

Homestake DUSEL Project Overview

BIG BANG

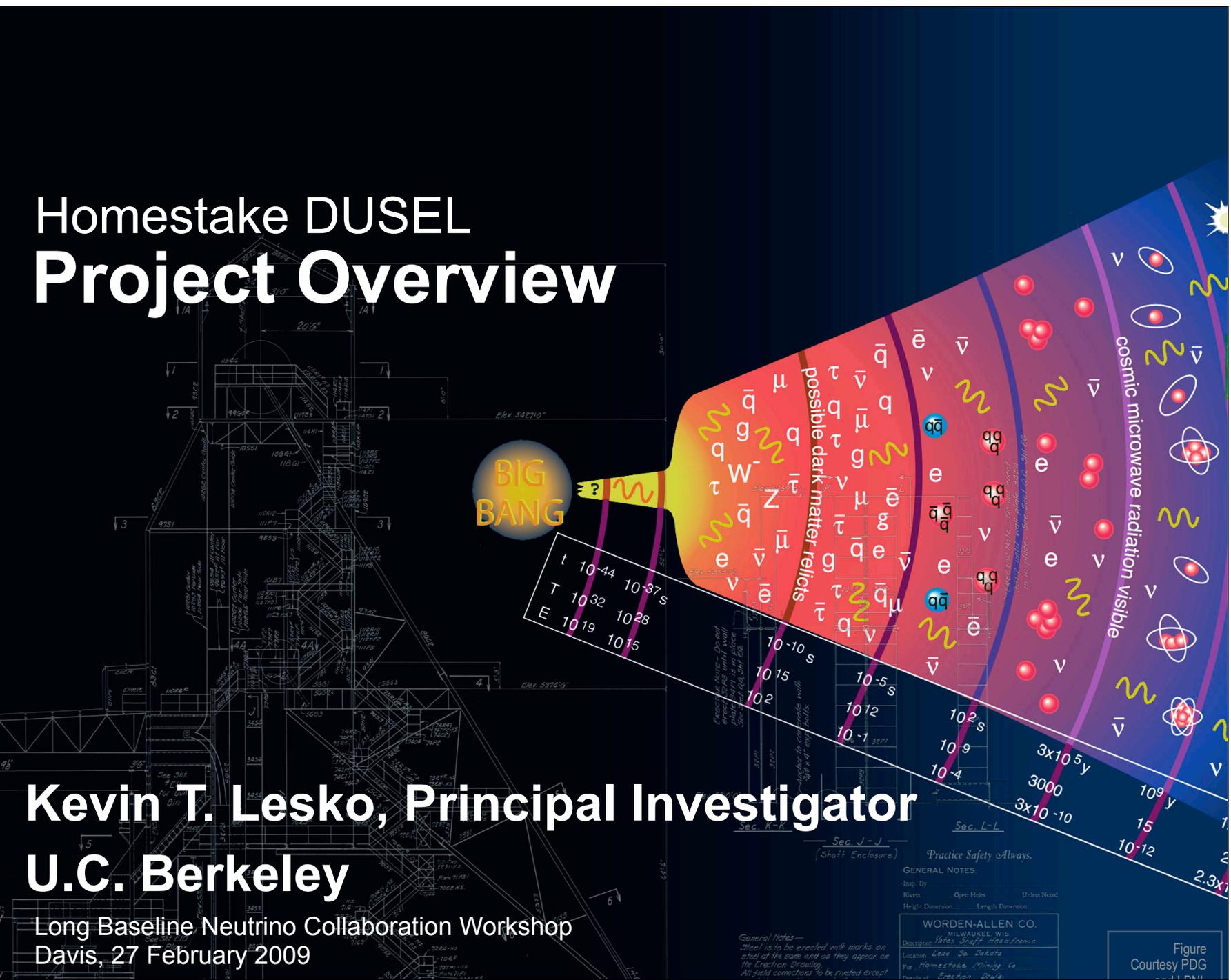
possible dark matter relics

cosmic microwave radiation visible

t	10^{-44}	10^{-37} s
T	10^{32}	10^{28}
E	10^{19}	10^{15}

Kevin T. Lesko, Principal Investigator
U.C. Berkeley

Long Baseline Neutrino Collaboration Workshop
 Davis, 27 February 2009

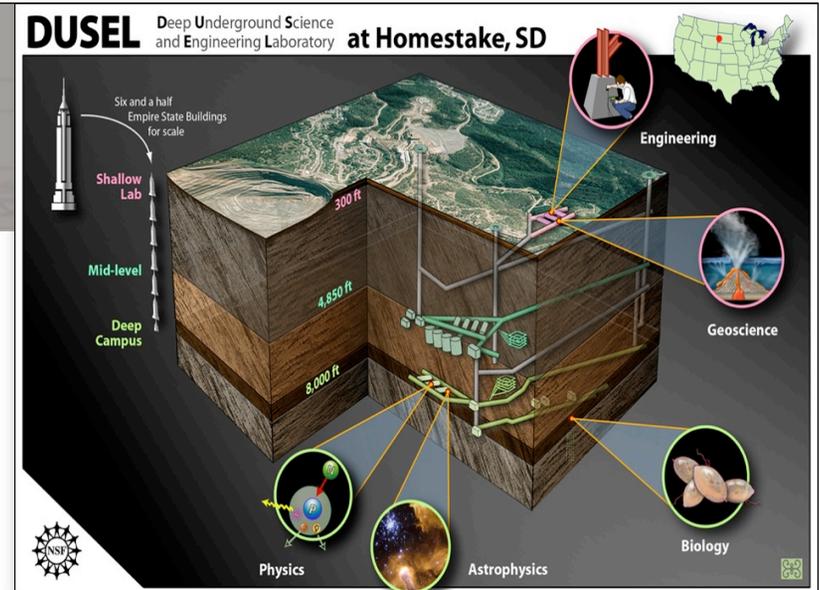


Practice Safety Always.
 GENERAL NOTES
 Insp. By: _____
 Rivers: _____ Open Holes: _____ Unless Noted
 Height Dimension: _____ Length Dimension: _____
WORDEN-ALLEN CO.
 MILWAUKEE, WIS.
 Description: *Steel Shaft Transformation*
 Location: *Level 50, Pit 6*
 Project: *Homestake Mining Co.*
 Drawing: *Section - K-K*

Figure
 Courtesy PDG

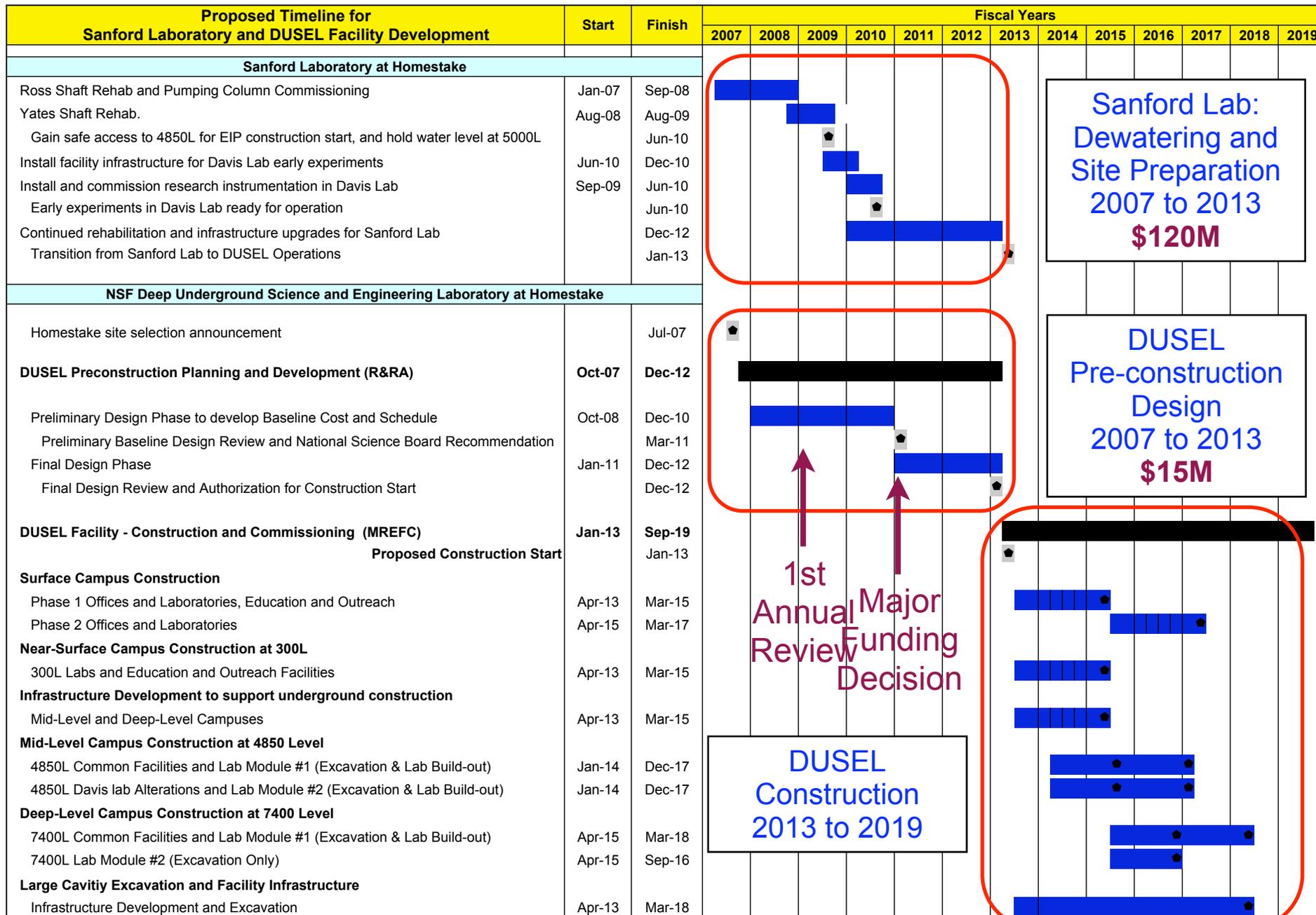
Outline of Presentation

- The DUSEL Project
 - Major Milestones
 - Key Facility Parameters
 - Facility Conceptual Design
- DUSEL's Scientific Programs
- Developing DUSEL and Preparing Facility Designs
 - Progress in Developing Advanced Designs
 - Progress in Preparing Homestake and its Early Science Programs
- Summary

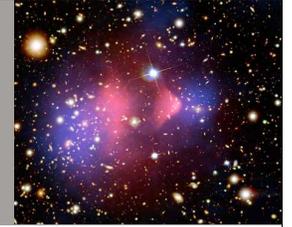


We are Working to Establish a Proposal for DUSEL and its Integrated Suite of Experiments

- In 2004 the National Science Foundation established a process to create a Deep Underground Science and Engineering Laboratory (DUSEL)
- Through a process of evaluations Homestake was selected in 2007 as the prime site for investigation and for advance design work
- The State of South Dakota strongly supports the efforts at Homestake
- In 2007 UC Berkeley was funded to advance designs and prepare a plan for completing the facility design phase and to prepare an “integrated suite of experiments”
- **World-class, Dedicated Multidisciplinary Underground Research Facility Providing**
 - Environment, Health and Safety Functions
 - Research Space, Environment, and Support
 - Operations and Support Staff and Technical Experts
- **Defining and Integrating a Suite of Experiments**
 - Physics
 - Biology
 - Geosciences
 - Engineering
- **Encouraging and Providing Key Facility Infrastructure Enabling Participation in addition to the NSF (and US)**
- **Integral Education and Outreach Programs**



Why Are We Developing DUSEL?

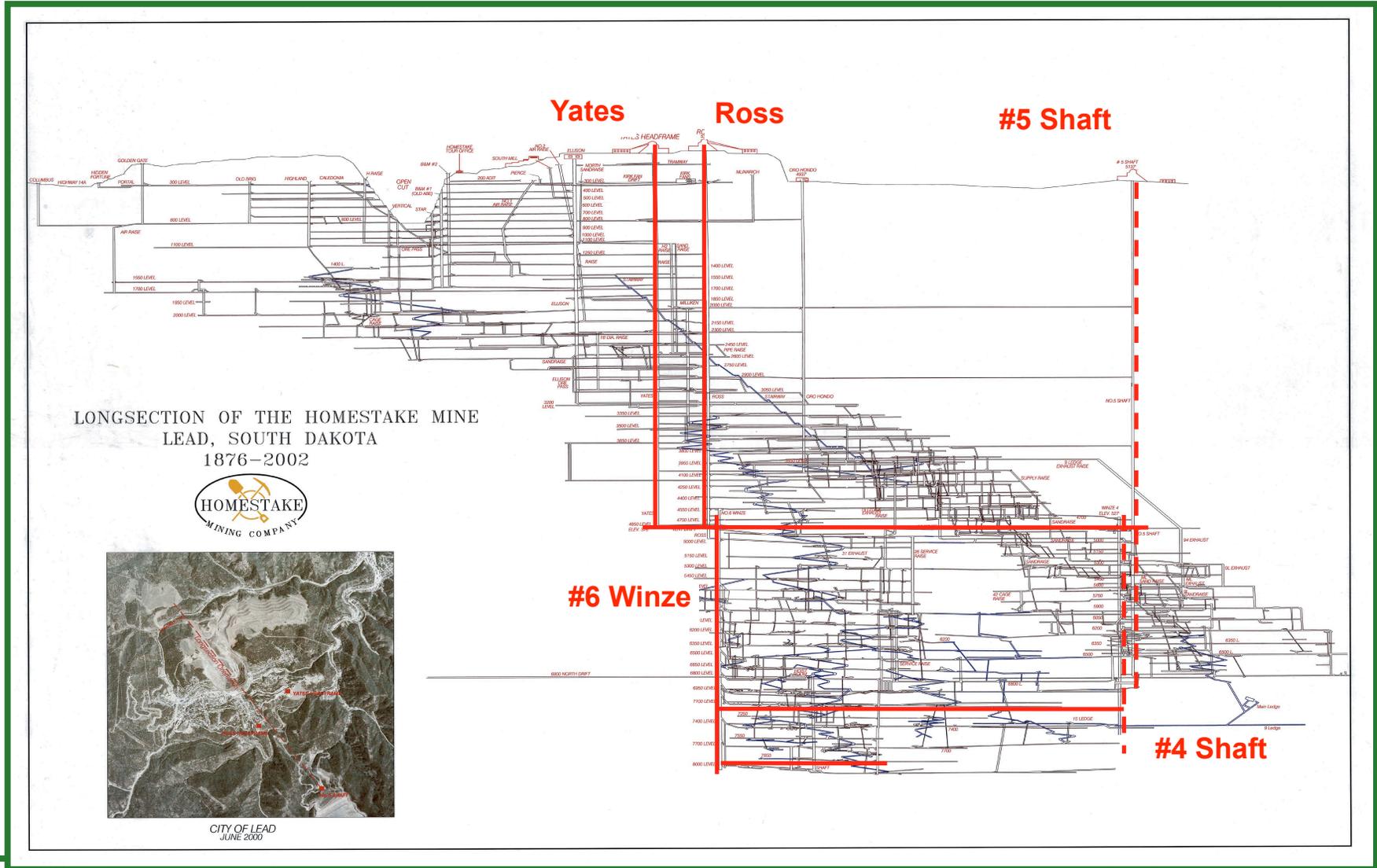


To enable the Science, exploit synergisms, maximize the benefits of a dedicated facility, and integrate Education and Outreach functions

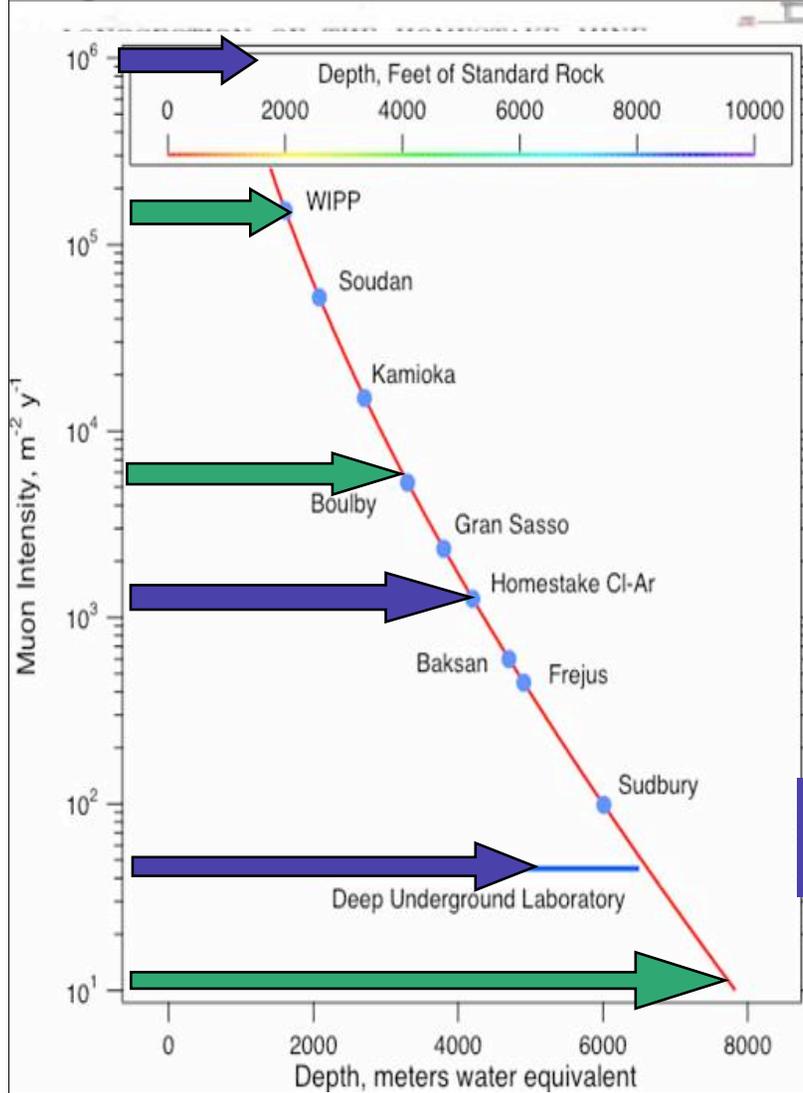
- Neutrinos - discover new physics, known-unknown physics
- Dark Matter - identify ~25% of the known-unknown universe
- Dark Life - limits of life, life in extremes, life in isolation, new life
- Origin of the Elements - how, where did the elements originate
- Symmetries and High Energy Scale Physics - matter/antimatter asymmetry, the universe at extreme energies and physics of the early universe
- Natural Resources - understanding, probing, predicting
- Engineering - safer, deeper, larger, faster
- Education and Outreach - welcome, attract, excite, engage
- Energy and Carbon Research - imperative societal questions

Cross Section of the Homestake Facility

LONGSECTION OF THE HOMESTAKE MINE



Plans for Research Campuses Optimized for Science



300L R&D
E&O 10k ft²

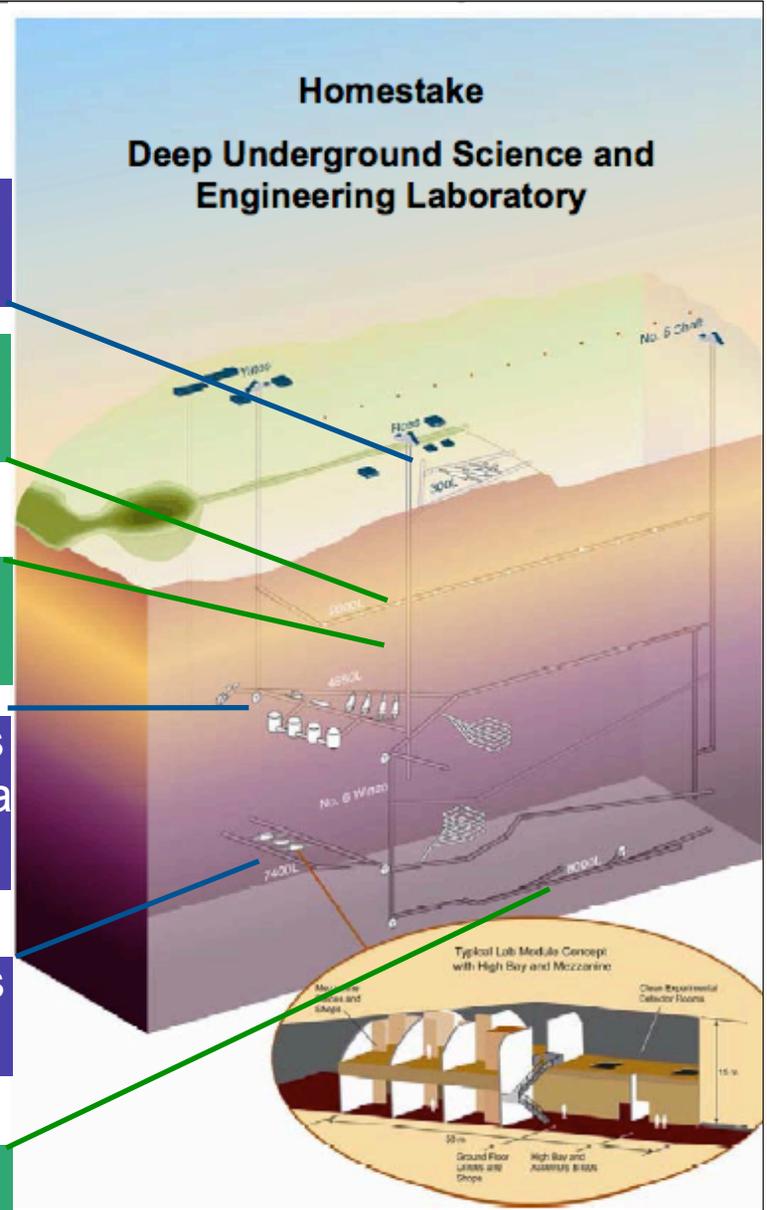
2000L BGE
Level

3800L BGE
Level

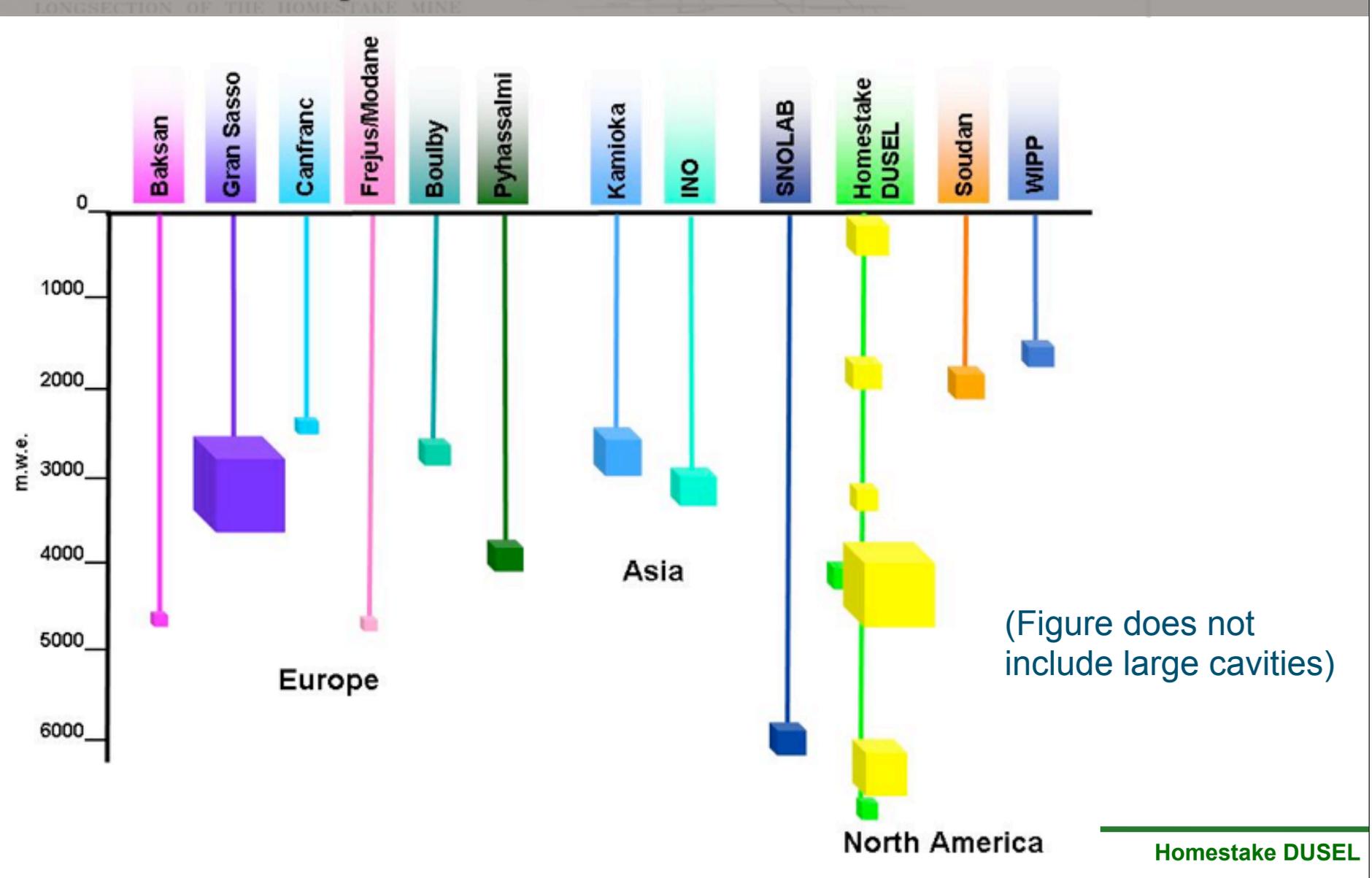
4850L Campus
100k ft² + Mega
Cavities

7400L Campus
65k ft²

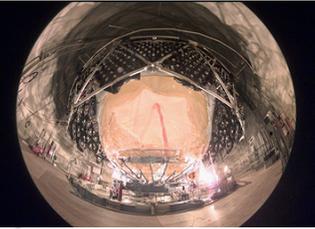
8000L BGE
Lab



Providing Critical Research Space, Especially at Great Depths



DUSEL's Experimental Programs



- **DUSEL Experimental Development Committee (DEDC)**

Steve Elliott, LANL **Physics**
Derek Elsworth, PSU **Bio/Geo/Eng**
Daniela Leitner, LBNL **Physics**
Larry Murdoch, Clemson **Bio/Geo/Eng**
T.C. Onstott, Princeton **Bio/Geo/Eng**
Hank Sobel, UCI **Physics**

Promotes and aids the development of the Scientific Program, provides high-level coordination with facility team, actively working with collaborations on S-4

- **Project Scientists**

Jason Detwiler, LBNL **Other Physics**
Azriel Goldschmidt, LBNL **Other Physics**
Richard Kadel, LBNL **Long Baseline Neutrinos**
Bill Roggenthen, SDSM&T **Bio/Geo/Eng**
Rohit Salve, LBNL **Bio/Geo/Eng**

Points of Contact for Science Collaborations to the Facility Design Team

- **Experimental Instrumentation Requirements Engineering**

Steve Marks, LBNL
Dave Plate, LBNL

Develop Requirements Database, Model Experiments, And Laboratory Module Design

- ***NSF, DOE & other Experimental/Instrument Collaborations***

Development of DUSEL's Scientific Program

- NSF will fund a *superset* of experiments to be developed to ~Preliminary Design Level (call for Proposals January 2009)
 - ~June 2009 funding anticipated (\$15M)
- NSF will select using *Peer Review* and then fund the design of the experiments to be included in the DUSEL Proposal
 - Selection by Spring/Summer 2010 Required to maintain schedule
- DEDC *Coordinates* the Individually Funded Projects until 2010
- DOE-NSF Joint Oversight Group (JOG) will weigh-in on DOE components - JOG members are meeting to establish *process*
- DUSEL Facility Team will oversee the Integration of the Experiments into the Proposal

Responses to the January S-4 Call for Proposals (information shared with us)

- Dark Matter Searches
 - ~ten Proposals
 - Neutrinoless Double Beta Decay
 - several Proposals
 - Long Baseline Neutrinos and Nucleon Decay
 - several Proposals
 - Low Background Assay and Material Production
 - several Proposals
 - Nuclear Astrophysics
 - at least one Proposal
 - Solar Neutrinos
 - several Proposals
 - Bio/Geo/Eng
 - ~ 8 proposals
- NSF: 25 proposals
8 non-physics
- + Other Physics Proposals

DOE's OHEP Intensity Frontier Plans

DOE OHEP has indicated that it has used P5 Report guidance in the development of its budgets and strategic plan

- In particular, for the development of world-leading neutrino program comprised of a large, long-baseline underground detector and an intense neutrino beam



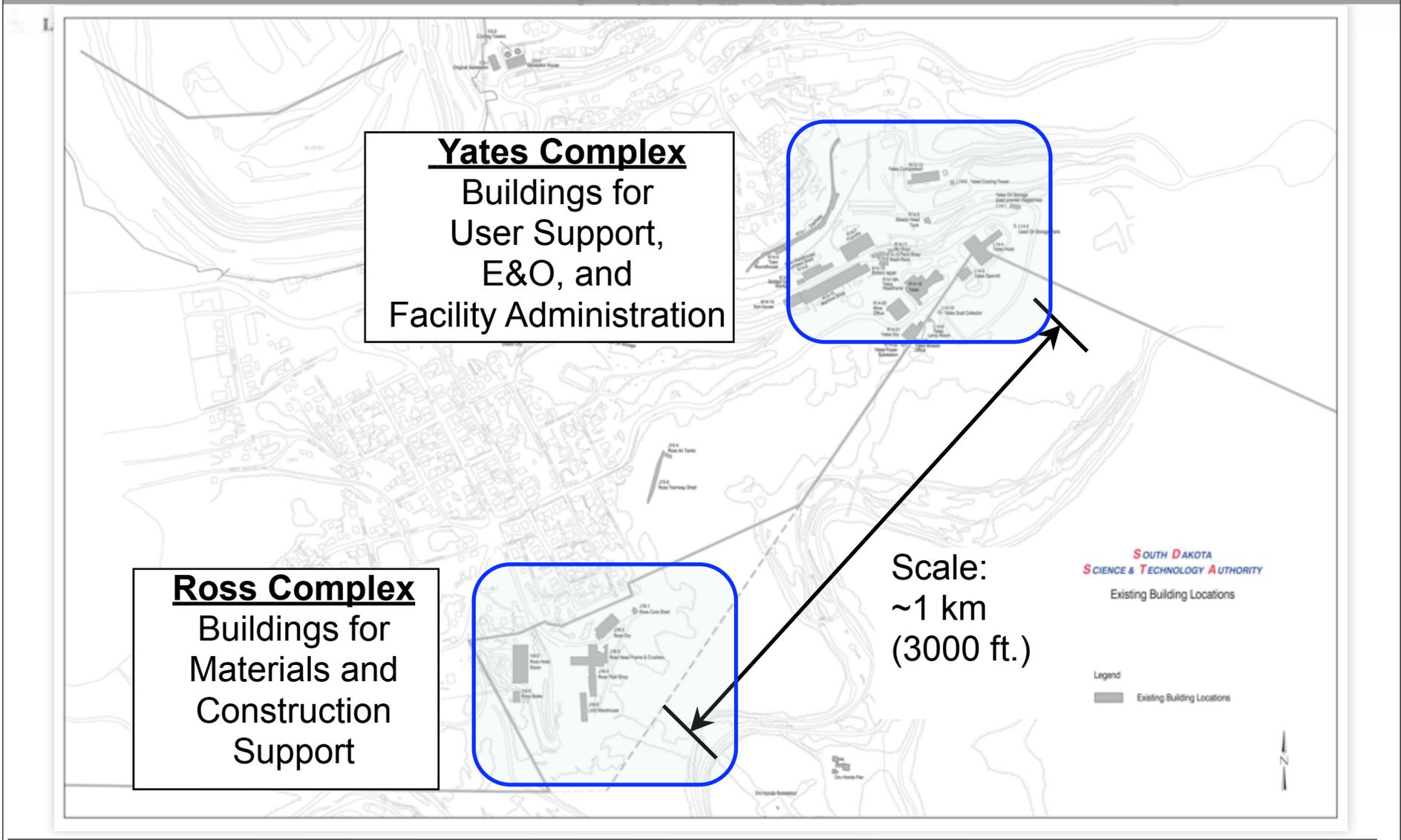
OHEP is putting in place a process to implement this proposed program (i.e.; follow DOE Order 413.3)

- Seek CD-0 approval for a long baseline neutrino oscillation experiment, tentatively in the first quarter of FY09
- Name a lead laboratory (Fermilab) to develop a conceptual design, explore the alternatives and risks, and establish preliminary cost ranges and schedule
- Support collection of information (e.g.; issues/cost of large excavations)
- Support R&D for proposed elements in the proposed plan
- Seek partners to enhance the scientific reach/scope of the experiment

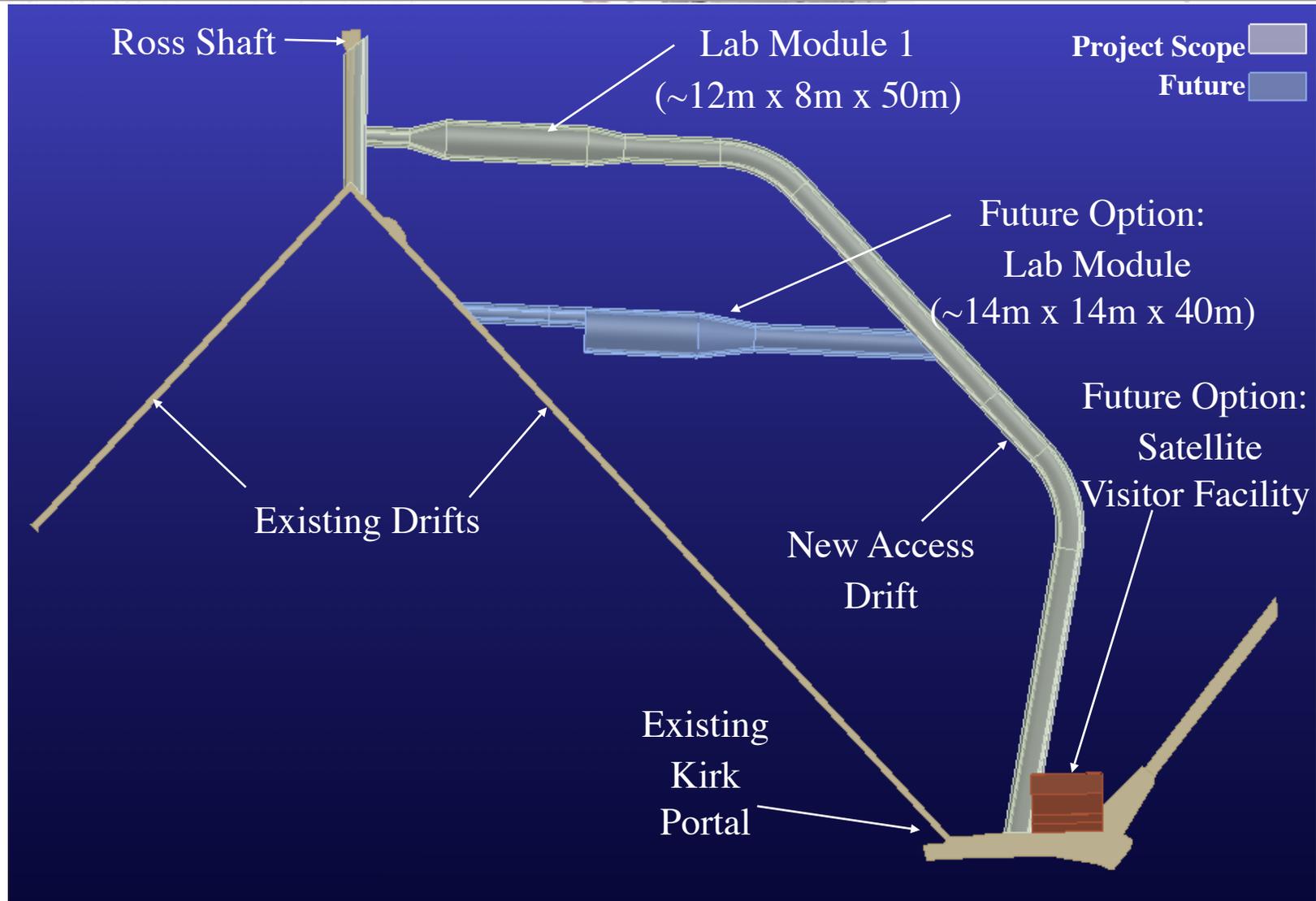
Since June, DOE (OHEP & ONP) and NSF have been developing a framework for coordination of a joint nuclear and particle physics program at an underground laboratory

- OHEP, ONP, and NSF will coordinate the experimental program through a Joint Oversight Group (JOG) which will hold an inaugural meeting this December.

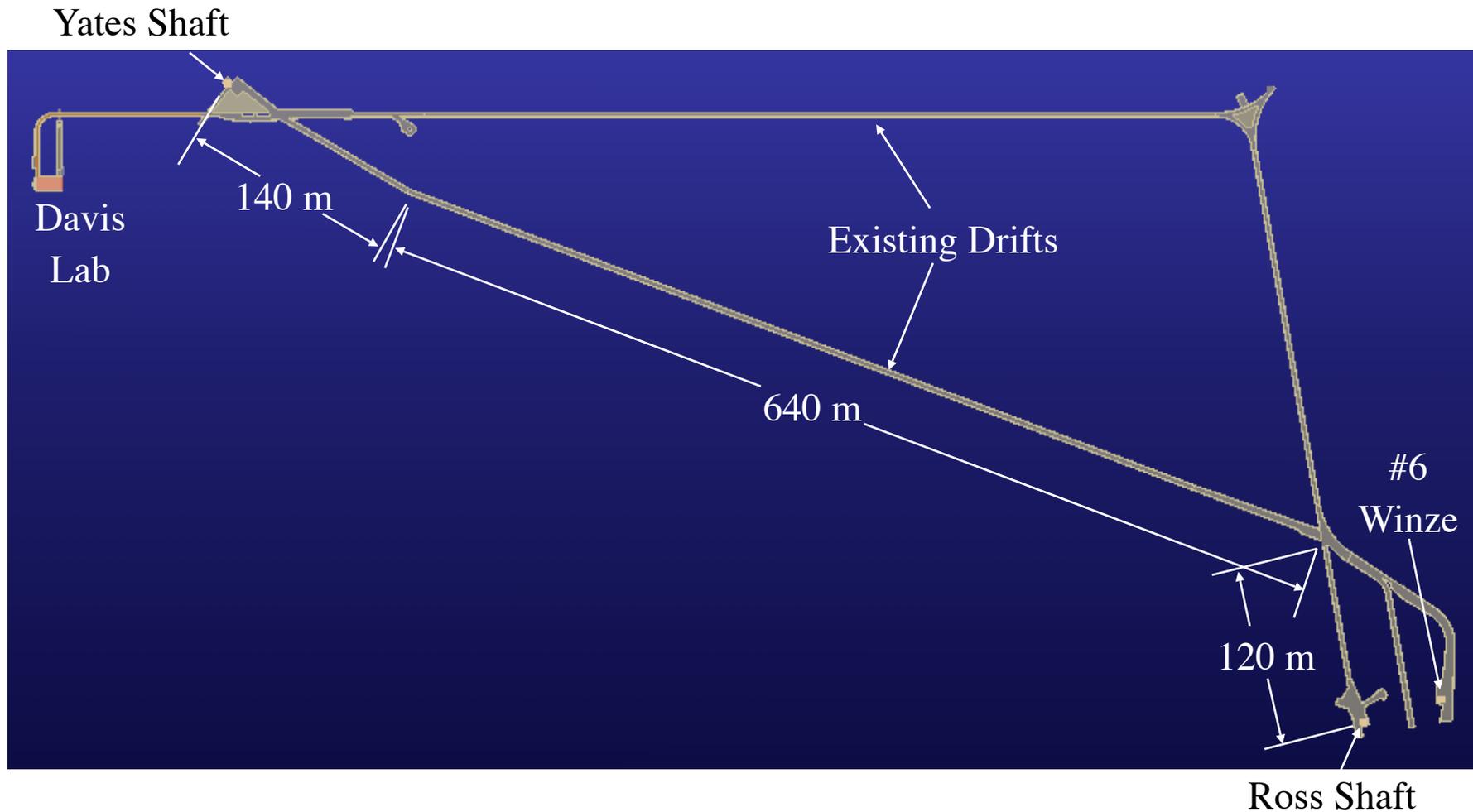
Development of the Surface Campus will utilize existing structures, as feasible and cost-effective



Development at 300L for Near-surface Campus Preliminary Layout (Plan View)



Existing Development at 4850L Campus (Plan View)



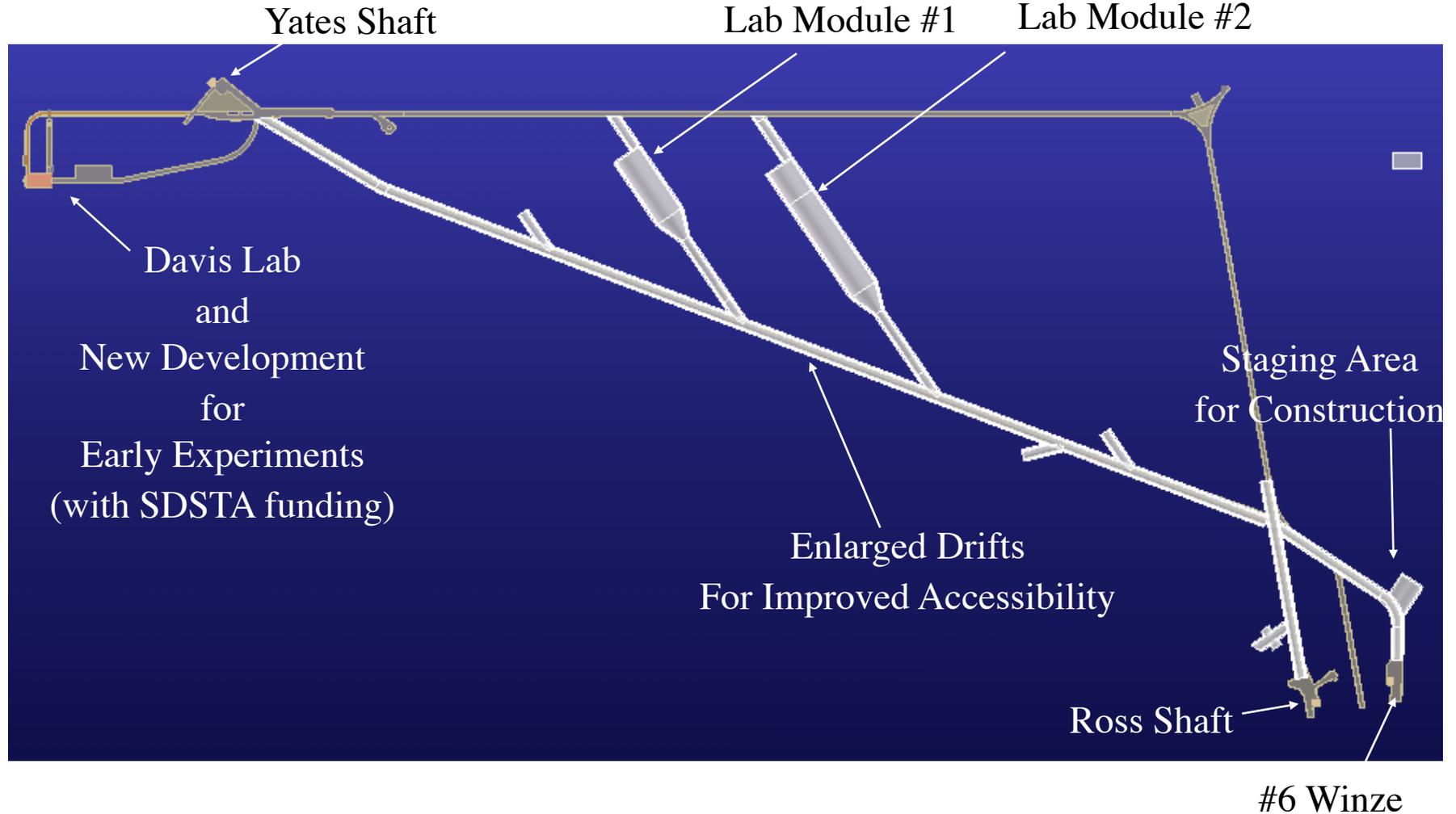
Sequential Development of Space at 4850L: Two Lab Modules for DUSEL Experiments (Plan View)

LONGSECTION OF THE HOMESTAKE MINE

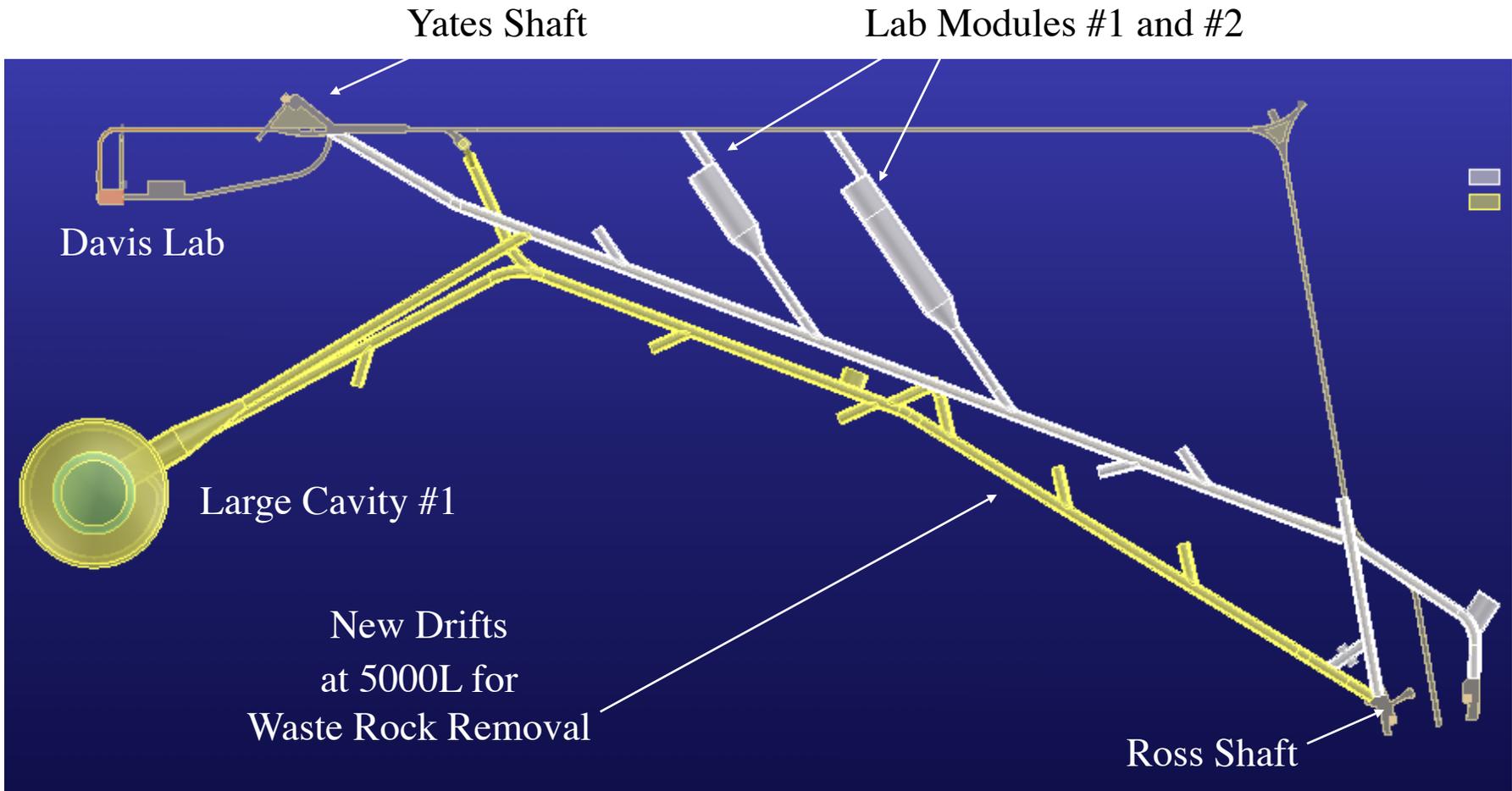
Standard Lab Modules: ~20m x 20m x 50-100m long

Lab Module #1

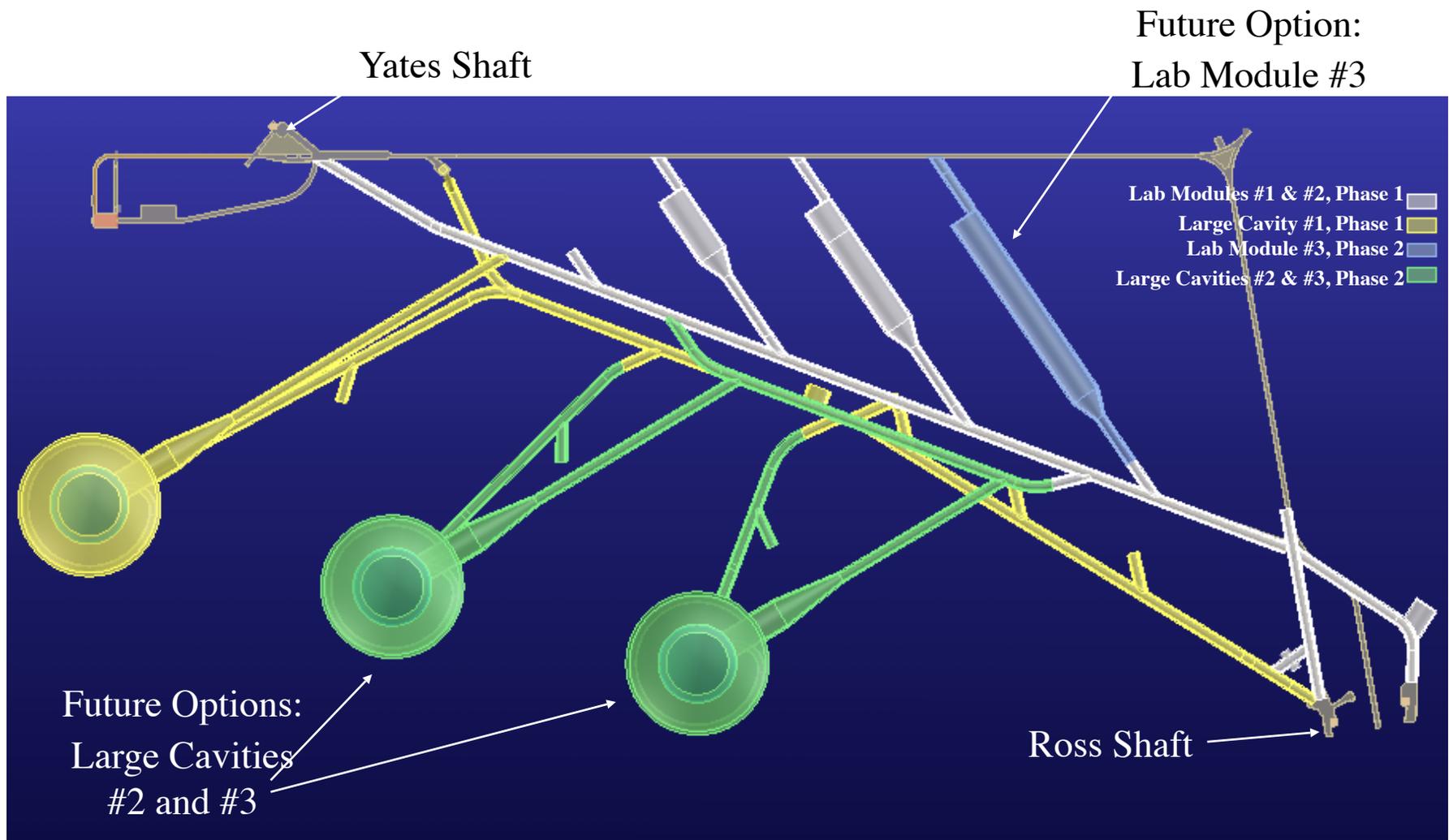
Lab Module #2



Sequential Development of Space at 4850L: Two Lab Modules and 1st Large Cavity

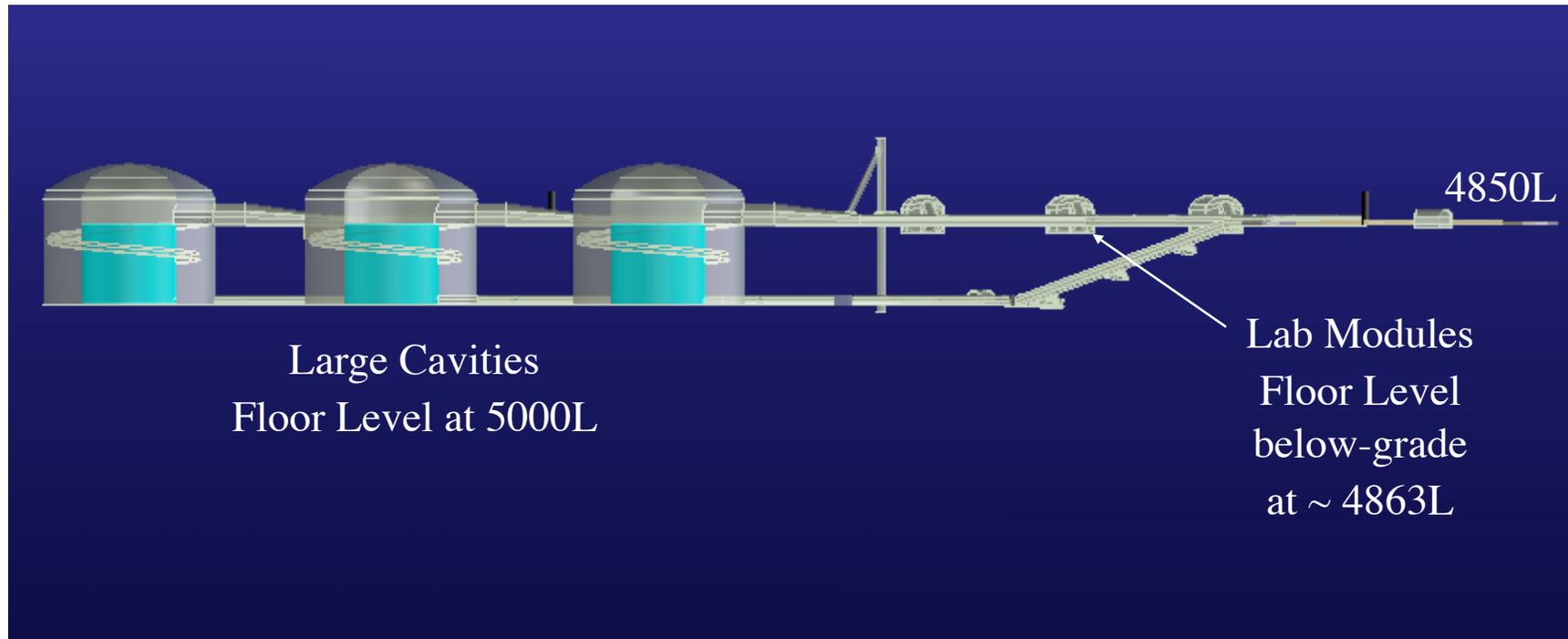


Sequential Development of Space at 4850L: Future Expansion Options for Mid-level Campus



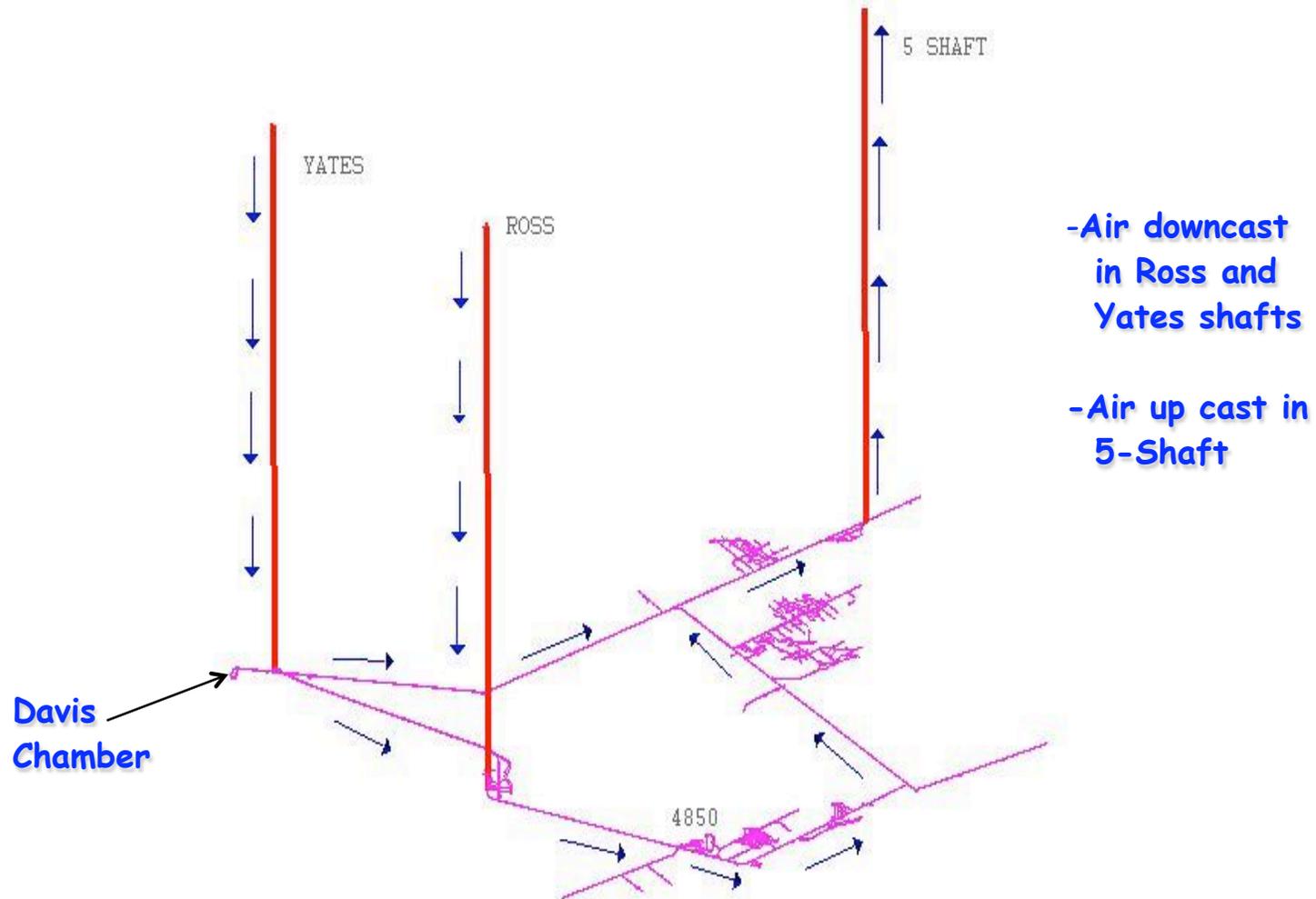
4850L Preliminary Layout

Elevation View with 3 Lab Modules and 3 Large Cavities

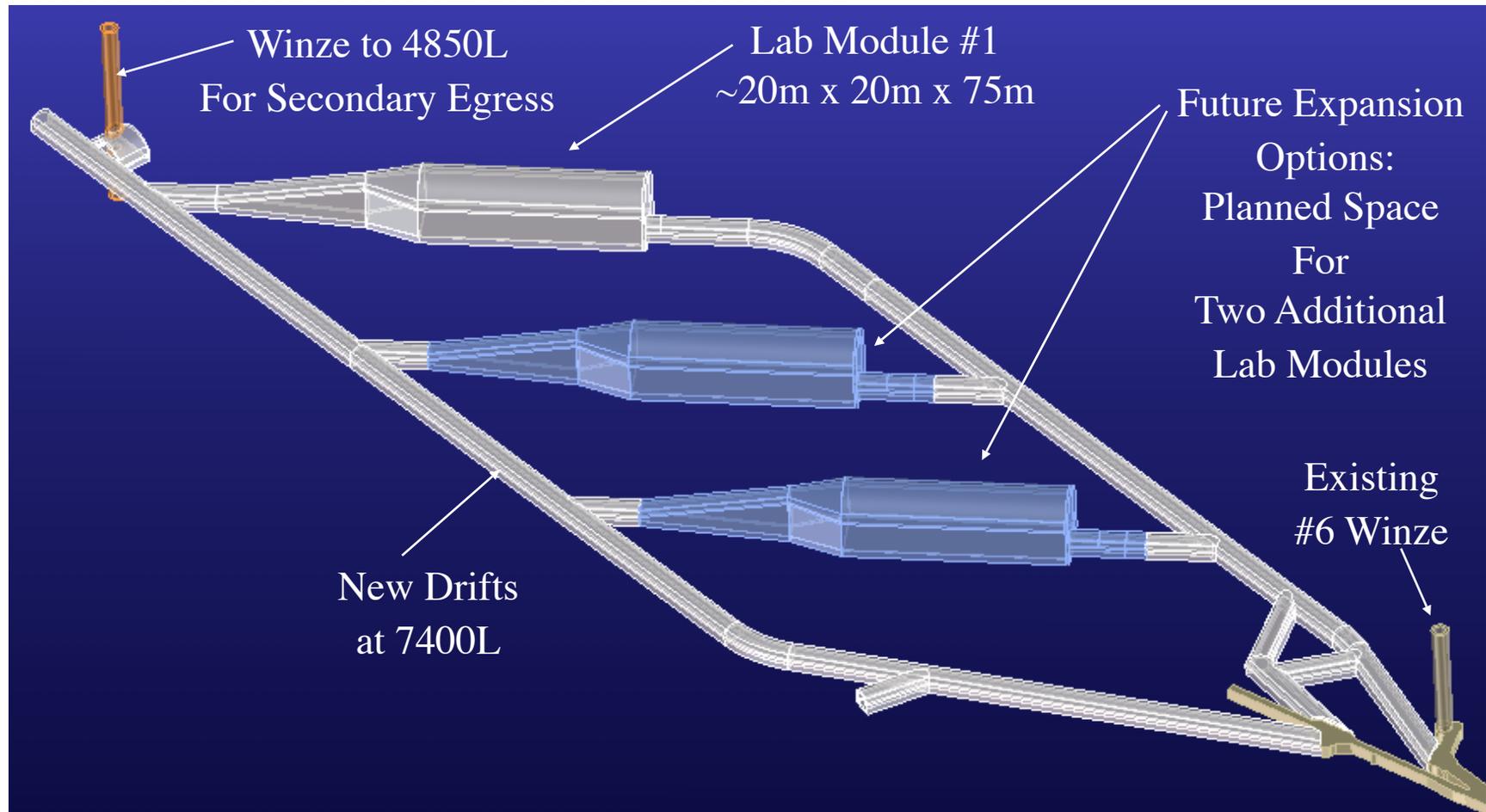


Ventilation on the 4850L

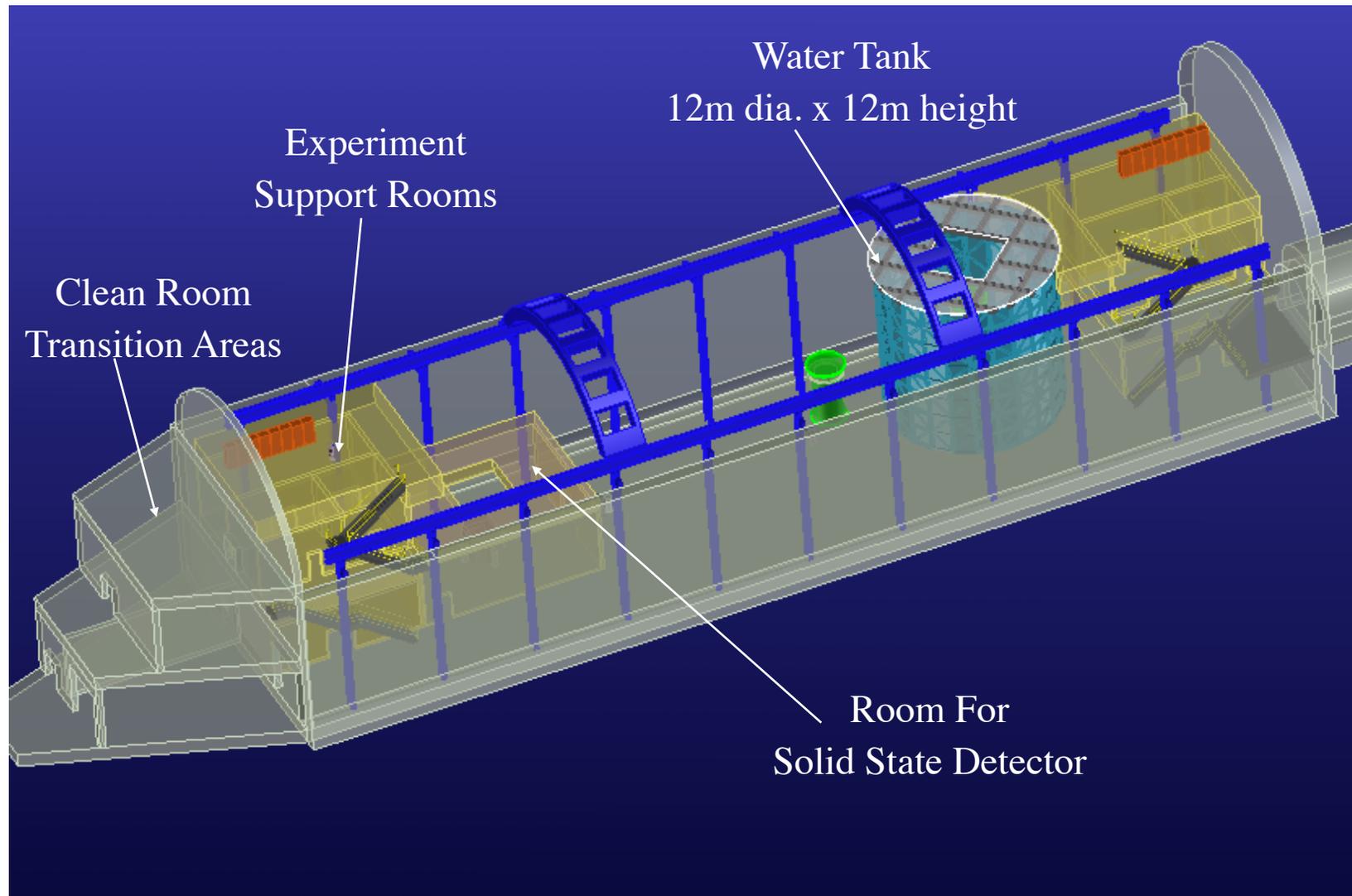
LONGSECTION OF THE HOMESTAKE MINE



Development at 7400 Level for Deep Campus Preliminary Layout (Plan View)



Conceptual layout of laboratory space

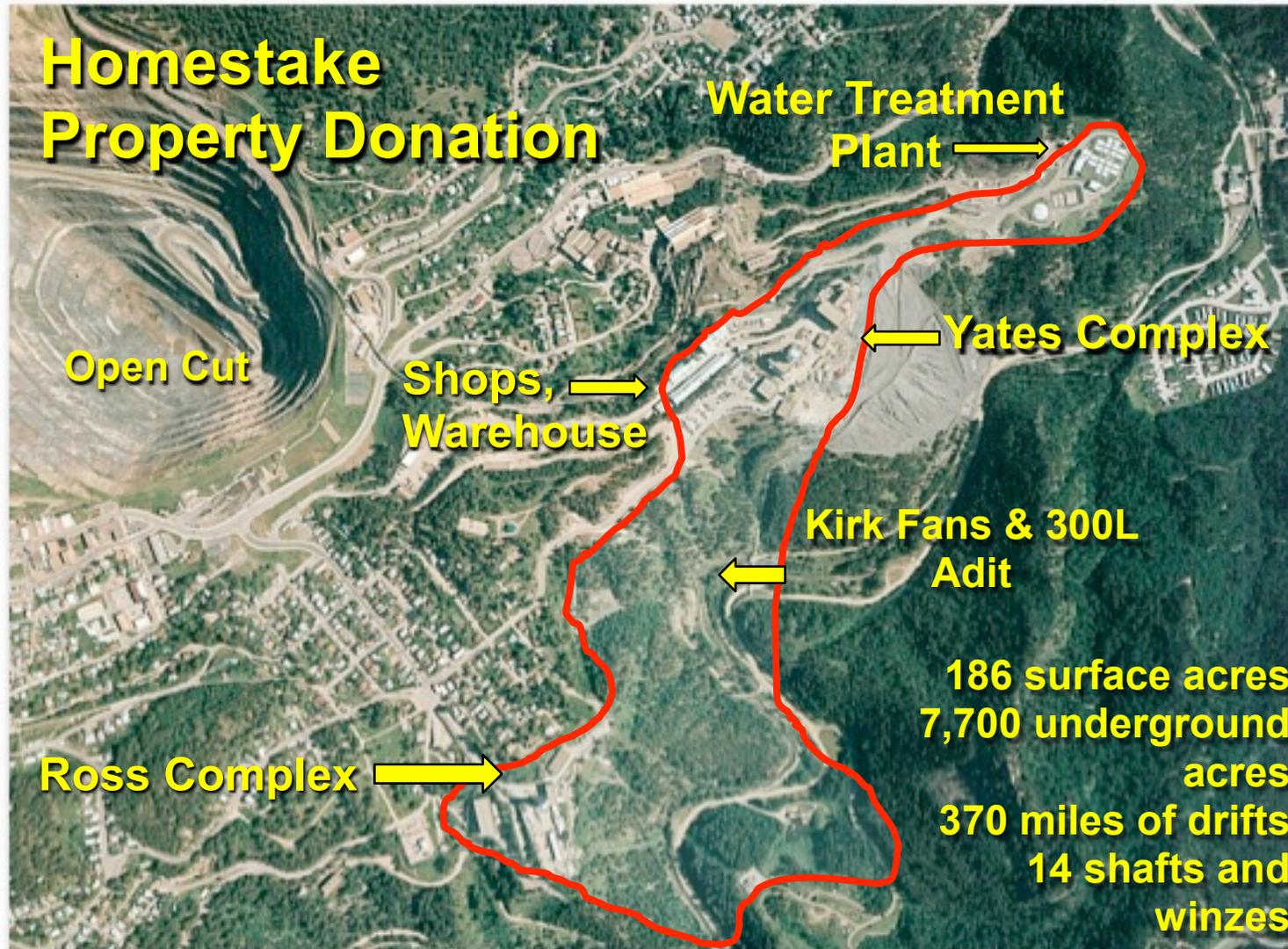


South Dakota and Sanford Lab Participation in Preparing for DUSEL

- Major Financial Support from the State of South Dakota
 - \$45M from State (HUD grant and General Fund)
 - \$70M from Philanthropic Donation (T. Denny Sanford)
 - Owns the Property (Donation from Barrick)
- Partnership to “achieve DUSEL”
- DUSEL assimilates Sanford Lab at MREFC Construction
- Facility Work Initiated (Site Preparation and Risk Reduction)
 - Rehabilitation of Surface and Underground Infrastructure
 - Lifts & Shafts
 - Pumps
 - Facility Stabilization and Rehabilitation
 - Initial Operations, Environment, and Safety Programs
 - Early Science Program
 - Rock Disposal Sites - *Agreement in Principal* with Barrick to use the “Open Cut”, alternative sites identified



South Dakota Science and Technology Authority (SDSTA) Property



SDSTA Recent Progress

LONGSECTION OF THE HOMESTAKE MINE

REHABILITATION OF SHAFTS & HOISTS

- Ross Shaft rehabilitated to water level. (\$9.2 million)
- Ross Hoist re-certified and operating.
- Yates Shaft rehabilitation in process. (\$9 million bid awarded)

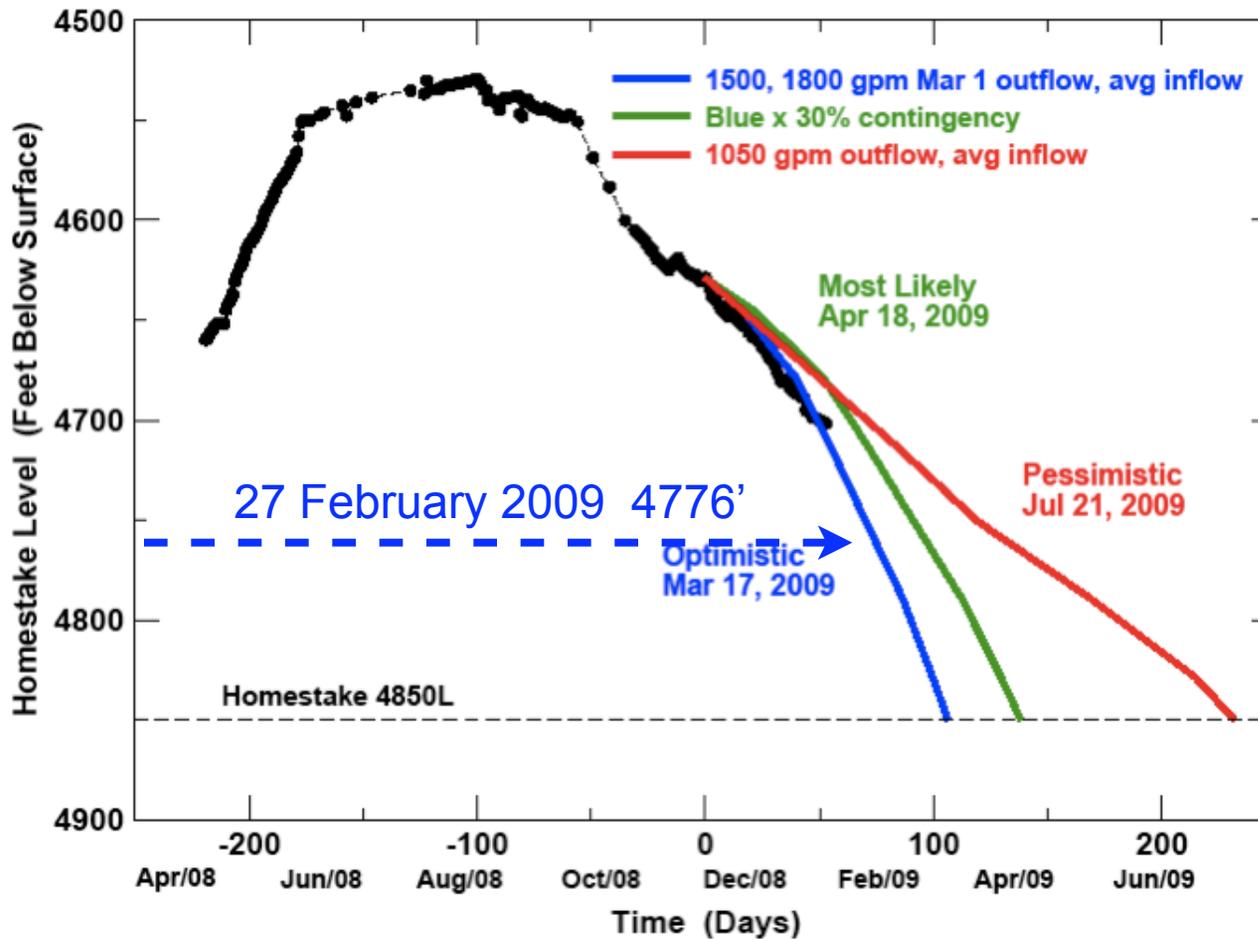
Yates Hoist is re-certified and operating.

Dewatering Projection to 4850L

LONGSECTION OF THE HOMESTAKE MINE

Sanford Lab Dewatering

Projection for the 4850L starting Dec 1/08 based on Barrick mine model

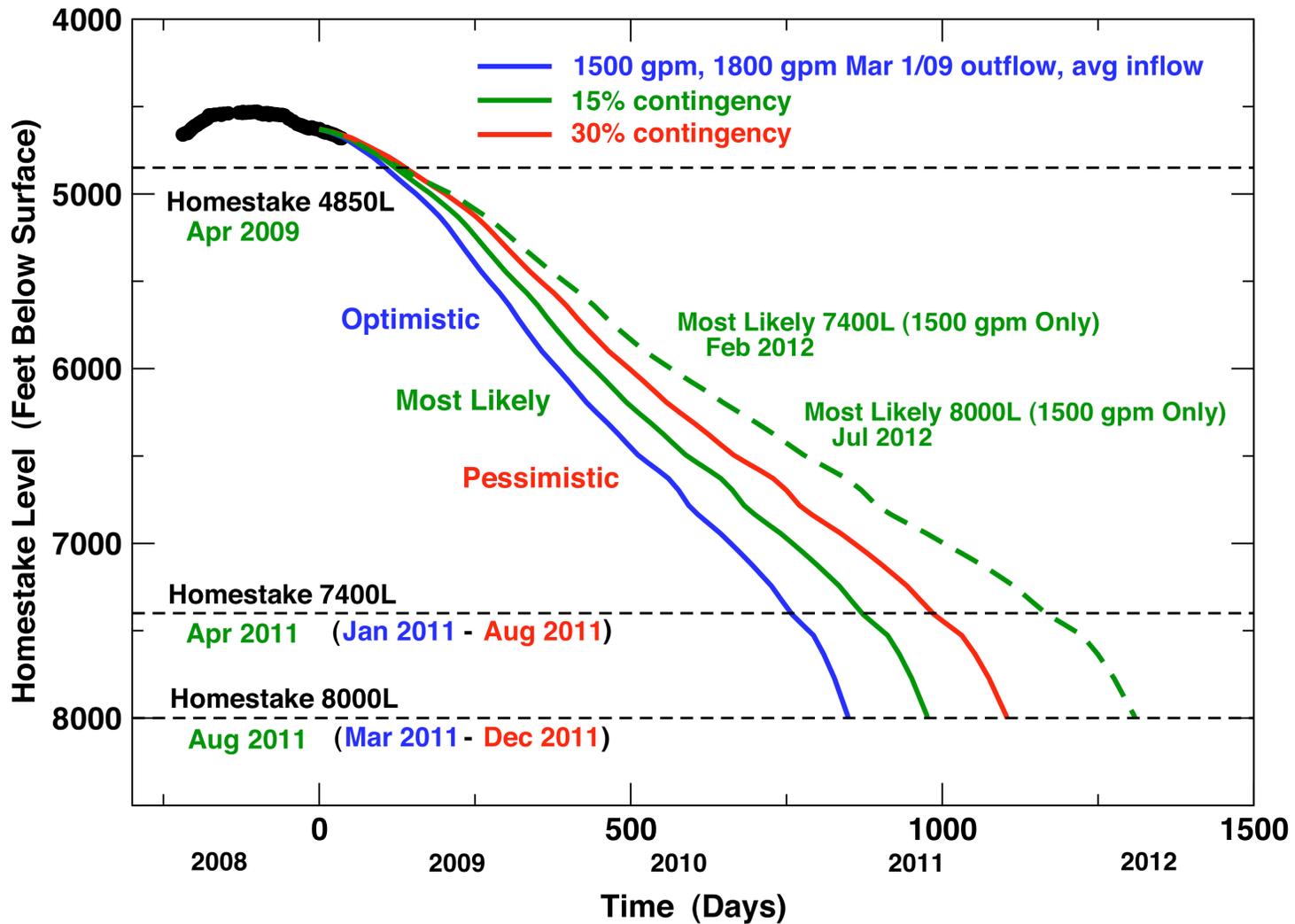


Updated: January 23, 2009

Dewatering Projection to 7400L and 8000L

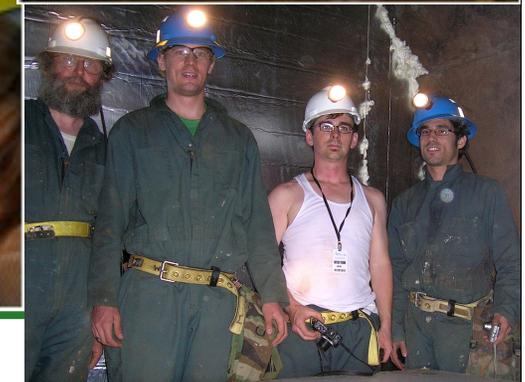
DUSEL Dewatering

Projection for the 8000L starting Dec 1/08 based on the Barrick mine model

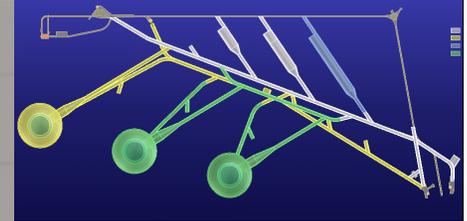


SDSTA Accomplishments Early Science Efforts

- Seismology: Dr. Bill Roggenthen (SDSM&T), Dr. Steven Glaser (UC Berkeley)
- Hydrology: Dr. Larry Stetler (SDSM&T)
- Gravitational Studies: Dr. Vuk Mandic (U of Minn.), Dr. Riccardo DeSalvo (CalTech)
- Microbiology – Dr. Cynthia Anderson (BHSU)
- Background characterization – Dongming Mei (USD)
- Preparation and Planning for LUX and MAJORANA



DUSEL Attributes



- DUSEL will be a Critical Facility with Unparalleled Attributes:

- Large excavations to host a variety of experimental programs
- Long term, non-competed access to site
- Access to unusual depth for important initiatives in deep science
- Broad access to a large volume of low radioactivity rock

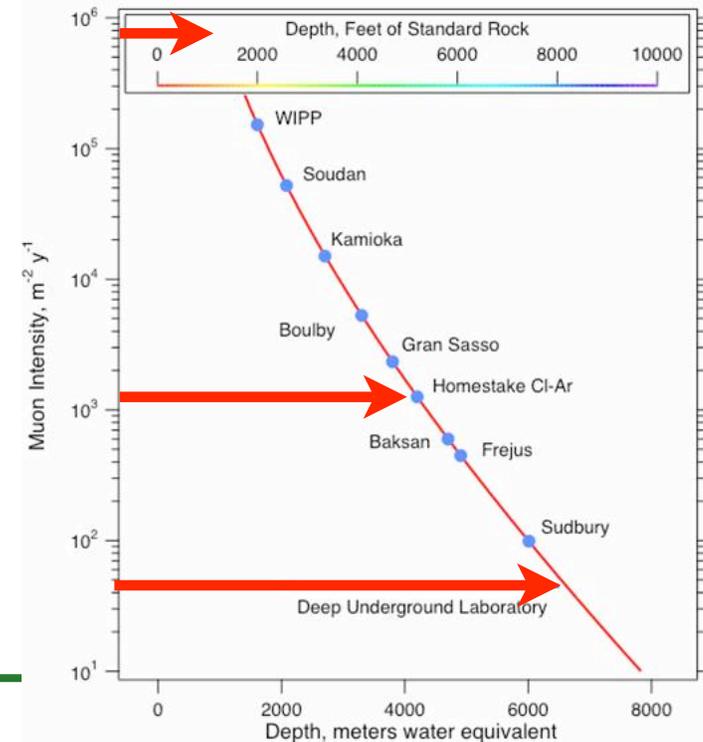
- A Facility Enabling World-class Science and Engineering in:

- Physics
- Biology
- Geosciences
- Engineering

- A Facility Addressing Questions with Significant Societal Impact:

- Underground Construction
- Energy Sources and Sustainability
- Resource Recovery and Sustainability
- Mitigating Natural Hazards

- **Education and Public Outreach**

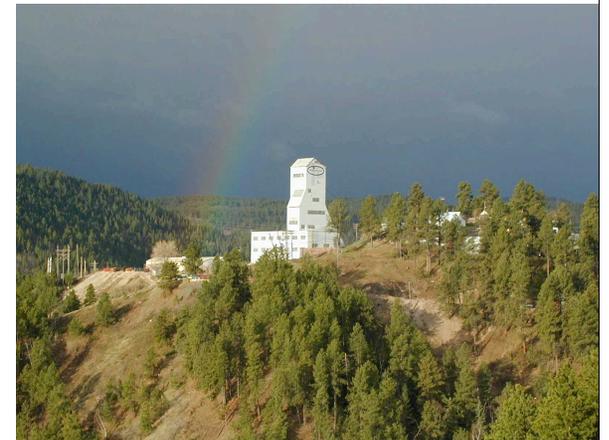


Summary of Progress

- DUSEL is Motivated by Well Documented Transformational Science Goals
- Progress in Preparing the Site and Mitigating Risks
- Progress in Advancing the Technical Design
- Experimental Proposals Coordinated by DEDC and serve as the Basis for Requirements Management and “Model Experiments”
- Most Key Project Personnel in Place
- Key Committees & Boards Staffed & Functioning
- Plan developed for the Design (PDR & FDR)

Goals for FY09

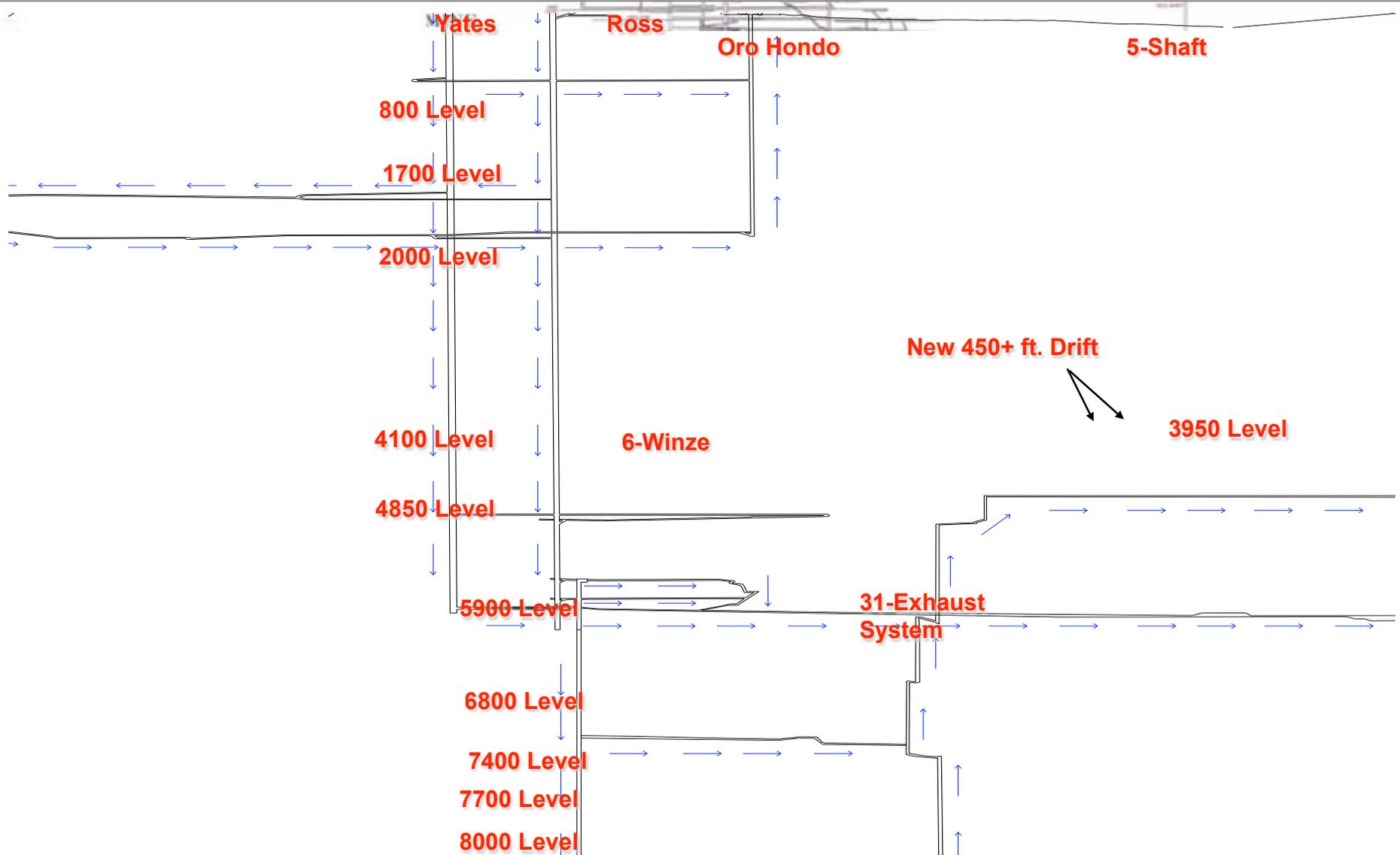
- Initiation of Major Design Contracts
 - geotechnical assessment
 - infrastructure assessment
 - surface campus planning
- Initiated Large Cavity Work
- Initiated Environmental Impact Statement Efforts



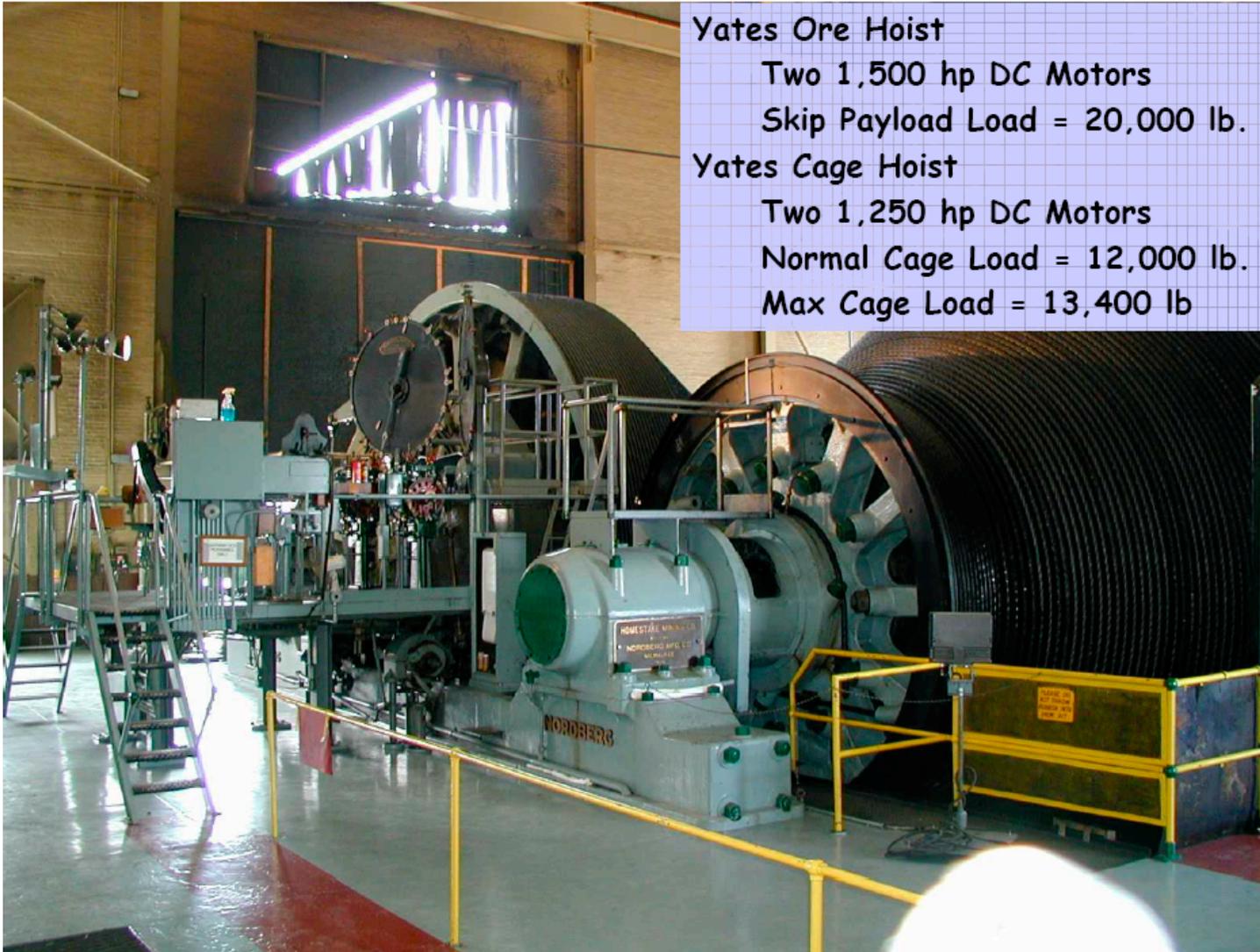


LONGSECTION OF THE HOMESTAKE MINE

Ventilation Concept 8000L and Above



Project Scope includes re-use, alterations and upgrades to existing infrastructure for conversion from mining to laboratory operations.



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

Underground Engineering and Operations

Progress Towards Charge – Infrastructure Assessment

Preliminary Observations Continued

- Track Infrastructure
 - Significant Corrosion of Rail and Associated Hardware
 - Some replacement Likely in Highly Travelled Areas
- Ventilation Infrastructure
 - Ventilation Doors Require Repairs and Servicing. Some Replacements Required
 - Oro Hondo Shaft Blocked at 3950 L. Plan to send Camera down Shaft in February for Detailed Inspection
 - Kirk Fan, Oro Hondo Fan and #5 Shaft Fans Operational

Hoist Inspections

- Ross Shaft Cage and Skip Hoists Certified for Operation
- Yates Shaft Cage and Skip Hoists Certified for Operation

Underground Engineering and Operations

Progress Towards Charge – Excavation Design

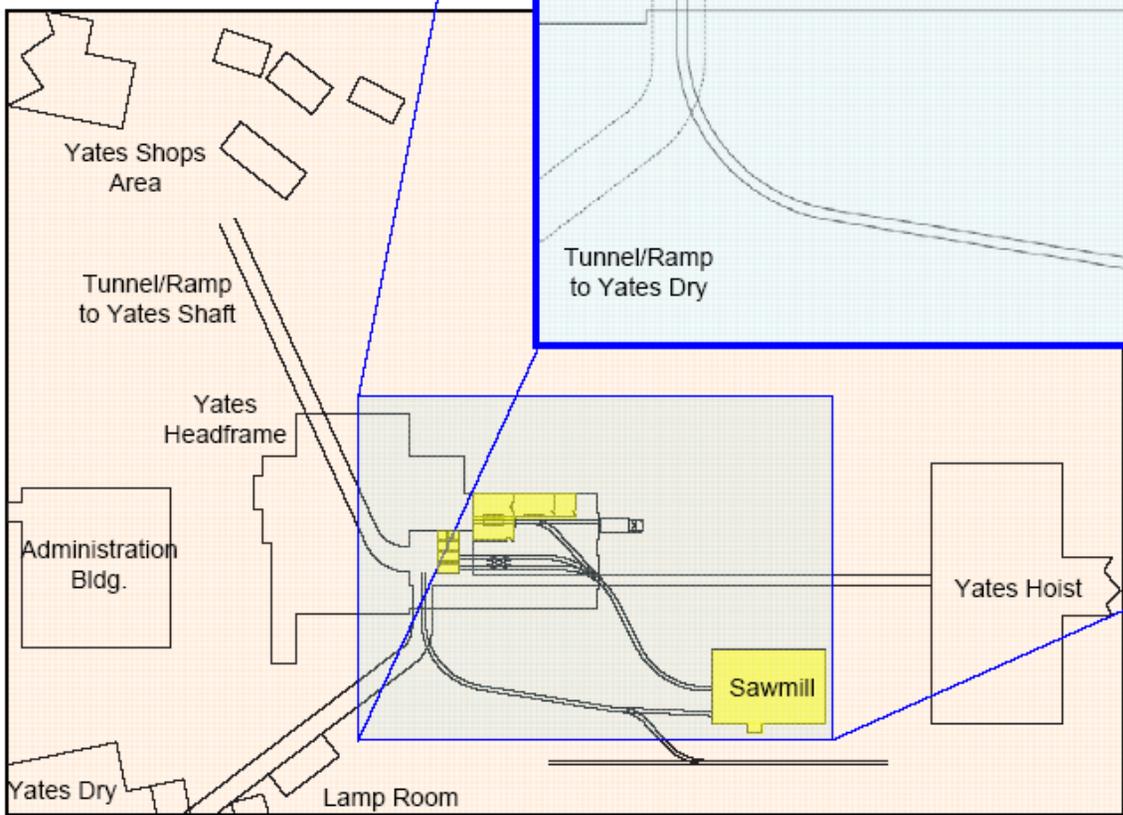
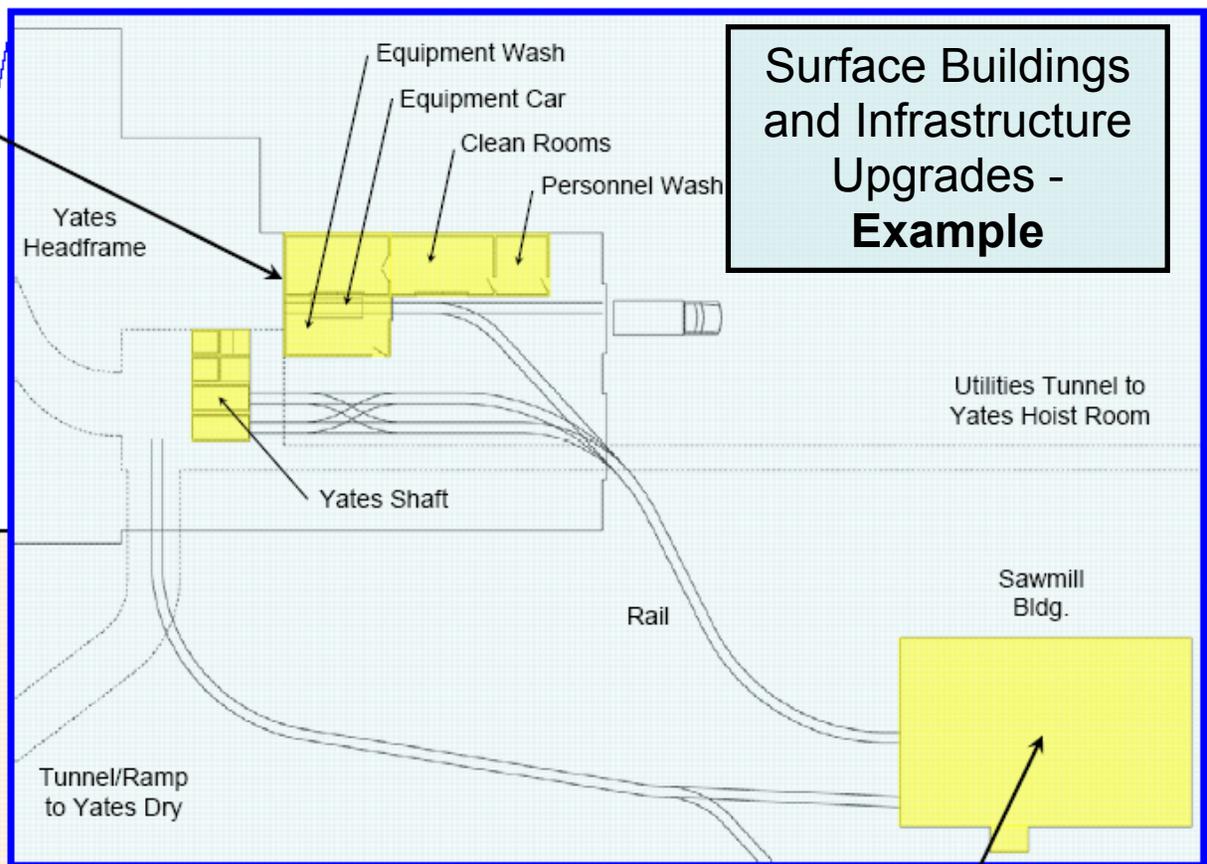
Geotechnical Engineering Contract

- Successful Bidder – RESPEC/Golder/Lachel Felice
- Contractor selected in September, 2008
- Field Work to Commence February, 2009
- Anticipate Phase 1 Geotechnical Study at 300 L complete November, 2009
- Anticipate Phase 1 Geotechnical Study at 4850 L complete July, 2010
- Scope focused on obtaining Geotechnical Information from the Rock Mass on the 300 L and 4850 L including Geological Mapping, determination of the Magnitude and Direction of the Three Dimensional Stress Fields, Tensile and Compressive Strengths, Strength under Confining Pressure, as well as Discontinuity Strength and Stiffness
- Current Scope does not include Geotechnical activities specific to the Large Cavity

Yates Clean Transfer Station

Research equipment wash facilities to transfer from transport shipping crates to clean Equipment Cars and Containers for conveyance to underground laboratories.

Surface Buildings and Infrastructure Upgrades - Example



Yates Assembly, Staging and Test Area

Clean room and assembly shop for post-shipment inspection and pre-assembly prior to transport to underground laboratories.