 110v outlets. Patrick Crill (TGB-1) is the lab chief.

SSA Lab: Paddockwood School

This modern elementary school is no longer used for classes and has been leased by the project, see figure 4.2.2b. Each classroom is equipped with some bench space and a sink. There will be an area of common use, where two medium sized drying ovens and a dual range balance will be located. The project will also provide a chest freezer and a refrigerator in the common area. Because of an excess of space, we will not lease the gym and kitchen area of the school in 1996. We will also not assign areas to certain groups before the field season, as was done in 1994. All assignments will be worked out with the lab chief upon arrival at the SSA. Betsy Middleton (TE-10) is the lab chief.

Figures 4.2.2c,d show the locations of the Ops Centers and Labs in the NSA (4.2.2c) and SSA (4.2.2d).

4.2.3 Field resources; huts, generators, transport

All the BOREAS huts will be available for use in BOREAS-96; however, only the <u>active</u> ones (SSA-OBS; SSA-OA; NSA-OBS, NSA-YJP, NSA-OJP, NSA-Fen) will have the full complement of medical, tower climbing and fire equipment available. Generators in the NSA for the three active sites will be on-line well before the start date of 4/16/96. (NSA-OBS runs continuously). All investigators should arrange for their own transport; the Ops Center staff transport is not for general use but may be used to help investigators out, at the staff's discretion.

The schedule for SAM duties is given in section 4.1.2

Name	Notes	Category	BORS	BORS	West	North	ULW .	LAUM	UTM	Source of
			X	Y I	Longitude	Latitude	Essing	Northing	Zone	Location
Flux Tower, Sites				1						
C3B7T	SSA OA	1	317.3	303.4	-106.197	53.629	420,874	5,942,688	13	GPS
FOLST	SSA Fen	1	419.5	330.6	-104.619	53.799	525.1011	5.961.204	13,	Air photo
FBLET	SSA YJP	! <u> </u>	416.9	538.9	•104.647	53.5/5	492.000	5,969,705	12	Air photo
GBI4T	SSA UBS		419.0	048.9	-105.422	53,016	520 314:	5.976.015	13	666
G2L3T	SSA CUP		913.0	116 7	-105 912	53,709:	479 4001	5,851,000	13	Map
D6M41	33A 1A		214.0	810.71	-100.018					
77/107	NSA O IP	1	769.5	617.1	-98,624	55.927	523,501	6.197.997	5.4	Air photo
13687	INSA OBS	1	778.1	613.3	-98.4841	55.879	532,301	6,192.700	14	Air photo
17511	INSA Fen	1	781.2	617.6	-98.4221	55,914	536.103	6,195,703	141	Air photo
Tasat	INSA YJP	1	789.6	618.2	-98.288i	55.903	544,498:	6,195.502	54!	Air photo
T4U6T	INSA Beaver Pond	1	806.9	614.B	-98.025	55.845	561.0001	6,189,000	14	Map
						1				
Mesonet Stations										<u>^</u>
SSA DA AMS Tower	Suite A		317.3	303.5	-106,196;	\$3.628	420.938	5,942,576	13'	<u>. GPS</u>
SSA OA Flux Tower	Sulte B		317.8	303.4	-106.197i	53,629;	420,874	5.942.688	13	98
SSA DA AFM	Precip	<u> </u>	317.3	303.1	-105.196	53,525:	420,934	5.942,353	18	
SSA OJP AMS Tower	ISURE A		413.7	343.3	-104.689	53.916- 60.045	520.445	5,974,041	12.	695
SSA CUP Flux Tower	SUGE B		413.0	9/9.2	404.590	55 616	520,456	5.974.043	18	OF5
SSA OUP AFM	Precip		£40.7	393.3	-303.056	53 958I	365,158	5,981,696	54	GPS
The Pas Amb Towe:	Dracie		£49.7	376.7	-1D1.056	53,9681	365, 1581	5,981,696	14	GFS
NSA OJP Flux Tower	Stille A		768.6	517.2	-98.622	55.928	523,637	6,197.905	54;	GPS
NSA Fen-Bill AMS Tower	Suite B		781.3	618.1	-98,420	55.916	536.270	6,196,657	14	OF5
INSA OJP AFM	Precip		768.5	617.3	-98.623	55.929	523,574	6,198.016	54;	GPS
Thompson Airport AMS Tower	Suite A		817.1	B12.1	-97.874	55.604	570.598	6,184,614	161	699
Thompson Airport AFM	Precip		817.2	612.0	-97.873	55.803	570,662	6,184.503	141	GFS
Lynn Lake AMS Tower	Suite A		601.2	698.4	-101,093	 \$6.888 	372.492	6.306.422	14:	GPS
Lyon Lake AFM	Precip		601.2	698.6	-101.093	56.888	372.499	6.305.644;	14	GPS
Fin Flon AMS Tower	Suite A		598.1	448.5	-101.690	54.671	326.559	6,061,281	16	GPS
Fin Fion AMS Trestle	Suite B		598.2	44B.B	-101.689;	54.672	326.628;	6.061.390	391	<u>690</u>
Fin Fion AFM	Precip		598.2	448.B	-101.689	54.672	326.628	6,061,390;	1 21	679
La Ronga AMS Tower	Suite A		363.2	474.D	-105.293	55.124	481.301	6 108 518		699
La Ronge AFM	Precip		363.2	1 4/4,1	103.298	54 123	882 824	6 000.295	32	05
Maadow Lake AMS tower	Sune A		162.7	350.0	-108.508	54.127	662.824	6.000.295	12	GPS
Meadow Lake APM	Suite A		301.1	137 4	-108.60D	52.150	390,530	5,778,711	13	Мар
Seckaroon (OFIC-CHO) AMO TOWEL	Suite R		301.1	137.4	106.600	52,150	390,530:	5.778.711	13:	Мар
Saskatoon AFM	Precio	F	301.1	137.4	-105.600	\$2.150	390,530	5.778.711	13	Map
	1			i						
Upper Air Stations							1		!	
Existing Regular		1					E			
Baker Lake UA, NWT	YBX		730.0	1559.0	96.000	64.317	645.032	7,125,725	14	Cetalogué
For Smith UA, NWT	YSM		-52.1	1008.4	111.933	ED.033	447,894	6.655,490	12:	Catalogue
Churchill UA, MB	MO		970.4	979.9	-94.083	58.7331	437,281	6.510,866	25	Catalague
The Pas UA, MB	Y00 · · ·		646.9	376.2	-101,100	53.967	362.245	5,981,8331	14	Catalogue
Edmonton-Stony Plain, AB	WEE	<u> </u>	-205.2	266.2	114.100	50.550	209 792	8 700 030	18	Catalogua
Saskaloon, 5K	1992		294.1	064 1	-00.217	51 4501	601 203	5 703 543	15	Catalogue
Pickie Lake, UN	(TPL	i	-77 B	1 204.0	111 367	47 483	472,437	5.258.947	12	Catalogue
Closen MT	'GOW		327.4	-298.2	-106.6171	48.217	379.9561	5,341,643	13	Catalogue
Bismark MD	85		786.8	-410.5	-100.750	46.767	366,409	5.180,722	14	Catalogue
International Falls MN	INL		1292.9	-105.3	-93,363	48.567	471,731	5,379,364	15	Catalogue
the second			-	1						
Existing DND			1	1			1			
Primrose Lake, AB	WO		61.1	417.8	-110.050	\$4.750	561.146	5.067.386	12	Catalogue_
Shiki, MB	WLO	1	<u> B16.4</u>	-68.3	-99.650	49,783	453.234	5,514,744	14	Catalogue
			į	<u> </u>						
BOREAS SHes				L		FE 367		6 176 897	10	Man
Thompson Zoo, MB	IYTH		1 618.7	0.000.3	108.167	50,700	492 4091	5 953 R86	18	Map
Candle Laxe, SK	WILZ		304 9	706.6	105.617	\$7.250	462.791	6,345.384	13	Mag
Key Lake, Sh	TNJ		1 044.6	100.0						
Cooperative Siles		1				i				
Oult Lake, SK	WOH	[452.3	138.2	-104,400	52.050	541,144	5,766,769	13	Catalogue
Lynn Lake, M8	YTL	1	602.1	696.3	-101.DB3	56.867	373,001	6.304,478	14	Catalogue
		1								
Other points of interest:		1		1			:			
SANQ			378.0	319.7	-105.252	53.734	482,750	5,953.900	13-	Мар
Prince Albert Airport			354.6	259.9	-105.660	53.220	454,370	5,696,374	13	Map
Thompson Airport & NAHQ		1	B17.7	611.6	97.870	55.600	571.048	5 000 000	14:	enap Man
SSA LIDAR		!	414.1	358.3	-104.650	54.050;	524,916	5,973 239	1.3	Map
SSA Profiler		···	<u>+ +15,8</u> 1 760 4	1 610 4	-104,00/	55,809	521.030	6,198.576	14	Map
ATTICLE Sensor Cathering Sat			344	C 250 B	105.696	53.133	453.468	5,887.107	13	Unknown
AVIDIC Contex Pallaces Sta			352	7: 274 8	105.695	\$3.350	453,701	5,911.210	13	Linkspath
RATING GROSPI CARDINGS 316										

Table 4.2.1 Coordinates for selected features in the BOREAS Region

Ann. Lingry Store: Ann. Ann. <th>Name</th> <th>Notes</th> <th>Calegory</th> <th>BORIS X</th> <th>BORIS Y</th> <th>West Longitude</th> <th>North Latitude</th> <th>אינע Easting</th> <th>UTM Northing</th> <th>UTM Zone</th> <th>Source of Location</th>	Name	Notes	Calegory	BORIS X	BORIS Y	West Longitude	North Latitude	אינע Easting	UTM Northing	UTM Zone	Source of Location
Sandtrast al. SSA. Sandtra	Auxiliary sites:										
ALA Bucche 3 282.5 200.1 26.7.00 5.7.6.00 1.8 Map SBAL Ab4.7 307.0 7.5.0 1.06.237 5.5.186 477.00 5.8.9.4.00 1.0 692 SBAL Ab4.7 992 1.05.152 5.5.186 477.00 5.9.8.4.70 1.0 692 SD55.4 Ab4.7 2.8.9.1 1.05.251 5.5.2.1 420.5.10 1.0 692 SD55.4 Ab4.7 2.8.9.1 1.05.201 5.5.2.1 420.5.2.4 5.5.6.8 5.5.6.	Southeast of SSA:				n						
ADP Nobel 9. 377,9 955.4 106,237 65,182 417,200 54,94,800 10 Map DBSA. Ad41:9 0 317,7 992,54 455,427 53,247 53,247 53,247 53,247 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 53,257 54,258 53,452 53,257 54,258 53,452 53,257 54,258 53,452 53,257 54,258 53,452 53,257 54,258 53,452 53,257 53,277 53,257 53,277 53,277 53,277 53,277 53,277 53,277 53,277 53,277 53,277 53,277 53,277 53,277 <td< td=""><td>A1A</td><td>Satoche</td><td>3</td><td>328.3</td><td>205.2</td><td>-106.134</td><td>52,742</td><td>423,500</td><td>5.844.000</td><td>13</td><td>Mao</td></td<>	A1A	Satoche	3	328.3	205.2	-106.134	52,742	423,500	5.844.000	13	Mao
BAB. AUX-13 Constrain Constrain <thconstrain< th=""> <thconstrai< td=""><td>A2P</td><td>Nisbel</td><td>3</td><td>317.9</td><td>255,4</td><td>-106.237</td><td>53.198</td><td>417,400</td><td>5.894,8DC</td><td>13</td><td>Мар</td></thconstrai<></thconstrain<>	A2P	Nisbel	3	317.9	255,4	-106.237	53.198	417,400	5.894,8DC	13	Мар
Displan Displan <t< td=""><td>SSA:</td><td>A11.4 4 B</td><td></td><td>4 4 10 10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	SSA:	A11.4 4 B		4 4 10 10							
Doess Doess <thdoess< th=""> Doess <thd< td=""><td>D964A</td><td>AIM-78</td><td>2</td><td>317.7</td><td>299.2</td><td>-106,195</td><td>53.591</td><td>420,942</td><td>5.936.470</td><td>13</td><td><u> </u></td></thd<></thdoess<>	D964A	AIM-78	2	317.7	299.2	-106,195	53.591	420,942	5.936.470	13	<u> </u>
OptiMa AH-3 2 53 1 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201 105 201	00/63	BMM-1	3	376.8	810.6	-105,201	53,7411	469,282	5,954.618	131	<u> </u>
D51.5A Abhé 3 41.1 -1.04.469 65.864 65.878.88 65.844 65.845 66.845 65.845 66.845 65.845 66.845 65.845 66.845 65.845 66.845 <td>MURC</td> <td>AIH-3</td> <td>2</td> <td>381.6</td> <td>319.3</td> <td>-105.207</td> <td>53.727</td> <td>486,366'</td> <td>5,952,968</td> <td>13</td> <td>GPS</td>	MURC	AIH-3	2	381.6	319.3	-105.207	53.727	486,366'	5,952,968	13	GPS
DCAM AMA-12 3. 322.5 327.5 105.051 05.84.1 428.61.2 6.865.712 1.91 GPS DPDP MH-4	DSL9A	ADH-2	3	419.5	316.1	-104.639	53.669	523.888	5.946.556	13	GFS
Carbon Carbon Carbon Constraint Constraint Constraint Source Constraint Source Constraint Constraint <thconstraint< th=""> <thconstraint< th=""> <thco< td=""><td>E7C3A</td><td>AMM-12</td><td>3.</td><td>323.2</td><td>327.5</td><td>-106.0B1</td><td>53.841</td><td>428,916</td><td>5.966,173</td><td>13</td><td>GPS</td></thco<></thconstraint<></thconstraint<>	E7C3A	AMM-12	3.	323.2	327.5	-106.0B1	53.841	428,916	5.966,173	13	GPS
Print Jost-A1 St. 21, 27, 27, 4 OS. 201 St. 201 <thst. 201<="" th=""> St. 201 St. 201</thst.>	iF7J0P	UMH-5	3	366.6	335.3	-105.113	53.866	492.737	5.96B.441	13	<u>675</u>
Pr.11 JMALAQ S1 391-71 327.4 -105.021 52.881 -25.782 5.90.049 12 DB GR155 JBH 5 JBLAS JALAS JALAS </td <td>F7J1P</td> <td>JMB-A1</td> <td>3</td> <td>391.7</td> <td>337.4</td> <td>105.046</td> <td>53.664</td> <td>496,881</td> <td>5,970,405</td> <td>13</td> <td>GPS GPS</td>	F7J1P	JMB-A1	3	391.7	337.4	105.046	53.664	496,881	5,970,405	13	GPS GPS
C2845 (94) 3 34,3 342,2 -105,137 53,930 491,027 5,775,468 131 GFB G42MA MM1 5 383,4 342,1 -105,137 55,330 451,027 5,577,468 131 GFB G42MA MM45 342,0 -104,748 55,047 457,029 13 GFB G42MA BM46 340,0 342,0 -104,748 55,049 55,279 55,715,651 13 GFB G42MP AM46 340,0 340,0 -104,768 53,944 55,279 50,715,851 13 GFB G2A75 DFV 31 410,2 246,5 -104,672 53,974 507,522 5,910,21 13 GFB G4LP JM4 141,73 245,5 -105,733 54,064 439,100 591,007 13 May G5A9 JM4 13,532 54,001 549,001 13 May G4A9 JM40 33,317 252,53 <t< td=""><td>F7J1P</td><td>JMR-A2</td><td>S</td><td>391.7</td><td>337.4</td><td>-105.031</td><td>\$3,881</td><td>497,992</td><td>5.970.082</td><td>13</td><td> 0%6</td></t<>	F7J1P	JMR-A2	S	391.7	337.4	-105.031	\$3,881	497,992	5.970.082	13	 0%6
Bill Bill State S	G2I4S	SVA	3	394.3	342.2	-105,137	53.930	491,027	5.975.486	13	GPS
Diffield Diffield 38.4 38.4 34.4 -105.1481 53.647 452.76 5.077.457 131 GPS GPMB AMA9A 3 402.0 102.789 53.948 515.527 507.392 132 GPS GPMB AMA9A 3 402.1 147.29 53.948 515.527 52.77.952 13 GPS GRAP JMM48 3 417.3 342.2 1.104.637 53.948 51.527 52.79.02 13 GPS GRAP JJM4 3 416.7 34.84.7 104.637 53.964 62.77.852 5.970.92 13 GPS 55.970.92 13 May 105.759.02 13 May 100.5 590.02 13 May May 100.759.100 13 May May May 100.759.100 13 May M	G2145	- AH	<u>: Si</u>	384.3	342.2	-105.137	53.930	4\$1.027	5.975.486	13;	GPS
Condes David p data David p data Data <thdata< th=""> Data Data</thdata<>	Gakee	MW-1	3	383.4	344.11	-105.149	53,947	490.276	5.977,457	33:	OPS
OTHER INM-64 3 409.1 347.3 -104.765 5.5.851 5.5.71 5.75.72 5.75.72 5.75.72 5.75.72 5.75.75.77 5.75.72 5.75.72<	G6K8S	BMH9	2	408.6	346.2	+104.749	53,908.	516,552	5,973,092	13	GPS
SchopP JAMA 48 3 403.4 34.4 1-10.75g1 55.617 5.96.01007 1.3 0.97 H2D1M 3 34.2 4.94.7 32.8.7 105.925.5 5.4061 425.000 5.961.400 13 Map H12D1M 3 34.2 83.12 105.051 5.40.601 425.000 5.961.400 13 Map H12D1M 3 34.2 34.2 104.2 104.772 5.862.001 104.762 104.5 104.5 5.977.1 13 Map	G7K9P	JMM-BA	3	408.1	347.3	-104.769	53.958	515,238	5.978.595!	13	063
G20.75 B7L 3 417.3 442.1 -104.637 53.604 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.22 5.97.6.21 5.97.6.22 5.97.6.21 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20 5.97.6.20	G8K8P	JMM-8B	3	408.4	348.2	-104.762	53.965	515,617	5.979.3B7	13	GPS
DBL8 JDMA 3 16.7.7 94.8.6 1-104.627 5.3.8.74 5.7.5.25 5.8.9.02 17 13 OPS H3D1/m 3 33.1.3 558.3.2 1-106.733 5.3.97.4 5.7.5.2 5.890.400 13 Map H3D1/m 3 33.1.2 553.8 1-105.925 5.5.4.061 4.591.100 5.991.400 13 Map H3D1/m 3 33.1.2 553.8 1-105.925 554.061 4.591.100 5.991.400 13 Map H3D1/m 3 344.4 53.1.3 1-105.921 54.112 456.70 5.895.729 13 Map GP48 BDL.60 2 8.8.1 541.10 1-105.021 554.14 5.072.727 13 Map GP48 BDL.60 2 8.45.1 3.822 156.44 5.072.727 13 Map GP48 BDL.60 2 3.25.9 2.82.61 105.421 5.8.210 5.8.212 5.8.227 5.1.6.8.22	G2L7S	B?L	3	417.3	342.1	-104.637	53.504	523.899	5,972,524	13	GPS
Domini Domini 21	GOLDP	JDM-8	3	416.7	34B.5	-104.637	53.961	523.846	5,979,032	13	675
H2D1S 1 2017 2022 1 2018 4.961 4.95 4.961 4.95 4.961 4.95 4.961 4.95 4.961 4.95 4.961 4.95 4.961 4.95 4.961 4.95	H2D1M	1 SMM-TU	2	410.2	349,41	•104.733	53.974	517.522	5.980,417	13.	GPS
H3DIM 13 31 32 32 32 32 32 32 32 32 32 32 32 32 32 42 43 42 40 42 50 33 52 53 55 53 64 600 55 56	H2D1S		3	331.7	352.7	-105.3011	54.000	439,100	5,991,000	13:	Map
HIESS 13 34.4.4 851.3 105.733.4 4 54.112 496.00 53.80.00 13. Mee GR45 EDL-20 21 34.8.7 105.031 54.112 49.02 59.02 5.925.279 13. Mag GR45 EDL-20 21 34.73 44.9.8 105.121 53.922 51.344 59.757 13. Mag GR45 DMM Jail Site 3 450.8 332.0 104.447 53.802 51.444 59.777 13. Mag GR45 HYD-5 Tower 3 325.9 92.6.6 100.641 53.461 431.500 595.000 13 Mag GP3 S 514.6 99.7 102.846 55.218 634.500 6.121.000 13 Mag GP4 S 514.5 59.27 102.846 55.218 632.500 13 Mag GP4 S 514.5 50.2 102.846 55.218 632.500 61.21.000 13 Mag GP4 S 514.52 102.8460 55.218<	H3D1M		3	331.2	353.6	-105.931	54,069	439,100	5.991.400	13	Man
IZEP JH-7 2 385.8 S01.0 11.0 12.0 15 653 GMAS EDL_20 2 344.7 044.5 -100.511 53.995 492.0841 5.982,708 13 Map GMAS 3 400.5 344.5 -100.447 53.801 555.464 5.975,727 13 Map E787C HYD-5 Tower 3 373.9 926.6 -100.644 53.801 55.965.000 13 Map CPP 3 375.9 926.6 -100.644 55.219 634.500 6.120.000 13 Map CPP 3 515.1 499.2 -102.879 65.216 635.200 6.120.000 13 Map CPP 3 515.1 492.2 -102.879 65.214 654.500 6.120.000 13 Map CPP 3 513.1 492.1 +102.810 55.214 653.200 6.120.000 13 Map CPP 3	H1E4S		3	344.4	351.3	-105.733	54.040	452.000	5.988.000	13	Map
Desce Dell. 420 21 284.2 -105.121 95.096 492.084 5.082.703 13 Mage D1M0M Jall Sine 3 480.8 332.0 -104.447 55.084.5 55.844.5 55.77.77 13 Mage D2700 HYD.5 Tower 3 325.9 226.6 109.041 55.041.45 55.021.453 13 Mage E605W HYD.5 Tower 3 325.9 926.6 109.041 55.041.6 53.000 6.120.000 158.000 13 Mage Tinnsect: - - - - 102.806 55.219 654.500 6.120.000 13 Mage D28 - - 102.800 55.216 652.216 653.000 6.120.000 13 Mage D28 - - - 102.800 55.216 653.200 6.120.000 14 Map D28 - - - 102.807 55.216 653.200 6.120.000	1218P	(J3H-7	2	388.3	361.9	-105.051	54.112	496.702	5.995,729	13	GFS
PHOM Date Size 3 405, 3 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 240, 5 106, 447, 5 30, 601, 5 55, 648, 5 556, 648, 5 556, 648, 5 556, 648, 5 556, 648, 5 556, 600, 5 13 Mage 171, 192, 448, 1 423, 000, 5 5, 627, 000, 1 3 Mage 3 514, 5 499, 2 102, 848, 423, 500, 5 513, 1 Mage 3 514, 5 499, 2 102, 866, 55, 214, 5 633, 500, 6 512, 000, 13 Mage 202 0 102, 800, 1 102, 800, 55, 214, 5 633, 000, 6, 120, 500, 13 Mage 202 0 114, 480, 1 102, 910, 55, 216, 533, 000, 6, 120, 500, 13 Mage 207S 1 3 513, 1 480, 1 102, 910, 55, 216, 533, 000, 6, 120, 500, 13 Mage 207S 1 3 744, 1 654, 1 947, 907, 6, 120, 900, 14 Mage 207S 1 3 744, 1 940, 455,	G4K8P	BDL-20	2	364.7	349.5	-105.121	\$3.995	492,084	5,982,703	13	Map
E787C IVD.5 Tower 3 17.2 3 27.3 100.121 50.801 298.40 298.40 298.40 108.41 13 Map Transect: 3 285.9 3 285.9 3 285.9 3 285.9 3 285.9 3 285.9 3 285.9 3 285.9 3 514.5 499.7 102.865 53.201.5 13 Map D3P 3 514.5 499.7 102.866 55.219 654.500 6.121.000 13 Map D3S 3 515.1 499.7 102.866 55.218 633.500 6.121.500 13 Map D3S 3 514.5 500.2 102.866 55.214 634.500 6.121.500 13 Map D3P 3 514.1 699.9 102.847 55.215 632.000 6.121.500 13 Map D3P 3 514.1 699.9 102.847 55.224 64.500.00 13 Map D7S 3 513.1 690.1 102.847 55.241 633.000 6.120.000 13 Map <td>FINOM</td> <td>Jail Site</td> <td>0 3</td> <td>400.5</td> <td>332.0</td> <td>-104.767</td> <td>53.932</td> <td>\$15,344;</td> <td>5.975,7371</td> <td>13</td> <td>Map</td>	FINOM	Jail Site	0 3	400.5	332.0	-104.767	53.932	\$15,344;	5.975,7371	13	Map
S6C5W HYD-5 Tower 3 325.9 326.6 -106.041 431.600 5,955.000 13 Map 0.4P 5 515.1 492.7 102.886 55.219 634.500 6,121.000 13 Map 0AP 3 515.1 499.7 102.879 55.215 634.500 6,121.000 13 Map 0AP Deleted 3 515.5 400.1 -102.879 65.216 634.500 6,121.000 13 Map 0AP Deleted 3 514.5 500.1 -102.866 55.224 654.500 6,121.000 13 Map 0AP 3 513.1 490.1 -102.866 55.227 538.000 6,121.000 14 Map 0AP 3 764.1 603.9 55.261 633.000 6,153.000 14 Map 0AW 3 774.1 69.09 55.662 57.06 6,157.000 14 Map 0AWA 3	E787C	HYD-5 Tower	3	317.3	327.9	-106,171	53.849	423 000:	5 967 000	14	. qsm
Transect:	E6C5W	HYD-5 Tower	3	325.9	326.6	-106.041	53.831	431.500	5,965,000	13	Map
D2 3 514.51 499.7 -102.886 55.819 534.500 6.121.000 13 Map D38 3 515.1 499.2 -102.878 55.815 535.000 6.124.050 13 Map D38 3 515.4 55.218 639.500 6.121.000 13 Map D39 3 514.4 500.2 -102.886 55.224 634.500 6.121.500 13 Map D28 3 513.1 499.1 -102.891 55.224 634.500 6.120.500 13 Map D28 3 513.1 499.1 -102.816 55.224 634.500 6.120.500 14 Map D38 91.60 642.8 -98.034 55.825 538.400 6.130.100 14 Map D142 MM2 3 914.2 57.74 -98.059 55.855 58.61.600 6.157.000 14 Map D142 D37.4 690.05 55.857	Ifansect:		· · ·					1			
Sign Sign <th< td=""><td>028</td><td></td><td>3</td><td>514.5</td><td>499.7</td><td>102.886</td><td>55.219</td><td>634.500</td><td>6,121,000</td><td>13</td><td>Мар</td></th<>	028		3	514.5	499.7	102.886	55.219	634.500	6,121,000	13	Мар
Ope Operation Oper	035		3	519.5	500 1	-102.879	55.215 45.218	635.000	6,120,500	13	Map
OSP 3 514.5 500.2 -102.886 55.224 634.500 6.121,500 13 Map OPP 3 513.1 499.0 102.8910 55.215 633,000 6,120,500 13 Map OPS 3 513.0 499.0 102.447 55.215 633,000 6,120,500 14 Map OBM 3 796.1 542.8 -98.031 55.227 533,000 6,130,100 14 Map NSA: 1 1 -99.034 55.885 497,900' 6,133,100 14 Map OLY2M MM-2 3 812.3 577.4 -98.059 55.666 508,002 6,157.000 14 Map C1Y2M MM-2 3 613.0 588.5 97.000 6,157.000 14 Map SBV9A 3 613.6 598.6 507.724 6,133,162 14 GPS SBVMOP 3 260.6 600.7 97.837 55.86<	048	Deleted	1				30.216	033,300	0.121.000		Map
OPF 3 513.11 499.1 -102.847 55.215 633.000 6.120.500 131 Map OBM 3 796.1 542.8 -98.403 55.227 538.000 6.120.000 14 Map OBM 3 796.1 542.8 -98.403 55.227 538.000 6.120.000 14 Map OBP 3 714.1 608.1 -99.034 55.227 538.000 6.120.000 14 Map DY1A AMH-1 3 811.2 577.4 -98.069 55.566 558.002 6.155.757 14 OP6 Q1V2M MW-2 3 813.0 583.3 -98.024 55.557 561.600 6.157.000 14 Map G2V2A 3 518.0 609.6 -97.867 55.862 570.000 6.157.000 14 Map S8M0P 3 753.6 609.7 -97.837 55.768 573.000 6.190.070 14 Map	052		3	514.5]	500.2	-102.886	55.224	634.500	6,121,500	13;	Мар
D/S 31 517.0 499.9 +102.447 55.218 637.000 6,120.000 14 Map OPP 37 744.1 606.1 -99.034 655.227 538.000 6,120.000 14 Map OPP 3 744.1 606.1 -99.034 655.885 497.900 6,139.100 14 Map DY1A AMH-1 3 811.2 577.4 -98.069 55.506 568.0629 6,151.000 14 Map Q1V2M MW-2 3 613.0 583.3 -98.024 55.557 561.600 6,157.000 14 Map Q3V3P 3 613.0 583.66 697.667 55.682 570.000 6,171.000 14 Map R8V8A 3 753.6 609.2 -98.77 55.866 507.724 6,193.100 14 Map T07PS BMM-4 3 755.1 610.4 -98.824 55.891 519.595 193.790 14 GR3 <td>067</td> <td></td> <td>3</td> <td>513.1</td> <td>499.1</td> <td>-102.910</td> <td>55.215</td> <td>633.000</td> <td>6.120.500</td> <td>13</td> <td>Мар</td>	067		3	513.1	499.1	-102.910	55.215	633.000	6.120.500	13	Мар
Ope 3 7 50.1 542.5 994.03 55.227 538.000 6, 120,000 14 Map NSA: - <td>OAM .</td> <td></td> <td>31</td> <td>517.0 206 st</td> <td>499.9</td> <td>-102.847</td> <td>55.219</td> <td>637.000</td> <td>E,121,000</td> <td>13</td> <td>Map</td>	OAM .		31	517.0 206 st	499.9	-102.847	55.219	637.000	E,121,000	13	Map
NSA: NSA: <th< td=""><td>092</td><td></td><td>3</td><td>744.1</td><td>608 1</td><td>-98.4031</td><td>55.227</td><td>497 000</td><td>6.120.000</td><td>14</td><td>Map</td></th<>	092		3	744.1	608 1	-98.4031	55.227	497 000	6.120.000	14	Map
PrV1A AMH-1 3 811.2 577.4 -98.069 55.506 553.800 6,151.500 14 Map Q1Y2M NW-2 3 812.3 581.9 -98.029 55.546 560.623 6,157.000 14 Map R8V8A 3 818.3 589.6 -97.667 55.682 570.000 6,171.000 14 Map R8V8A 3 818.3 589.6 -97.667 55.682 570.000 6,171.000 14 Map S8V9A 3 818.3 589.66 -97.667 55.682 570.000 6,171.000 14 Map T0P3X MW-1 3 755.0 610.5 -97.837 55.768 573.000 61.97.001 14 Map T0P3S BMM-8 3 757.1 610.1 -98.824 55.883 511.059 6192.928 14 GP3 T0P3S BMH-6 3 767.7 161.2 -98.676 55.938 520.267 6.198	NSA:						00.000	431,300	0,100,100		map
Q1V2M MW-2 3 612.3 581.9 -98.039 55.857 561.602 6.155.735 14 GPG Q3V3P 3 613.0 583.3 -98.024 55.557 561.600 6.157.000 14 Map R8V8A 3 818.8 598.6 -98.877 55.682 570.000 6.137.100 14 Map S9P3A AlH-14 3 753.8 609.8 -98.877 55.686 507.724 6.193.162 14 Map T027M MW-1 3 755.0 608.7 -97.887 55.686 507.724 6.193.699 14 GPG T027S BMM-6 3 757.1 610.4 -96.802 55.883 511.059 6.192.847 14 GPG T206A TE Carbon 1 766.4 610.2 -96.676 55.081 522.267 6.198.633 14 GPG TBOBP JJH-2 3 769.9 618.2 -96.641 55.961 52	P7V1A	AMH-1	3[811.2	\$77.4	-98.069	55.508	558,800 [;]	6,151,500	14	Map
BARS 3 013.0 583.0 583.0 583.2 580.24 55.557 561.600 6.157.000 14 Map S8P3A AllH-14 3 753.6 609.6 -98.877 55.682 570.000 6.173.000 14 Map S8W0P 3 620.2 609.6 -98.855 55.880 507.724 6.183.162 14 GPS T0P3K MW-1 3 755.0 610.5 -99.355 55.882 510.055 6.192.847 14 GPS T0P3S BMM-8 3 757.1 610.1 -96.824 55.883 511.055 6.192.847 14 GPS T0P3S BMH-7 3 756.4 610.4 -96.820 55.894 512.423 6.192.847 14 GPS T0P3S BMH-6 3 767.7 615.7 -96.676 55.984 522.671 6.198.9016 14 GPS T502S BMH-6 3 767.7 615.7 -96.676<	Q1V2M	MW-2	3	812.3	581.9	-98.039	55.546	560,629	6,155,735	14	G#S
S3P3A AlH-14 S 125.3 250.3 297.4 S55.62 570.000 6,177,003 14 Map S8W0P 3 620.2 609.8 -97.837 55.668 507.724 6,180.700 14 Map T0P3M MW-1 3 755.0 609.6 -97.837 55.768 573.000 6,180.700 14 Map T0P3M MW-1 3 755.0 610.5 -98.854 55.808 509.033 6,192.847 14 GPS T0P3S BMM-6 3 757.1 610.4 -96.802 55.884 512.423 6,192.928 14 GPS T206A TE Carbon 1 766.1 612.7 -98.641 55.916 522.450 6,192.928 14 GPS TBORP JIH-2 3 769.9 618.6 -96.597 55.938 522.450 6,196.963 14 GPS TBORP JIH-4 3 769.9 618.6 -96.597 55.938 <t< td=""><td>Asva</td><td></td><td>3</td><td>813.0</td><td>563.3</td><td></td><td>55.557</td><td>561,600</td><td>6.157.000</td><td>14</td><td>Map</td></t<>	Asva		3	813.0	563.3		55.557	561,600	6.157.000	14	Map
SBWOP 3 620.2 600.7 -97.837 55.768 573.000 6, 130.700 14 Map TQPSM MW-1 3 755.0 610.5 -98.855 55.890 509.0931 6, 130.700 14 Map TQPSM MM-4 3 757.1 610.5 -98.855 55.890 509.0931 6, 132.028 14 GPS TDP3S BMH-7 3 758.4 610.4 -98.824 55.883 511.059 6, 192.028 14 GPS T206A TE_Carbon 1 766.1 612.2 -98.676 55.884 522.450 6, 199.016 14 GPS T206A TE_Carbon 1 766.9 91.641 65.97 55.838 522.450 6, 199.016 14 GPS T206A JIL-1 2 768.9 619.8 -98.610 55.951 524.404 6.200.425 14 GPS TP03P JIL-4 2 768.9 619.8 -98.500	S9P3A	AIH-14	3	753.8	609.8	-98.877	55.886	507 724	6 193 162		<u></u> 792
TG25M HW-1 3 755.0 610.5 -99.855 55.890 509.093 6.193.899 14' GPS T0P7S BMM-8 3 757.1 610.1 -99.855 55.890 509.093 6.192.847 14' GPS T0PAS BMM-7 3 758.4 610.4 -96.802 55.894 512.423 6.192.847 14' GPS T2O6A TE Carbon 1 766.1 612.2 -96.676 55.894 512.423 6.192.922 14' GPS T609P JJH-2 3 769.9 618.6 -96.597 55.938 522.450 6.196.63 14' GPS T609P JJH-1 2 768.9 619.8 -98.610 55.951 524.404 6.200.425 14' GPS T693S EDH-9 2 775.4 616.2 -98.519 53.908 530.101 6.185.719 14' GPS T789S EDH-9 2 775.4 616.2 <td< td=""><td>SEWOP</td><td></td><td>3</td><td>620.2</td><td>608.7</td><td>-97.837</td><td>55.768</td><td>573,000;</td><td>6,190,700</td><td>14</td><td>Map</td></td<>	SEWOP		3	620.2	608.7	-97.837	55.768	573,000;	6,190,700	14	Map
IDP7S IBMM-9 3 757.1 610.1 -98.824 55.883 511.059 6.192.847 14 GPS IDP8S IBMH-7 3 758.4 610.4 -98.802 55.884 512.423 6.192.928 14 GPS IDP3S IBMH-6 3 767.7 615.7 -98.676 55.884 522.257 6.198.392 14 GPS IBO8P JII-1 2 768.9 618.6 -98.597 55.938 522.450 6.196.393 14 GPS IBO8P JII-1 2 768.9 619.8 -98.610 65.961 524.404 6.200.426 14 GPS IFRSS EH+9 2 775.4 616.2 -98.519 65.901 534.534 6.196.454 14 GPS ITMPS BDH-3 3 779.6 617.6 -98.448 55.916 534.624 6.194.546 14 GPS ITSSP JIM-4 3 789.1 617.6 -98.30	TOPSM	MW-1	. 3	755.0	610.5	-98.855	55.890	509,093	6.193.599	14	G#5
Interv 9 786.5 610.4 95.802 55.894 512.423 6.192.928 14 GFS 1206A TE Carbon 1 766.1 612.2 -98.676 55.688 520.257 6.192.928 14 Spt. Image 1507S IBMH-6 3 767.7 615.7 -98.641 55.916 522.450 6.199.9016 14 GFS 1509P JJH-2 3 769.9 618.6 -98.597 55.938 525.174 6.199.016 14 GFS 1508P JJH-2 3 769.9 618.6 -98.513 55.901 524.404 6.200.425 14 GFS 1789S ISIH-9 2 775.4 616.2 -98.513 53.905 53.0.101 6.185.719 44 GFS 1789S ISIH-9 2 775.4 617.2 -98.300 55.918 539.500 6.197.000 14 Map 1789P JDH-3 3 789.1 617.3 -98.284	TOPAS	BMM-9	3	757.1	610.1	-98.824	55.883	511,059	6.192.847	14	GFS .
TBORS TBORS <th< td=""><td>T206A</td><td>TE Carbon</td><td>1</td><td>766 1</td><td>610.4</td><td>-98.802</td><td>55.884</td><td>512.423</td><td>6.192.92B</td><td>- 14</td><td>675</td></th<>	T206A	TE Carbon	1	766 1	610.4	-98.802	55.884	512.423	6.192.92B	- 14	675
TBQ9P JJH-2 3 769.9 618.6 -96.597 55.938 525.174 61.99,016 14 GPS TBQ8P JLL-1 2 768.9 619.8 -98.610 55.951 524.404 6.200,425 14 GPS T6R5S EJH-9 2 775.4 616.2 -98.513 55.905 530.101 6.185,713 14 GPS T7R9S EDH-3 3 779.6 617.6 -98.448 55.914 534,534 6.196,454 14 GPS TSSP JMA-4 3 788.1 617.3 -98.448 55.915 534,534 6.196,454 14 GPS TSSP JMA-4 3 788.1 617.3 -98.264 55.905 544.608 6.197.000 14 Map T8S9P JDH-3 3 799.6 616.5 -98.284 55.905 544.608 6.192.742 14 GPS T7T3S BML-21 3 799.7 617.9 -98.225 </td <td>T5076</td> <td>EMH-6</td> <td>3</td> <td>767.71</td> <td>615.7</td> <td>-98.641</td> <td>55,916</td> <td>522,450</td> <td>6 196 563</td> <td>141 1</td> <td>APC 1</td>	T5076	EMH-6	3	767.71	615.7	-98.641	55,916	522,450	6 196 563	141 1	APC 1
IPCBP JL-1 2 768.9 619.8 -98.610 55.951 524.404 6.200,425 14 GPS ICRESS EH+9 2 775.4 616.2 -98.519 55.905 530.101 6.195,719 14 GPS T7R9S EDH-3 3 779.6 617.6 -98.448 55.914 534,534 6.195,719 14 GPS TSSP JMA4 3 788.1 617.3 -98.369 543,824 6.196,454 14 GPS T8S4A 3 788.1 615.3 -98.369 55.905 544,608 6.197,000 14 Map T8S9P JDH-3 3 795.4 615.5 98.284 55.905 544.608 6.192,742 14 GPS T7T3S BML-21 3 790.7 617.9 -98.225 55.880 550.943 6.192,742 14 GPS T8T1P JDM-1 3 791.2 618.8 -98.262 55.905 546.151 </td <td>TEQSP</td> <td>(J0H-2</td> <td>3</td> <td>769.9</td> <td>618.6</td> <td>-96.597</td> <td>55.938</td> <td>525,174</td> <td>6,199,016</td> <td>14</td> <td>GPS </td>	TEQSP	(J0H-2	3	769.9	618.6	-96.597	55.938	525,174	6,199,016	14	GPS
IEH-9: 2 775.4 616.2 -98.513 55.906 530.101 6.185.719 14 GPG T7R9S BDH-3 3 779.6 617.6 -98.448 55.914 534.534 6.185.719 14 GPG T7SPP JMA-4 3 789.1 617.3 -98.300 55.896 543.824 6.196.4544 14 GPG T8S4A 3 789.1 617.3 -98.300 55.918 539.500 6.197.000 14 Map T8S4A 3 789.4 619.0 -98.368 55.918 539.500 6.197.000 14 Map T8S9P JDH-3 3 789.9 616.5 -98.284 55.905 544.608 6.192.742 14 GPG T6T6S BiL-2 3 795.4 616.8 -98.285 55.801 56.943 6.192.742 14 GPG T81P JDM-1 3 791.2 618.8 -98.262 55.906 546.151 6.1	TEQSP	JIL-1	2	768.9	619.8	-98.610	55.951	524.404	6.200,425	14	GPS
1/1935 BDR-3 3 778.0.6 -98.448 55.914 534,534 6,196,4541 141 GPG 17S9P JMA-4 3 78.0.1 617.46 -98,300 55.896 543,624 6,194,5461 141 GPG 18S4A 3 78.4.4 617.0 -98,300 55.896 543,624 6,194,5461 141 GPG 19S9P JDH-3 3 784.4 615.6 -98,284 55.905 544,608 6,195,513 141 GPG 19S9P JDH-3 3 795.4 616.5 -98,284 55.905 544,608 6,192,742 141 GPG 17T3S BML-21 3 795.7 617.9 -98,225 55.854 546.492 6,192,742 141 GPG 181P JDM-1 3 791.2 618.8 -98.262 55.631 563.817 6,187,459 141 GPG 13USA BIM-12 3 B10.0 613.8 -97.992 55.631 563.817 6,187,459 14 GPG 14USA AIM-1 <t< td=""><td>TERSS</td><td>BIH-9</td><td>2</td><td>775.4</td><td>616.2</td><td>-98.519</td><td>55.908</td><td>530,101</td><td>6,195,719</td><td>14</td><td>GPS -</td></t<>	TERSS	BIH-9	2	775.4	616.2	-98.519	55.908	530,101	6,195,719	14	GPS -
Instruction Instruction <thinstruction< th=""> <thinstruction< th=""></thinstruction<></thinstruction<>	17592	100.000	3	779.6	617.6	-98.448	55,914	534,534	6,196,454	34	
TBSSP JDH-3 3 789.9 618.5 -98.284 55.905 544.608 6.195.513 14 GFS TETES BiL-2 3 796.4 616.8 -98.186 55.905 544.608 6.195.513 14 GFS T7T3S BML-21 3 790.7 617.9 -98.225 55.694 546.492 6.194.272 14 GFS T8T1P JDM-1 3 791.2 618.8 -98.262 55.906 546.151 6.194.272 14 GFS T8T1P JDM-1 3 791.2 618.8 -98.262 55.906 546.151 6.194.272 14 GFS T3U9S BIM-12 3 B10.0 613.8 -97.992 55.631 563.817 6.187.459 14 GFS T4U5A AIM-1 3 800.0 614.2 -98.041 55.831 563.867 6.189.197 14 GFS T4U91-S BIM-1 3 809.4 614.5 4797	T8S4A		3	784.4	619.0	-98.368	55,919	539,500	6.197.000	14	Man
TeTES BiL-2 3 795.4 615.8 -98.186 55.880 \$50.943 6.192.742 14 GPS T7T3S BML-21 3 793.7 617.9 -98.225 55.684 548.492 6.192.742 14 GPS T8T1P JDM-1 3 791.2 618.8 -98.262 55.0654 548.492 6.194.272 14 GPS T8T1P JDM-1 3 791.2 618.8 -98.262 55.906 546.151 6.195.603 14 GPS T8USS BIM-12 3 B10.0 613.6 -97.982 55.631 563.817 6.187.459 14 GPS T4USA AIM-1 3 806.0 614.2 -98.041 55.831 563.367 6.189.197 14 GPS T4U91-S BIM-1 3 809.4 614.5 497.999 55.835 563.367 6.189.231 14 GPS T4U92-S BIM-1 3 810.0 614.3 -	T\$\$9P	JDH-3	3	789.9	618.5	98.284	55.905	544,608	6.195.513	14	GPS
I/135 BML-21 3 793.7 617.9 -98.225 55.694 548.492 6.194.272 14 GPS T8T1P JDM-1 3 791.2 618.8 -98.262 55.694 548.492 6.194.272 14 GPS T3U9S BIM-12 3 810.0 618.8 -97.982 55.631 56.817 6.187.459 14 GPS T4U5A AIM-1 3 806.0 614.9 -98.641 55.831 563.817 6.187.459 14 GPS T4U5A AIM-1 3 806.0 614.5 -97.999 55.833 563.367 6.189.197 14 GPS T4U91-S BIM-1 3 806.0 614.5 -97.999 55.835 563.934 6.187.972 14 GPS T4U92-S BIH-1 3 810.0 614.3 -97.990 55.835 563.934 6.187.972 14 GPS V5X7A AIH-30 3 837.7 635.3 -9	TETES	BiL-2	3	795.4	616.8	-98.186	55.880	\$50,943	6.192.742	14	GPS
Up 1 Up 1 <th< td=""><td>17135 78119</td><td>BML-21</td><td>3</td><td>793.7</td><td>617.9</td><td>-98.2251</td><td>55.894</td><td>548.492</td><td>6.194.272</td><td>14</td><td>GPS</td></th<>	17135 78119	BML-21	3	793.7	617.9	-98.2251	55.894	548.492	6.194.272	14	GPS
Tausa AlM-1 3 806.00 614.3 97.892 55.831 558.017 6,187,493 14 GPS Tausa AlM-1 3 806.00 614.5 -97.894 55.847 560.071 6,189,197 14 GPS Tausa BlM-1 3 809.4 614.5 -97.999 55.835 563.367 6,189.231 14 GPS Tausa BlM-1 3 810.0 614.3 -97.990 55.835 563.934 6,167.972 14 GPS Tausa AlM-30 3 837.7 635.3 -97.480 55.873 594.911 6.203.870: 14 GPS WOY5A - AlM-2D 2 845.9 640.5 -97.336 56.004 603.601 6.207.559: 14 GPS WOY5A - AlM-2D 2 845.9 640.5 -97.336 56.004 603.601 6.207.559: 14 GPS WOY5A - BIL-21 2//// <td>TSU9S</td> <td>BIM-12</td> <td>3</td> <td>810.0</td> <td>613 6</td> <td>-98.262</td> <td>55.906</td> <td>546.151</td> <td>B, 195, 583</td> <td>14</td> <td>GPS (</td>	TSU9S	BIM-12	3	810.0	613 6	-98.262	55.906	546.151	B, 195, 583	14	GPS (
T4UB1-S PIM-1 3 809.4 614.5 497.999 55.835 558.367 6,189.231 14 GPS T4UB2-S BIH-1 3 810.0 614.3 -97.990 55.835 568.367 6,187.972 14 GPS VSX7A AIH-30 3 887.7 635.3 -97.480 55.873 594.911 6.203.870: 14 GPS WOY5A - AIM-2D 2 845.9 640.5 -97.336 56.004 603.601 6.207.559: 14 GPS U6W5S BIL-21 2 825.8 627.0 -97.693: 55.920 5617.70.0 617.710 61.77.71 14 GPS	T4U5A	AIM-1	3	806.0	614.9	-98.041	\$5,847	560.071	6,189,197	14	665
T4U62-S BH-1 3 810.0 614.3 -97.990 55.835 563.934 6.167.972 14 GPS V5X7A AHI-30 3 887.7 635.3 -97.480 55.835 594.911 6.203.870: 14 GPS WOY5A - AIM-2D 2 845.9 640.5 -97.336 56.004 803.601 6.207.559: 14 GPS WOY5A - IM-2D 2 845.9 640.5 -97.336 56.004 603.601 6.207.559: 14 GPS U6W5S IBL-21 2 825.8 627.0 -97.693: 55.920 55.17.00 6.107.712 14 GPS	T4U91-S	Bittle 2	1 3	809.4	614.5	497.989	55.838	563,367	6,189,231	14	GPS
V957A [All-30] 3] 887.7 645.3 -97.480 55.873 594.911 6.203.8703 141 09% W0Y5A - AllM-2D 2 845.9 640.6 -97.336 56.004 603.801 6.207.559 141 09% U6W5S : : : 925.9 647.0 -97.693 55.920 581.700 617.700 617.700 141 09%	T4U92-S	BIH-1	3	810.0	614.3	-97.980	55.835	563,934	6.187.972	14	GPS
USW5S (BIL-21 2) 925.9 627.0 -97.693 55.920 581.700 6.107.712 1.4 GPS	V5X7A	AIH-30	3	837.7	635.3	-97.480	55.973	594,911;	6.203.870	14	075
	U6W5S	BIL-21	21	825.8	627.01	-97.693	55,920	581,700	6.197 719	14	Map

Table 4.2.1 (cont) Coordinates for selected features in the BOREAS Region

Name	Notes Co	iegory	BORIS	BORIS	West	North	MLC)	UTIM	UTIM	Source of
			X	Y	Longitude	Latitude	Easting	Northing	Zone	Location
AES Surface Weather Station Collecting15 Minute Data for BOREAS										
15 minute Data		1					ĺ			
Colline Bay	wwc		428.5	622.6	-103.700	56.183	576,449	6,449,648	13	
Lucky Lake	WLE	1	270.6	1.9	-107,150	50.950	348.976	5,646,247	13	
Meadow Lake	WLJ .		162.1	351.5	-108.517	54,133	270.258	6.003.857	13	
Melfort	WFF		430.8	221.8	-104,6001	52.817	526,959	5.851,734	13	
Nipswin (AES)	WBU		465.3	283.0	-104.000	53.3331	556.594	5,909,601		
Rosetown East	WBJ		213.9	67.7	-107.917	51.567	297,855	<u> </u>	13	
Southend	WUH j		475.7	620.3	-103.283	50.000	330 332!	5 915 874	13	
Speetwood West	WSM 1		228.4	200.3	+105.067	53.917;	429.940;	5.974.561	13	
Waskesid Lake			387.3	69.7	105.400	51,6671	472,335	5.723.822	13	
Rachelore Island Marine	WBL !		763.9	144.4	-99.900	51,750	437.869	5,733,398	14	
Fin Fion	WFO		598.4	450.0	-101.683	54.683	327,017	6.062.645	14	
Gilam	WGX		996.9	714.9	-94.700	56.367	765.550	6,254.979	140	
Hunters Point	WHR		672.7	274.9	-100.933	53.033	370,356	5.877.509	14	
15 min. Data during IFC's only										
(nourly otherwise)	i www.		160.6	541.1	108,433	55.833i	284,990	6.192.649	13	
Uranium City	WOC		142.4	956.7	-108.463	59.5671	303.224	6,60B,10B	13	
Wynyard Lake	WOY		469.0	108.11	-104.200	51.767	555,207	5.735.171	13	
Fisher Branch	WSZ	i	938.0	100.2	-97.550	51.063	601.565	5,659,873	14	
Grand Rapids	WJD		780.3	306.8	-99.267	53.163	482,179	5,892.481	14	
Swan River	WEQ		667.1	171.0	-101.233	52.117	347.064	5,776,149	14	
Hudson Bay	iyh B		583.8	238.5	-102.317	52.817	680,830	5.855.034	13	
Key Lake	YKJ		324.3	708.6	-105.617	57.250	462.769	6,345,172	10	
Dauphin	YDN		764.9	71,4)	-100.0501	51.100	420,478	2,001,201		
A secondary and all ARC Condees	Weather and Olimet	e Station	e in the	sector a	re in en ennen	diy.				
A complete set of AES Softace	Heather and Chinas			i and i						
BOREAS Regional Grid	NW i		0.0	1000.0	-111.000	59.979	500,100	6.648,824	12	
	NE		1000.0	1000.0	93.5021	58.B44	471,015	6,522,535	15	
	æ		1000.0	0.0	-96.970	50.089	645.272	5,550,297	14	
	ISN		0.0	0.0	-111.000	51.000	500.060	5,649,599	12	
	4141	···· +	760	650	-98.82	56 247	510884	6233585	14	N/A
Northern	INVY		850	650	.97.24	55,081	609930	6216458	14	N/A
Area	SE .		850	570	-97,49	55.377	595766	6137770	14	N/A
	ISW.		750	570	-99.05	55,54	497150	6154889	14	N/A
										NU.
NSA	NW/		760	630	-98.72	56.055	517312	621 1970	14:	N/A
Modeling	INE		800	630	-96.09	55.99	555757	6205124	14	N/A
Sub-Area	195		800	600	-98.18	55.720	512162	6182466	14	N/A
	2%v		750	615	-98.92	55.938	504876	6198930	14	N/A
AL NSA	<u></u>		760	815	-98.76	55.922	\$14737	6197218	14	N/A
Modelino	INW I	i	760	605	+98.79	55.834	513020	6187383	14	N/A
Sub-Area	iNE.		750	605	-98.95	55.849	503159	6189095	14	N/A
					1					NUA
Southern	NW		310	360	-108.23	54.319	420187	6019734	131	N/A
Study	INE		440	380	-104.24	53.410	549199	5919013	13	N/A
Area	185		440	290	-104.37	50.619	4124681	5930178	13	N/A
	3//			280	-190.02					
CP1	i NAV		380	360	-105,181	54.093	488258	5993612	13	N/A
Modeling	NE		430	360	-104.42	54.053	536103	5989312	13	N/A
Sub-Area	ŞE.		430	320	-104.48	53.695	534652	5949512	13	<u>N/A</u>
	SW		380	320	-105.23	53,735	484815	5953813	18	_ <u>N/A</u>
			1	1						
Coordinates are based on NAD83	datum, except for UTN	é coordina	tes.							
UTM Coordinates are based on the	a NAD27 datum.				t to the second s	i	1			

Table 4.2.1 (cont) Coordinates for selected features in the BOREAS Region

Northern Study Area – Old Black Spruce site (NSA-OBS)



Figure 4.2.1a: TF-3 Site Map (NSA-OBS) i) Site Layout and Infrastructure





Northern Study Area - Old Jack Pine site (NSA-OJP)

Figure 4.2.1b: TF-8 Site Map (NSA-OJP) (i) Site Layout and Infrastructure





Northern Study Area - Young Jack Pine site (NSA-YJP)

Figure 4.2.1c: TF-10 Site Map (NSA-YJP) (i) Site Layout and Infrastructure



Figure 4.2.1c: TF-10 Site Map (NSA-YJP) (ii) Orientation of WAB





Northern Study Area – Fen site (NSA-Fen)

Figure 4.2.1d: TF-10 Site Map (NSA-Fen) (i) Site Layout and Infrastructure





Northern Study Area – Beaver Pond site (NSA-BP)

Figure 4.2.1e: TGB-4 Site Map (NSA-BP) (i) Site Layout and Infrastructure



No access to WAB without the specific permission of the site captain.

Site Captain: Nigel Roulet

Figure 4.2.1e: TGB-4 Site Map (NSA-BP) (ii) Orientation of WAB



Southern Study Area - Old Aspen site (SSA-OA)

Figure 4.2.1f: TF-1 and TF-2 Site Map (SSA-OA) (i) Site Layout and Infrastructure



Figure 4.2.1f: TF-1 and TF-2 Site Map (SSA-OA) (ii) Orientation of WAB







Figure 4.2.1g: TF-4 Site Maps (SSA-YJP) (i) Site Layout and Infrastructure



Figure 4.2.1g: TF-4 Site Map (SSA-YJP) (ii) Orientation of WAB





Southern Study Area – Old Jack Pine site (SSA-OJP)

Figure 4.2.1h: TF-5 Site Maps (SSA-OJP) (i) Site Layout and Infrastructure





Southern Study Area – Old Black Spruce site (SSA-OBS)

Figure 4.2.1i: TF-9 and TF-7 Site Map (SSA-OBS) (i) Site Layout and Infrastructure



Figure 4.2.1i: TF-9 and TF-7 Site Map (SSA-OBS) (ii) Orientation of WAB





Southern Study Area – Fen site (SSA-Fen)

Figure 4.2.1j: TF-11 Site Map (SSA-Fen) (i) Site Layout and Infrastructure



Figure 4.2.1j: TF-11 Site Map (SSA-OBS) (ii) Orientation of WAB





NSA Lab -- Heritage North Museum

Figure 4.2.2a Layout of NSA Lab



Figure 4.2.2b Layout of SSA Lab at Paddockwood School

NSA Operations Center and Lab



Figure 4.2.2c Location of NSA Ops and NSA Lab

SSA Operations Center and Lab



Figure 4.2.2d Location of SSA Ops and SSA Lab