



U.S. DEPARTMENT OF  
**ENERGY**

PNNL-22569

Prepared for the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

# Leadership and Stewardship of the Laboratory (Objective 4.1) Notable Outcome – Phase II Alternative Analysis and PNNL Site Plan Recommendation

N2013-1.3-RPT-P11-01, Revision 0

JP Pittman  
SR Cassidy  
WC Mosey  
EM Leitz  
LJ Oukrop

July 2013



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY

*operated by*

BATTELLE

*for the*

UNITED STATES DEPARTMENT OF ENERGY

*under Contract DE-AC05-76RL01830*

Printed in the United States of America

Available to DOE and DOE contractors from the  
Office of Scientific and Technical Information,  
P.O. Box 62, Oak Ridge, TN 37831-0062;  
ph: (865) 576-8401  
fax: (865) 576-5728  
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,  
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161  
ph: (800) 553-6847  
fax: (703) 605-6900  
email: orders@ntis.fedworld.gov  
online ordering: <http://www.ntis.gov/ordering.htm>



This document was printed on recycled paper.

(9/2003)

# **Leadership and Stewardship of the Laboratory (Objective 4.1) Notable Outcome – Phase II Alternative Analysis and PNNL Site Plan Recommendation**

JP Pittman  
SR Cassidy  
WC Mosey  
EM Leitz  
LJ Oukrop

July 2013

Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

# Executive Summary

Pacific Northwest National Laboratory (PNNL) and the Pacific Northwest Site Office (PNSO) have recently completed an effort to identify the current state of the campus and gaps that exist with regards to space needs, facilities and infrastructure. This effort has been used to establish a campus strategy to ensure PNNL is ready to further the United States (U.S.) Department of Energy (DOE) mission. Ten-year business projections and the impacts on space needs were assessed and incorporated into the long-term facility plans. In identifying/quantifying the space needs for PNNL, the following categories were addressed: Multi-purpose Programmatic (wet chemistry and imaging laboratory space), Strategic (Systems Engineering and Computation Analytics, and Collaboration space), Remediation (space to offset the loss of the Research Technology Laboratory [RTL] Complex due to decontamination and demolition), and Optimization (the exit of older and less cost-effective facilities). The findings of the space assessment indicate a need for wet chemistry space, imaging space, and strategic space needs associated with systems engineering and collaboration space.

Based on the analysis, a 10-year campus strategy evolved that balanced four strategic objectives, as directed by the DOE Office of Science (DOE-SC):

- Mission Alignment – maintain customer satisfaction
- Reasonable & Achievable – do what makes sense from a practical and cost perspective
- Campus Continuity – increase the federal control of assets and follow the Campus Master Plan
- Guiding Principles – modern, collaborative, flexible, and sustainable.

This strategy considered the following possible approaches to meet the identified space needs:

- Institutional General Plant Project (IGPP) funded projects
- Third party leased facilities
- Science Laboratory Infrastructure (SLI) line item funded projects.

Pairing the four strategic objectives with additional key metrics as criteria for selection, an initial recommendation was made to DOE-SC to use all three funding mechanisms to deliver the mission need. DOE-SC provided feedback that third party facilities are not to be pursued at this time. The decision was made by DOE that an IGPP-funded program would be the base plan, while retaining the possibility of a 2019 SLI-funded project. The SLI project will be designed to deliver significant impact on science and technology (S&T) and support the development of a modern, synergistic core campus where a collaborative and innovative environment is fostered. The specific scientific impact will be further defined in the 2015 and 2016 Annual Laboratory Plans. Additionally, opportunities will be explored to construct annexes on current federal facilities, including the Environmental Molecular Sciences Laboratory (EMSL), if proven synergistic and cost effective.

The final result of this effort is an actionable, flexible plan with scope, schedule, and cost targets for individual acquisition projects. Implemented as planned, the result will increase federal ownership by approximately 15 percent, reduce the operating cost by approximately 7 percent, and reduce the geographic facility footprint by approximately 66,000 gross square feet (GSF). Reduction of surplus space will be addressed while maintaining customer satisfaction, lowering operating costs, reducing the campus footprint, and increasing the federal control of assets. This strategy is documented in PNNL's 2014 Laboratory Plan.

## Acronyms and Abbreviations

APEL	Applied Process Engineering Laboratory
B&U	Building and Utilities
BMI	Battelle Memorial Institute
CFC	Cost of Facilities Capital
CFO	chief financial officer
D&D	decommissioning and demolition
DOE	U.S. Department of Energy
DOE-HQ	DOE Headquarters
DOE-SC	DOE Office of Science
F&I	Facilities and Infrastructure
FIMS	Facility Information Management System
FPS	financial processing system
Ft <sup>2</sup>	square feet
FY	fiscal year
GSF	gross square feet
IGPP	Institutional General Plant Project
LCCA	life cycle cost analysis
MARS	Maintenance & Renewal Forecast System
NFSF	net functional square feet
NPV	net present value
NSF	net square feet
O&M	operations and maintenance
OMB	Office of Management and Budget
OPC	other project costs
OSD	Operational Systems Directorate

PEMP	Performance Evaluation and Measurement Plan
PNNL	Pacific Northwest National Laboratory
PNSO	Pacific Northwest Site Office
R&D	research and development
REMO	Real Estate Management Office
RTL	Research Technology Laboratory
S&T	science and technology
SLI	Science Laboratory Infrastructure
TEC	total estimated cost
U.S.	United States
USACE	United States Army Corps of Engineers
WBS	work breakdown structure

# Contents

Executive Summary .....	iii
Acronyms and Abbreviations .....	v
1.0 Introduction and Background .....	1.1
1.1 Guidance from DOE.....	1.1
1.2 Strategic Objectives.....	1.2
1.3 Project Description.....	1.3
1.4 Gap Analysis Summary.....	1.4
1.4.1 PNNL Business Projections .....	1.4
1.4.2 Integrated Data Systems.....	1.5
1.4.3 Gap Analysis Results .....	1.6
1.5 Client Validation .....	1.7
1.6 Assumptions.....	1.8
2.0 Additional Space Needs.....	2.1
2.1 Contract Requirement (Remediation Impacts).....	2.1
2.2 Campus Optimization.....	2.2
2.3 Total Space Gap .....	2.6
3.0 Alternatives.....	3.1
3.1 IGPP .....	3.1
3.2 IGPP and Third Party .....	3.1
3.3 IGPP, Third Party, and SLI.....	3.1
3.4 IGPP and SLI .....	3.1
4.0 Evaluation of Alternatives .....	4.1
4.1 Overview .....	4.1
4.2 Metrics Analyzed .....	4.1
4.3 Analysis.....	4.3
4.4 Evaluation of Alternatives.....	4.8
5.0 Recommended Alternative .....	5.1
5.1 DOE Recommendation/Feedback .....	5.1
5.2 Recommended Alternative.....	5.1
6.0 Summary.....	6.1
Appendix A Client Validation Profile Sheets .....	A.1
Appendix B Client Validation of Work Conducted at the Pacific Northwest National Laboratory (DRAFT) .....	B.1
Appendix C Facility Economic Analysis Summary .....	C.1
Appendix D Alternative Mass Balance.....	D.1
Appendix E Life Cycle Cost Analysis Methodology.....	E.1
Appendix F Alternative Waterfall Schedules .....	F.1



# Figures

Figure 1.1. Notable Outcome Project Integrated in Existing Facility Planning Processes .....	1.1
Figure 1.2. PNNL Site Plan Strategic Objectives .....	1.2
Figure 1.3. Notable Outcome Work Breakdown Structure.....	1.3
Figure 1.4. PNNL 10-Year Cost Projections With Historical Conservative Forecasting Results ..	1.5
Figure 1.5. Starlight, a PNNL-Developed Visual Analytic Tool, Provides an Image of the Interconnectivity of Our Integrated Capabilities and the Clients that Fund Our Work .....	1.6
Figure 2.1. Location of RTL on PNNL Campus and the Adjacent New Apartment Complex .....	2.1
Figure 2.2. Process for Determining Notable Outcome Cost Per Square Foot.....	2.3
Figure 4.1. IGPP Metrics .....	4.4
Figure 4.2. IGPP and Third Party Metrics .....	4.5
Figure 4.3. IGPP, Third Party, and SLI Metrics .....	4.6
Figure 4.4. IGPP and SLI Metrics.....	4.8
Figure 5.1. DOE Strategy for Lab Plan.....	5.1

# Tables

Table 1.1. Gap Analysis Summary Table From Phase I .....	1.7
Table 2.1. Buildings by Space Category .....	2.2
Table 2.2. Total Space Gap.....	2.6
Table 4.1. Life Cycle Cost Analysis Summary .....	4.3
Table 4.2. Alternatives Analysis Findings .....	4.9

# 1.0 Introduction and Background

## 1.1 Guidance from DOE

DOE-SC initiated an effort in fiscal year (FY) 2013 to develop an expanded and more comprehensive, long-term (10-year) strategic facilities plan for PNNL. This plan was to focus on clarifying the facilities use at PNNL and the future needs for these facilities, as informed by government clients that use the Laboratory, given their forecasts of long-term need for the type of work performed at PNNL.

This DOE-SC initiative was incorporated into the PNNL contract through the creation of the Performance Evaluation and Measurement Plan (PEMP) Notable Outcome (see [DOE-Battelle Prime Contract for the Management and Operation of Pacific Northwest National Laboratory DE-AC05-76RL01830, Appendix E, Standards of Performance-Based Fee, section 4.3](#)), “Develop a site plan for PNNL, including specifically addressing customers, usage, and requirements.” Figure 1.1 illustrates how the results of the Notable Outcome are integrated into the Laboratory’s facilities and infrastructure planning processes and DOE-SC’s annual Laboratory planning process.

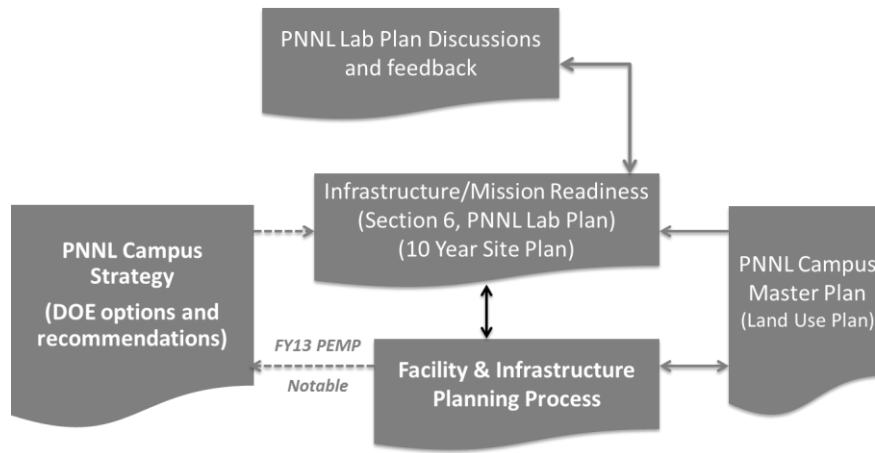


Figure 1.1. Notable Outcome Project Integrated in Existing Facility Planning Processes

In partnership, DOE-SC and PNNL established four strategic objectives to guide the development of the plan for acquiring and sustaining critical PNNL facilities and infrastructure to further the DOE mission. These objectives are Mission Alignment, be Reasonable & Achievable, Campus Continuity, and follow the Campus Master Plan Guiding Principles. These are discussed further in section 1.2. IGPPs and SLI were the funding mechanisms identified as bounding conditions for evaluating viable alternatives associated with addressing the mission needs in a timely manner. Although third party leases were initially included as an option in the bounding conditions, DOE-SC determined that alternative should not be pursued at this time.

The scope was limited to PNNL Richland-campus facilities only, excluding the 300 Area and Marine Sciences Laboratory facilities. This was affirmed in a meeting on March 5, 2013 with PNSO.

## 1.2 Strategic Objectives

As stated previously, the facility strategy must balance four strategic objectives. Figure 1.2 summarizes the strategic objectives and bounding conditions agreed to with PNSO and DOE-SC at the conclusion of the Gap Analysis presentation in January 2013.

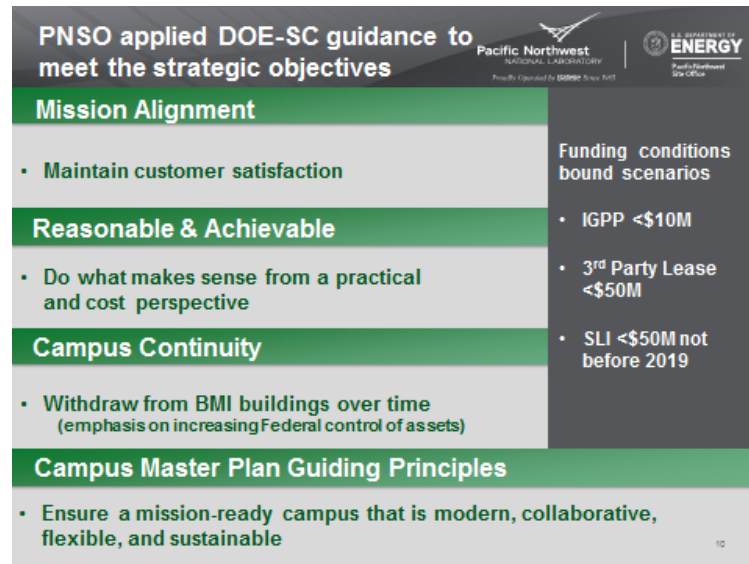


Figure 1.2. PNNL Site Plan Strategic Objectives

A more detailed explanation of each of those objectives is described below.

### Mission Alignment

This objective involves validating that campus investment plans are aligned to meet the scientific mission of the Lab. The scope incorporates three areas specific to mission-aligned facilities. The first includes needs identified by research to support the clients. The second incorporates strategic needs identified by the Laboratory leadership team. Finally, the objective incorporates the need to provide a functional space inventory and surplus space reduction.

### Reasonable/Achievable

This objective focuses on developing an achievable plan, given current financial conditions and realistic projections. The strategy is bounded by a 10-year investment period and includes a total operating cost evaluation over a 30-year study period.

### Campus Continuity

This objective emphasizes increasing the federal footprint and federal control of assets on the PNNL campus. It is aimed at reducing the quantity Battelle Memorial Institute (BMI) owned facilities over time and provides an improved environment for contract competition.

## Campus Master Plan Guiding Principles

This objective verifies the guiding principles agreed to by PNSO and PNNL in the September 2012 Campus Master Plan will be used to develop and invest in the future campus. The guiding principles are modern, collaborative, flexible, and sustainable. A detailed description can be found in the PNNL Campus Master Plan.<sup>1</sup>

## 1.3 Project Description

A phased approach was used to accomplish the PEMP Notable Outcome. Phase I identified gaps associated with the client-forecasted needs and is documented in the gap analysis presentation delivered to DOE Headquarters (DOE-HQ) January 29, 2013. Phase II incorporated the Phase I gaps and additional space needs, and developed and evaluated acquisition scenarios to meet the identified space needs over the next 10 years. Included in Phase II is the quantification of overall space needs (i.e., net laboratory space, common space, and other space types resulting in an overall GSF amount), parametric cost estimates for the various scenarios, and preliminary schedule logic for scenario implementation. The evaluation of these scenarios (i.e., alternatives analysis) resulted in the preferred subset of actions that comprise the PNNL Site Plan documented in the 2014 Laboratory Plan as the Facilities and Infrastructure (F&I) Strategy.

A project was chartered to complete the work, and the project work breakdown structure (WBS) is presented below in Figure 1.3.

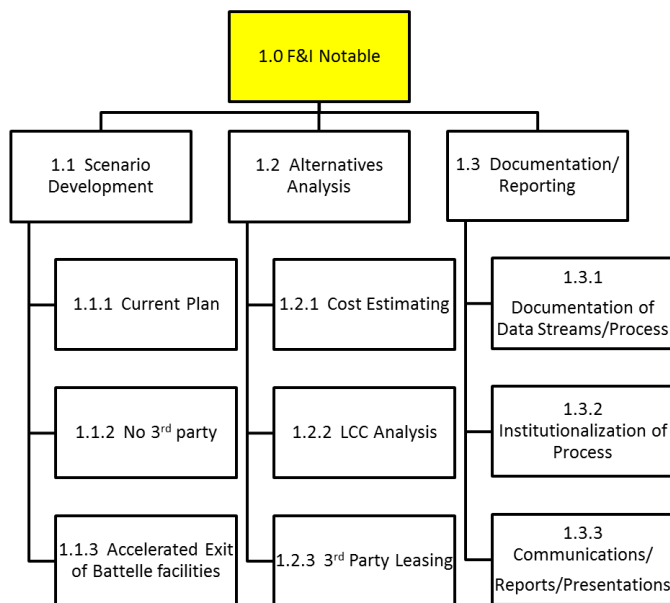


Figure 1.3. Notable Outcome Work Breakdown Structure

<sup>1</sup> [https://collaborate.pnl.gov/projects/facilitiescontent/SiteAssets/Home\\_Page/Campus\\_Master\\_Plan.pdf](https://collaborate.pnl.gov/projects/facilitiescontent/SiteAssets/Home_Page/Campus_Master_Plan.pdf) (PNNL-21700, rev.0)

## **Project Objectives and Deliverables (Key Performance Parameters)**

Each WBS element is responsible for key deliverables that contribute to the overall success of the project. Those deliverables are summarized below:

- Document the data streams and process used to deliver the information for Phase I, including a plan to institutionalize the results and methodologies into PNNL's space management process.
- Develop scenarios with the ability to meet the identified space gap via the available funding mechanisms through a combination of existing and new facility additions (i.e., new construction, renovation of existing space [either Battelle-owned facilities or DOE-owned facilities], additions to or renovation of existing third party leased facilities, and/or newly leased third party facilities). The scenarios will generally be characterized by scope (square feet [ft<sup>2</sup>] by space type) initial cost, life cycle cost, and acquisition schedule.
- Perform an analysis of those scenarios in accordance with the consensus criteria.
- Provide a final report (this document).
- Deliver a PowerPoint presentation (about 20 slides) summarizing the project, process, and outcomes (delivered to DOE-SC by PNSO on April 9, 2013).
- Provide input to the 2014 Laboratory Plan, section 6.0, "Infrastructure/Mission Readiness" (submitted to DOE-SC on May 2, 2013).

## **1.4 Gap Analysis Summary**

This section summarizes the results in Phase I that were presented to DOE-SC on January 29, 2013.

### **1.4.1 PNNL Business Projections**

A 10-year business forecast was developed based on programmatic information received from the clients. The typical business planning process is based on a 5-year projection and has historically been conservative with a clear alignment of trends (e.g., increases or decreases), providing confidence in the use of these data. An additional 5-year projection (FY 2019-2023) was requested. Figure 1.4 represents the 5-year actual and 10-year forecasted internal and external costs. The results indicated a stable business environment that remains flat for the next 10 years. In Figure 1.4, the "FY 2007 Internal Cost Estimate" line is the 5-year client projection calculated in FY 2007, which is below the actual realized cost.

## PNNL Cost Analysis & Projections

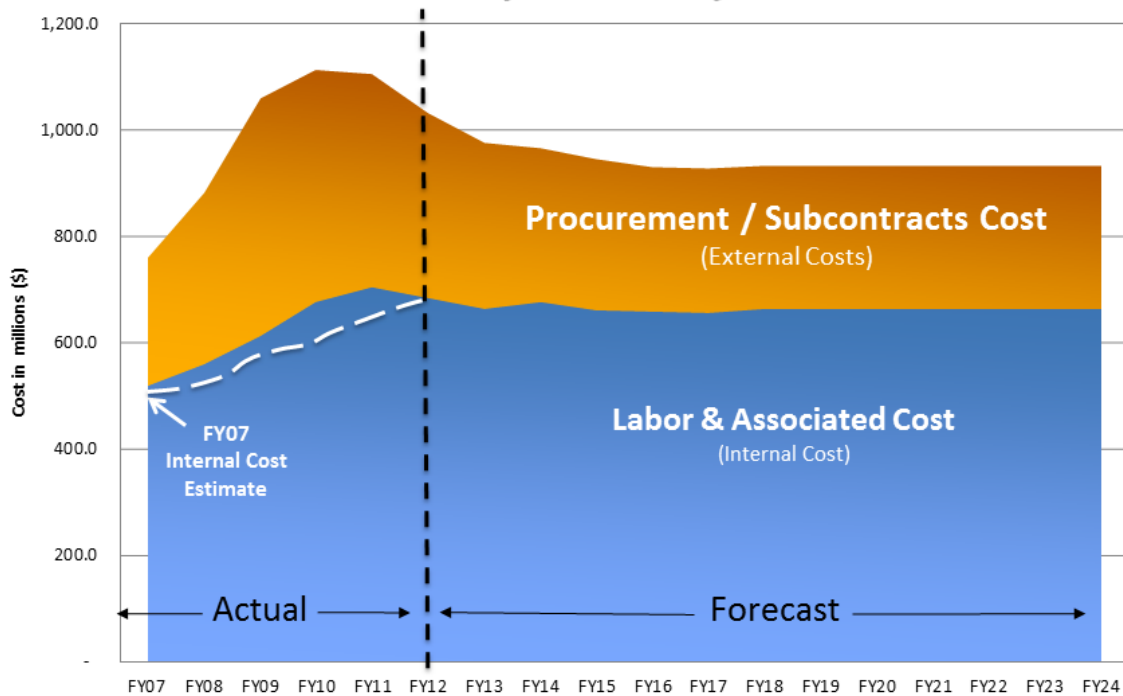


Figure 1.4. PNNL 10-Year Cost Projections With Historical Conservative Forecasting Results

### 1.4.2 Integrated Data Systems

A creative approach was used to quantitatively define the current use and existing gap in the type of space on the PNNL campus. Three existing data systems were integrated to connect people and the project(s) they are working on to the core capabilities, to the lab space(s) they work in, and the specific client(s) they support. The Financial Processing System provided employee's time (FTE), with cost incurred on a project charged to a client. The Integrated Operations System provided employee's access to lab spaces. The Facility Information System provided facility inventory (i.e., type of space, gross square footage, functionality, and core capability). Starlight, a PNNL-developed visual analytic tool, was used to analyze the interconnectivity of PNNL's staff, facilities, type of space, core capabilities, and clients—one of the views can be seen in Figure 1.5. Integrating the data systems allowed for the amount of functional space, along with the current use, to be defined and analyzed. The client projections were overlaid on the current use to define the future projected needs. Integrating existing data systems allowed for the current and future gap to be quantitatively defined.

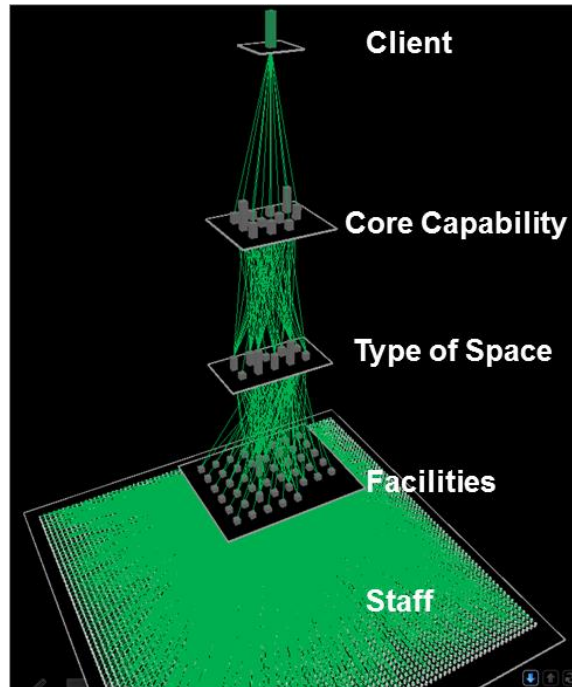


Figure 1.5. Starlight, a PNNL-Developed Visual Analytic Tool, Provides an Image of the Interconnectivity of Our Integrated Capabilities and the Clients that Fund Our Work

This integrated view provided information on how the facilities and spaces are used across the campus and to what magnitude each is used in support of client work. It also provided a clear understanding of the amount of facility space currently existing at PNNL.

### 1.4.3 Gap Analysis Results

*Multi-purpose Programmatic* – A systematic review of customer forecasts, current space usage, and surplus space over a 10-year period identified a gap in wet chemistry and imaging space. The gap is based on a relatively flat customer forecast from FY 2014 through FY 2023 and was validated by DOE through an independent review of customer forecasted needs. Needs, both current and projected, were defined by integrating existing data from space inventory, time charging, and project financial systems. In addition, merging the client forecasted needs over a 10-year period resulted in a comprehensive understanding of the mission gaps to include types of needed space, as well as surplus space.

*Strategic* – Facility capabilities identified as strategic investments supporting Laboratory major initiatives and core capabilities were incorporated into the gap analysis. For example, the Efficient and Secure Electricity Management major initiative identified the combination of systems engineering and computational analytic space as a needed facility capability not currently available within the existing portfolio. Laboratory leadership is championing the strategic development of flexible onsite S&T collaborative meeting space, services and amenities, and a prominent and centralized point of entry into the Laboratory, which would support capabilities across PNNL. These two strategic capability needs add to the mission gap.

Defining the gap in terms of mission alignment verifies that facilities will be available to meet the needs of research. Two space types, wet chemistry and imaging, were identified as needed gaps in space.

The gap also includes surplus of space based on current use and projected needs. Table 1.1 summarizes the gap—both surplus and needs.

Table 1.1. Gap Analysis Summary Table From Phase I

Space Type	Current	Projected Need	Gap	
			Surplus	Need
	Functional Square Feet (K)			
Office	629	576	53	
Chemistry/Materials				
• Radiological	18	14	4	
• Non-Radiological	57	71		14
Biological/Procedure	99	76	23	
Instrumentation	156	145	11	
Lab Support	71	63	8	
Computational	56	54		
Other				
• Imaging	3	8		5
• Other	62	53	9	

The wet chemistry need of 14,000 net square feet (NSF) is a current year, FY 2013, need for space. Two imaging cells, 1,200 net square feet, are needed by the end of 2017, with the remaining 3,800 NSF needed by 2020.

## 1.5 Client Validation

One of the major inputs to define PNNL’s projected space needs was the 10-year business projections for each major client (i.e., DOE-SC, DOE Energy, NNSA, etc.). These projections came from PNNL’s client relationship managers (i.e., sector managers) and were translated to space based on the type of space they were currently using. It was later validated that the type of space used in the future would not change substantially from what they are using now. With that understanding, the complete mission alignment gap was defined. Client profile sheets were used to facilitate discussions with clients and included information on the core capabilities, the type of space, amount of funding, and the forecast for key programs specific to the client. This provided a greater understanding on the impact of the client at PNNL. An example client profile sheet can be found in Appendix A.

The validation of PNNL’s 10-year business projections was conducted by DOE-SC. The results of DOE-SC’s validation were delivered by PNSO in a PNSO-issued report (see Appendix B, “Client Validation of Work Conducted at the Pacific Northwest National Laboratory”).



## 1.6 Assumptions

In order to develop the PNNL Site Plan, assumptions had to be made and agreed to by the PNNL project team. Those assumptions are listed below.

- The quantification of the facilities space need by type of space (gap) and projection of future program funding by client (forecast) is as presented to DOE on January 29, 2013.
- A line item project is proposed, funded by the SLI program (initially <\$100M, later revised to <\$50M), with a projected authorization date of 2019. Space provided by the line item project will not be available until 2022 at the earliest.
- Third party financed facilities on privately owned land are a viable solution to meet specific space needs, as long as they remain below the \$50M Office of Management and Budget (OMB) approval threshold (sum of lease payments with initial Tenant Improvements over term).
- IGPPs are a viable solution to meet specific space needs constrained by a \$9.5M total estimated cost (TEC) and will be located on federal land.
- Parametric cost estimating methods using past PNNL actual construction cost data will be the basis for determining scenario total project costs.
- Life cycle costs will be included for all scenarios.
- The approved FY 2013-2017 Facilities and Infrastructure Investment Plan is the current facilities strategy for PNNL.
- The PNNL Campus Master Plan dated September 2012 is the current and approved plan.
- The 10-year planning horizon for implementing the strategy is FY 2014-2023.
- DOE agrees with need for flex space.
- DOE/U.S. Department of Homeland Security (DHS) are the main drivers for the facility needs.
- Existing third party lease agreements remain intact for current lease term.
- RTL will be vacated by 2020 and remediated by 2022 (consideration will be given to accelerating this date).
- 300 Area facilities are retained until PNNL no longer has a mission need for the facilities.

- Funding levels:
  - For the first 5 years, the funding level for IGPP acquisition projects will be \$12M; for the second 5 years, the funding level will be \$8M (per PNNL chief financial officer [CFO] direction).
  - Annual Facilities & Infrastructure budget will determine the pace of new facility acquisitions—IGPP and third party.
- Renovation to BMI facilities may be considered only to increase functionality, with payback in the window of government rights (Battelle contract plus 5 years).
- Economics over the 10-year planning horizon will drive the list of targeted facilities for strategic exits:
  - Service life of all facilities is considered viable for the study period.
  - Agreement on economics-based facility “targets of opportunity” list is needed with PNSO before the alternatives analysis study.
- 30-year study period for the Life Cycle Cost Analysis includes only the affected facilities within the proposed alternatives.
- ECONPACK software (U.S. Army Corps of Engineers [USACE]) will be used for the life cycle cost analysis.
- Investment and operations and maintenance (O&M) costs will be differentiated by ownership, method of delivery (IGPP, third party, or SLI), and Facility Information Management System (FIMS) usage code.
- The type of facility (e.g., Office, Laboratory, Other Laboratory, Computational Laboratory, and Shops/Warehouse) and operating costs inform the facility exit strategy:
  - Allocations are excluded.
  - Lease costs will compare like types of facilities to provide an apples to apples comparison of facilities.

## 2.0 Additional Space Needs

In addition to the gap analysis performed for mission-related space, space needs incorporated remediation impacts and the opportunity to optimize the campus over the next 10 years. A summary of the needs and analysis is provided below.

### 2.1 Contract Requirement (Remediation Impacts)

The current PNNL Contract (<http://doeprimecontract.pnnl.gov/default.asp>) requires remediation of the radiological contamination in the BMI facilities (see Section J, Appendix J, paragraph 8). The RTL complex at the south end of the campus is one of the contaminated facilities requiring remediation. Preliminary assessment information assumes that the most effective and efficient remediation will be to demolish RTL. Encroachment by the public, including the mixed use development in Innovation Center, urges expedition of the remediation plans. The core capabilities impacted by the remediation include Systems Engineering and Integration, Environmental Subsurface Science and Applied Materials Science and Engineering. The elimination of key research space due to the demolition is added to the mission alignment gap analysis.

The facilities in the contract will be remediated (except RTL) by September 30, 2017. The project assumes approximately 3K ft<sup>2</sup> of laboratory “swing” space is required as contingency, in case restoration requires vacating lab space. These needs will be incorporated in the scenario planning. Plans for RTL (Lab 1 & 2: 8K net ft<sup>2</sup>, Lab 3: 12K net ft<sup>2</sup>, Office: 14K net ft<sup>2</sup>) include vacating the facility by June 2020 in support of remediation and decommissioning and demolition (D&D); this is a prerequisite milestone. The facility is contractually required to complete the D&D by September 30, 2022. Based on the projected needs, an opportunity exists to optimize the campus footprint and absorb some radiological and support space into the facility portfolio.



Figure 2.1. Location of RTL on PNNL Campus and the Adjacent New Apartment Complex

## 2.2 Campus Optimization

To achieve the strategic objective of a continuous campus and optimize the campus operations, a review of older, non-federal facilities was conducted to identify those that may be less efficient. In order to determine possible candidate facilities for exit, each was categorized by its function and major space type, and the operating costs of each were analyzed.

### Building by Major Space Category

Each of the PNNL Richland-campus facilities was binned into a major space category as follows: Laboratory and Laboratory-Other (special use/high bay), Office, and Shop/Warehouse. This was accomplished by reviewing the space types and quantities in each building and selecting the predominant space type and/or function, leveraging the information in PNNL’s FIMS database. For subsequent analysis, buildings were compared within that major space category only. Buildings by space category are shown below.

Table 2.1. Buildings by Space Category

Facility Category for Economic Analysis				
Computation Laboratory	Laboratory	Other Labs	Office	Shops/Whse
CSF	BSF	PSF 3440	AUD	350
Salk	BSEL	3425	ISB1	BRSW
	RPL	PDLE	ISB2	RSW
	BIL	PDLW	NSB	3475
	APEL	CEL	ETB	TSW
	EMSL	PGF	Sigma5	GES
	AML		LSB	
	2400 Stevens		Sigma1	
	RTL		Sigma2	
	LSL2		Sigma3	
	PSL		Sigma4	
	331		ROB	
	3410		SEF	
	3420		Math	
	318		ESB	
	3430		3455	
			3465	

### Operating Costs

By combining operating metrics with maintenance forecasting data, PNNL was able to analyze the tradeoffs between facility costs and mission accomplishments in support of the F&I strategy. The operational cost metrics are based on the last 5 years of direct building operating costs. Forecast data came from the Maintenance & Renewal Forecast System (MARS), which is a recognized industry standard for maintenance costs forecasting applications. PNNL analyzed building-to-mission comparison

by placing the building cost metrics on a square footage basis, inclusive of both gross and net functional square feet. Reviewing the data on a square foot basis allowed the future liability of direct O&M costs to be understood for existing and new acquisitions. This provides a standard for cost comparisons of future analysis, and the approach will be incorporated into the Facility Strategic Planning processes used to support future decisions pertaining to PNNL's facility portfolio.

### Cost Per Square Foot Data

The metric of direct cost per square feet of laboratory and office space in PNNL facilities promotes effective financial trade-offs in making facility decisions. PNNL's financial processing system (FPS) consistently captures costs by common budget categories for all facilities. The Landlord system contains detailed data describing the make-up of the square footage in each building. Dividing the costs by square feet gives a common comparator across facilities. Comparing the costs for usable square feet enables a normalized decision-making approach that was standardized across all facilities. Figure 2.2, below, provides a process overview.

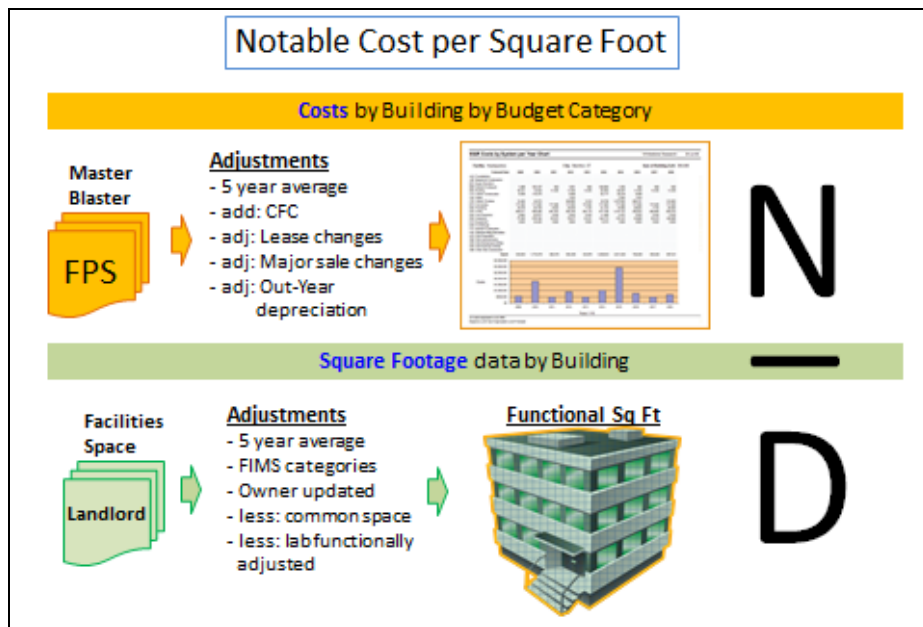


Figure 2.2. Process for Determining Notable Outcome Cost Per Square Foot

### Facility Costs by Budget Category

Referencing Figure 2.2 above, “N” (the numerator) is cost. PNNL has consistently tracked costs by budget category for each facility since 2001. While continuously improving the cost capture process, these budget categories have been consistently used over time. At the end of each fiscal year, cost data by budget category is captured in the “FY## B&U Annual Cost Rollup Data:” file and downloaded to the Operational Systems Directorate (OSD) Business Office server.

In support of this project, five adjustments are made to this data:

1. **5-Year Average:** An average cost for each budget category is calculated using the last 5 years. This is done to remove annual anomalies.
2. **Add CFC Costs:** The Cost of Facilities Capital (CFC) is interest cost incurred for the last completed fiscal year and reimbursed by the government. The total is captured and spread based upon current year facility depreciation in BMI facilities.
3. **Lease Adjustments:** Based on the lease service rate data from the Real Estate Management Office (REMO), an applicable budget category data is created.
4. **Major Sales Adjustment:** Based on REMO-forecasted sales of PNNL space to external entities, an applicable budget category data is adjusted for space sales.
5. **Out-Year Depreciation:** Based on Property Accounting balances for each facility and work in progress, out-year depreciation balances are appropriately adjusted.

The result provides a comparable future estimate of costs by budget category for each PNNL facility.

### **Square Footage of Usable Space**

In Figure 2.2 above, “D” or the denominator is usable square footage. PNNL tracks space costs by billed space types: laboratory, office, storage, and common. This data is captured in PNNL’s Landlord system. A database of space type is maintained for each PNNL facility.

Five modifications are made to adjust square footage:

1. **5-Year Average:** An average footprint for each space type is calculated using the last 5 years. This is done to remove annual anomalies.
2. **Add FIMS Categories:** PNNL and DOE desired to compare “like” facilities. The FIMS categories were adopted to enable comparisons between various DOE sites.
3. **Owner Update:** Lease ownership categories have been reconciled with the sun setting of the Use Permit.
4. **Common Space:** Based on the lease service rate data from the REMO, an applicable budget category data is created. This is done to enable a comparison on useful space.
5. **Laboratory Functional Adjustment:** Based on an analysis of standard capabilities for wet chemistry space, PNNL evaluated the capability of all wet chemistry space. For space that was less than fully functional, a square foot adjustment was calculated. This adjustment enables a comparison of useful space.

The facility costs are divided by the functional square feet (N/D). The product is a reasoned cost comparator of the beneficial square footage in each PNNL facility. This data empowers an approach for

economic facility comparisons, where facility cost can be clearly differentiated based on type of space and ownership. This allows for balancing economic data with other strategic objectives to make better trade-offs in determining facility options.

### **Benefit**

This approach is a measured and repeatable approach which provides a clear understanding of the relationship between the costs and mission of each PNNL facility, thus enabling more informed decisions concerning balancing operating costs and obtaining a more productive operating environment. The data also provides increased confidence for internal and external decision makers, aids in making trade-offs between mission options, assists in balancing different space types, and improves the ability to support strategic campus planning.

### **Future Maintenance Costs**

Maintenance cost forecasts were developed by the cognizant building engineers and building managers for each facility. Cost forecasts for preventive and corrective maintenance for each facility were primarily based on facility-specific budget and actual spending data from many years of cost collection. Cost forecasts for major planned maintenance and rehabilitation were based on facility condition assessment reports, deferred maintenance estimates, and MARS replacement task forecasts for each facility.

### **Facility Economic Analysis Summary**

One of the four strategic objectives is Campus Continuity—increasing federal control of facility assets. To do that, older, privately owned buildings not on the core campus were analyzed for annual operating costs, anticipated future maintenance and rehabilitation costs, and space types. This information was used to rank the facilities, resulting in the order of priority for exit. The final spreadsheet reflecting that effort is included in Appendix C.

## 2.3 Total Space Gap

The resulting total space gap, therefore, addressed the gaps identified in Phase I (multi-purpose programmatic and strategic intent), as well as the new gaps identified in Phase II (remediation and facility exit). The total gap summary is presented below.

Table 2.2. Total Space Gap

Space Type	Gap		Surplus Space Exits FY 2013-2014	RTL Exit	Revised Gap
	Surplus	Need			
	Functional Sq. Feet (K)				
Office	53		-33	-14	6
Chemistry/Materials Radiological	4			-2	2
Chemistry/Materials Non-Radiological		14	-3	-2	19
Biological/Procedure	23		-17	-1	5
Instrumentation	11		0	-8	3
Lab Support	8		-1	-6	1
Computational	2		-2	0	0
Imaging		5		0	5
Other	9		-6	0	3



## **3.0 Alternatives**

A set of alternatives based on the various bounding conditions was developed to address the total space gap forecasted over the next 10 years. The descriptions of each alternative are contained in this section. The sequence of facility builds and exits and the impact to both GSF and NSF for each of the alternatives are shown in the Mass Balance Table that can be found in Appendix D.

### **3.1 IGPP**

The IGPP-only alternative provides 11 new facilities ranging in size from 12K to 22K GSF, totaling 211K GSF for a 10-year capital investment cost of ~\$100M. This alternative enables the exit of 28 existing facilities, totaling 251K GSF for a net reduction to the campus of 40K GSF. This alternative reduces the average age of facilities (total campus including 300 Area) by 24 percent.

### **3.2 IGPP and Third Party**

The IGPP & Third Party Lease alternative adds a 60K GSF third party leased building to the IGPPs of the IGPP-only alternative above, providing a total of 12 new facilities and 271K GSF for a 10-year capital investment cost of approximately \$100M. It enables the exit of 29 existing facilities totaling 333K GSF, for a net reduction to the campus of 62K GSF. This alternative reduces the average age of facilities (total campus including 300 Area) by 24 percent.

### **3.3 IGPP, Third Party, and SLI**

The IGPP, Third Party Lease & SLI alternative add a 50K GSF line-item-funded building to the previous alternative, providing 13 new facilities totaling 328K GSF, for a 10-year capital investment cost of approximately \$145M. It enables the exit of 32 existing facilities totaling 386K GSF for a net reduction to the campus of 57K GSF. This alternative reduces the average age of facilities (total campus including 300 Area) by 28 percent.

### **3.4 IGPP and SLI**

The final alternative, IGPP & SLI, also provides 13 new facilities (11 IGPPs, a line-item-funded building, and also includes the proposed Applied Process Engineering Laboratory [APEL] acquisition in FY 2013) totaling 299K GSF for a 10-year capital investment cost of approximately \$145M. This alternative enables the exit of 31 existing facilities totaling 366K GSF, for a net reduction of the campus by 66K GSF. This alternative reduces the average age of facilities (total campus including 300 Area) by 27 percent.

## 4.0 Evaluation of Alternatives

### 4.1 Overview

Originally, the alternatives analysis was planned to take the form of a traditional approach, with the format following DOE O 413.3b principles. However, as the project progressed, PNSO and PNNL made a decision to use a more qualitative approach, measuring against the strategic objectives in conjunction with a comparison of key quantitative metrics among the alternatives.

This section provides information on the metrics used to evaluate the alternatives and the results of that evaluation.

### 4.2 Metrics Analyzed

In performing the alternative analysis, qualitative metrics were vetted and established through an iterative process to ensure alignment with the overarching DOE-SC guidance to meet the strategic objectives of the FY 2013 Notable Phase II study for identifying the preferred alternative. The qualitative metrics include:

- Mission Alignment – the ability to maintain customer satisfaction
- Campus Continuity – increasing the federal control of assets on the PNNL campus
- Reasonable & Achievable – do what makes sense from a practical and cost perspective
- Campus Master Plan – ensure a mission ready, modern, collaborative, flexible, and sustainable campus.

In support of the qualitative analysis, quantitative metrics were established to provide an objective analysis. These include:

- Schedule for filling the mission gap (wet chemistry, imaging, remediation)
- GSF of non-federal buildings exited
- Percent federal ownership of PNNL facilities
- Percent federally owned wet chemistry laboratory space
- Impact to the annual, direct O&M costs
- Life Cycle Cost Analysis.

Additional metrics analyzed for each alternative included:

- Total GSF Lab footprint change
- Net Present Value per GSF of new construction
- Change in operating costs
- Change in the number of buildings (federal and non-federal)
- Percent change in campus ownership (federal, BMI, lease)
- 10-year change in space type by square feet:
  - Biological/procedure
  - Instrumentation
  - Other
  - Lab support
  - Chemistry – radiological
  - Computational
  - Imaging
  - Chemistry – non-radiological.

The Life Cycle Cost Analysis results with GSF changes are summarized in Table 4.1 below.

Table 4.1. Life Cycle Cost Analysis Summary

<b>Life Cycle Cost Analysis Summary</b>				
	<b>IGPP</b>	<b>IGPP &amp; 3rd</b>	<b>IGPP, 3rd Party</b>	
	<b>Construction</b>	<b>Party Lease</b>	<b>Lease &amp; SLI</b>	<b>IGPP &amp; SLI</b>
10-Year Investment Cost	\$ 100,000,000	\$ 100,000,000	\$ 145,000,000	\$ 145,000,000
Net Present Value	\$ 101,886,840	\$ 138,036,351	\$ 181,431,737	\$ 124,065,350
<b>NPV/GSF Built*</b>	<b>\$ 483</b>	<b>\$ 510</b>	<b>\$ 553</b>	<b>\$ 458</b>
GSF Built*	210,800	270,800	328,300	299,300
GSF Vacated**	(250,884)	(333,040)	(385,735)	(365,735)
<b>GSF Impact to Campus</b>	<b>(40,084)</b>	<b>(62,240)</b>	<b>(57,435)</b>	<b>(66,435)</b>
<b>Future Operational Cost Changes</b>				
FY13 Direct O&M Budget	\$ 64,664,059	\$ 64,664,059	\$ 64,664,059	\$ 64,664,059
Total FY13/14 Planned Exits	\$ (2,724,362)	\$ (2,724,362)	\$ (2,724,362)	\$ (2,724,362)
Total New Campus Facilities	\$ 2,790,182	\$ 5,567,141	\$ 6,434,866	\$ 3,699,332
Total Outyear Planned Exits	\$ (3,257,364)	\$ (5,069,818)	\$ (6,109,418)	\$ (5,654,418)
Totals	\$ 61,472,515	\$ 62,437,020	\$ 62,265,145	\$ 59,984,611
<b>O&amp;M Annual Delta</b>	<b>\$ (3,191,544)</b>	<b>\$ (2,227,039)</b>	<b>\$ (2,398,914)</b>	<b>\$ (4,679,448)</b>
<b>O&amp;M % Decrease</b>	<b>-5%</b>	<b>-3%</b>	<b>-4%</b>	<b>-7%</b>
* NPV/GSF Built based on actions occurring within the study period, FY14-23				
** GSF Built for IGPP & SLI includes the GSF added by the planned APEL acquisition in FY13				
*** Inclusive of FY13/14 Actions Underway (Sigma 3 & 5; BIL; PGF; LSL II ***)				
**** LSL-II is not being exited but is associated with those facilities listed				

### 4.3 Analysis

**Alternative 1 – IGPP Only:** delivers the wet chemistry need in FY 2019, the imaging need in FY 2020, and enables the exit of RTL in FY 2019. This alternative provides 11 new facilities totaling 211K GSF, for a 10-year capital investment cost of \$100M, and enables the exit of 28 existing facilities totaling 251K GSF for a net reduction to the campus of 40K GSF, while increasing federal ownership of the campus by 10 percent. Inclusive of all costs, the net present value (NPV) of this alternative is \$102M, yielding an NPV/GSF built value of \$483/GSF. When all actions within the alternative are complete, a savings of \$3M (5 percent) annual direct O&M are realized.

Strengths:

- Low initial capital investment
- High level of local control surrounding investments

Weaknesses:

- Delivers the wet chemistry gap the latest
- Dispersed research collaboration and capabilities
- Small incremental additions; lacks an additional anchor facility

Resulting Metrics:

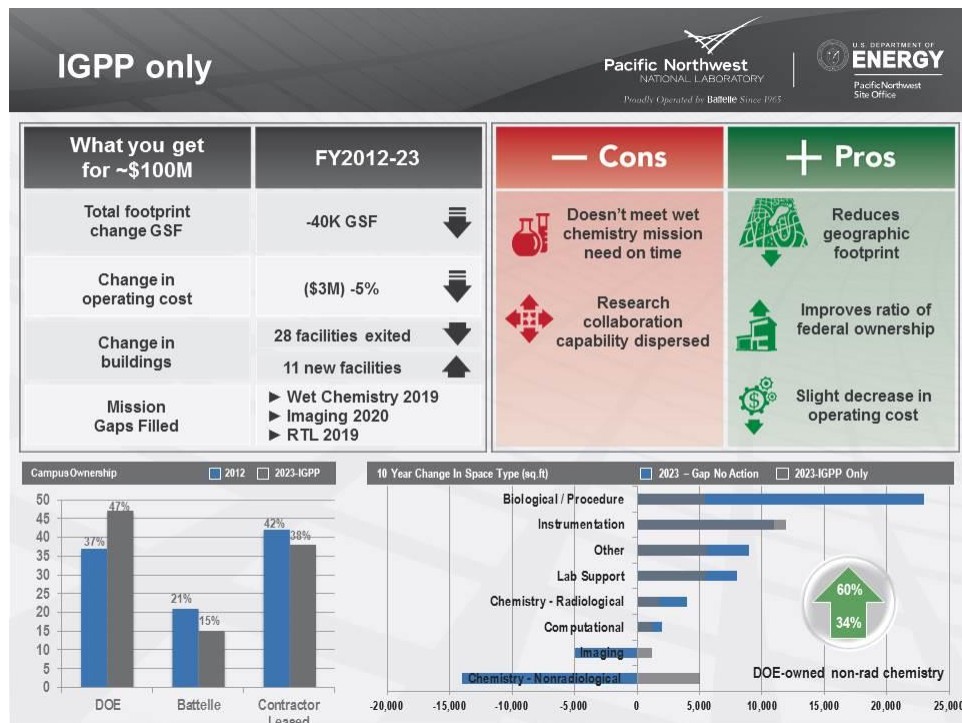


Figure 4.1. IGPP Metrics

**Alternative 2 – IGPP & Third Party Lease:** delivers the wet chemistry need in FY 2017, the imaging need in FY 2020, and enables the exit of RTL in FY 2018. This alternative provides 12 new facilities totaling 271K GSF, for a 10-year capital investment cost of \$100M, and enables the exit of 28 existing facilities totaling 333K GSF for a net reduction to the campus of 62K GSF, while increasing federal ownership of the campus by 11 percent. Inclusive of all costs, the NPV of this alternative is \$138M, yielding an NPV/GSF built value of \$510/GSF. When all actions within the alternative are complete, a savings of \$2M (3 percent) annual direct O&M are realized.

Strengths:

- Accelerates critical wet chemistry mission delivery
- Accelerates RTL exit and succeeding decontamination and demolition activity

- Improves research collaboration and capability co-location
- Low initial capital investment while enabling an anchor facility

Weaknesses:

- Risk associated with finding a willing developer
- Long-term annual lease liability with ownership potentially reverting back to land owner

Resulting Metrics:

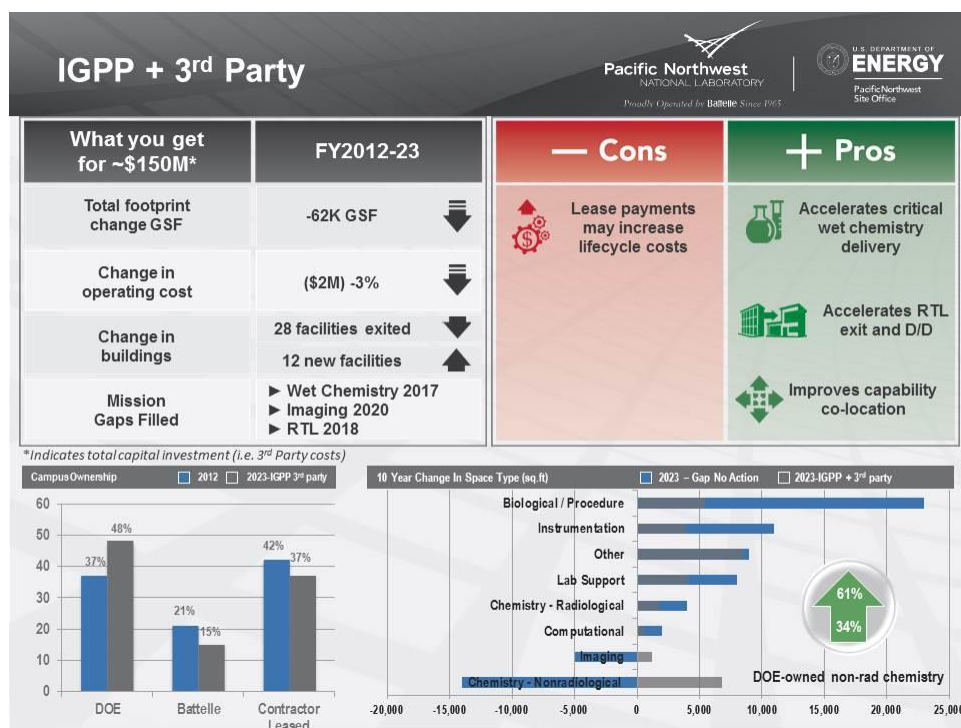


Figure 4.2. IGPP and Third Party Metrics

**Alternative 3 – IGPP, Third Party Lease & SLI:** delivers the wet chemistry need in FY 2017, the imaging need in FY 2020, and enables the exit of RTL in FY 2018. This alternative provides 13 new facilities totaling 328K GSF, for a 10-year capital investment cost of \$145M, and enables the exit of 31 existing facilities totaling 386K GSF, for a net reduction to the campus of 57K GSF, while increasing federal ownership of the campus by 13 percent. Inclusive of all costs, the NPV of this alternative is \$181M, yielding an NPV/GSF built value of \$553/GSF. When all actions within the alternative are complete, a savings of \$2M (4 percent) annual direct O&M are realized.

Strengths:

- Accelerates critical wet chemistry delivery
- Accelerates RTL exit and succeeding decontamination and demolition activity
- Improves co-location of all capabilities and associated staff
- Greatest opportunity to positively impact future research and development (R&D) mission
- Enables an additional anchor facility on the Core Campus

Weaknesses:

- Introduces risk associated with finding a willing developer
- Long-term annual lease liability
- Introduces risk associated with obtaining SLI funding

Resulting Metrics:

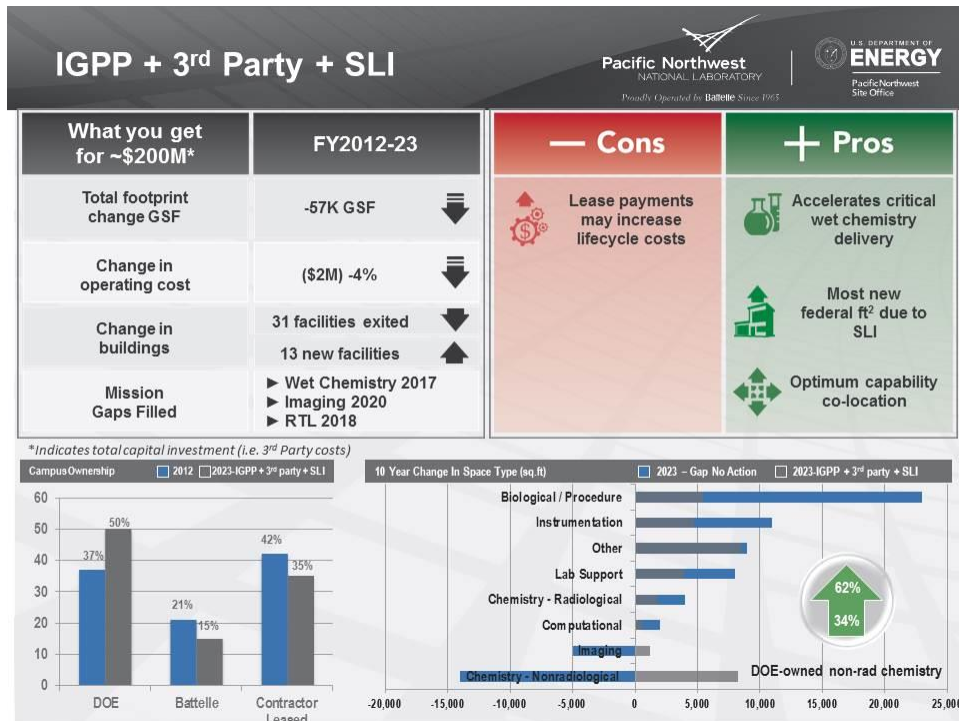


Figure 4.3. IGPP, Third Party, and SLI Metrics

**Alternative 4 – IGPP & SLI:** delivers the wet chemistry need in FY 2019, the imaging need in FY 2017, and enables the exit of RTL in FY 2020. This alternative provides 13 new facilities (including the planned APEL acquisition in FY 2013) totaling 299K GSF, for a 10-year capital investment cost of

\$145M, and enables the exit of 31 existing facilities totaling 366K GSF, for a net reduction of the campus by 66K GSF, while increasing federal ownership of the campus by 15 percent. Inclusive of all costs, the NPV of this alternative is \$124M, yielding an NPV/GSF built value of \$458/GSF. When all actions within the alternative are complete, a savings of \$5M (7 percent) annual direct O&M are realized.

Strengths:

- Accelerates critical wet chemistry delivery
- Improves research collaboration and capability co-location
- Adds most new federal footprint
- Provides the greatest geographical footprint reduction
- Lowest NPV/GSF built
- Greatest reduction of annual, direct O&M costs
- Enables an additional anchor facility
- Annexing to existing federal facilities provides efficiency and flexibility

Weakness:

- Introduces risk associated with obtaining SLI funding
- Managing segmentation risk associated with IGPP funds



Resulting metrics:

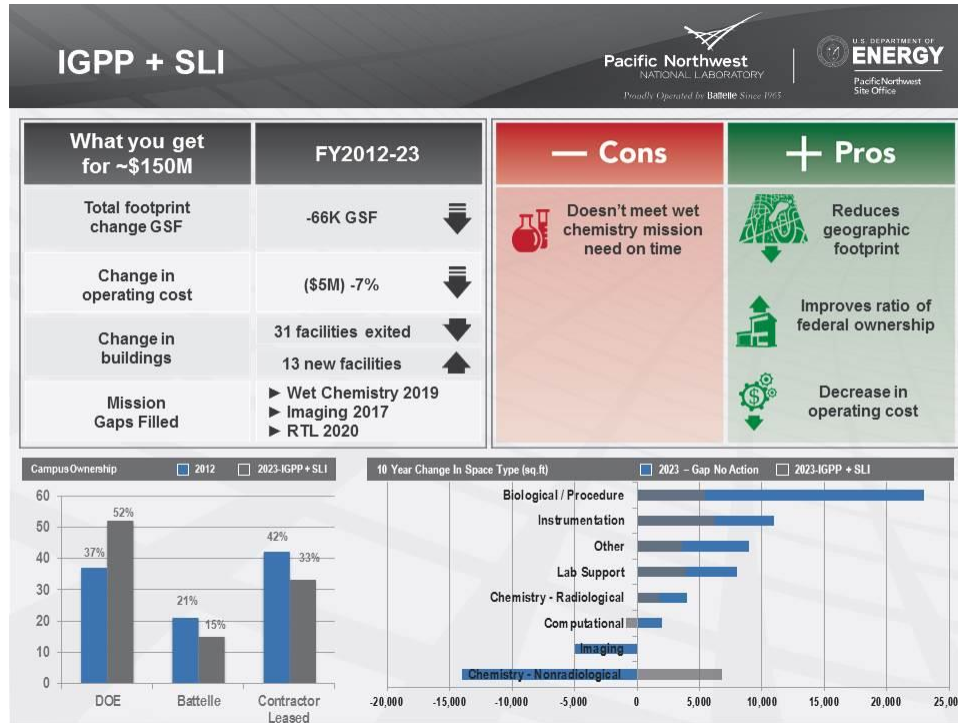


Figure 4.4. IGPP and SLI Metrics

## 4.4 Evaluation of Alternatives

A dashboard was created, combining both the qualitative and quantitative metrics, along with narrative pertaining to mission impact and other key points to determine the preferred alternative. Qualitative metrics were provided a value of excellent, very good, good, fair, or poor, while quantitative metrics returned the impacts as revealed through objective analysis.

Table 4.2. Alternatives Analysis Findings

Scenarios (total investment cost)	Mission Impact	GSF of Non-Federal Exits	Federal Ownership	Leased Ownership	BMI Ownership	% Federal Non-Rad Chemistry	Mission Alignment	Campus Continuity	Reasonable & Achievable	Campus Master Plan	Key Points
		Current Baseline	37%	42%	21%	34%					
IGPP only ~\$100M	<ul style="list-style-type: none"> <li>Wet chem. 2019</li> <li>Imaging 2020</li> <li>RTL exit 2019</li> </ul>	251K GSF	47%	38%	15%	60%					<ul style="list-style-type: none"> <li>Delays critical wet chemistry delivery</li> <li>Disruptive due to small incremental additions</li> <li>Dispersed staff and capabilities for extended period</li> </ul>
IGPP + Third Party ~\$150M	<ul style="list-style-type: none"> <li>Wet chem. 2017</li> <li>Imaging 2020</li> <li>RTL exit 2018</li> </ul>	333K GSF	48%	37%	15%	61%					<ul style="list-style-type: none"> <li>Accelerates critical wet chemistry delivery</li> <li>Accelerates RTL exit/D&amp;D</li> <li>Improved co-location of chemistry/imaging/computational capabilities</li> </ul>
IGPP + Third Party + SLI ~\$200M	<ul style="list-style-type: none"> <li>Wet chem. 2017</li> <li>Imaging 2020</li> <li>RTL exit 2018</li> </ul>	386K GSF	50%	35%	15%	62%					<ul style="list-style-type: none"> <li>Accelerates critical wet chemistry delivery</li> <li>Improves co-location of all capabilities</li> <li>Accelerates RTL exit/D&amp;D</li> <li>Adds most new federal footprint</li> <li>Greatest opportunity to impact future R&amp;D mission</li> </ul>
IGPP + SLI ~\$150M	<ul style="list-style-type: none"> <li>Wet chem. 2019</li> <li>Imaging 2017</li> <li>RTL exit 2020</li> </ul>	366K GSF	52%	33%	15%	61%					<ul style="list-style-type: none"> <li>Accelerates critical wet chemistry delivery</li> <li>Add the most new federal footprint</li> <li>Greatest reduction of direct O&amp;M costs</li> </ul>
											Excellent
											Very Good
											Good
											Fair
											Poor

## 5.0 Recommended Alternative

### 5.1 DOE Recommendation/Feedback

The IGPP, Third Party, and SLI investment option was recommended as the preferred alternative due to meeting the objectives in the shortest amount of time. However, DOE provided additional guidance at the conclusion of the April 9, 2013 presentation, which is summarized below.

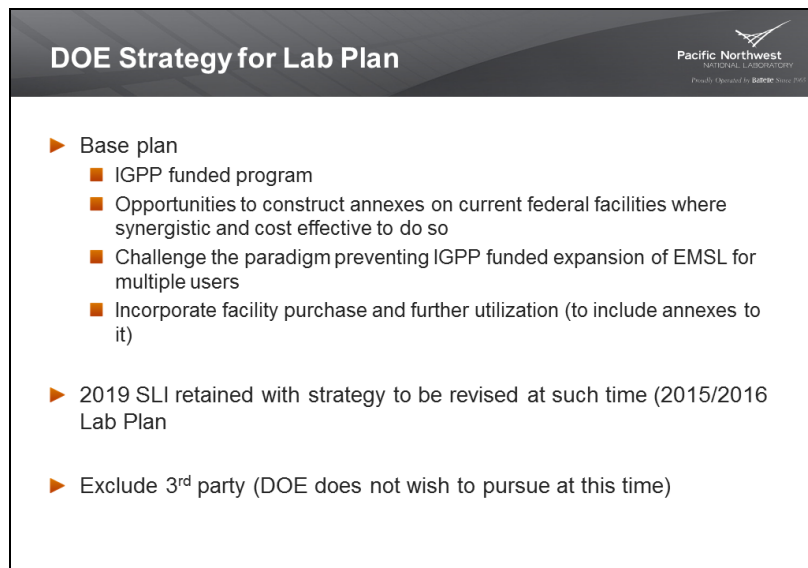


Figure 5.1. DOE Strategy for Lab Plan

### 5.2 Recommended Alternative

Based on DOE’s guidance, the final recommended alternative is Alternative #4, with adjustments noted in Figure 5.1, which uses IGPP and SLI funding to address the strategic objectives of the F&I strategy—to keep core capabilities mission ready, deliver space and facilities according to the guiding principles, and support the achievement of PNNL’s vision (i.e., to inspire and enable the delivery of world-leading S&T in support of Laboratory missions). By implementing the recommended alternative within 10 years, PNNL’s F&I strategy will result in a mission ready PNNL campus that has decreased operating costs, decreased campus footprint, and a reduced average age of facilities, while increasing federal control of assets. Overall, this strategy results in 13 new DOE facilities and divests of 31 contractor-owned or -leased (or non-DOE) facilities.

The gap analysis, described in the previous sections, identifies needs and surplus space that will be addressed by this F&I strategy. Where possible, the plan leverages existing space and uses capabilities already present on the campus. The F&I strategy incorporates options to resolve the gap and maintain the campus capabilities. It includes options to transfer ownership of leased facilities to DOE, build additions/annex(es) to existing federal facilities, build stand-alone facilities (through IGPP), and to make investments to maintain existing facility and infrastructure assets.

As one of the initial investments, DOE is investigating the acquisition of a 90,000 GSF facility with approximately 60 occupants, currently leased in part by PNNL. This facility includes wet chemistry, instrument, high bay, and office space. Non-PNNL tenants currently occupy approximately 50 percent of the facility. As these tenants vacate the facility, additional instrument and high bay space would become available to DOE/PNNL. There is also potential for future building annex(es), which could add additional high bay and large instrument scale-up space to the PNNL building as the need arises. The potential facility purchase is anticipated to be accomplished with FY 2013 IGPP funding.

Another element of the strategy addresses a space gap by acquiring new multipurpose space as annex(es) to existing federal facilities. Planned acquisitions include expansion of EMSL or other federal facilities, providing wet chemistry, imaging (quiet space), and office space. This approach may provide greater connectivity with existing research compared to building new, stand-alone buildings. Annexes to existing federal facilities will be accomplished with IGPP funds and considered when it is cost effective and the work is synergistic.

Facility annexes will partially close the mission need gap. New stand-alone IGPP facility acquisitions, located on federal land, will also be required to completely close the gap. One of the new planned IGPP acquisitions will provide multipurpose space capability, allowing, amongst other functions, the integration of modeling, monitoring, and analysis of the U.S. electric grid, supporting a broader spectrum of energy and national security research and operation in ways not possible today. This space will also house the PNNL Building Operations Control Center to centralize campus energy management and utility operations and provide a central location for managing unplanned events or emergencies affecting the campus operations. The SLI project will be designed to deliver significant impact on S&T and support the development of a modern, synergistic core campus where a collaborative and innovative environment is fostered. The specific scientific impact will be further defined in the 2015 and 2016 Annual Laboratory Plans.

The final element of the strategy incorporates a divestment of surplus space and non-DOE facilities identified as costly or inefficient as part of the optimization analysis. In total, the strategy exits 31 leased and contractor-owned facilities outside the core campus and modernizes the campus, while eliminating the high operating costs of older facilities.

## 6.0 Summary

In summary, the Notable Outcome Phase II project provided the background and data necessary for a facility strategy to be developed for the next 10 years. As a recap, the project's deliverables and their final status are summarized below:

- Document the data streams and process used to deliver the information for Phase I, including a plan to institutionalize the process into the space management scope of work. *This work is continuing as part of the Facility Strategic Planning Office's scope of work.*
- Develop scenarios with the ability to meet the identified space gap via the available funding mechanisms, through a combination of existing and new facility additions (i.e., new construction, renovation of existing space [either Battelle-owned facilities or DOE-owned facilities], additions to or renovation of existing third party leased facilities, and/or newly leased third party facilities). The scenarios will generally be characterized by scope (ft<sup>2</sup> by space type) initial cost, life cycle cost, and acquisition schedule. *Alternatives were developed for IGPP, IGPP + Third Party, IGPP + Third Party + SLI, and IGPP + SLI funding scenarios.*
- Perform an analysis of those scenarios in accordance with the consensus criteria. *An alternative analysis was completed, with the recommendation of an IGPP + SLI strategy as the alternative most closely meeting the strategic objectives.*
- Provide a written report documenting the work (this document).
- Deliver a PowerPoint presentation (about 20 slides) summarizing the project, process, and outcomes. *A presentation was completed and delivered on April 9, 2013 by PNSO to DOE-SC.*
- Provide input to the 2014 Lab Plan, section 6.0, "Infrastructure/Mission Readiness." *Based on the efforts completed in both Phase I and Phase II, input to the 2014 Lab Plan was provided and incorporated into the Laboratory planning strategy.*



## **Appendix A**

### **Client Validation Profile Sheets**

# Appendix A

## Client Validation Profile Sheets

**Pacific Northwest**  
NATIONAL LABORATORY  
*Proudly Operated by Battelle Since 1965*

U.S. DEPARTMENT OF  
**ENERGY**  
Pacific Northwest  
Site Office

# DOE SC Client Validation

## with the Office of Science

DATE: MARCH 2013



# Why we are talking with you

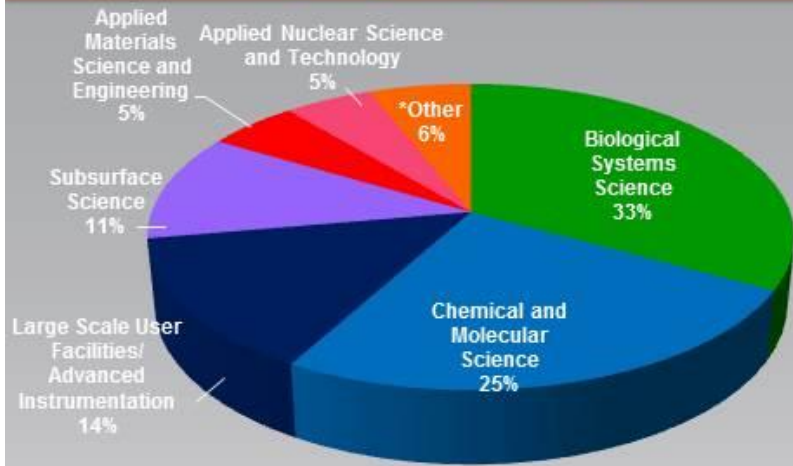
## Informed perspective on the appropriate long term government need for the type of work performed at PNNL

- ▶ Talking to clients that compose 75% of the PNNL business
- ▶ Share data with you on how work is integrated into PNNL
- ▶ Perspective on your need for the type of work performed at PNNL
- ▶ Information will be used to:
  - Validate the Contractor's 10 yr forecast
  - Understand changing needs for space/facilities
  - Develop a robust, long-term strategic facilities plan for PNNL

Client	Contact
Science <ul style="list-style-type: none"><li>• BER</li><li>• BES</li><li>• ASCR</li></ul>	Sharlene Weatherwax Harriet Kung Barbara Helland
NNSA <ul style="list-style-type: none"><li>• DNN/NA-22</li></ul>	Anne Harrington and Rhys Williams
EERE	Steve Chalk
DHS <ul style="list-style-type: none"><li>• S&amp;T</li></ul>	Dan Gerstein
SP <ul style="list-style-type: none"><li>• DOE IN</li></ul>	Steve Black
DOE-EM	Alice Williams

# SC Profile

## SC Core Capability footprint (%)



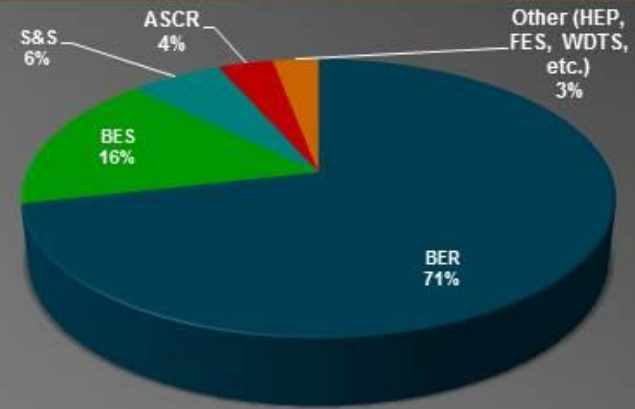
\*Other includes:

- Chemical Engineering
- Systems Engineering and Integration
- Climate Change
- Advanced Computer Science, Visualization and Data

Type of Space	SC Total Net ft <sup>2</sup>	% Total Net Lab-wide
Chemistry/ Materials	16,884	23%
Lab Support	21,945	31%
Instrument	42,057	27%
Biological/Procedure	19,005	19%
Computation	14,961	20%
Other	12,933	20%
<b>Grand Total</b>	<b>127,784*</b>	<b>25%</b>

\*does not include office

## SC FY2012 Funding (Cost data - \$172M)



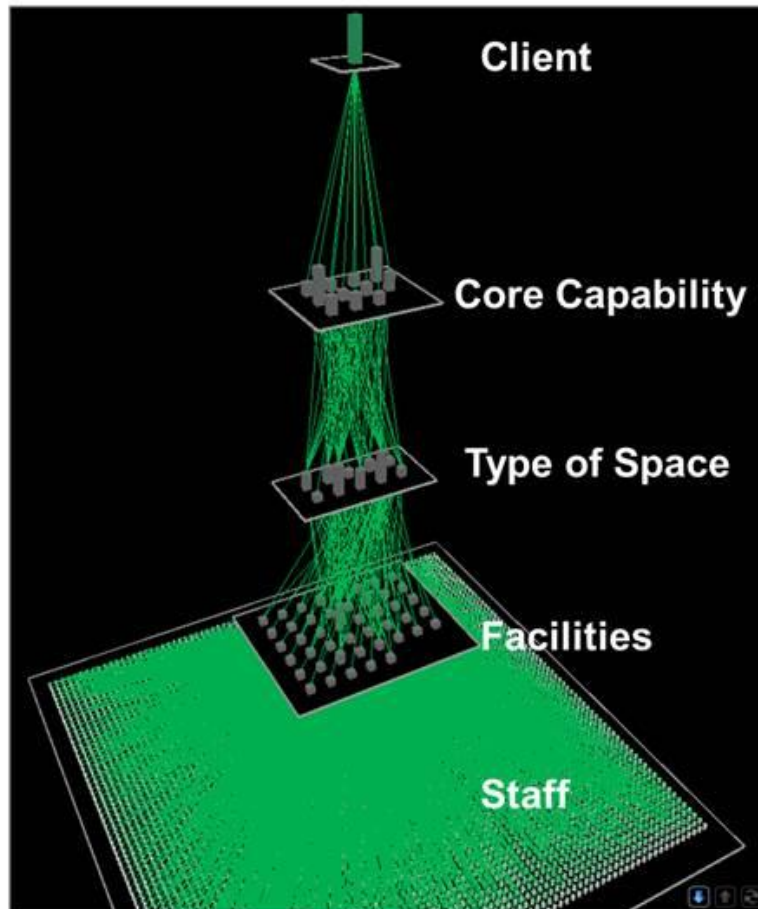
- 20% of PNNL's total FY12 funding (cost data)

## DOE SC Ten Year Forecast

- Overall flat projections
- BER potential increase in biology, climate and environmental science
- BES potential increase in catalysis and materials science
- ASCR increases in data analytics, multifaceted math and exascale computing

# SC Profile

## Integration of staff, facilities, and capabilities to achieve program objectives



Clients	*Direct FTEs	Staff Engaged
<b>DOE-SC</b>	<b>534</b>	<b>1,950</b>
NNSA	449	1,685
DSP <i>(DOD, SP, IN, etc.)</i>	429	3,035
DOE Energy <i>(EERE, OE, Fossil Energy, etc.)</i>	403	1,751
DHS	176	1,156
DOE Other	127	1,749
DOE-EM	116	870
DHHS	83	421
NRC	49	360
DOE-NE	47	640

\*Indirect FTEs not included

# What we would like to know

## Informed perspective on the appropriate long term government need for the type of work performed at PNNL

- ▶ In your mission area, for what specific needs/capabilities do you go to PNNL?
  
- ▶ For each of the areas noted above, why do you go to PNNL? (Choose as many as apply)
  - World leading/competitive award
  - Unique capability
  - Synergy with other capabilities/programs
  - Staff, equipment and/or facilities?
  - Industry/market knowledge, emphasis on commercialization
  - Long standing relationships
  - Project management/responsiveness
  - Good value/low cost
  
- ▶ How central to your mission is the work performed for you by PNNL?
  
- ▶ As you look out over the next 5 years, do you anticipate your funding at PNNL to increase, stay flat or decrease? Why?

## **Appendix B**

### **Client Validation of Work Conducted at the Pacific Northwest National Laboratory (DRAFT)**

## **Appendix B**

### **Client Validation of Work Conducted at the Pacific Northwest National Laboratory (DRAFT)**

Department of Energy  
Office of Science  
Pacific Northwest Site Office

April 2013

## **Contents**

Executive Summary

1.0 Validation Approach

2.0 Contractor Forecast and Type of Space Needs

3.0 Validation Results

4.0 Conclusion

## **Appendix**

A Interview Schedule

B Client Profile Presentations

C Interview Form

D Client Input Forms (Questions 1-3)

E Client Input Forms (Question 4) – Not for further distribution?

F Space Type Definitions

G Consolidated Client Input for Question 1

H Consolidated Client Input for Question 2

I Consolidated Client Input for Question 3

J Consolidated Client Input for Question 4



## **Executive Summary**

The Office of Science is developing a robust, long-term (10-year) strategic facilities plan for the Pacific Northwest National Laboratory. This plan will put special emphasis on clarifying the facilities situation at the laboratory and the future needs (or not) for these facilities. It will be informed by clients that utilize the laboratory and their perspectives on the long term government need for the type of work performed at PNNL. To obtain this perspective, the Office of Science and the Pacific Northwest Site Office worked together to conduct a set of interviews with clients that compose approximately 75 percent of the Laboratories business.

This report documents the approach and results of DOE's efforts to validate major customers of the laboratory and their needs and expectations of the work performed at the laboratory over the next ten years. Input received from PNNL clients validated the PNNL Contractor's *forecast of relatively stable funding over the next 5-10 years*. All clients interviewed provided information on the types of capabilities they will continue to need/seek from PNNL; they discussed how these capabilities are central to their mission objectives and indicated that in part, they conduct work at PNNL because the work is world leading and/or competitively awarded; their capabilities are unique; and in some cases synergistic with other capabilities and programs.

The informed perspective received from the clients validated the Contractor's forecast and provides confidence that the type of space needed over the next ten years will remain fairly consistent with the Laboratories current space types/capabilities. This information will primarily be used to inform the development of the long-term strategic facilities plan for PNNL.

### **1.0 Validation Approach**

The approach to obtain an informed perspective on the appropriate long-term government need for the type of work performed at PNNL utilized two sets of information. The first set of information was a Contractor developed forecast over a 10-year period (FY 2014-2024). The second set of information was client input on what they anticipate needing from the laboratory over the next 5-10 years. The information from the clients was used to validate the forecast developed by the Contractor and identify additional perspectives that should be considered when developing a long-term facilities strategic plan.

Eight major clients (Figure 1) that compose approximately 75 percent of the Laboratory business were interviewed by a joint SC/PNSO team. Interviews were conducted in accordance with the schedule included in Appendix A. In preparation for the interviews, a presentation package was prepared for each client (Appendix B). The presentation packages included a profile specific to each client that outlined how work is integrated at the laboratory and mapped by staff, facilities and core capabilities. The profiles also highlighted the contractor's ten year forecast and types of space used to conduct the clients work. The profile packages were shared with the client as appropriate.



## **PNNL Clients that compose ~75% of Laboratory Business**

- Office of Science Biological and Environmental Research
- Office of Science Basic Energy Sciences
- Office of Science Advanced Scientific Computing Research
- National Nuclear Security Administration
- Energy Efficiency and Renewable Energy
- Department of Homeland Security
- Office of Environmental Management
- Other

**Figure 1:** PNNL Clients that Compose ~75% of Laboratory Business

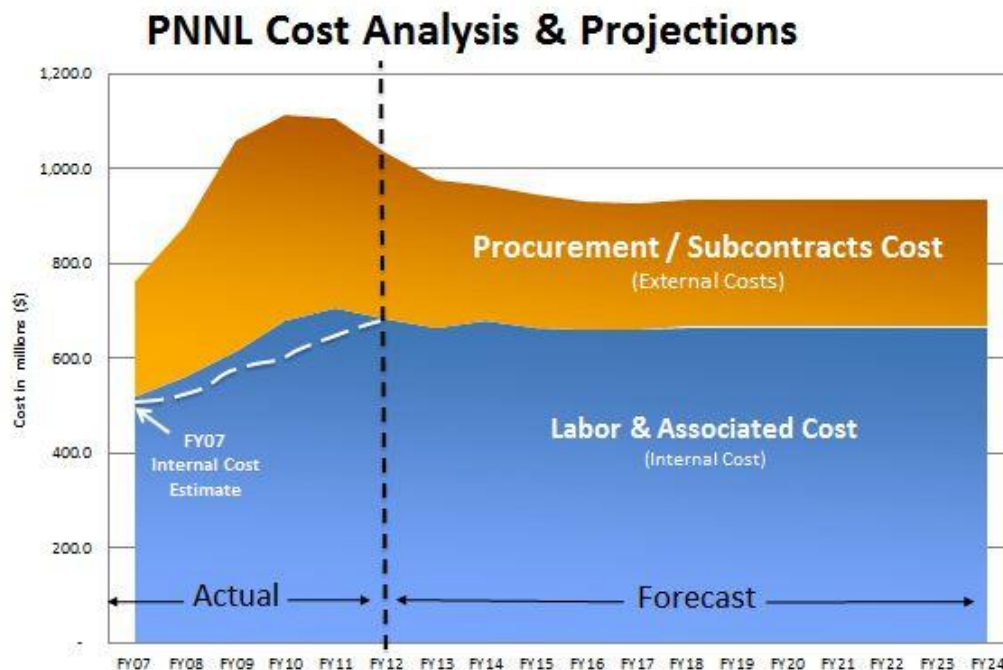
In preparation for the interviews, the following four questions were shared with the clients in advance:

1. In your mission area, for what specific needs/capabilities do you go to PNNL?
2. For each of the areas noted in Question 1, why do you go to PNNL?
  - a. World Leading/competitive award
  - b. Unique capabilities
  - c. Synergy with other capabilities/programs
  - d. Staff, equipment, or facilities
  - e. Industry/market knowledge, emphasis on commercialization
  - f. Long standing relationships
  - g. Project management/responsiveness
  - h. Good value/low cost
3. How central to your mission is the work performed for you by PNNL?
4. As you look over the next 5 years, do you anticipate your funding at PNNL to increase, stay flat, or decrease? Why?

The question set was discussed in the interview and in most cases the clients followed up with written responses to the questions. Client responses were input by the interview team into a standard interview form (Appendix C) to allow for consolidation of the information. Forms with client input for questions 1-3 are contained in Appendix D and input for question 4 is contained in Appendix E. Question 4 was separated from questions 1-3 and should not be shared with the contractor per the client's request.

## 2.0 Contractor Forecast and Type of Space Needs

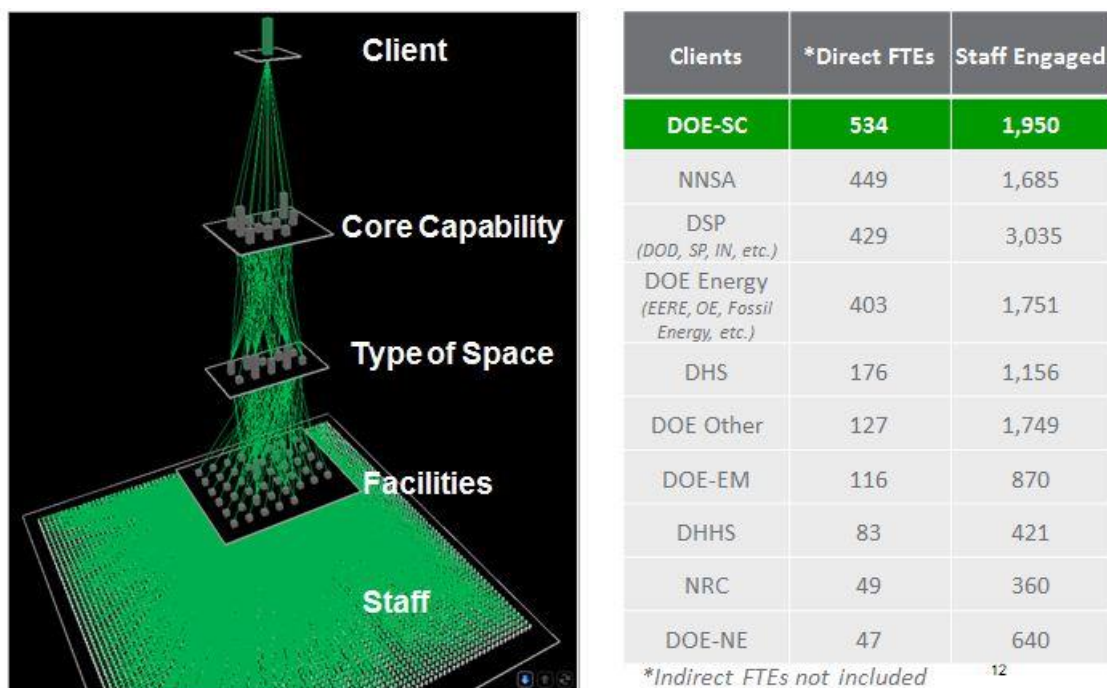
The PNNL Contractor's 10-year cost analysis and projections are reflected in Figure 2. Over the next 10 years, the contractor foresees relatively stable funding. This recognizes that there may be decreases in some programs which are offset by increases in others. The projection does not account for unknown impacts due to events like sequestration. The projections are a programmatic build up and reflect normal course of business discussions between the contractor and the clients. An analysis of the accuracy of the contractor's business planning projections over a five year period (FY 2007-2012) indicate that historically, their estimates have been conservative giving additional confidence in the out-year projections.



**Figure 2:** PNNL Cost Analysis & Projections

Since future program needs drive the type of laboratory space required, a relatively stable 10-year funding forecast translates into a similar stable need for the type and quantity of space at the laboratory. Space planning is based on the forecast for the "Labor & Associated Cost" or the internal costs. These costs are tied to the work that is done directly at the Laboratory. Space is determined by translating the cost into FTEs and then the FTEs into the type and amount of space they will need to do the work. PNNL has implemented an integrated capability management approach which provides the ability to map client

funding to core capabilities, type of space, facilities and staff. Figure 3, Starlight View of Integrated Staff, Facilities, and Capabilities, is a visual representation of this integrated view. The highlighted example in Figure 3, shows that the funding (for fiscal year 2012) coming from the Office of Science funds 534 FTEs at PNNL. The 534 FTEs touch 1,950 staff across the laboratory and demonstrates the stewardship footprint SC and other clients have at PNNL. Mapping of this information results in a clearer understanding of the types and quantities of space that are used to meet client needs today. Based on anticipated flat projections and minimal changes in the type of work that will be done over the next 10 years it is expected that the same type (office and Laboratory) and quantity (functional square feet) of space will be needed. The current and projected space needs over the next 10 years is summarized in Table 1. Space types are further defined in Appendix F.

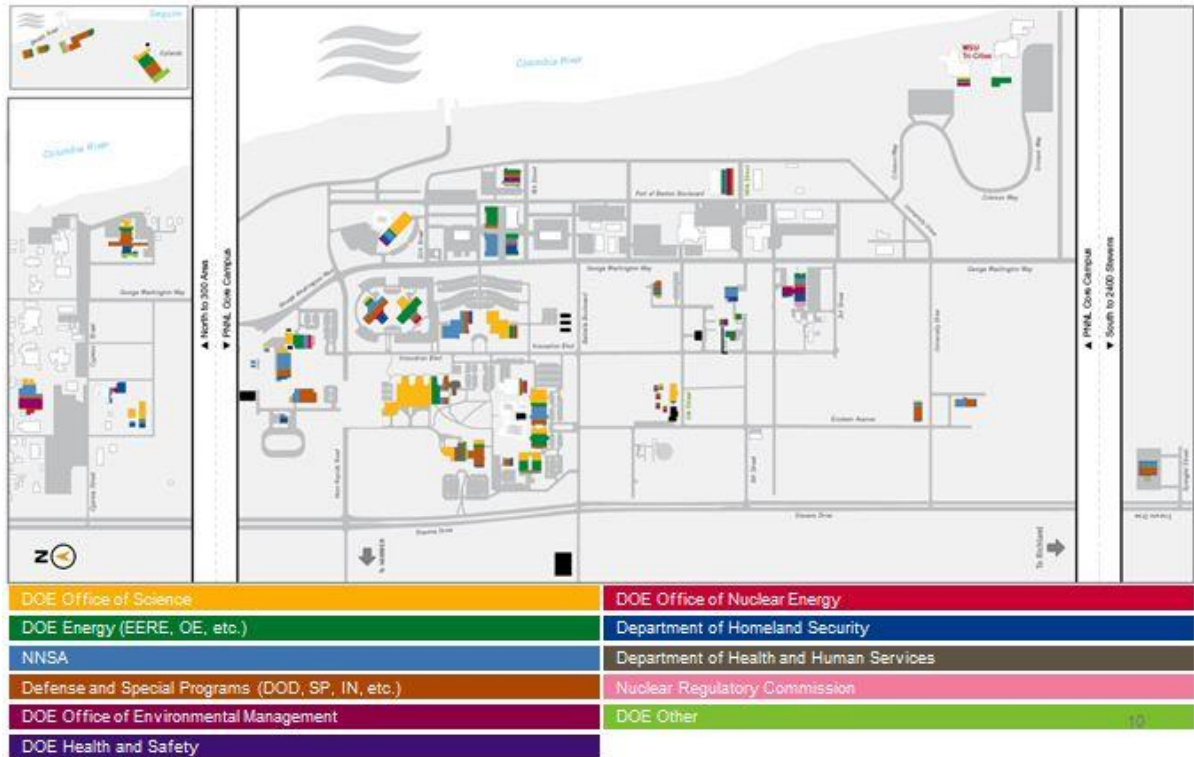


**Figure 3:** Starlight View of Integrated Staff, Facilities, and Capabilities

**Table 1:** Current/Projected Space Type Needs

Space Type	Current/Projected Need Functional Square Feet**
Office	576,000
Biological/Procedure	76,000
Chemistry/Materials (Radiological)	14,000
Chemistry/Materials (Non-Radiological)	71,000
Computational	54,000
Instrumentation	145,000
Laboratory Support	63,000
Imaging	8,000
Other	53,000
**Functional Square Feet -	

The integrated capability management concept is further demonstrated in Figures 4, PNNL Facilities Support Multiple Clients. In general, staff located in the facilities use their expertise to address the needs of multiple clients (Figure 4). With the exception of the user portion of the Environmental Molecular Sciences Laboratory (EMSL), all clients support (through an indirect charge) the operation and maintenance of the facilities.



**Figure 4:** PNNL Facilities Support Multiple Clients

### 3.0 Client Validation Results

Table 2 summarizes the results of the input received from PNNL clients with respect to the four questions that were discussed with them. Overall, all clients clearly articulated capabilities which span across basic to applied research. Clients indicated across the board that they in part go to PNNL for their respective capabilities because they are world leading, unique and are synergistic with other capabilities and programs. In addition, many clients highlighted PNNL’s responsiveness and abilities related to project management integration. All clients indicated that the work PNNL performs (in the areas noted in questions 1 and 2) is central to their missions. Finally, all clients indicated that they anticipate a relatively flat funding level for PNNL over the next 5-10 years. Client input, consolidated by each question, is contained in the following appendices; Question 1 is in Appendix G, Question 2 is in Appendix H, Question 3 is in Appendix I and Question 4 is in Appendix J.

**Table 2: Client Validation Summary**

	BER	BES	ASCR	NNSA	EERE	Other	DHS	EM
<b>Q1. Client Identified Capabilities</b>	X	X	X	X		X		
<b>Q2. Why PNNL?</b>								
✓ <b>World Leading/ Complete Award</b>	X	X	X	X				
✓ <b>Unique capability</b>	X	X	X	X		X		
✓ <b>Synergy with other capabilities/programs</b>	X	X	X	X		X		
✓ <b>Staff, equipment, facilities</b>	X	X		X				
✓ <b>Industry/market knowledge, emphasis on commercialization</b>	X	X		X				
✓ <b>Long standing relationships</b>	X	X		X				
✓ <b>Project management/ responsiveness</b>	X	X		X		X		
✓ <b>Good value/low cost</b>	X			X				
<b>Q3. Central to the mission</b>	X	X	X	X		X		
<b>Q4. Validated Contractor Forecast</b>	X	X	X	X		X		

#### 4.0 Conclusion

Validation of the Contractor's forecast by the clients provides confidence that the type of space needed over the next ten years will remain fairly consistent with the Laboratories current space types/capabilities.

## **Appendix C**

### **Facility Economic Analysis Summary**

# Appendix C

## Facility Economic Analysis Summary

Facility Economic Analysis Summary	Building	Ownership	GSF	Laboratory Functional NSF	Office NSF	Asset Condition	End of Current Lease Term	Planned Use (also FIMS Type of Space)	5 Year Avg Annual Operating Direct Cost/GSF (Adjusted for Functionality & CFC)	Forecasted Annual PM & CM Cost/GSF to Maintain Asset Condition	Forecasted Annual Cost/GSF of Rehabilitation/ Life Extension (planned use)	Forecasted Annual Total Operating & Rehabilitation/ Life Extension Cost/GSF	Alternative #1, IGPP Only New Construction	Alternative #3, IGPP New Construction + 3rd Party	Alternative #6, IGPP + 3rd Party + SLI	IGPP Units Required to Exit (NFSF)		
													3 Units of IGPP Available for Building Exit	7 Units of IGPP Available for Building Exit	11 Units of IGPP Available for Building Exit	Lab	Office	
Lab and Lab - Other	BIL	BMI	17,621	6,090	0	Excellent		Lab	\$43.90	\$8.60	\$0.47	\$44.37						
	APEL	Lease	49,481	23,009	7,258	Excellent	9/30/2012	Lab	\$30.47									
	AML	BMI	9,311	4,597	1,455	Good		Lab	\$28.50	\$8.06	\$3.39	\$31.89	X	X	X		<1	
	LSL 2	BMI	102,107	35,873	12,080	Adequate		Lab	\$24.86	\$6.16	\$3.26	\$28.12				5	1	
	2400 STEVENS	Lease	99,626	26,307	27,652	Excellent	TBD	Lab	\$22.65					X	X		4	3
	PSL	BMI	89,379	28,287	21,094	Excellent		Lab	\$22.17	\$4.64	\$2.45	\$24.62				4	2	
	CEL	BMI	600	427	0	Fair		Lab - Other	\$22.12									
	PDLE	BMI	3,882	3,627	157	Good		Lab - Other	\$22.12				X	X	X	1	N/A	
	PDLW	BMI	6,826	4,148	345	Good		Lab - Other	\$22.12									
	PGF	BMI	6,000	5,732	0	1-Good, 2-5 Excellent		Lab - Other	\$15.75									
	EDL	BMI	16,071	9,182	946	Good		Lab - Other	\$11.87								1	<1
	LSB	Lease	83,921		40,483	Excellent	3/31/2014	Office	\$27.16									
	SIGMA 1	Lease	20,000		12,200	Excellent	2/29/2016	Office	\$22.75							X	N/A	1
SIGMA 2	Lease	20,100		11,470	Excellent	9/30/2013	Office	\$21.49							X	N/A	1	
AUD	BMI	12,110		408	Good		Office	\$21.39										
ROB	BMI	69,640		31,460	Adequate		Office	\$20.84	\$4.55	\$3.52	\$24.36							
SIGMA 4	Lease	20,530		10,661	Excellent	5/31/2015	Office	\$19.67							X	N/A	1	
MATH	BMI	29,416		10,656	Good		Office	\$15.70	\$2.91	\$2.67	\$18.37							
ESB	BMI	12,595		3,567	Good		Office	\$12.12	\$3.66	\$4.65	\$16.77			X	N/A	<1		
Shop/Whse	BRSW	BMI	9,654		825	Excellent		Shop/Whse	\$11.61									
	RSW	Lease	8,000		0	Excellent	12/31/2015	Shop/Whse	\$9.62				X	X	X	N/A	1-2 Warehouse	
	TSW	BMI	8,000		0	Excellent		Shop/Whse	\$4.41									
	GES	BMI	2,100		0	Excellent		Shop/Whse	\$2.02									

C.1

The facility economic analysis table summarizes the facility square footage, the type of space, the five year average annual operating costs with anticipated future maintenance and rehabilitation costs. The table was used to prioritize the facilities to exit in support of increasing federal facility control and is discussed in Section 2.2.

**Appendix D**  
**Alternative Mass Balance**



# Appendix D

## Alternative Mass Balance

2013 Notable: FY13-23 Mass Balance (GSF)

Description	FY Completed / Exited	Total GSF Added	Total GSF Exited	Office	Chem-Rad	Chem-Non Rad	Bio/Proc	Instrument	Lab Support	Computation	Imaging	Other	Total
<b>IGPP Only</b>				53,000	4,000	14,000	23,000	11,000	8,000	2,000	5,000	9,000	91,000
<i>FY13/14 Actions Underway (Sigma 3 &amp; 5; BIL; PGF; LSL II<sup>1</sup>)</i>	<i>FY 2014</i>		90,185	33,094		3,300	16,598	472	1,075	2,256		5,732	62,527
Wet Chemistry	FY 2015	15,000		711		7,287							7,998
Systems Engineering <sup>2</sup>	FY 2015	17,000		3,720				1,050		1,420			6,190
Chemical Imaging	FY 2016	12,500		1,926		1,452		1,452			1,152		5,982
Instrument	FY 2017	15,000		711				7,287					7,998
Wet Chemistry	FY 2018	15,000		711		7,287							7,998
Office	FY 2018	22,500		11,324									11,324
<i>Sigma I, II or IV (Surplus)<sup>3</sup></i>	<i>FY 2019</i>		20,000	12,200									12,200
RTL	FY2019		72,326	14,096	2,279	1,406	986	7,832	5,524			367	32,490
Imaging	FY 2020	12,500				726		726			5,062		6,514
Collaboration <sup>4</sup>	FY 2020	21,300		1,000									1,000
Replacement - Wet Chemistry	FY2022	15,000		711		7,287							7,998
Replacement - Highbay/Instrument Complex	FY2023	20,000		711				3,600				10,000	14,311
Replacement - Warehouse/Shop Complex	FY2023	45,000		711					5,000				5,711
AML	FY 2023		9,311	1,455				4,901					6,356
CEL/PDLE/PDLW	FY 2023		11,308	502		283			526			7,337	8,648
BRSW/RSW/TSW/GES	FY 2023		27,754	825					361				1,186
<i>Sigma I, II or IV (Surplus)</i>	<i>FY 2023</i>		20,000	12,200									12,200
<i>Adds / Exits Sub-Total</i>		210,800	250,884										
<b>Total Impact to Campus Footprint</b>		<b>40,084</b>		864	1,721	5,050	5,416	11,910	5,514	1,164	1,214	5,564	38,417

GSF Translated to Net Functional Square Feet

D.1

<sup>1</sup>LSL-II is not being exited but is associated with those facilities listed.

<sup>2</sup>Systems Engineering facility consists of ~8K NSF of control room training space

<sup>3</sup>Sigma I footprint was used in the mass balance

<sup>4</sup>Collaboration facility consists of ~13K GSF of collaboration space

2013 Notable: FY13-23 Mass Balance (GSF)

Description		Total GSF Added	Total GSF Exited	GSF Translated to Net Functional Square Feet	Office	Chem-Rad	Chem-Non Rad	Bio/Proc	Instrument	Lab Support	Computation	Imaging	Other	Total	
<b>IGPP + 3rd Party Lease</b>						53,000	4,000	14,000	23,000	11,000	8,000	2,000	5,000	9,000	91,000
<i>FY13/14 Actions Underway (Sigma 3 &amp; 5; BIL; PGF; LSL II<sup>1</sup>)</i>	<i>FY 2014</i>		90,185			33,094		3,300	16,598	472	1,075	2,256		5,732	62,527
Wet Chemistry	FY 2015	15,000				711		7,287							7,998
Systems Engineering <sup>2</sup>	FY 2015	17,000				3,720				1,050		1,420			6,190
Chemical Imaging	FY 2016	12,500				1,926		1,452		1,452			1,152		5,982
3rd Party Leased Laboratory/Office	FY2016	60,000				12,768		9,438		5,082		1,452		4,901	33,641
Instrument	FY 2017	15,000				711				7,287					7,998
Wet Chemistry	FY 2018	15,000				711		7,287							7,998
Office	FY 2018	22,500				11,324									11,324
<i>Sigma IV (Surplus)</i>	<i>FY2019</i>		20,530			10,661				1,155		140			11,956
<i>RTL</i>	<i>FY2019</i>		72,326			14,096	2,279	1,406	986	7,832	5,524			367	32,490
Imaging	FY 2020	12,500						726		726			5,062		6,514
Collaboration <sup>3</sup>	FY 2020	21,300				1,000									1,000
Replacement - Instrument	FY2022	15,000				711				7,287					7,998
Replacement - Highbay/Instrument Complex	FY2023	20,000				711				3,600				10,000	14,311
Replacement - Warehouse/Shop Complex	FY2023	45,000				711					6,000				6,711
<i>AML</i>	<i>FY 2023</i>		9,311			1,455				4,901					6,356
<i>CEL/PDLE/PDLW</i>	<i>FY 2023</i>		11,308			502		283			526			7,337	8,648
<i>BRSW/RSW/TSW/GES</i>	<i>FY 2023</i>		27,754			825					361				1,186
<i>2400 Stevens (including 2410)</i>	<i>FY 2023</i>		101,626			27,652		419		19,240	2,428	1,916		2,000	53,655
<i>Adds / Exits Sub-Total</i>		270,800	333,040												
<b>Total Impact to Campus Footprint</b>			62,240			281	1,721	6,782	5,416	3,884	4,086	560	1,214	8,465	31,847

<sup>1</sup>LSL-II is not being exited but is associated with those facilities listed.

<sup>2</sup>Systems Engineering facility consists of ~8K NSF of control room training space

<sup>3</sup>Collaboration facility consists of ~13K GSF of collaboration space

D.2

2013 Notable: FY13-23 Mass Balance (GSF)

Description		Total GSF Added	Total GSF Exited	Office	Chem-Rad	Chem-Non Rad	Bio/Proc	Instrument	Lab Support	Computation	Imaging	Other	Total
<b>IGPP + 3rd Party Lease + SLI</b>				53,000	4,000	14,000	23,000	11,000	8,000	2,000	5,000	9,000	91,000
FY13/14 Actions Underway (Sigma 3 & S; BIL; PGF; LSL II <sup>1</sup> )	FY 2014		90,185	33,094		3,300	16,598	472	1,075	2,256		5,732	62,527
Wet Chemistry	FY 2015	15,000		711		7,287							7,998
Systems Engineering <sup>2</sup>	FY 2015	17,000		3,720				1,050		1,420			6,190
Chemical Imaging	FY 2016	12,500		1,926		1,452		1,452			1,152		5,982
3rd Party Leased Laboratory/Office	FY2016	60,000		12,768		9,438		5,082		1,452		4,901	33,641
Instrument	FY 2017	15,000		711				7,287					7,998
Wet Chemistry	FY 2018	15,000		711		7,287							7,998
Office	FY 2018	22,500		11,324									11,324
Sigma IV (Surplus)	FY2019		20,530	10,661				1,155		140			11,956
RTL	FY2019		72,326	14,096	2,279	1,406	986	7,832	5,524			367	32,490
Imaging	FY 2020	12,500				726		726			5,062		6,514
Collaboration <sup>3</sup>	FY 2020	21,300		1,000									1,000
SLI - Laboratory/Office	FY 2021	50,000		17,049		1,452		9,499					28,000
Replacement - Office	FY2022	22,500		11,324									11,324
Replacement - Highbay/Instrument Complex	FY2023	20,000		711				3,600				10,000	14,311
Replacement - Warehouse/Shop Complex	FY2023	45,000		711					6,000				6,711
AML	FY 2023		9,311	1,455				4,901					6,356
CEL/PDLE/PDLW	FY 2023		11,308	502		283			526			7,337	8,648
BRSW/RSW/TSW/GES	FY 2023		27,754	825					361				1,186
2400 Stevens (including 2410)	FY 2023		101,626	27,652		419		19,240	2,428	1,916		2,000	53,655
Sigma I	FY 2023		20,000	12,200									12,200
Sigma II	FY 2023		20,100	11,470									11,470
ESB	FY 2023		12,595	3,567				1,345	143				5,055
Adds / Exits Sub-Total		328,300	385,735										
Total Impact to Campus Footprint			57,435	144	1,721	8,234	5,416	4,751	3,943	560	1,214	8,465	34,448

GSF Translated to Net Functional Square Feet

<sup>1</sup>LSL-II is not being exited but is associated with those facilities listed.  
<sup>2</sup>Systems Engineering facility consists of ~8K NSF of control room training space  
<sup>3</sup>Collaboration facility consists of ~13K GSF of collaboration space

D.3

Note: BIL carried at 16,195 GSF to match ILA. 4th Q space data base shows 17,621 GSF

2013 Notable: FY13-23 Mass Balance (GSF)

Description		Total GSF Added	Total GSF Exited	Office	Chem-Rad	Chem-Non Rad	Bio/Proc	Instrument	Lab Support	Computation	Imaging	Other	Total
<b>IGPP + SLI Baseline (Exit Sigma V 2014 to LSLII; Exit RTL 2019 to LSL II / APEL)</b>				53,000	4,000	14,000	23,000	11,000	8,000	2,000	5,000	9,000	91,000
APEL Purchase (GSF is net of space rented to others; NSF assumes all back by 2023 except ISORAY)	FY 2013	28,500		7,746				3,725					11,471
Actions Underway: Exit Sigma III & V, BIL, and PGF; and, Repurpose a portion of LSL II basement to storage	FY 2014		90,185	33,094		3,300	16,598	472	1,075	2,256		5,732	62,527
Wet Chemistry (EMSL annex)	FY 2015	15,000		711		7,287							7,998
Systems Engineering* (North)	FY 2015	17,000		3,720				1,050		1,420			6,190
Imaging (EMSL annex)	FY 2016	12,500				726		726			5,062		6,514
Office (EMSL annex)	FY 2017	22,500		11,324									11,324
Wet Chemistry (North)	FY 2018	15,000		711		7,287							7,998
Office (North)	FY2018	22,500		11,324									11,324
Sigma IV (Surplus)	FY2019		20,530	10,661				1,155		140			11,956
RTL	FY2019		72,326	14,096	2,279	1,406	986	7,832	5,524			367	32,490
ESB	FY 2019		12,595	3,567				1,345	143				5,055
Wet Chemistry (North)	FY 2020	15,000		711		7,287							7,998
Collaboration**	FY 2020	21,300		1,000									1,000
SLI - Laboratory/Office	FY 2021	50,000		10,576				17,424					28,000
Replacement Chemistry/Instrument/TBD Laboratory (North)	FY 2022	15,000		711		3,643		3,644					7,998
Replacement - Highbay/Instrument Complex (North)	FY2023	20,000		711				3,600				10,000	14,311
Replacement - Warehouse/Shop Complex (North)	FY2023	45,000		711					6,000				6,711
AML	FY 2023		9,311	1,455				4,901					6,356
CEL/PDLE/PDLW	FY 2023		11,308	502		283			526			7,337	8,648
BRSW/RSW/TSW/GES	FY 2023		27,754	825					361				1,186
2400 Stevens (including 2410)	FY 2023		101,626	27,652		419		19,240	2,428	1,916		2,000	53,655
Sigma II	FY 2023		20,100	11,470									11,470
<b>Adds / Exits Sub-Total</b>		<b>299,300</b>	<b>365,735</b>										
<b>Total Impact to Campus Footprint</b>		<b>66,435</b>		<b>366</b>	<b>1,721</b>	<b>6,822</b>	<b>5,416</b>	<b>6,224</b>	<b>3,943</b>	<b>892</b>	<b>62</b>	<b>3,564</b>	<b>26,494</b>

GSF Translated to Net Functional Square Feet

D.4

Note: BIL carried at 16,195 GSF to match IIA. 4th Q space data base shows 17,621 GSF

\*Systems Engineering facility consists of ~8K NSF of control room training space

\*\*Collaboration facility consists of ~13K GSF of collaboration space

N2013-1\_0-SRC-GSF Mass Balance for all Scenarios\_Post 4-9-13 Meeting\_Ver4.xlsx

5/17/2013

## **Appendix E**

### **Life Cycle Cost Analysis Methodology**

# Appendix E

## Life Cycle Cost Analysis Methodology

The analysis was performed per ADM-CM-055, PG-02 *Alternative Analysis Development Process Guide* section 3.1.1 Life Cycle Cost Analysis and meets the required intent of DOE O 413.3B *Program and Project Management for the Acquisition of Capital Assets* that the recommended alternative should, "...provide the essential functions and capabilities at an optimum life cycle cost, consistent with required cost, scope, schedule, performance, and risk consideration...reflected in the site's long-range planning documents..."

The life cycle cost analysis (LCCA) estimates the overall cost of viable alternatives on a comparable level to identify the lowest cost option that delivers the required scope. In order to achieve this, the LCCA identifies, assesses, and compares financial considerations of each viable alternative.

The list of viable alternatives presented for the Alternatives Analysis and that requires inclusion within the LCCA are as follows:

- Alternative 1 – IGPP Construction
- Alternative 2 – IGPP & Third Party Lease
- Alternative 3 – IGPP, Third Party Lease and SLI
- Alternative 4 – IGPP & SLI.

In relation to this analysis, costs considered include:

- Construction – initial cost of capital required to construct the facility
- Direct O&M
  - New Facilities – forecasted, direct O&M cost per GSF, based on facility type and ownership against the 5-year average of like spaces within the existing Building and Utilities (B&U) pool
  - Existing Facilities – actual direct O&M cost per GSF, based on the 5-year average and adjusted for the CFC.
- Office Moves – cost per GSF to relocate offices from one facility to another
- Lab Moves – cost per GSF to relocate laboratory equipment from one facility to another
- Other Project Costs (OPC) – estimated cost for planning, permitting, conceptual design, solicitation, and transition to operations

- Demolition – estimated cost to remediate radiological contamination and facility demolition
- Vacated Space – cost savings associated with exiting existing facilities in the form of direct O&M and lease costs
- Lease – estimated annual payments associated with acquiring a new third party facility.

The acquisition methodology for each alternative dictated the pace to which scope was planned for execution. Acquisition costs were bounded by DOE guidance for each planning scenario:

- IGPP (<\$10M)
- SLI Line Item (<\$100M), not before 2019
- Third Party Lease (<\$50M, sum of lease payments plus tenant improvements).

When new construction is complete or a lease is obtained, the direct O&M costs begin to be incorporated within the study. For new facilities and leases, direct O&M costs will be based on ownership and facility type against the 5-year average of like spaces within the direct B&U pool.

Only facilities affected by an alternative were included within the study. For existing facilities, the 5-year average of direct O&M cost for each particular facility was used against the GSF of the facility for annual O&M costs through the study period. As facilities were vacated, a credit was realized in the succeeding years for successfully vacating a space.

Each viable case was built in ECONPACK, a software package developed by USACE for use in the development of economic analysis in support of Department of Defense funding requests, and compared to one another for a full mission requirements analysis.

The period of analysis selected for this study was 30 years, with 2014 being the base year. A 30 year study period was chosen for four distinguishing factors:

- 30 years is an adequate time to ensure the run-time of the various cost strings are sufficiently included and properly analyzed for each alternative on a comparable basis.
- Lease options that contain an underlying ground lease, similar to the Biological Sciences Facility/Computational Sciences Facility, require a 30-year period to understand the impacts associated with either continuing the lease or abandoning the facility in place (change of ownership).
- If using a 10-year period, insufficient time would be allotted to account for the direct O&M costs associated with each alternative, which is a primary driver within the study.
- A 50-year period is acceptable and inclusive of all costs, but over the longer period the string of costs would not vary significantly. Assumptions would have to be incorporated into the alternatives containing leases to understand how the lease structure would be handled over an extended period of time, which may or may not inadvertently impact the results of the analysis.

A constant-dollar analysis based on the real interest rate was used for the LCCA to eliminate the uncertainty of escalation. Below is a forecast of real interest rates obtained from OMB Circular A-94, Appendix C (December 2012 revision), which is based on the economic assumptions from the 2014 Budget, with the inflation premium removed. These real rates will be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
-1.4	-0.8	-0.4	0.1	0.8	1.1

Through the course of the study a decision was made to implement the premise of the IGPP Construction alternative as the base for each alternative to be analyzed, with the individual facility type changing based on type of space provided with the addition of the third party Lease, the SLI line item, or a combination thereof. Due to the varying degrees of variability between each alternative, an “apples to apples” comparison is not achievable without breaking the net present value of each alternative into a cost per GSF built; therefore, the recommended alternative will be the one that displays the lowest NPV per GSF built. Non-monetary considerations were not taken into account within the LCCA, as the merits of those topics are addressed in the over-arching alternatives analysis.

**Enabling Assumptions:**

1. Study Period = 30 Years, Base Year = 2014
2. Constant-Dollar Analysis based on the real interest rate of 1.1 percent per OMB Circular A-94, Appendix C (December 2012 Revision)
  - ([http://www.whitehouse.gov/omb/circulars\\_a094/a94\\_appx-c](http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c))
3. For new facilities and leases, direct O&M costs based on ownership and facility type against the 5-year average of like spaces within the direct B&U pool. Assumes O&M costs begin the FY after construction completion in all cases. Annual facility O&M costs based on GSF.
  - Assumed O&M Costs for new DOE Office, Lab, and Warehouse Space:
    - New DOE Office: \$12.79/GSF
    - New DOE Laboratory: \$16.57/GSF
    - New DOE Warehouse: \$6.06/GSF
  - Assumed O&M Costs for new Leased Lab Spaces:
    - New Lease Laboratory: \$5.44/GSF (lease cost captured separately).



4. Move costs (laboratory and office) based on net functional square feet (NFSF). Cost per square foot based on parametric estimates:
  - Office Moves: \$16.67/NFSF
  - Laboratory Moves: \$27.41/NFSF
  - Move costs are included within each new facility
  - Move costs are applied to vacating existing space only when those facilities are being absorbed by surplus space.
5. Third Party construction cost estimated per GSF based on parametric data:
  - Assumes developer's financing over 25-year term at 5.7 percent interest, per OSD business office manager.
  - Soft costs of 28.93 percent (based on BSF model) account for developer fees, design, contingency, financing, bond insurance, and placement fees.
  - PV sum of initial term payments cannot exceed 90 percent of the capital amount.
  - Assumed 14-year lease term with 11-year tail based on PV of rental payments. PV of rental payments based on 30-year nominal interest rate as defined by OMB Circular A-94, Appendix C (December 2012 Revision)  
([http://www.whitehouse.gov/omb/circulars\\_a094/a94\\_appx-c](http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c)).
6. 10-year investment amounts only include capital funds pertaining to IGPP and SLI actions.
7. After RTL is vacated, assumed \$364,095/year O&M until remediation is finalized based on estimate provided by the OSD Business Office.
8. For "Sigma I, II, or IV Surplus" exits (IGPP Construction), the average rate of \$22.33/GSF to compute vacated space savings was used.
9. OPC for SLI construction based on percent of OPC against the Physical Sciences Facility construction ( $\$9.113\text{M PSF OPC} / \$174.879\text{M PSF Construction}$ ) = 5.2 percent.
10. OPC for IGPP projects based on value estimated for CIL (\$260K total) split evenly over the construction period.

## **Appendix F**

### **Alternative Waterfall Schedules**

# Appendix F

## Alternative Waterfall Schedules

F.1

Description	Total GSF	Total Cost (\$M)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023				
<b>IGPP Only Scenario New Construction</b>																
Wet Chemistry	15,000	\$9.5	\$5.5	\$4.0												
Systems Engineering	17,000	\$9.5	\$6.5	\$3.0												
Chemical Imaging	12,500	\$9.5		\$5.0	\$4.5	▲										
Instrument	15,000	\$9.5			\$7.5	\$2.0										
Wet Chemistry	15,000	\$9.5				\$5.5	\$4.0	▲	CHEMISTRY GAP FILLED							
Office	22,500	\$9.5				\$4.5	\$5.0	▲		▲	Exit RTL			▲	Imaging Milestones	
Imaging	12,500	\$9.5					\$3.0	\$5.0	\$1.5	▲				▲	RTL Exit Milestone	
Collaboration	21,300	\$9.5						\$3.0	\$6.5							
Replacement: Wet Chemistry	15,000	\$9.5								\$5.5	\$4.0					
Replacement: High Bay/Instrument	20,000	\$9.5								\$2.5	\$4.0	\$3.0				
Replacement: Warehouse/Shop	45,000	\$5.0										\$5.0				Total:
RTL Exit	(72,326)	-														
AML	(9,311)	-														
CEL/PDLE/PDLW	(11,308)	-														2024
BRSW/RSW/TSW/GES	(27,754)	-														2024
Sigma 1	(20,000)	-														
Annual F&I Cost (M)			\$12.0	\$12.0	\$12.0	\$12.0	\$12.0	\$8.0	\$8.0	\$8.0	\$8.0	\$8.0	\$100.0			


Description	Total GSF	Total Cost (\$M)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023		
<b>IGPP + 3rd Party Lease Scenario</b>														
Wet Chemistry	15,000	\$9.5	\$5.5	\$4.0										
Systems Engineering	17,000	\$9.5	\$6.5	\$3.0										Exit RTL
Chemical Imaging	12,500	\$9.5		\$5.0	\$4.5									
3rd Party Leased Laboratory/Office	60,000	~\$45M												
Instrument	15,000	\$9.5			\$7.5	\$2.0								
Wet Chemistry	15,000	\$9.5				\$5.5	\$4.0							
Office	22,500	\$9.5				\$4.5	\$5.0							
Imaging	12,500	\$9.5					\$3.0	\$5.0	\$1.5					
Collaboration	21,300	\$9.5						\$3.0	\$6.5					
Replacement: Instrument	15,000	\$9.5								\$5.5	\$4.0			
Replacement: High Bay/Instrument	20,000	\$9.5								\$2.5	\$4.0	\$3.0		
Replacement: Warehouse/Shop	45,000	\$5.0											\$5.0	
RTL Exit	(72,326)	-												
AML	(9,311)	-												
CEL/PDLE/PDLW	(11,308)	-												2024
BRSW/RSW/TSW/GES	(27,754)	-												2024
Sigma 1	(20,000)	-												
2400 Stevens	(101,626)	-												
Annual F&I Cost (M)			\$12.0	\$12.0	\$12.0	\$12.0	\$12.0	\$8.0	\$8.0	\$8.0	\$8.0	\$8.0		\$100.0

▲ Imaging Milestones  
▲ RTL Exit Milestone

FILLS GAP - Wet Chemistry

CHEMISTRY GAP FILLED IGPPs ONLY

Total:

Description	Total GSF	Total Cost (\$M)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023				
<b>IGPP + 3rd Party Lease + SLI Scenario</b>																
Wet Chemistry	15,000	\$9.5	\$5.5	\$4.0												
Systems Engineering	17,000	\$9.5	\$6.5	\$3.0												
Chemical Imaging	12,500	\$9.5		\$5.0	\$4.5											
3rd Party Leased Laboratory/Office	60,000	~\$45M														
Instrument	15,000	\$9.5			\$7.5	\$2.0										
Wet Chemistry	15,000	\$9.5				\$5.5	\$4.0									
Office	22,500	\$9.5				\$4.5	\$5.0									
Imaging	12,500	\$9.5					\$3.0	\$5.0	\$1.5							
Collaboration	21,300	\$9.5						\$3.0	\$6.5							
SLI - Laboratory/Office	50,000	\$45.0														
Replacement: Office	22,500	\$9.5									\$5.5	\$4.0				
Replacement: High Bay/Instrument	20,000	\$9.5									\$2.5	\$4.0	\$3.0			
Replacement: Warehouse/Shop	45,000	\$5.0														\$5.0
RTL Exit	(72,326)	-														
AML	(9,311)	-														
CEL/PDLE/PDLW	(11,308)	-														2024
BRSW/RSW/TSW/GES	(27,754)	-														
Sigma 1	(20,000)	-														
2400 Stevens	(101,626)	-														
Sigma 2	(20,100)	-														
Sigma 4	(20,530)	-														
ESB	(12,595)	-														
Annual F&I Cost (M)			\$12.0	\$12.0	\$12.0	\$12.0	\$12.0	\$8.0	\$8.0	\$8.0	\$8.0	\$8.0	\$100.0			

FILLS GAP - Wet Chemistry

CHEMISTRY GAP FILLED IGPPs ONLY

SLI Design/Construction

Exit RTL

 Imaging Milestones

 RTL Exit Milestone

Total:

Description	Total GSF	Total Cost (\$M)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<b>IGPP + SLI Baseline (Exit Sigma V 2014 to LSL II; Exit RTL 2019 to LSL II/APEL)</b>													
APEL Purchase (GSF is net of space rented to others)	28,500	\$7.0	\$7.0										
Actions Underway (Exits & Repurpose)	(90,185)	-											
Wet Chemistry (EMSL Annex)	15,000	\$9.5		\$5.5	\$4.0								
Systems Engineering	17,000	\$9.5		\$6.5	\$3.0								
Imaging (EMSL Annex)	12,500	\$9.5			\$5.0	\$4.5							
Office (EMSL Annex)	22,500	\$9.5				\$7.5	\$2.0						
Wet Chemistry (North)	15,000	\$9.5					\$5.5	\$4.0					
Office (North)	22,500	\$9.5					\$4.5	\$5.0					
Sigma 4 Exit	(20,530)	-											
RTL Exit	(72,326)	-											
ESB	(12,595)												
Wet Chemistry (North)	15,000	\$9.5						\$3.0	\$5.0	\$1.5			
Collaboration	21,300	\$9.5							\$3.0	\$6.5			
SLI - Laboratory/Office	50,000	\$45.0							SLI Design/Construction				
Replacement: Chem/Inst/TBD Lab (North)	15,000	\$9.5									\$5.5	\$4.0	
Replacement: High Bay/Instrument (North)	20,000	\$9.5									\$2.5	\$4.0	\$3.0
Replacement: Warehouse/Shop (North)	45,000	\$5.0											\$5.0
AML Exit	(9,311)	-											
CEL/PDLE/PDLW Exit	(11,308)	-											
BRSW/RSW/TSW/GES Exit	(27,754)	-											
2400 Stevens (including 2410) Exit	(101,626)	-											
Sigma 2 Exit	(20,100)	-											
Total Impact to Footprint	(66,435)												
Annual F&I Cost (M)			\$7.0	\$12.0	\$12.0	\$12.0	\$12.0	\$12.0	\$8.0	\$8.0	\$8.0	\$8.0	\$8.0





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)  
[www.pnnl.gov](http://www.pnnl.gov)



U.S. DEPARTMENT OF  
**ENERGY**