

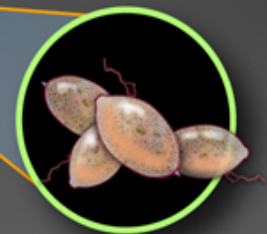
DUSEL Deep Underground Science and Engineering Laboratory at Homestake, SD



Engineering



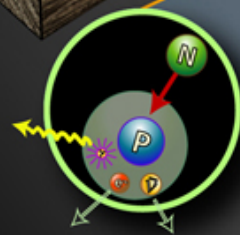
Geoscience



Biology



Astrophysics



Physics



Six and a half
Empire State Buildings
for scale

Shallow
Lab

Mid-level

Deep
Campus

300 ft

4,850 ft

8,000 ft



Homestake DUSEL

In July 2007, the National Science Foundation (NSF) announced the site selection of the former Homestake Gold Mine in Lead, South Dakota as the proposed site for a Deep Underground Scientific and Engineering Laboratory (DUSEL). The existing infrastructure includes nearly 370 miles of tunnels and shafts that extend to 8000 feet below the surface. All of the underground infrastructure and 186 acres of surface property have been donated to the state of South Dakota to be developed as a science and educational facility.

- PI Kevin Lesko, UCB/LBNL, Co-Pi, William Roggenthen, South Dakota School of Mines and Technology (SDSMT) and the Project Manager, Richard DiGennaro, LBNL.
- NSF has provided 15 million dollars in funding with a Cooperative Agreement to the University of California at Berkeley to prepare a Preliminary and Final Design proposal.
- Pending review and approval by the NSF, we anticipate a construction start as early as 2012 using the MREFC account.
- The proposed facility includes approximately 200,000 square feet of new underground laboratory space for a range of scientific experiments from various disciplines and 100,000 square feet of renovations to surface buildings for operations and user support.
- The State of South Dakota has established the South Dakota Science and Technology Authority to obtain and manage the property, to initially manage mining-to-labs conversion efforts, and to establish and operate an interim research facility on the site. South Dakota has also made available over 110 million dollars through state funding and philanthropic donations managed by the SDSTA.
- The preliminary estimate for construction of the DUSEL facility and infrastructure to support research activities is over 250 million dollars. In addition, NSF is considering an additional 250 million dollars funding for research instrumentation and experimental equipment for the Initial Suite of Experiments.
- Preconstruction project plans will be managed by UC Berkeley with subawards for institutional support to LBNL and SDSMT.
- DUSEL is planned to be a national/international user facility for underground research activities with an anticipated life of over 30 years

References:

<http://www.dusel.org>

<http://www.lbl.gov/nsd/homestake/index.html>

<http://www.sanfordlaboratoryathomestake.org/sdsta.html>

Contact Information

Homestake DUSEL Project Office, 510-486-7191

South Dakota Science and Technology Authority, 605-722-8650

PI, UCB/LBNL, Kevin T. Lesko, 510-486-7731, KTLesko@lbl.gov

CO-PI, SDSMT, William Roggenthen, 605-394-2460, William.Roggenthen@sdsmt.edu

PM, LBNL, Richard S. DiGennaro, 510-486-5516, RSDiGennaro@lbl.gov

Progress at Homestake

- ✓ October 2005, State Legislature approves additional \$20M funding for Homestake, total of \$46M from state controlled sources.
 - ✓ Rehab plan: \$15M
 - ✓ Indemnification fund: \$10M,
 - ✓ Operations: \$15M (initialization + 5 years of EIP)
 - ✓ Contingency: \$3.5M
 - ✓ Insurance: \$2.5M
- ✓ November 2005 - First call for Letters of Interest for Homestake ~ 85 letters received by February 2006
- ✓ Property Donation Agreement Completed 14 April 2006, Property formally transfers to S.D. at end of May 2006, SDSTA hiring staff now to oversee and operate Homestake: ~ 30 for rehab work, 16 staff members.
- ✓ CDR complete 23 June 2006 and, again, January 2007, R&D funds in FY07 for Physics and Engineering
- ✓ June 2007 \$70M Sanford Gift, \$15M gifted in 2007
- ✓ January 2007 Rehab work initiated, \$60M in hand
- ✓ October 2007 SDSTA Hires Jose Alonso, Lab Director, additional Key Staff
- ✓ July 2007 DUSEL Siting Decision
- Early Implementation Program at Homestake 2008 – 2012
“The Sanford Laboratory”
- DUSEL MREFC funding anticipated in FY12



Homestake DUSEL

Homestake's Plans and Progress

Near Term 3 phase rehabilitation of Ross shaft and Pumping

Phase 1 - Surface work, buildings hoists, ventilation equipment: December 06 - April 07

- ✓ Video inspection of Shafts
- ✓ Both Hoists operational 22 March
- ✓ Ventilation fans installed and operations (100-120kcfm)
- ✓ First water samples from u/g

Phase 2 - Underground work, including shaft and pumping: April 07 - August 07

- Secures 4850L with pumps at 5300L, expels ~ 500 gpm steady state

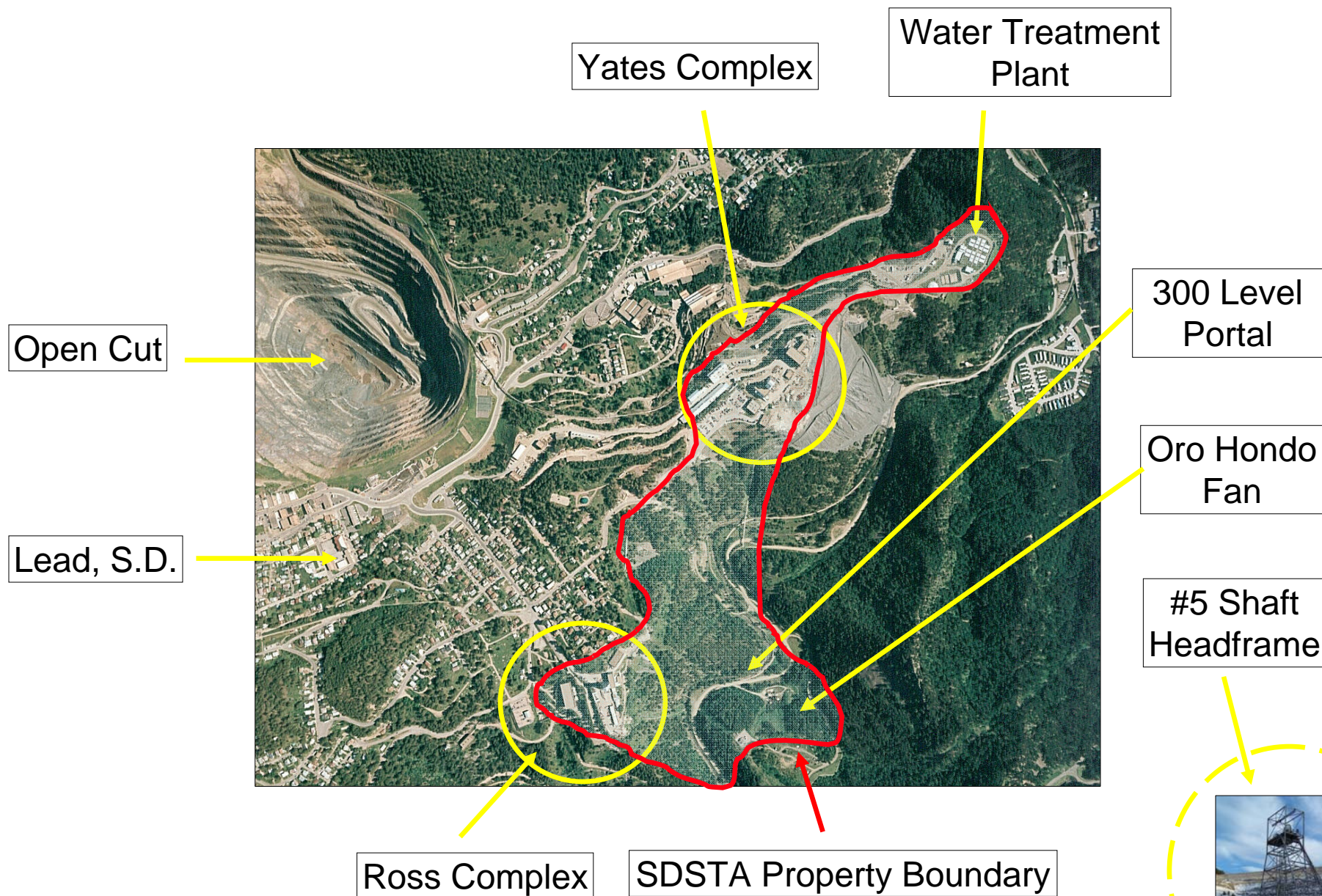
Phase 3 - Equipment Commissioning and : August 07 - July 08

Current Progress

- ✓ As of 3 August, work continues down beyond the 1700L (shaft &, level inspection, barricades, air, ponded water, other potential hazards etc.)
- ✓ New power & communications feeds
- ✓ New pump at 1250L is operational, water has been pumped to the surface for sampling
- Next pump rooms/stations at 2450L, 3650L, 5000L
- Work-in-progress will sequentially install and operate pumps, collecting and expelling in-flow. Permits in-place, first samples meet requirements for discharge.
- The current schedule for pump commissioning and operation will provide access to 4850L in July 2008



Homestake and Lead Aerial Photo



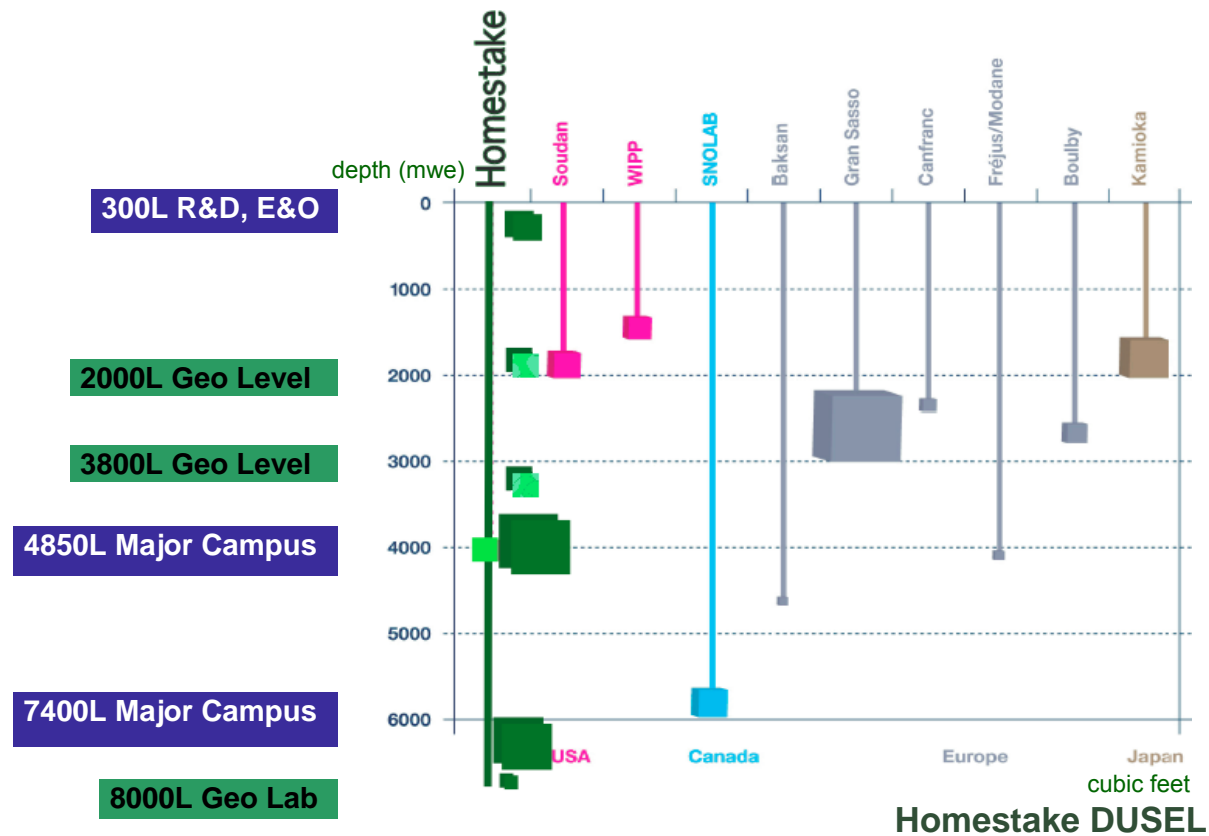
Scale

1 km (~3000 ft.)



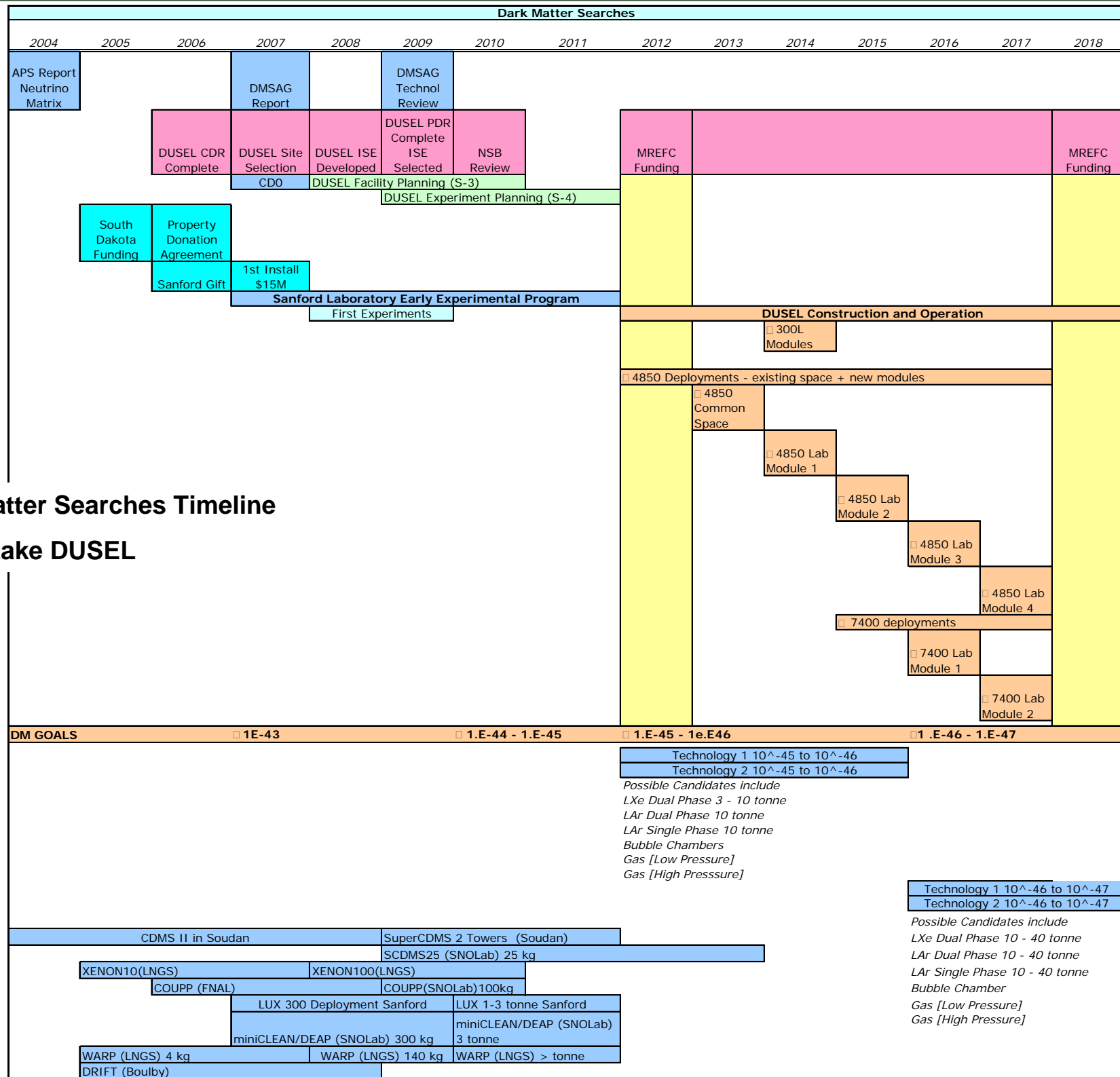
Homestake DUSEL

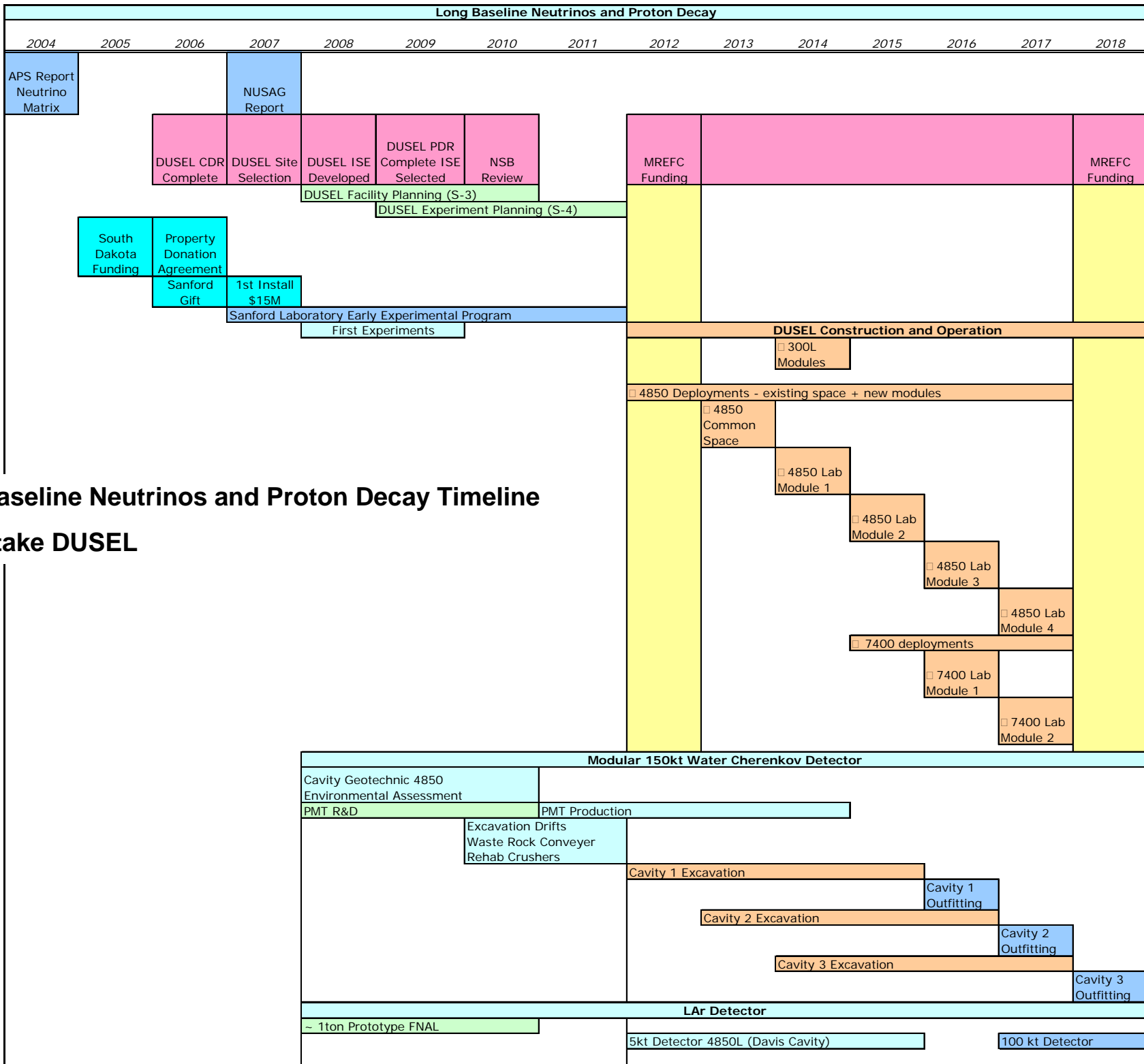
Sanford Laboratory and DUSEL Summary of Development of Space and Availability (Underground space fully outfitted and ready for detector installation)		Labs, Shops, Offices Usable Floor Area		Excavation Volume (including access drifts)		Preliminary Construction Schedule <i>(to be revised)</i>	
		sq. ft.	sq. m.	cu. yd.	cu. m.	Start	Finish
4850 Level	Subtotal	107,351	9,973	90,895	69,453		
Ross Shops for Construction Staging		12,469	1,158	5,738	4,385	Apr-08	Mar-09
Davis Lab, Sanford Lab, and Bio-Geo Lab		15,738	1,462	13,543	10,348	Sep-08	Apr-09
Lab Module #1 and Common Facilities		26,464	2,459	25,155	19,221	Oct-10	Sep-12
Lab Module #2		17,560	1,631	21,433	16,377	May-11	Apr-13
Lab Module #4 (excavation only, without lab outfitting)		17,560	1,631	1,906	1,456	Aug-14	Jul-15
Lab Module #3		17,560	1,631	23,121	17,667	Sep-13	Jul-15
4850 Level - Large Cavity Experiment	Subtotal	200	19	200	153		
Access and Waste Rock Haulage Drifts		100	9	100	76	Jan-12	Dec-12
Large Cavity #1		100	9	100	76	Jan-13	Dec-16
7400 Level	Subtotal	63,588	5,907	98,477	75,246		
Lab Module #1 and Common Facilities		28,468	2,645	29,594	22,613	Jan-12	Mar-14
Lab Modules #2 and #3 (excavation only, without lab outfitting)		35,120	3,263	68,883	52,633	Dec-12	Jan-14
300 Level	Subtotal	8,668	805	14,007	10,703		
Lab #1, Shops, and E&O Rooms		8,668	805	14,007	10,703	Nov-10	Nov-11
Surface	Subtotal	98,000	9,104				
DUSEL Offices and User Support Areas, Phase 1		10,000	929			Dec-10	Jun-12
Sanford Clean Room and Assembly Shop		6,000	557			Dec-10	Jun-12
DUSEL Offices and User Support Areas, Phase 2		32,000	2,973			Jul-11	Jun-13
Sanford Center for Science Education		50,000	4,645			Sep-09	Sep-11
Total		277,807	25,808	203,580	155,555		



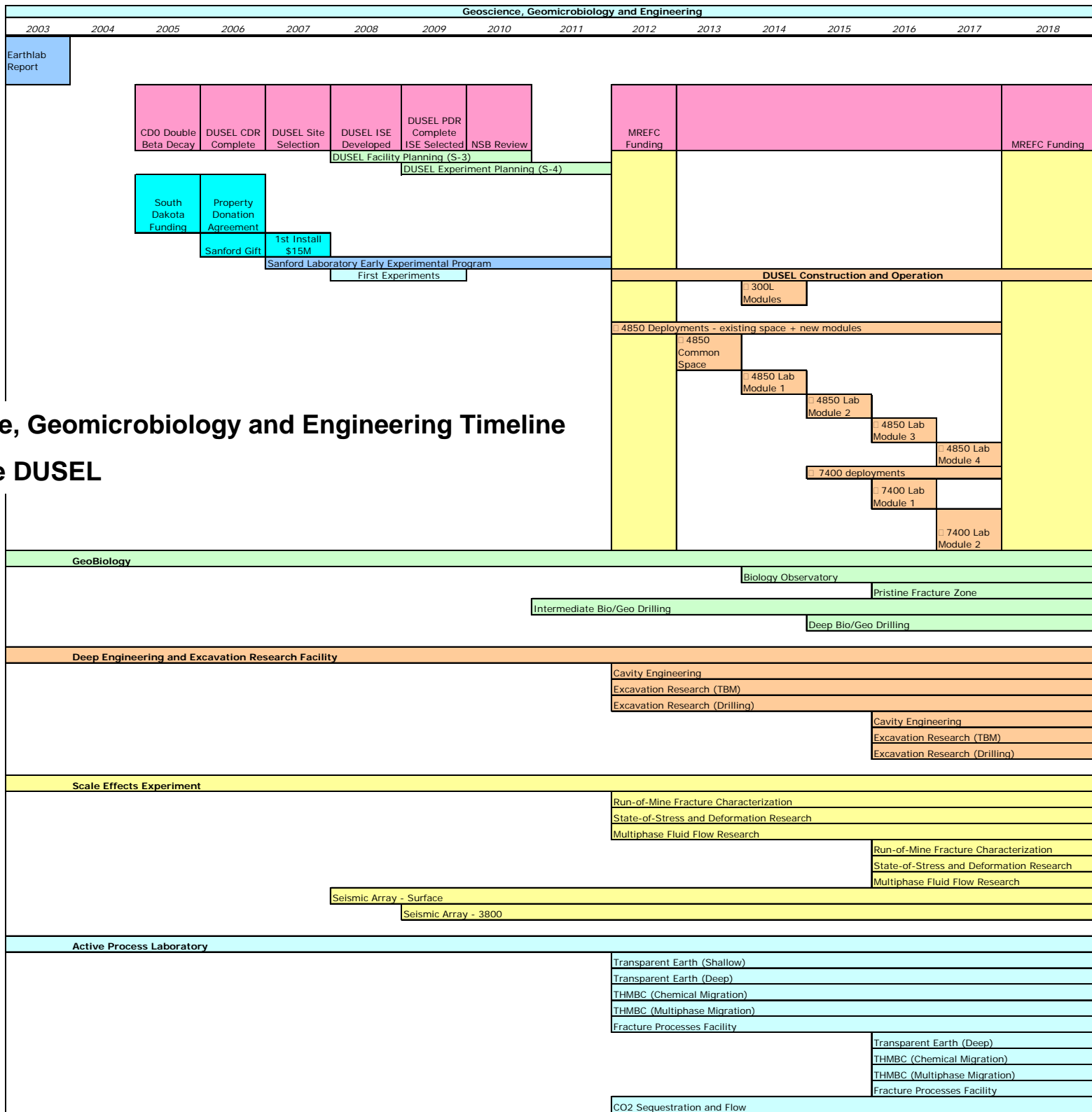
Dark Matter Searches Timeline

Homestake DUSEL





**Long Baseline Neutrinos and Proton Decay Timeline
Homestake DUSEL**



Geoscience, Geomicrobiology and Engineering Timeline Homestake DUSEL

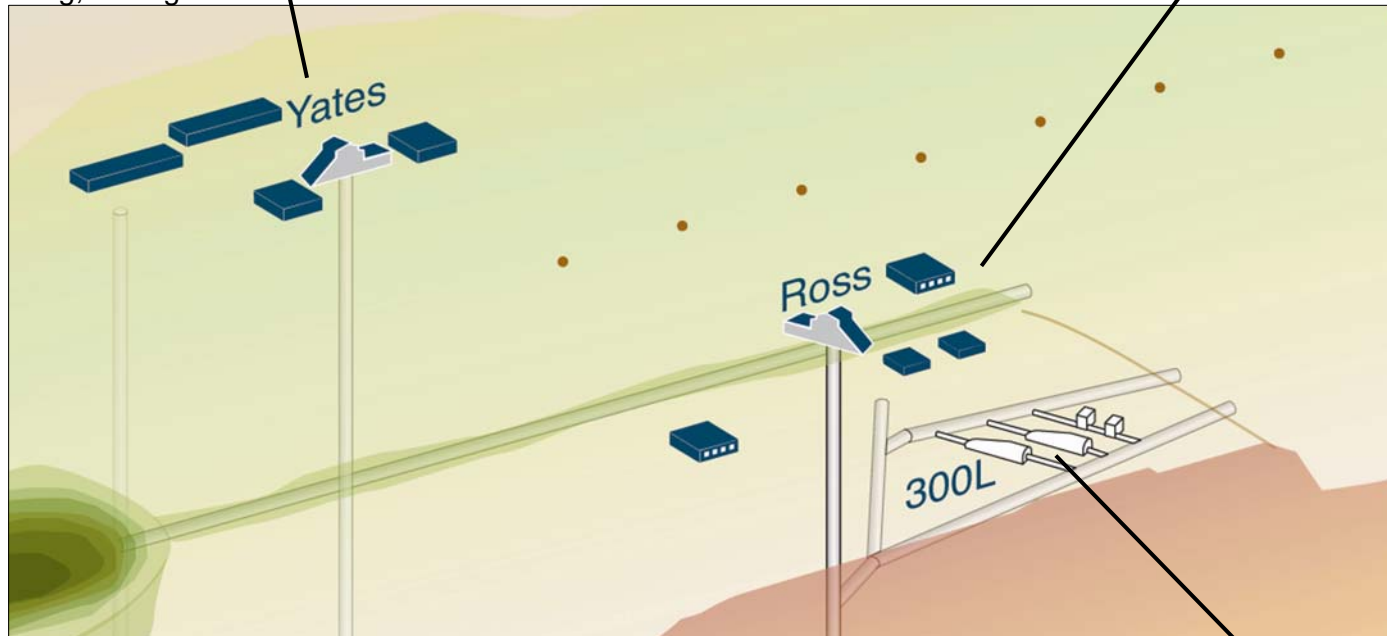
Campus Development Concepts for Surface Facilities and 300 Level

Yates Complex Surface Facilities:

- Laboratory Administration Building and Training
- User Support Services: Clean Room Assembly Shop, Fabrication Shops
- R&D Laboratories, User Offices, Meeting Rooms
- Education and Outreach: Sanford Center for Science Education
- Shipping and Receiving, Storage

Ross Complex Surface Facilities :

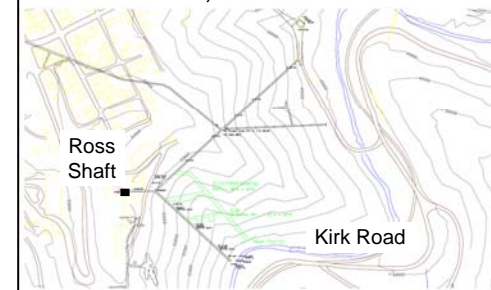
- Construction Materials and Equipment Staging
- Construction Superintendents and Contractor Offices
- Maintenance Shops
- Shipping and Receiving, Storage
- Facility Site Services and Operations



Experiments and Facilities at 300 Level:

- Education and Outreach Classroom and Laboratory
- User Support Shops: Assembly, Fabrication and Underground Storage
- Research and Development Laboratories
- Near-surface Experiments
- Low-background Counting and Calibration Facility

300 Level Campus Plan for near-surface, drive-in access



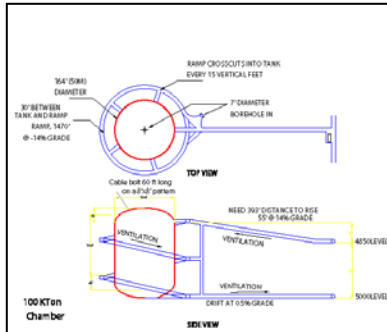
Campus Development Concepts for Mid- and Deep-level Experiments

Early Implementation Program and Facility Infrastructure Development at 4850L:

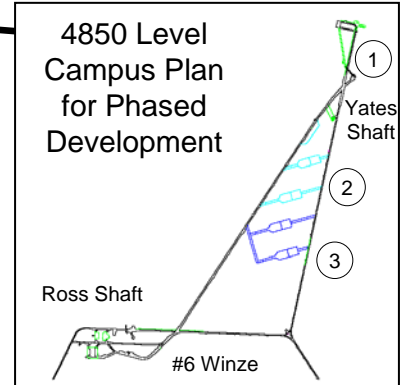
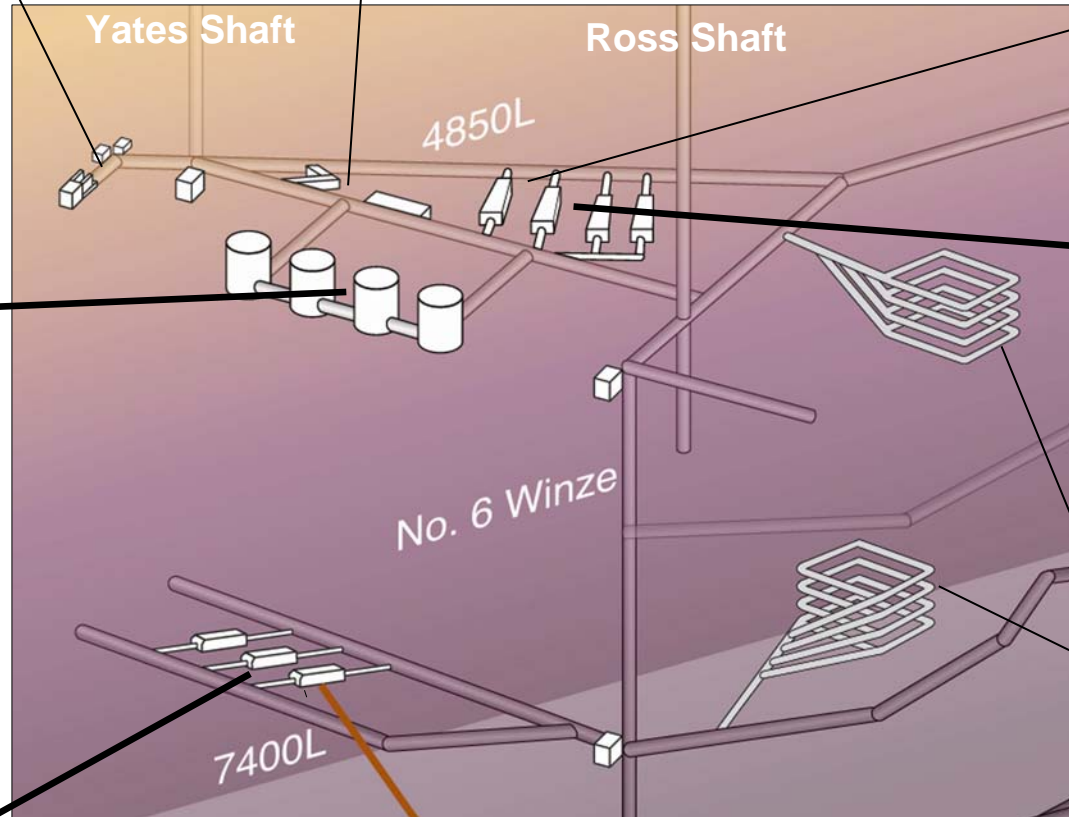
- Low-Background Counting Facility
- Neutrinoless Double Beta Decay
- Dark Matter
- Earth Sciences and Geo-microbiology Lab
- Common Facilities and Clean Room Transition
- Utility Services and Refuge Chamber

Initial Suite of Experiments at 4850 Level

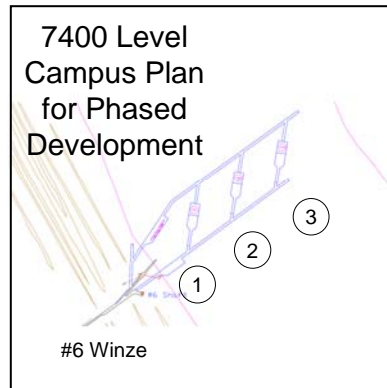
- Dark Matter
- Double Beta Decay
- Nuclear Astrophysics
- Solar Neutrinos
- Geoneutrinos



Design and Excavation concept for future, multiple 100 kTon chambers for Long Baseline Experiment

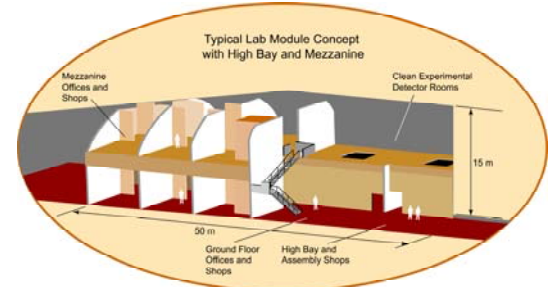


Geosciences:
Large Block Coupled Processes Experiments

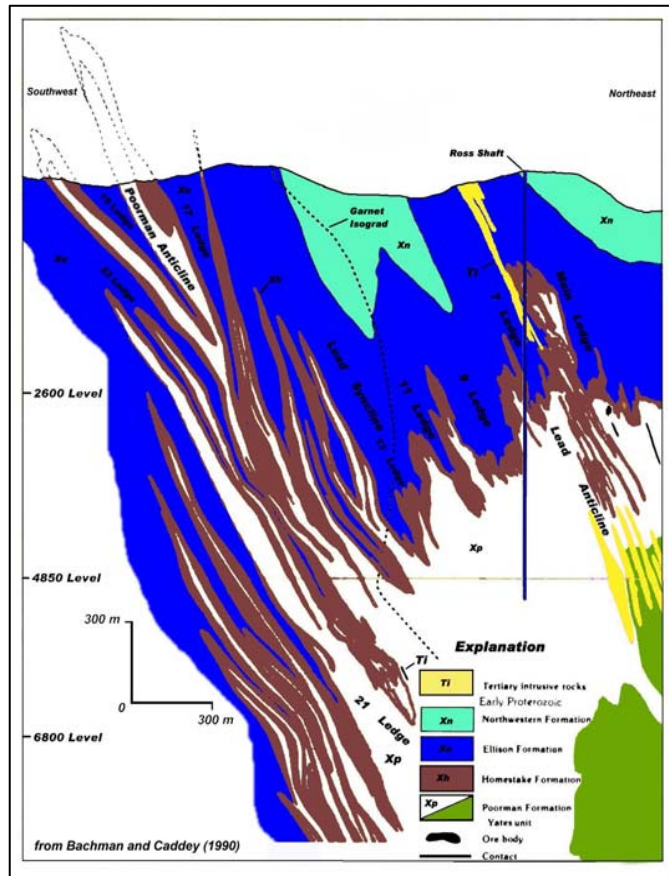


Initial Suite of Experiments at 7400 Level:

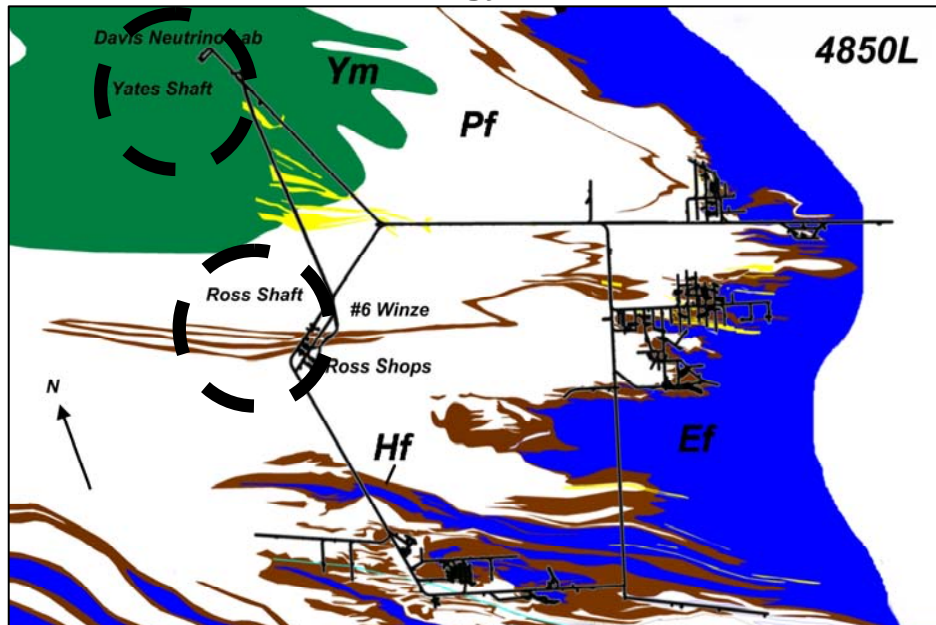
- Large Double Beta Decay
- Solar Neutrinos
- Supernovae Detection
- Large Dark Matter



Homestake Geology Generalized Cross-Section

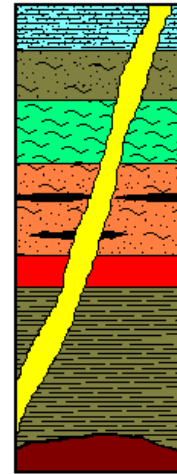


Homestake Geology at 4850 Level



Homestake Geology

Proterozoic Stratigraphy



- Grizzly Formation - Metagraywacke, sericite-biotite schist
- Flag Rock Formation - Biotite-sericite schist, graphitic phyllite
- Northwestern Formation - Biotite-qtz-sericite-garnet schist
- Ellison Formation - Quarzites, Sericite-biotite schist and phyllite
- Homestake Formation - Grunerite/Siderite schist, chert
- Poorman Formation - Well-banded sericite-biotite carbonate phyllite
- Yates Unit - Hornblende-plagioclase schist

Rock Properties

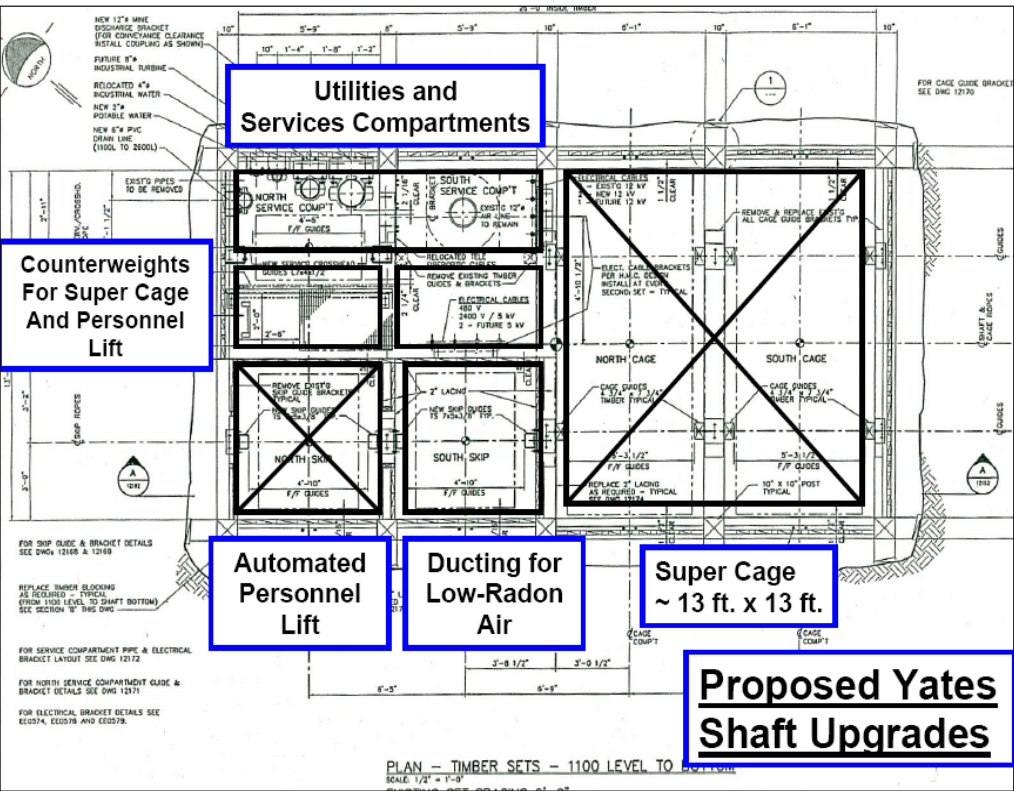
Property	Formation					
	Homestake	Ellison	Poorman	Yates	Yates contact with Poorman	Rhyolite
C ₁	20,150	13,620	11,340	22,000 to 31,000	7,900 to 26,000	14,000 to 34,000
C ₂	11,550	10,000	11,410			
C ₃	13,270	12,270	8,150			
T ₁	1,380	2,990	2,350			1,800 to 3,300
T ₂	1,140	820	590			
T ₃	1,920	1,910	1,650			
Notes:	1 and 3 directions are parallel to the schistosity.					
	2 direction is perpendicular to the schistosity.					

In-situ Stress Estimation (ref. NIOSH)

$$\sigma_v = 1.25 h \quad (\text{vertical psi})$$

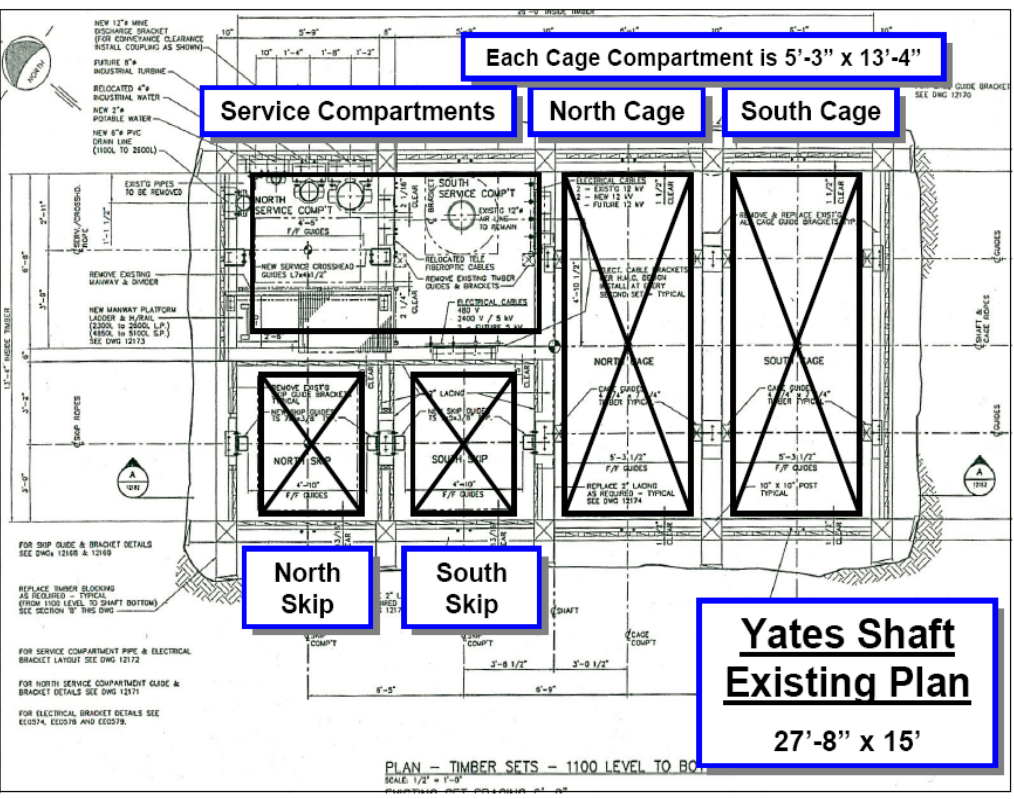
$$\sigma_{h1} = 2,078 + 0.53 h \quad (\text{dip direction psi})$$

$$\sigma_{h2} = 121 + 0.55h \quad (\text{strike direction psi})$$



Yates Ore Hoist
 Two 1,500 hp DC Motors
 Skip Payload Load = 20,000 lb.

Yates Cage Hoist
 Two 1,250 hp DC Motors
 Normal Cage Load = 12,000 lb.
 Max Cage Load = 13,400 lb



Yates Cage Hoist

- Maximum Cage dimensions: 1.4 x 3.7 x 2.2m high (side-by-side) (4' 8" x 12' 1.5" x 7' 2" high)
- Maximum cage payload: 5,450 kg (12,000 lb), nominal 5,900 kg (13,000 lb), allowable at half-speed.

Ross Cage Hoist

- Maximum Cage dimensions: 1.3 x 3.8 x 2.2m high (double deck) (4' 4-5/8" x 12' 5" x 7' 2" high)
- Maximum cage payload: 5,450 kg (12,000 lb), nominal 6,100 kg (13,400 lb), allowable at half-speed.

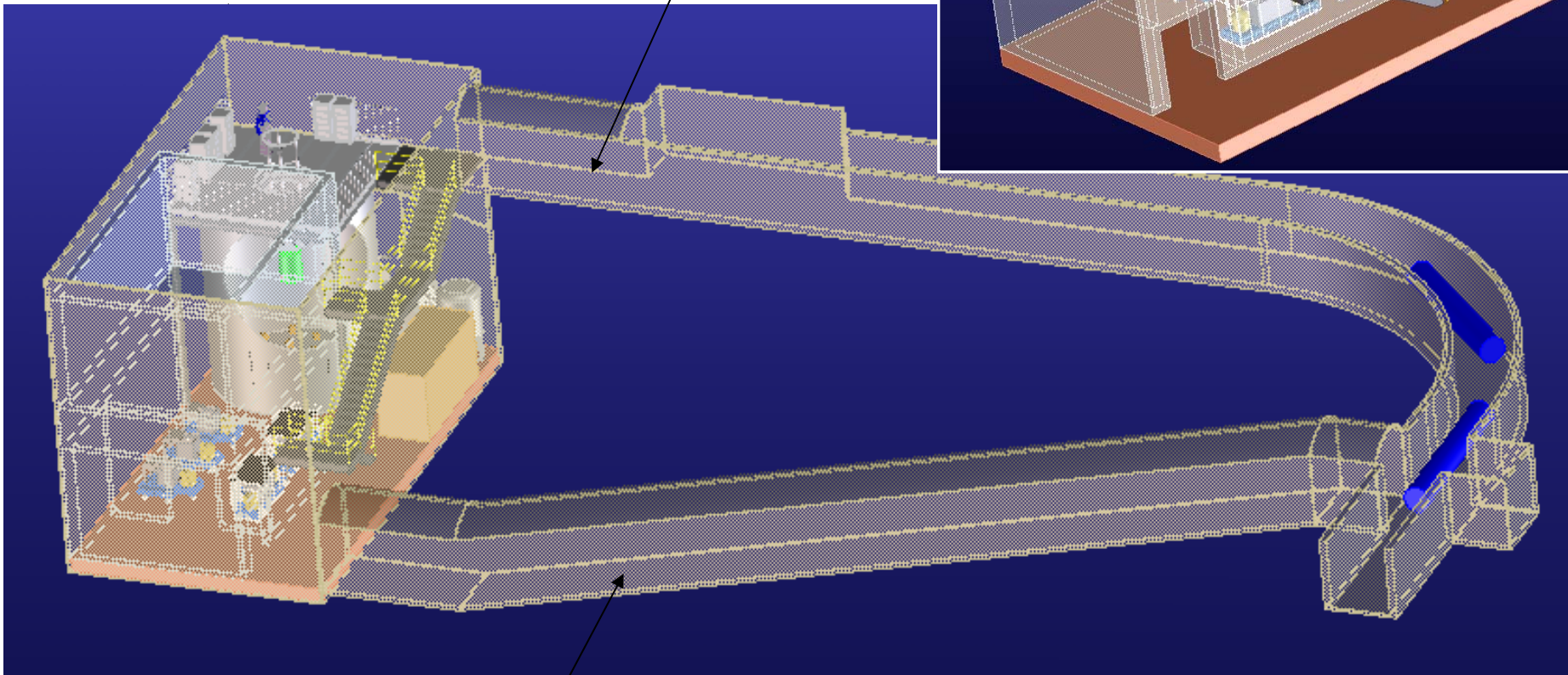
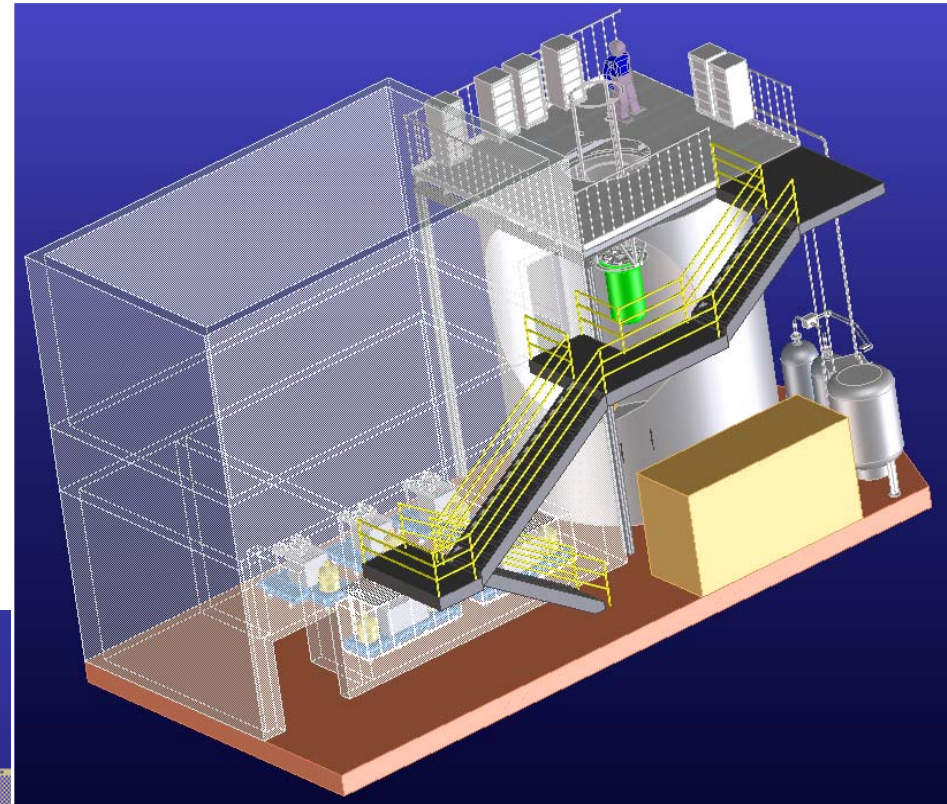
#6 Winze Cage Hoist

- Maximum Cage dimensions: 1.3 x 3.7 x 2.2m high (double deck) (4' 4" x 12' 1-1/2" x 2.2m high)
- Maximum cage payload: 5,450 kg (12,000 lb), nominal 6,400 kg (14,000 lb), allowable at half-speed.

Dark Matter Experiment with Low Background Facility

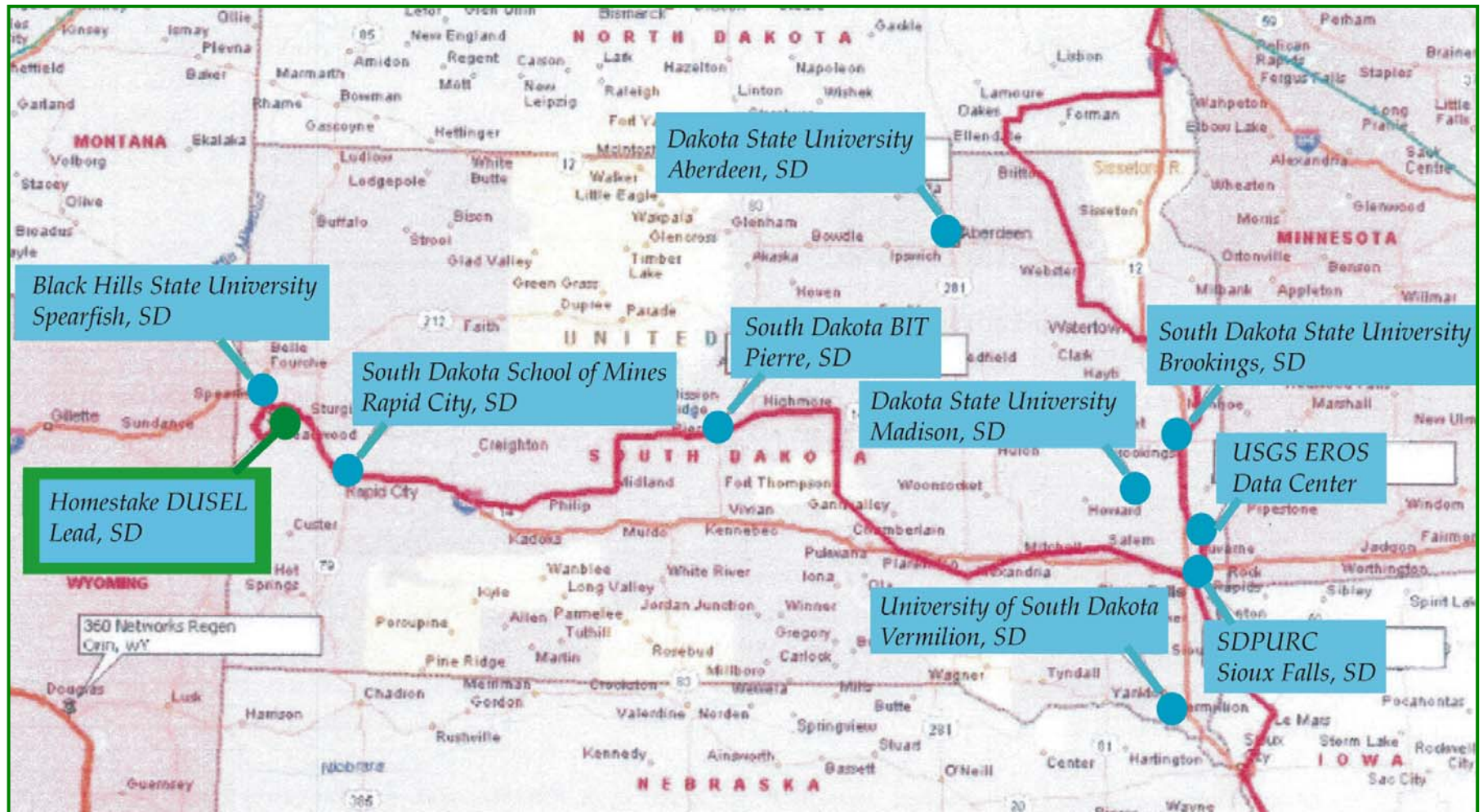
Current Davis Cavity
Dimensions:
55ft x 30ft x 32ft high

4850L Access



4850L Secondary Access

Cyberinfrastructure - Connecting Homestake with GigaBit Fiber



The Great Plains Foundation has recently agreed to make a gift to fund the estimated \$8M cost of this entire plan, which includes GigaBit connectivity to Homestake DUSEL. Details in Appendix A22.