2012 FCRPS Hydro Asset Strategy

May 2010

Scope

This strategy identifies condition and risk implications of the currently committed hydro investment program direct funded by Bonneville Power Administration and new investments prioritized around minimizing lifecycle cost. It represents a reasonable level and timing of future investment to maintain the production capability of the FCRPS hydro system at a cost effective level of reliability.

The strategy addresses costs associated with hydropower specific and joint-use features, but excludes costs for the Lower Snake River Compensation Plan and Columbia River Fish Mitigation prioritized by the Corps of Engineers with input from regional interests and funded through appropriations.

Strategy results are precise and directionally correct, but are not a prescriptive plan to be implemented exactly as shown. Significant additional effort is needed to develop resource plans for implementing this strategy which include requirements for engineering, design, contracting, financing, scheduling, construction, project management, and outage planning. Such plans will likely change the timing and cost of the estimates identified here, but will be consistent with the objective to minimize the lifecycle cost of the hydro system, and thus, consistent with this strategy.

The strategy does not include an evaluation of specific issues that may result in new strategic initiatives. Typically, these issues require a level of effort, including staffing and funding, that are outside of the scope of what can realistically be addressed in this strategy. As those issues gain more attention, resources are directed at studying them, and action plans are put into place for their implementation, the results of these efforts will be reflected in subsequent strategies. Potential issues include but are not limited to:

- New opportunities for expanding the capability of the hydro system;
- Operational changes or pumped storage alternatives for integrating wind resources;
- Alternatives for increasing flows through the turbine path at plants where flows are diverted for fish passage reasons;
- Specific equipment maintenance and replacement strategies;
- Procurement mechanisms;
- Automation; and,
- Staffing.

System Summary

Overview

The Federal Columbia River Power System (FCRPS) hydro program is a partnership between the US Army Corps of Engineers (Corps), the US Bureau of Reclamation (Reclamation), and Bonneville Power Administration (Bonneville). The program is financed through direct funding agreements between Bonneville and the Corps, and Bonneville and Reclamation, delivering power worth $4 billion annually to the people of the Pacific Northwest.

The program has a mandate to provide low cost, reliable power and effective resource stewardship to the Pacific Northwest region. Through direct funding agreements, it spends over $300 million annually on Capital Investment and O&M programs. In addition to delivering power and other services today, the partnership is challenged to effectively maintain and manage a substantial asset base for the long-term.

Statistics

The FCRPS hydro system consists of 31 hydroelectric plants with 196 generating units

System generating capacity is 22,060 MW, with an average generation of 76,354 GWh (8,716 aMW)

FCRPS hydro comprises about 80 percent of Bonneville Power Services generation

The plants have as few as 1 unit and as many as 27 units (Chief Joseph)

Generating unit sizes range from 1 MW to 805 MW

The oldest units were put into service in 1909 (Minidoka); the youngest in 1999 (Boise Diversion Rehabilitation)

The cost of the hydro Direct Funded Program in 2009 was $375 million:

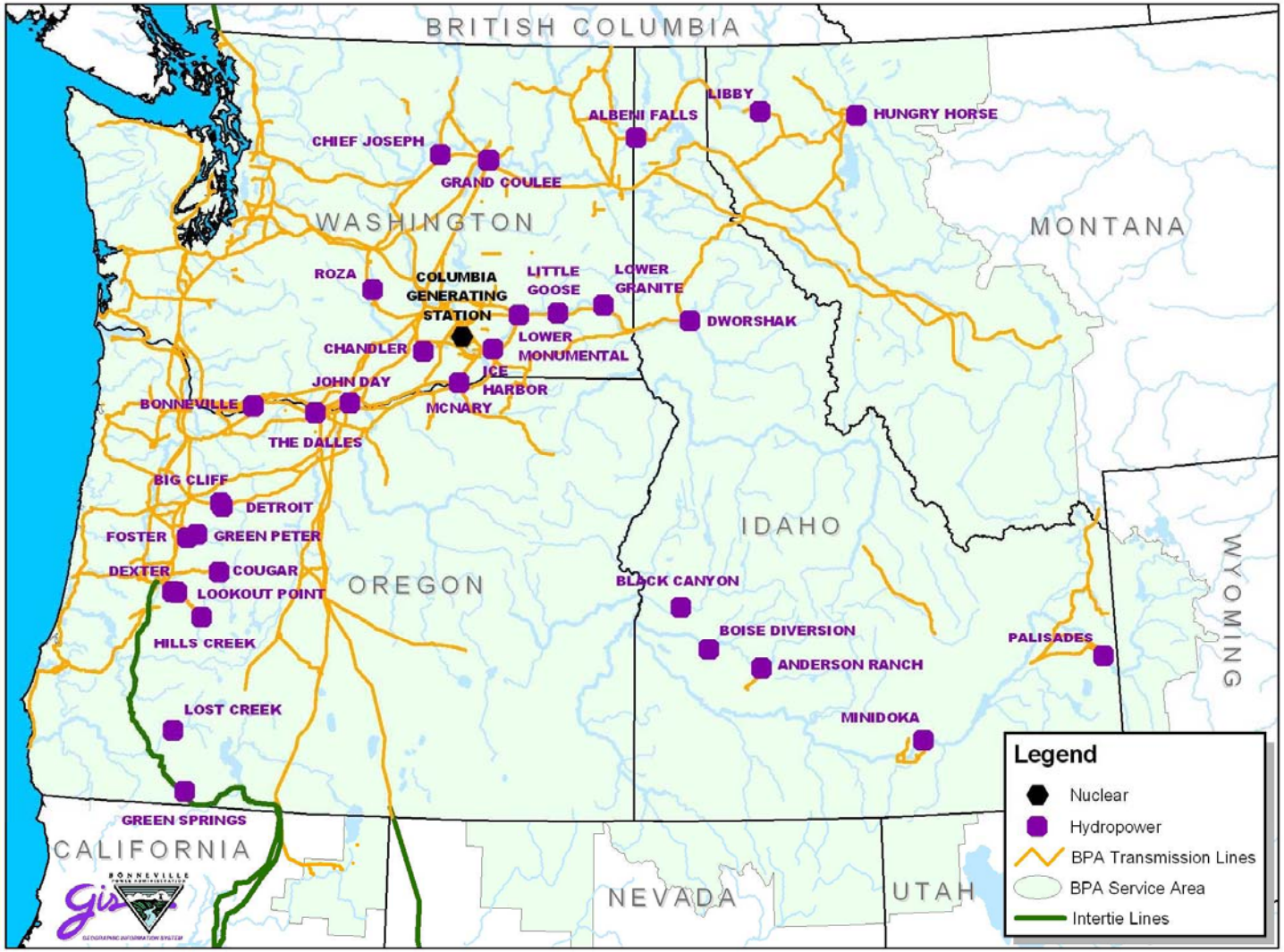
- Expense costs were $235 million
- Capital costs were $140 million

The hydro program employs about 1,500 employees working on:

- Hydropower (power-specific and joint-use facilities)
- Fish & Wildlife O&M (joint-use)
- Cultural Resources (joint-use)

Map of the System

Federal Columbia River Power System Generation and Transmission



FCRPS Hydro Strategy / Products and Services

The FCRPS Hydro Strategy focuses on three goals:

- Low Cost Power;
- Power Reliability; and,
- Trusted Stewardship

The strategy is implemented through a set of Direct Funding Agreements to:

- Ensure that life safety and environmental requirements are met;
- Meet FCRPS commitments for fish and wildlife and cultural resource programs;
- Meet Bonneville's needs for a reliable supply of low-cost generation by ensuring power generating assets are properly operated, inspected, and maintained;
- Mitigate the risk of power generation component failures by replacing or refurbishing equipment and purchasing spares when warranted;
- Increase the efficiency &/or capability of power facilities where economically feasible; and
- Fund a portion of high priority multi-purpose projects, in accordance with Bonneville's direct funding agreements with the Corps of Engineers and Bureau of Reclamation.

Key products and services provided from federal hydro assets include the following:

- Power Generation and Delivery
  - Electricity Production (MWh)
  - Peak Electricity Capacity (MW)
  - Spinning and Non-spinning Reserves
  - Load Following
  - Voltage Support
  - System Restoration (e.g., Black Start)
- Non-Power Purposes
  - Flood Damage Reduction – Use reservoir storage to shape natural water flows to reduce impacts to communities, farmland, and industry located along rivers
  - Navigation – Enable an inland waterway through a series of locks on the Columbia and Snake rivers
  - Irrigation – Increase the acreage of arable land in the Pacific Northwest through the storage and diversion of water.
  - Recreation – Provide economic and social benefits by facilitating access to reservoirs and by making available parks and recreation areas.
  - Fish and Wildlife – Protect, mitigate and enhance fish and wildlife, including related spawning grounds and habitat, of the Columbia River and its tributaries.

FCRPS Integrated Business Management Model

The Integrated Business Management Model (IBMM) is used by the FCRPS partnership to provide a framework for ongoing asset-based planning and management. The IBMM consists of 12 business processes contained within four major areas - Strategic Planning, Asset Planning, Resource Management, and Performance Assessment.

Joint Operating Committees (Bonneville/Corps and Bonneville/Reclamation) are responsible for overseeing the operational management of the FCRPS. Sub-committees of the FCRPS JOCs are tasked with more direct oversight of specific aspects of the IBMM:

- Capital Investment Program
- O&M Program
- Benchmarking and Performance Indicators
- River Management
- Hydro Optimization
- Technical Coordination
- Cultural Resources
- Fish and Wildlife

Direction from OMB and the three agencies of the FCRPS is to increase the level of efficiency, visibility and accountability for key business processes. The JOC sub-committees are the primary management means for implementing this direction.

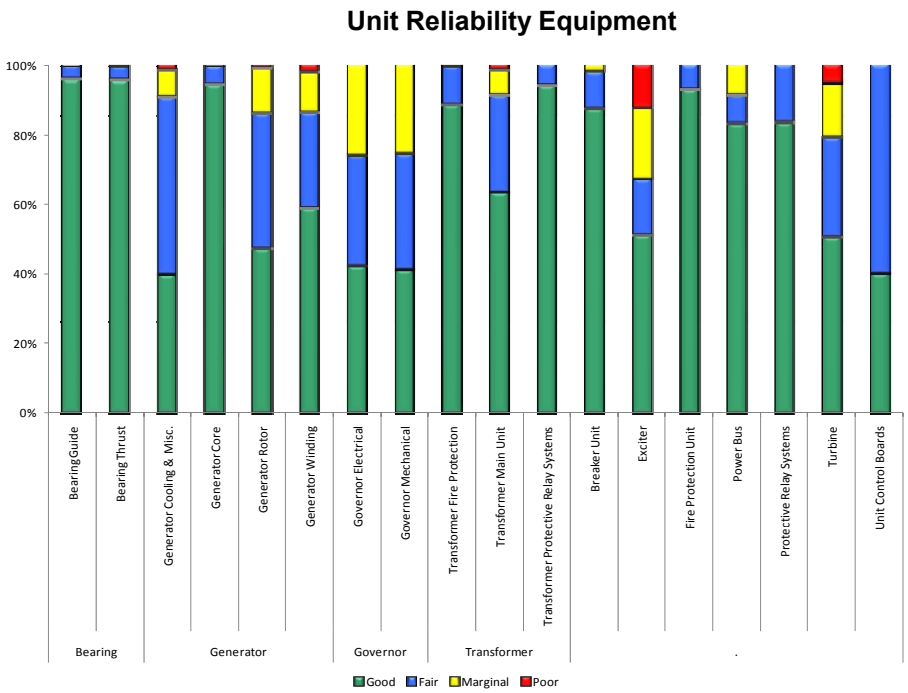
Equipment Condition

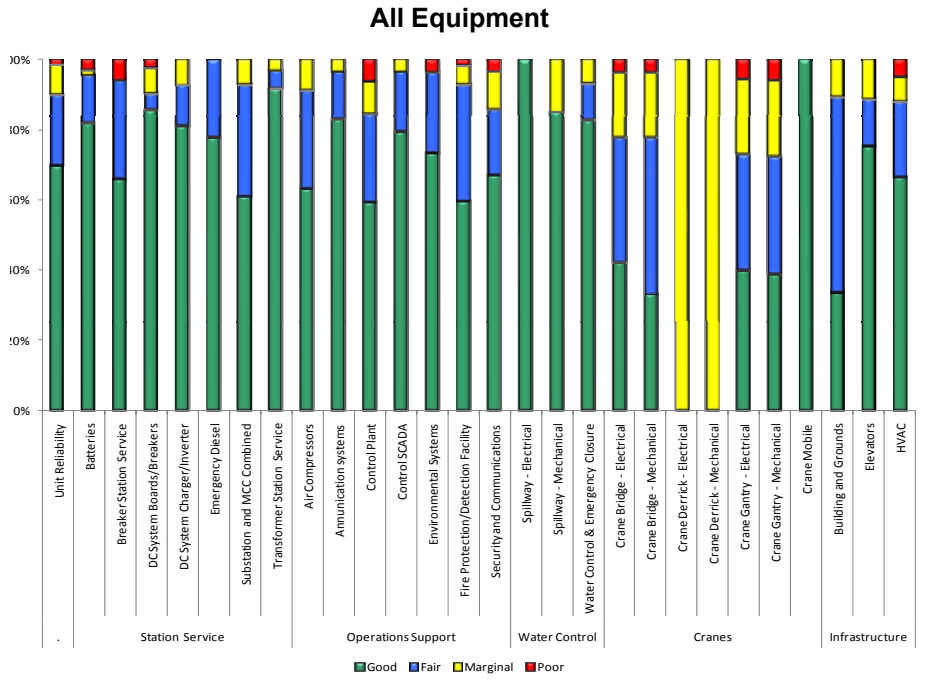
There are few redundant or spare components in hydroelectric generating facilities and, as such, it is important that the condition of major components be understood and managed.

The 2009 System Asset Plan focused on the condition of seven power train components: unit transformers, generator windings, generator rotors, exciters, governors, unit breakers, and turbine runners. This strategy expands condition assessments to nearly all equipment managed in a hydro plant, better informing asset investment decisions.

Overall, 85 percent of hydro plant equipment is currently in Good or Fair condition.

The class of equipment with the lowest condition rating is cranes, followed by infrastructure and unit reliability.





Risk Intervention

Equipment condition is further used to assess risk. Absent corrective action, equipment condition degrades over time, which increases the risk that it will fail to perform as needed.

Three financial factors influence equipment life cycle cost and the optimum time for corrective action:

- **Replacement Cost** – Typically, the longer a replacement can be deferred, the lower the present value of its cost.
- **Direct Cost Risk (DCR)** – If replacement is deferred, the risk of failure increases, which may result in higher costs for collateral damage and planning, procurement, and scheduling inefficiencies.
- **Lost Generation Risk (LGR)** – Equipment that fails may also result in longer outages and, thus, higher replacement power costs than if replaced on a planned basis.

The **Total Cost** is the present value sum of replacement and risk costs. The point at which risk is increasing faster than the benefit of investment deferral is the cost minima and represents the optimum time for corrective action to minimize lifecycle cost.

Equipment condition can also pose a risk to safety and environment, and may provide a rationale for corrective action regardless of whether a cost minima has been reached.

To derive the investment plan in this strategy, equipment is targeted for refurbishment/replacement if:

- It is determined to be at high risk for safety or environment; or,
- It is at the cost minima.
- If an annual funding limitation is reached, investment in equipment in which risk is increasing the least is deferred until the following year, where it is re-evaluated using the same prioritization logic.

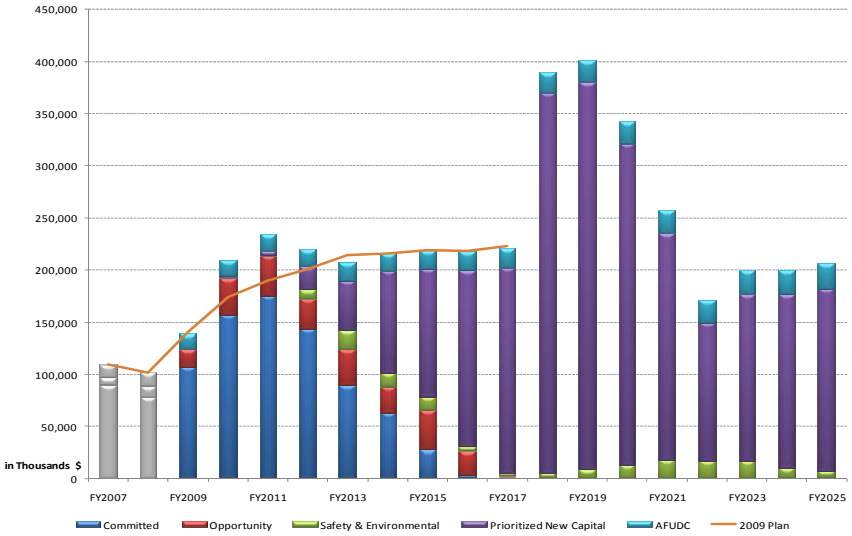
Hydro Investment Plan

The base case scenario constrains large capital funding to the current budget forecast for FY2010 – FY2017, after which funding constraints are removed. It yields an average annual program cost of $218 million over the eight year period, but results in a need of $350 million or more in each of the following three years. The need declines to about $200 million per year thereafter, representing a program that would be difficult to manage from a resourcing and outage availability standpoint, and one that may introduce significant program inefficiencies.

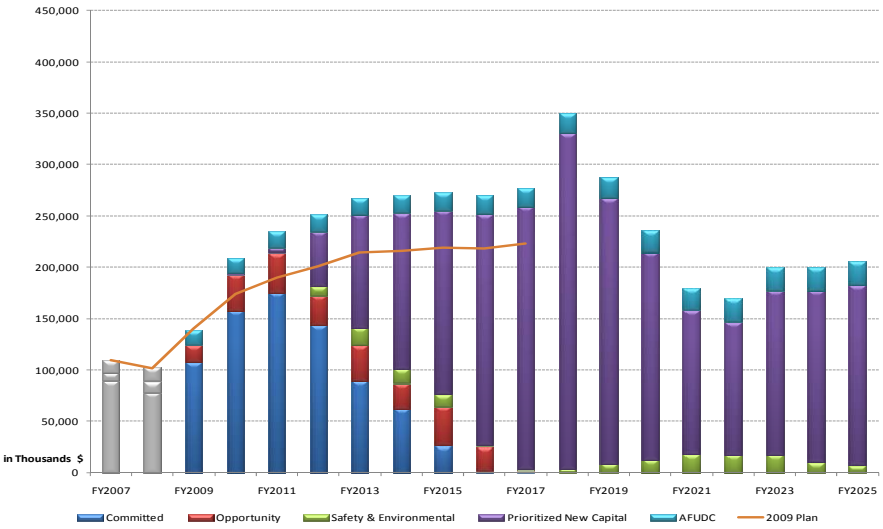
Sensitivities were run to determine how funding constraints affect results. A recommended plan was selected that identifies a relatively flat program level over a 10 year period (FY2012 – FY2021), which results in a $63 million increase in present value of costs relative to the base case, but reduces the present value of risk by $164 million.

The recommended plan has an average annual cost of $257 million during the FY2010 – FY2017 period, representing an 18 percent increase to the base case.

Base Case
Constrained to Current FY2010 – FY2017 Budget Forecast



Recommended Plan
18 Percent Increase to the Base Case

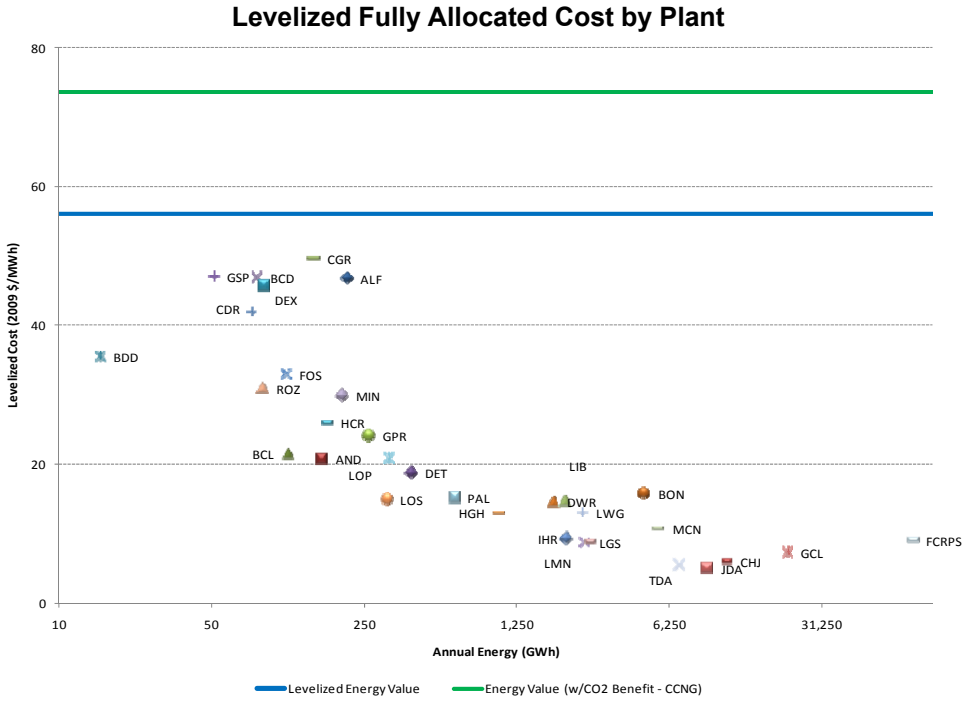


Lifecycle Cost

The recommended plan results in a levelized fully allocated cost for the hydro system of $9 per MWh and includes the following costs for FY2010 – FY2025:

- The remaining un-depreciated investment in the system of $4.2 billion (net utility plant);
- The currently committed large capital program of $881 million;
- Incremental large capital investment of $3 billion prioritized in this plan;
- AFUDC of $334 million;
- Incremental extraordinary maintenance of $325 million, primarily for turbine overhauls at Grand Coulee's Third Powerplant; and,
- Forecasted O&M of $250 million in FY2010, increasing at two percent per year thereafter.

Over half of the plants have levelized costs of less than $20 per MWh, with all plants having costs below the value of energy produced.



Contents

1. Asset Category Overview

Introduction

The Federal Columbia River Power System (FCRPS) is a partnership between the US Army Corps of Engineers (Corps), the US Bureau of Reclamation (Reclamation), and Bonneville Power Administration (Bonneville).

FCRPS power related assets are financed through Direct Funding agreements between Bonneville and the Corps, and Bonneville and Reclamation. Through Direct Funding, over $350 million is spent annually by the FCRPS on Investment and O&M programs.

The FCRPS has a mandate to provide low cost, reliable power and effective resource stewardship to the Pacific Northwest region. It delivers power worth nearly $4 billion annually to the people of the Pacific Northwest in addition to providing protection, mitigation, and enhancement of fish and wildlife.

FCRPS Integrated Business Management Model (IBMM)

The Integrated Business Management Model (IBMM) is used by the FCRPS partnership to provide a framework for ongoing asset-based planning and management. The IBMM consists of 12 business processes contained within four major areas - Strategic Planning, Asset Planning, Resource Management, and Performance Assessment.

Joint Operating Committees (Bonneville/Corps and Bonneville/Reclamation) and sub-committees of the FCRPS are tasked with managing specific aspects of the IBMM:

- Capital Investment Program
- O&M Program
- Benchmarking and Performance Indicators
- River Management
- Hydro Optimization
- Technical Coordination
- Cultural Resources
- Fish and Wildlife

Direction from OMB and the three agencies of the FCRPS is to increase the level of efficiency, visibility and accountability for key business processes. The FCRPS sub-committees are the primary management means for implementing this direction.

FCRPS Hydro System

The FCRPS is comprised of 31 hydroelectric plants – 21 operated by the Corps and 10 by Reclamation. The FCRPS has an overall capacity of 22,060 MW and, in an average water year, produces 76 million megawatt-hours of electricity.

Within the hydro asset category, the plants are grouped into four strategic classes depending on the role they play in the system. These categories are as follows:

- **Main Stem Columbia**: plants that provide the majority of power, ancillary services, and non-power benefits to the Pacific Northwest.
- **Headwater/Lower Snake**: plants that support services provided by Main Stem Columbia plants.
- **Area Support**: plants that do not support the region as a whole, but provide key power and non-power benefits to an area of the Pacific Northwest.
- **Local Support**: plants that primarily provide services to a local area only.

FCRPS Hydro System

Plant	ID	Units	MW Capacity	aMW Energy	Strategic Class	Operator
Grand Coulee	GCL	24	6,735	2,497	Main Stem Columbia	Reclamation
Chief Joseph	CHJ	27	2,614	1,387	Main Stem Columbia	Corps
McNary	MCN	14	1,120	575	Main Stem Columbia	Corps
John Day	JDA	16	2,480	991	Main Stem Columbia	Corps
The Dalles	TDA	22	2,052	773	Main Stem Columbia	Corps
Bonneville	BON	18	1,195	513	Main Stem Columbia	Corps
Dworshak	DWR	3	465	214	Headwater/Lower Snake	Corps
Lower Granite	LWG	6	930	272	Headwater/Lower Snake	Corps
Little Goose	LGS	6	930	263	Headwater/Lower Snake	Corps
Lower Monumental	LMN	6	930	278	Headwater/Lower Snake	Corps
Ice Harbor	IHR	6	693	211	Headwater/Lower Snake	Corps
Libby	LIB	5	605	238	Headwater/Lower Snake	Corps
Hungry Horse	HGH	4	428	113	Headwater/Lower Snake	Reclamation
Albeni Falls	ALF	3	49	24	Area Support	Corps
Detroit	DET	2	115	46	Area Support	Corps
Big Cliff	BCL	1	21	13	Area Support	Corps
Green Peter	GPR	2	92	30	Area Support	Corps
Foster	FOS	2	23	12	Area Support	Corps
Lookout Point	LOP	3	138	37	Area Support	Corps
Dexter	DEX	1	17	10	Area Support	Corps
Cougar	CGR	2	28	17	Area Support	Corps
Hills Creek	HCR	2	34	18	Area Support	Corps
Lost Creek	LOS	2	56	36	Area Support	Corps
Palisades	PAL	4	177	74	Area Support	Reclamation
Minidoka	MIN	4	28	22	Local Support	Reclamation
Anderson Ranch	AND	2	40	18	Local Support	Reclamation
Boise Diversion	BDD	3	3	2	Local Support	Reclamation
Black Canyon	BCD	2	10	9	Local Support	Reclamation
Roza	ROZ	1	13	10	Local Support	Reclamation
Chandler	CDR	2	12	9	Local Support	Reclamation
Green Springs	GSP	1	17	6	Local Support	Reclamation
Total		**196**	**22,060**	**8,716**		

Products and Services

Power Generation and Delivery

- Electricity Production (MWh)
- Peak Electricity Capacity (MW)
- Spinning and Non-spinning Reserves
- Load Following
- Voltage Support
- System Restoration (e.g., Black Start)

Non-Power Purposes

- Flood Damage Reduction – Use reservoir storage to shape natural water flows to reduce impacts to communities, farmland, and industry located along rivers.
- Navigation – Enable an inland waterway through a series of locks on the Columbia and Snake rivers.
- Irrigation – Increase the acreage of arable land in the Pacific Northwest through the storage and diversion of water.
- Recreation – Provide economic and social benefits by facilitating access to reservoirs and by making available parks and recreation areas.
- Municipal and Industrial Water Supply
- Water Quality
- Fish and Wildlife – Protect, mitigate and enhance fish and wildlife, including related spawning grounds and habitat, of the Columbia River and its tributaries.

Value of Strategic Classes by Purpose

Purpose	Main Stem Columbia	Headwater/Lower Snake	Area Support	Local Support
Power	Provides 76% of energy and capacity, and 30% of storage from the FCRPS. Provides nearly all the reserves and other ancillary services for supporting the 500 KV grid.	Provides 20% of energy and capacity, and 50% of storage from the FCRPS. Provides supplementary ancillary services for supporting the 500 KV grid.	Provides 3% of energy and capacity, and 18% of storage from the FCRPS. Provides voltage support to specific areas of the regional transmission grid	Provides 1% of energy and capacity, and 2% of storage from the FCRPS. Provides limited voltage support to local areas of the Pacific Northwest.
Flood Damage Reduction	Seasonal flood reduction and water management storage affecting significant parts of the Columbia River basin.	Seasonal flood reduction and water management storage affecting significant parts of the Columbia River basin.	Provides flood reduction benefits primarily in the Willamette Valley, but does not contribute significantly to the flood reduction capability of the overall Columbia River basin.	Provides flood reduction benefits in a local area
Navigation	Provides navigation for the lower Columbia River from below Cascade Locks to the Tri-Cities	Provides navigation for the lower Snake River from the Tri-Cities to Lewiston, ID	None	None
Irrigation	Primary source of irrigation for the Columbia River Basin	None	None	Primary source of irrigation within a specific region
Recreation	Significant recreation for boating and camping. Includes several “destination” recreation sites and numerous local sites.	Major recreation for boating and camping. Includes several “destination” and local sites.	Major recreation for boating and camping. Includes several “destination” and local sites.	Some boating and camping at local sites.

2. Asset Strategy Scope, Direction, and Objectives

FCRPS Hydro Strategy Logic and Scope

The FCRPS Hydro Strategy focuses on three goals:

- Low Cost Power;
- Power Reliability; and
- Trusted Stewardship

The strategy is implemented through a set of Direct Funding Agreements to:

- Ensure that life safety and environmental requirements are met;
- Meet FCRPS commitments for fish and wildlife and cultural resource programs;
- Meet Bonneville's needs for a reliable supply of low-cost generation by ensuring power generating assets are properly operated, inspected, and maintained;
- Mitigate the risk of power generation component failures by replacing or refurbishing equipment and purchasing spares when warranted;
- Increase the efficiency and/or capability of power facilities where economically feasible; and
- Fund a portion of high priority multi-purpose projects, in accordance with Bonneville's direct funding agreements with the Corps of Engineers and Bureau of Reclamation.

With this in mind, the 2012 strategy includes:

- Direct Funded O&M Program,
- Direct Funded Investment Program, and
- Appropriations reimbursed by Bonneville.

FCRPS Hydro Strategy Logic and Scope

Program funding needs are established through the IBMM model, as described in section 1.

In general, the **O&M Program** reflects core funding for maintenance, operations, and minor equipment replacements, and is largely driven by the staffing needs of each facility.

In contrast, the **Investment Program** is comprised primarily of large, discrete investment needs for equipment replacement or refurbishment, largely driven by condition and risk.

Two timelines for Investment Program funding proposals are presented within this strategy:

- The current and next three rate periods, FY2010 to FY2017, reflecting specific projects that are already committed, and new investments that are identified for safety, environment, or financial risk mitigation reasons, and
- FY2018 to FY2025, identifying out-year risk mitigation needs.

Objectives of the Strategy

Target investments that address hydro strategic goals and achieve the following results by 2022:

Strategic Goal	FCRPS Hydro Partnership Objective	Bonneville Agency Long-term Outcome	Targeted Plan Result (Draft)
Low Cost Power	Provide a cost effective power supply	Meet environmental and reliability goals at the least lifecycle cost	Achieve a fully allocated cost of production of less than $10 per MWh in 2009 dollars
			Reduce Lost Generation Risk to 300 aMW or less
Power Reliability	Provide a reliable power supply	Meet availability requirements	Maintain an average condition rating of 7.0 or higher for unit reliability equipment (Main Stem Columbia and Headwater/Lower Snake classes)
	Support a reliable transmission system	Meet reliability standards	Comply with WECC/NERC reliability standards applicable to generators
Trusted Stewardship	Optimize the multiple benefits of the river for the region	Meet hydro system environmental requirements	Reduce the number of equipment items with high environmental risk to zero
	Maintain a safe work environment	Meet safety and security standards	Achieve a Lost Time Accident Rate of less than 2.0 per 200,000 employee-hours

Criticality of Assets

Relative Cost of Unavailability. The criticality of a hydro asset is based largely on the quantity of energy produced, particularly at peak periods, and the financial impact of a loss of generation. Assets in the Main Stem Columbia and Headwater/Lower Snake strategic classes provide more than 96 percent of energy and capacity for the system.

Five plants – Grand Coulee, McNary, Chief Joseph, John Day and Dworshak – are considered particularly critical to the power system based on the significant financial impact of a generating unit outage at these facilities.

The figure on the following page groups FCRPS hydro plants by their strategic class and relative cost of unavailability (RCU) to the power system. The relative cost of unavailability is the annual cost of replacing lost generation from the least-used generating unit, or first 20 percent of lost plant availability, whichever is larger. No costs are included for replacing lost capacity, ancillary services, or non-power benefits.

Major RCU is up to $10 million per year, and is based on Bonneville's long-term forward price forecast and average water conditions. Extreme RCU ranges from $10 to $20 million annually, while Severe RCU exceeds $40 million per year. No value is included for avoided CO2 emissions.

The figure shows that Grand Coulee, McNary, Chief Joseph, John Day and Dworshak are the plants with the highest RCU.

Criticality of Assets

FCRPS Hydro Plant Classification

Relative Cost of Unavailability	Local Support	Area Support	Headwater/ Lower Snake	Main Stem Columbia
Severe				CHJ GCL MCN
Extreme			DWR	JDA
Major	AND, BCD BDD, MIN, ROZ, CDR, GSP	BCL, DEX, LOS, DET, GPR, LOP, HCR, CGR, FOS, ALF, PAL	LIB, HGH, IHR, LGS, LWG, LMN	BON TDA

Strengths of the FCRPS Hydro System

Low, Stable Costs: The FCRPS hydro system provides a low and relatively stable cost of power, with a fully allocated cost of $6.34 per megawatt-hour in FY2009. Capital charges and O&M expenses each total approximately $250 million per year. Average annual generation is 76 million megawatt-hours. Costs are increasing somewhat over time for investments to repair and replace aging equipment and for growth in the O&M Program.

Storage and Peaking: The FCRPS hydro system has a maximum useable storage of 10.5 ksfd, providing flood damage reduction, irrigation, fish and wildlife benefits, recreation opportunities, and increased value from the power system by storing water to be used when it is more valuable for generation.

Ancillary Services and Resource Integration: The hydro system provides all voltage support, load following, reserves, and other ancillary services for Bonneville's transmission system. Hydropower also serves as the primary mechanism for integrating wind resources into the power system.

Climatic Risk: FCRPS hydro generation produces zero carbon dioxide emissions, which now are recognized as a primary contributor to global warming. Hydro both lessens global warming effects by reducing emissions that otherwise would be produced by alternative generation sources and remains cost effective within resulting weather variations that may influence water supply.

Energy Payback: Energy payback ratio is a comparison of the energy produced by a system divided by the energy consumed to build and operate the system over its useful life. Hydropower, with an energy payback ratio of 205, has the highest ratio of all generation sources. By comparison, the ratio for wind is 23 (without backup), nuclear fission (16), coal (11), and natural gas (4).

Skilled Workforce: The FCRPS has a dedicated and skilled workforce with a keen understanding of the operations and maintenance needs of the hydro system.

Weaknesses of the FCRPS Hydro System

Weather and Water Supply: Changing weather conditions and the resulting changes in water supply create a degree of uncertainty in hydropower production different than that from thermal generation alternatives. Between years, the difference in energy production from FCRPS hydro can be several thousand average megawatts. This presents unique challenges to managing the entire portfolio of power supply needed to meet the demands of Bonneville customers.

Environmental Costs: The FCRPS faces high environmental costs for mitigating the impact of developing the Columbia River Basin. The direct funded program costs considered in this strategy include $34 million per year for maintaining fish passage equipment and hatcheries. In addition to costs included in this strategy, environmental costs total more than $250 million per year for Bonneville's direct fish and wildlife program and the Corps' appropriated program to construct additional fish rearing and passage facilities. Indirect costs for changes in system operations now total several hundred million dollars per year.

Aging Workforce: The power industry as a whole is now facing a retirement eligibility bubble that poses significant risk to maintaining the workforce needed to operate and maintain facilities effectively. A large percentage of personnel working on-site at FCRPS hydro plants are eligible for retirement within five years.

Aging Infrastructure: The hydro system is also an aging infrastructure, approaching an average age of 50 years. The oldest plant in the system is Minidoka, with an in-service date of 1911. Bonneville Dam is the oldest Main Stem Columbia plant, with an in-service date of 1938. While many more years of valuable production can be expected from the hydro system, it faces significant challenges associated with maintenance and replacements demands to preserve this value.

Politically Unpopular: In Canada, Europe, and Australia / New Zealand, hydropower is generally seen as a clean and reliable source of renewable energy. However, in the United States, and particularly in the Northwest, hydropower is often perceived more negatively, which introduces added uncertainty into the future cost and supply of FCRPS hydro generation.

3. Current Performance, Condition, and Risk

US Army Corps
of Engineers

Performance, Low Cost Power: O&M Program

The direct funded **Operations and Maintenance (O&M) Program** is segmented into:

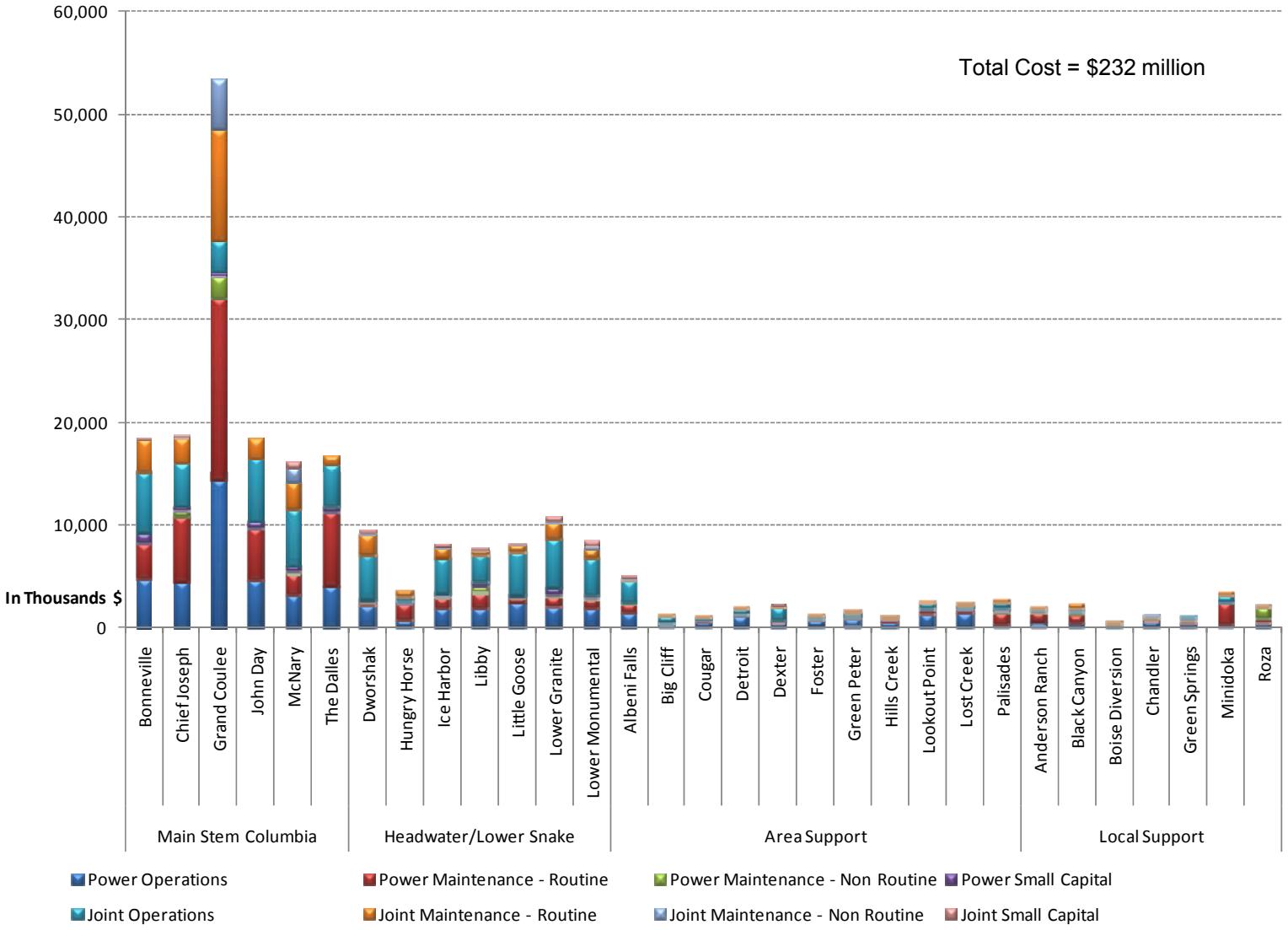
- **Power** (for spending on hydropower components); and
- **Joint** (for spending on equipment that serves multiple purposes which are partially funded by Bonneville through Direct Funding arrangements).

Within Power and Joint costs, work is further segmented as follows:

- **Operations**: day-to-day costs for operating power and joint-use facilities;
- **Routine Maintenance:** day-to-day costs for inspection, preventive maintenance, and unscheduled repairs;
- **Non-Routine Maintenance**: recurring maintenance that is performed on a cycle greater than one year, and
- **Small Capital:** allowances for maintenance-related replacement of small components but by virtue of accounting treatment is capitalized.

Total O&M Program costs in FY2008 were $232 million.

Performance, Low Cost Power: 2008 O&M Program



Performance, Low Cost Power: Large Capital Program

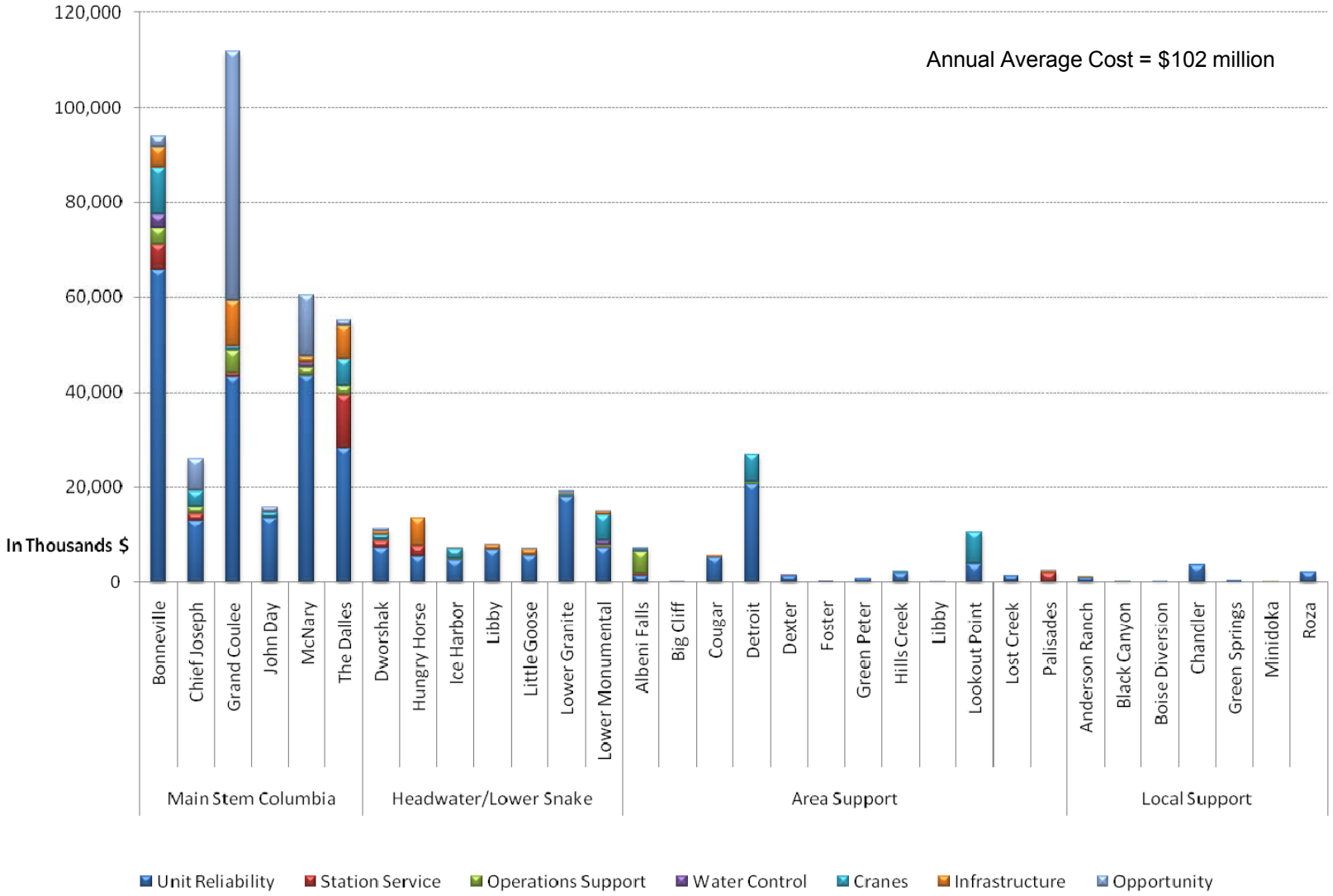
In the 5-year period, FY2005 to FY2009, the hydro program invested $511 million in repairs, replacements, and improvements to the system. The annual average cost was $102 million, or $4.60 per kW-year.

The 5-yr hydro program investment breaks down as follows:

- Unit reliability: $306 million
- Station service: $25 million
- Operations support: $19 million
- Water control: $5 million
- Cranes: $43 million
- Infrastructure: $33 million
- Economic opportunity: $79 million (primarily runner replacements)

Performance, Low Cost Power: Large Capital Program

(Total Cost, FY2005 – FY2009)



Performance, Low Cost Power: Fully Allocated Cost

Name of Asset	Completed Plant	Net Utility Plant	CWIP	Accumulated Depreciation	FY 2009 Depreciation	FY 2009 O&M Expense	FY 2009 Interest	Outstanding Fed. Approp.	Capital Investment	Net Generation (GWH)	Production Cost ($/MWh)	Fully Allocated Cost ($/MWh)
	"Cumulative Capital cost" /a	"Useable value of plant" /b	"included in Net Utility Plant but not in Completed Plant"	"included in Net Utility Plant but not in Completed Plant"	"FY 2009 Accumulated Depreciation less FY 2008 Accumulated Depreciation" /c	"Annual expense" /d	"Interest for this year" /e	"Sum of remaining principle" /f	"Total Capital invested during the year"	"Average generation based on 50-year hydro regulation studies"	"FY 2009 O&M Expense divided by Net Generation"	"(FY 2009 O&M Expense + Interest - Depreciation) divided by Net Generation"
Main Stem Columbia												
Bonneville	$1,035,062	$732,258	$70,969	($373,773)	($11,216)	$19,337	$33,882	$505,989	$27,962	4,490	4.31	14.35
Chief Joseph	$607,749	$356,583	$37,176	($288,342)	($8,429)	$17,189	$15,147	$238,378	$7,782	12,154	1.41	3.35
John Day	$523,118	$307,817	$7,453	($222,755)	($6,019)	$18,700	$5,475	$80,718	$2,933	8,685	2.15	3.48
McNary	$357,394	$185,280	$24,479	($196,593)	($4,765)	$15,648	$696	$13,142	$18,481	5,033	3.11	4.19
The Dalles	$398,174	$235,754	$40,018	($202,438)	($9,247)	$16,014	$4,424	$75,078	$18,441	6,771	2.37	4.38
Grand Coulee	$1,352,991	$968,504	$52,440	($436,927)	($14,581)	$59,897	$37,892	$548,020	$23,580	21,872	2.74	5.14
Total Main Stem Columbia	**$4,274,489**	**$2,786,196**	**$232,536**	**($1,720,828)**	**($54,257)**	**$146,786**	**$97,516**	**$1,461,325**	**$99,178**	**59,003**	**2.49 $/MWh**	**5.06 $/MWh**
Headwater/Lower Snake												
Dworshak	$303,725	$191,791	$3,170	($115,104)	($4,497)	$9,444	$10,891	$154,747	$3,517	1,873	5.04	13.26
Ice Harbor	$172,834	$97,290	$4,130	($79,674)	($2,778)	$7,832	$2,136	$35,145	$2,634	1,845	4.25	6.91
Libby	$440,573	$285,487	$2,223	($157,309)	($5,564)	$7,039	$16,764	$235,932	$2,815	2,086	3.37	14.08
Little Goose	$224,340	$123,428	$1,428	($102,340)	($3,312)	$7,444	$7,430	$107,492	$1,475	2,304	3.23	7.89
Lower Granite	$370,584	$235,408	$2,627	($137,802)	($4,087)	$11,081	$12,142	$176,228	$5,228	2,386	4.64	11.44
Lower Monumental	$250,690	$144,135	$5,589	($112,144)	($3,974)	$7,877	$6,261	$62,672	$142	2,435	3.23	7.44
Hungry Horse	$126,874	$81,619	$5,760	($51,015)	($1,377)	$3,706	$777	$11,983	$6,161	986	3.76	5.94
Total Headwater/Lower Snake	**$1,889,619**	**$1,159,159**	**$24,928**	**($755,388)**	**($25,589)**	**$54,424**	**$56,401**	**$784,199**	**$21,973**	**13,915**	**3.91 $/MWh**	**9.80 $/MWh**
Area Support												
Albeni Falls	$45,049	$32,233	$9,946	($22,762)	($986)	$4,970	$204	$3,048	$1,883	208	23.84	29.55
Cougar	$82,494	$76,316	$6,005	($12,183)	($1,123)	$960	$2,706	$52,208	$329	146	6.56	32.73
Detroit-Big Cliff	$51,258	$50,413	$26,085	($26,930)	($378)	$4,150	$85	$1,592	$8,146	519	8.00	8.90
Green Peter-Foster	$56,042	$33,419	$1,147	($23,769)	($592)	$3,498	$14	$226	$665	368	9.51	11.15
Hill Creek	$20,861	$10,488	$1,527	($11,900)	($490)	$892	$543	$7,976	$739	161	5.53	11.94
Lookout Point-Dexter	$61,704	$33,092	$12,673	($41,285)	$425	$4,494	$730	$13,232	$1,357	410	10.96	11.71
Lost Creek	$28,620	$16,903	$53	($11,770)	($458)	$1,844	$1,006	$14,096	$3,653	317	5.82	10.43
Minidoka-Palisades	$113,836	$85,665	$953	($29,123)	($1,344)	$5,976	$3,644	$50,953	$85	841	7.11	13.04
Total Area Support	**$459,864**	**$338,531**	**$58,388**	**($179,722)**	**($4,946)**	**$26,784**	**$8,930**	**$143,332**	**$16,859**	**2,971**	**9.02 $/MWh**	**13.69 $/MWh**
Local Support												
Boise Diversion-Anderson Ranch-Black Canyon	$29,162	$20,324	$147	($8,986)	($322)	$4,206	$294	$4,422	$18	253	16.61	19.05
Chandler-Roza	$10,578	$8,963	$1,805	($3,420)	($96)	$2,185	$105	$1,713	$2,123	161	13.56	14.80
Green Springs	$10,821	$3,134	$650	($8,338)	($39)	$581	$655	$11,145	$86	51	11.44	25.09
Total Local Support	**$50,561**	**$32,420**	**$2,602**	**($20,744)**	**($457)**	**$6,972**	**$1,054**	**$17,280**	**$2,226**	**465**	**14.99 $/MWh**	**18.24 $/MWh**
Total Power Assets	**$6,674,534**	**$4,316,306**	**$318,454**	**($2,676,682)**	**($85,249)**	**$234,966**	**$163,902**	**$2,406,137**	**$140,236**	**76,354**	**3.08 $/MWh**	**6.34 $/MWh**

/a -- Sum of the initial capital and replacement costs; capital cost of retired equipment is deducted. [FY09 ASPRJ Summary-SUMMARY2009.xls: Completed Plant]
/b -- Completed plant (previous column) with accumulated depreciation deducted and CWIP added. [FY09 ASPRJ Summary-SUMMARY2009.xls: Net Utility Plant]
/ c -- Includes effects of prior period depreciation adjustments.
/d -- Annual expense cost by dam. [Summary2009.xls: Total O&M]
/e -- For the life of a debt, BPA pays interest annually, the principle is paid as a lump sum at the end of its payment period.
BPA refinanced its debt in FY1998, resulting in slightly higher interest rates. [Appropriated Interest FY09.xls: line 128]
/f -- Remaining unpaid principle [Appropriated Interest FY09.xls: line 66]

Performance, Low Cost Power: Cost Benchmarks

The FCRPS benchmarks its hydro program annually in order to identify areas of best practice and the potential for performance improvement.

Costs benchmarked include Corps and Reclamation costs for hydropower, recreation, and joint-use purposes, and Bonneville costs for program coordination, planning, scheduling, generation dispatch, and fish and wildlife mitigation.

Because Direct Funding program costs are only a subset of all costs benchmarked, one-to-one comparisons cannot be made between the Direct Funding program and the benchmarks.

But the benchmarking results do provide useful information on the allocation of costs within the program and how FCRPS costs compare with those of its peers.

Performance, Low Cost Power: Cost Benchmarks
(O&M Costs for the FCRPS)

Public Affairs and Regulatory (49%): Recreation, fish and wildlife mitigation (including Bonneville's direct fish program), cultural stewardship, and fees for the use of land and water.

Support (16%): Human resources, fleet services, information services, security, purchasing, training, budgeting and accounting, and legal.

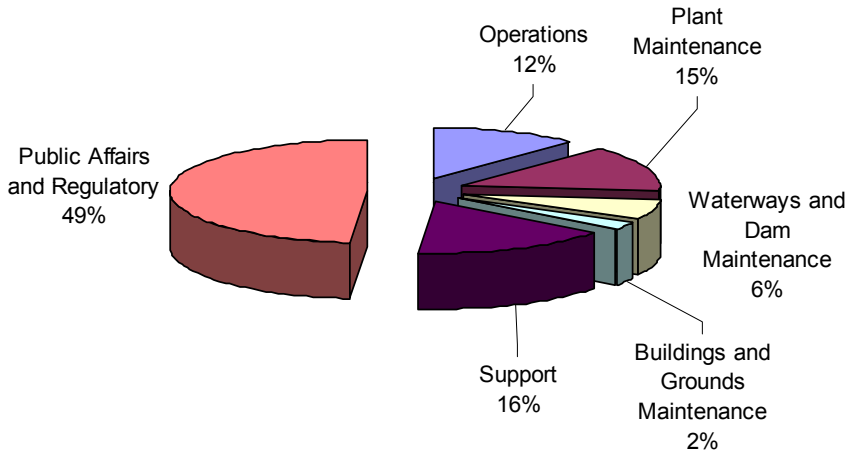
Operations (12%): On-site plant operations, off-site water management, and Bonneville's generation scheduling and dispatch.

Plant Maintenance (15%): Maintenance of generation facilities.

Waterways and Dam Maintenance (6%): Dam, spillways, and reservoir maintenance.

Buildings and Grounds Maintenance (2%).

Distribution of FCRPS O&M Costs



Performance, Low Cost Power: Cost Benchmarks

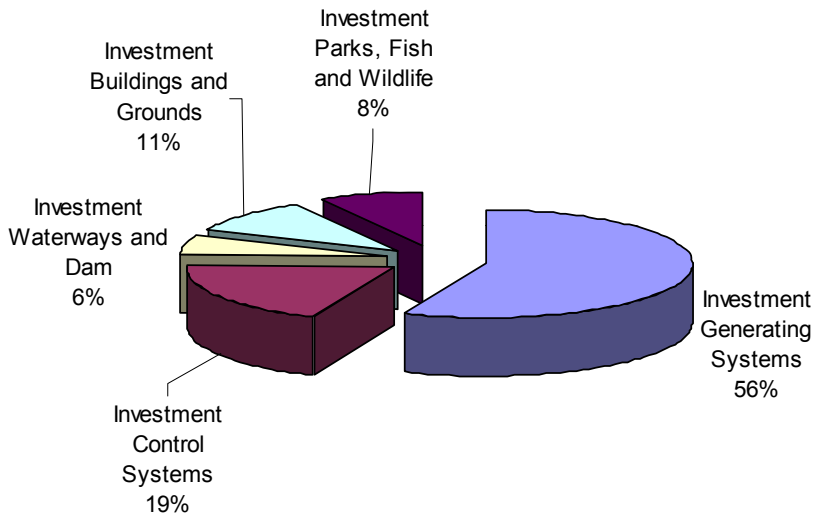
(Investment Costs for the FCRPS)

Large Capital and Extraordinary Maintenance projects to repair, replace, and enhance hydropower and joint-use equipment.

Investment is comprised of both Direct Funding and appropriated dollars.

More than half of benchmarked Investment costs are in Generating Systems, with the remainder of costs in Control Systems and other multi-purpose equipment.

Distribution of FCRPS Investment Costs



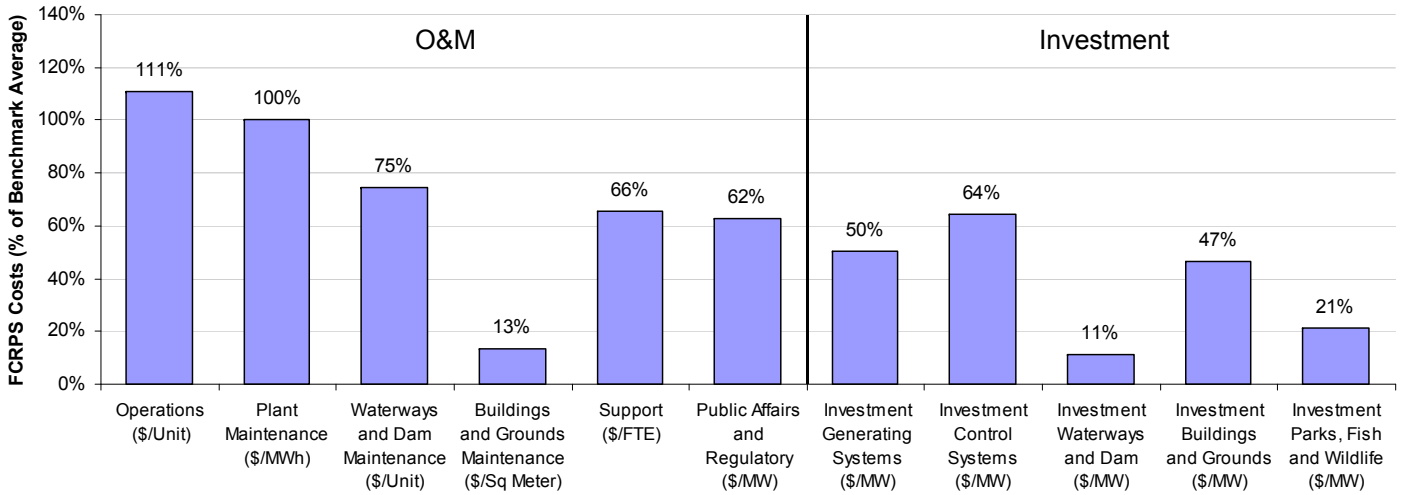
Performance, Low Cost Power: Cost Benchmarks

Most O&M Program function costs are lower than benchmark averages.

- Operations costs are 11 percent higher than benchmark averages, in part due to water management functions that reside in three FCRPS federal agencies, but also to the number of Corps plants with staffed control rooms. Much of the industry now has automated stations, which lowers Operations staffing costs significantly.
- Powerhouse maintenance costs, which are increasing as hydro plant equipment gets older.
- Operations, Plant Maintenance, and Public Affairs and Regulatory costs are above the median in each function.

Historical Investment costs are less than half of benchmark averages.

FCRPS Costs as a Percent of Benchmark Averages



Current Performance, Power Reliability

Availability: FCRPS hydro availability statistics have been fairly stable over the past five years. The availability factor averages 84 percent, ranging from 83 percent in 2005 to nearly 86 percent in 2006.

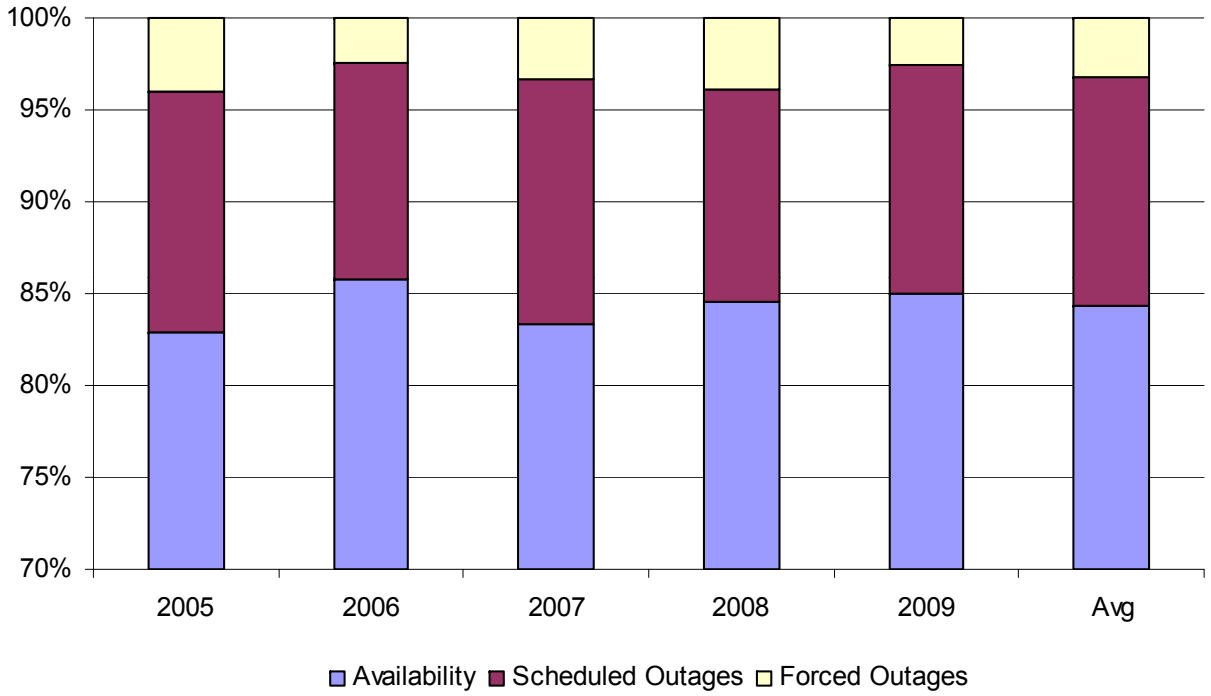
Scheduled Outage Factor: The scheduled outage factor averages 12.5 percent, one-third higher than the industry average of 9.4 percent, in part due to extended outages for extraordinary maintenance projects, capital projects, and fish screen maintenance.

Forced Outage Factor: The forced outage factor is 3.2 percent, also above the industry average of 3.0 percent. The 2009 rate was 2.5 percent, the lowest rate in several years. The 2009 rate would have been lower if not for the powerhouse fire that took Detroit and Big Cliff out of service; and bearing, rotor, and generator failures at Bonneville.

Number of Instances: Other measures important to power reliability include the number of startup failures and number of forced outages. For the system, forced outages average about 2.5 per unit per year. Nearly 25 percent of forced outages are Fish and Transmission related.

Current Performance, Power Reliability

FCRPS Hydro Availability Statistics



Number of Instances

Measure	2005	2006	2007	2008	2009	5-yr Avg.
Startup Failures	11	18	10	18	11	14
Forced Outages	587	521	479	487	375	490

Current Performance, Trusted Stewardship

Avoided CO2 Emissions: The U.S. economy produces six billion tons of CO2 emissions each year, one third of which is produced by the electric power sector. The majority of electricity derived CO2 is produced by coal-fired power plants, with considerably less produced by natural gas and petroleum generation.

FCRPS hydro delivers positive climate change benefits by reducing the amount of emissions for electricity that would be generated by other sources were the hydro system not available.

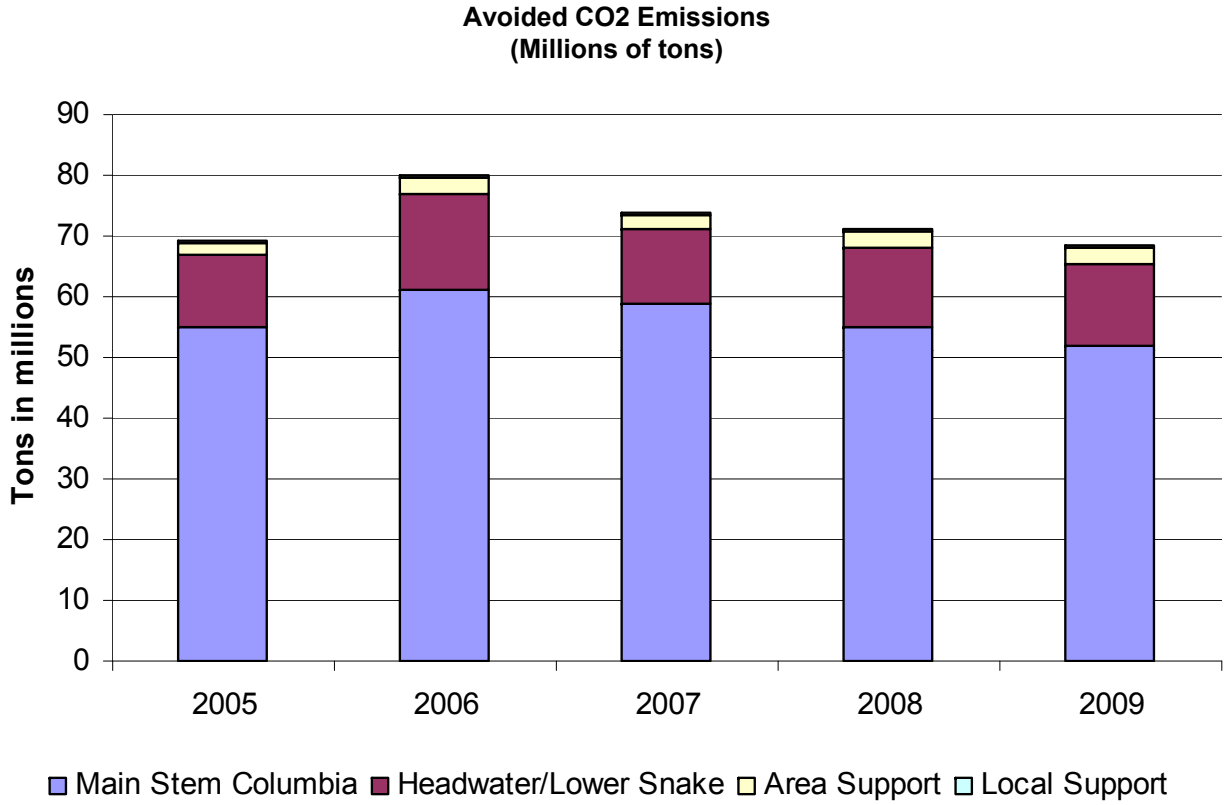
In an average water year, the FCRPS reduces the CO2 footprint of a coal-fired alternative by 78 million tons – over one percent of total U.S. emissions.

Safety: The number of lost time accidents per 200,000 person-hours averaged 1.9 over the past five years.

The results show that management of the safety program remains effective even during this period of growth in the large capital and extraordinary maintenance expense programs.

This work involves activities that are non-routine and higher risk, presenting increased challenges to the workforce safety environment. The safety program also faces additional challenges related to an aging workforce.

Current Performance, Trusted Stewardship



Lost Time Accidents per 200,000 person-hours

Measure	2005	2006	2007	2008	2009	5-yr Avg.
Lost Time Accident Rate	1.6	1.3	1.9	3.3	1.2	1.9

Condition Overview

The FCRPS manages 196 generating units in 31 hydro plants, plus 16 additional station service, fish, and pump turbine units. Overall, it considers more than 5,500 equipment components in maintenance and investment planning.

Component condition is a key driver of maintenance and investment needs.

- Routine maintenance activities identify and address deficiencies prior to their posing threats to equipment reliability.
- Even with effective maintenance programs, condition will eventually deteriorate to the point where inadequate reliability will warrant re-investment.

There are few redundant or spare components in hydroelectric generating facilities and, as such, it is important that the condition of major components be understood and managed.

In the 2009 System Asset Plan, hydroAMP was used to assess the condition of seven power train components: unit transformers, generator windings, generator rotors, exciters, governors, unit breakers, and turbine runners. In this strategy, the hydroAMP framework is used to develop a complementary condition rating system for assessing condition of other equipment for which hydroAMP guides are not available. While the list of equipment components evaluated in this strategy is not yet comprehensive, it is significantly larger than before.

Condition Ratings

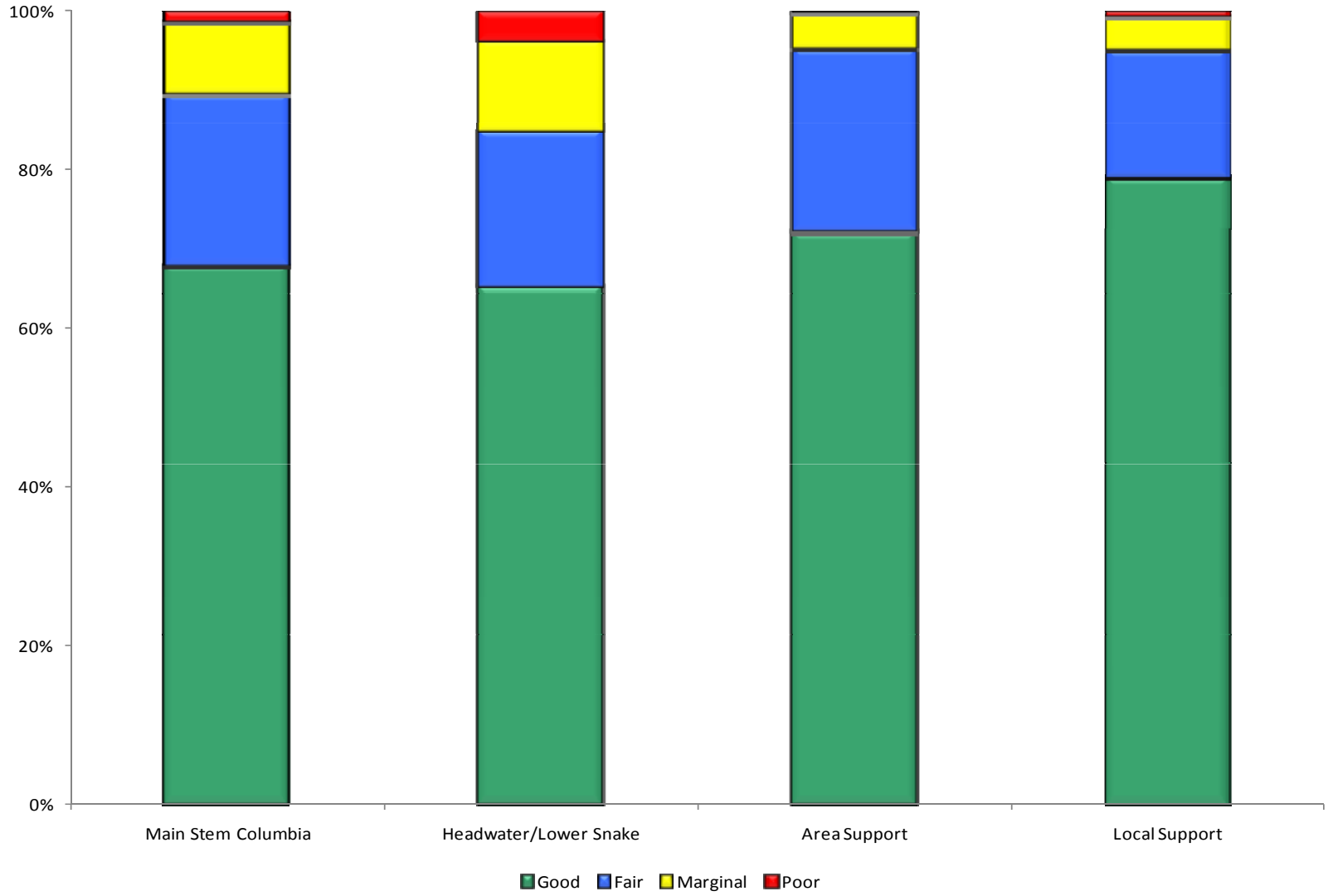
Condition ratings for each equipment type are based on a set of objective condition indicators related to operational performance, maintenance history, physical inspection, and age. Condition indicators are weighted and summed to derive a condition rating, ranging from 10 to 0. Numeric scores are further described qualitatively as follows:

- 8.0 – 10.0: Good
- 6.0 – 7.9: Fair
- 3.0 – 5.9: Marginal
- 0.0 – 2.9: Poor

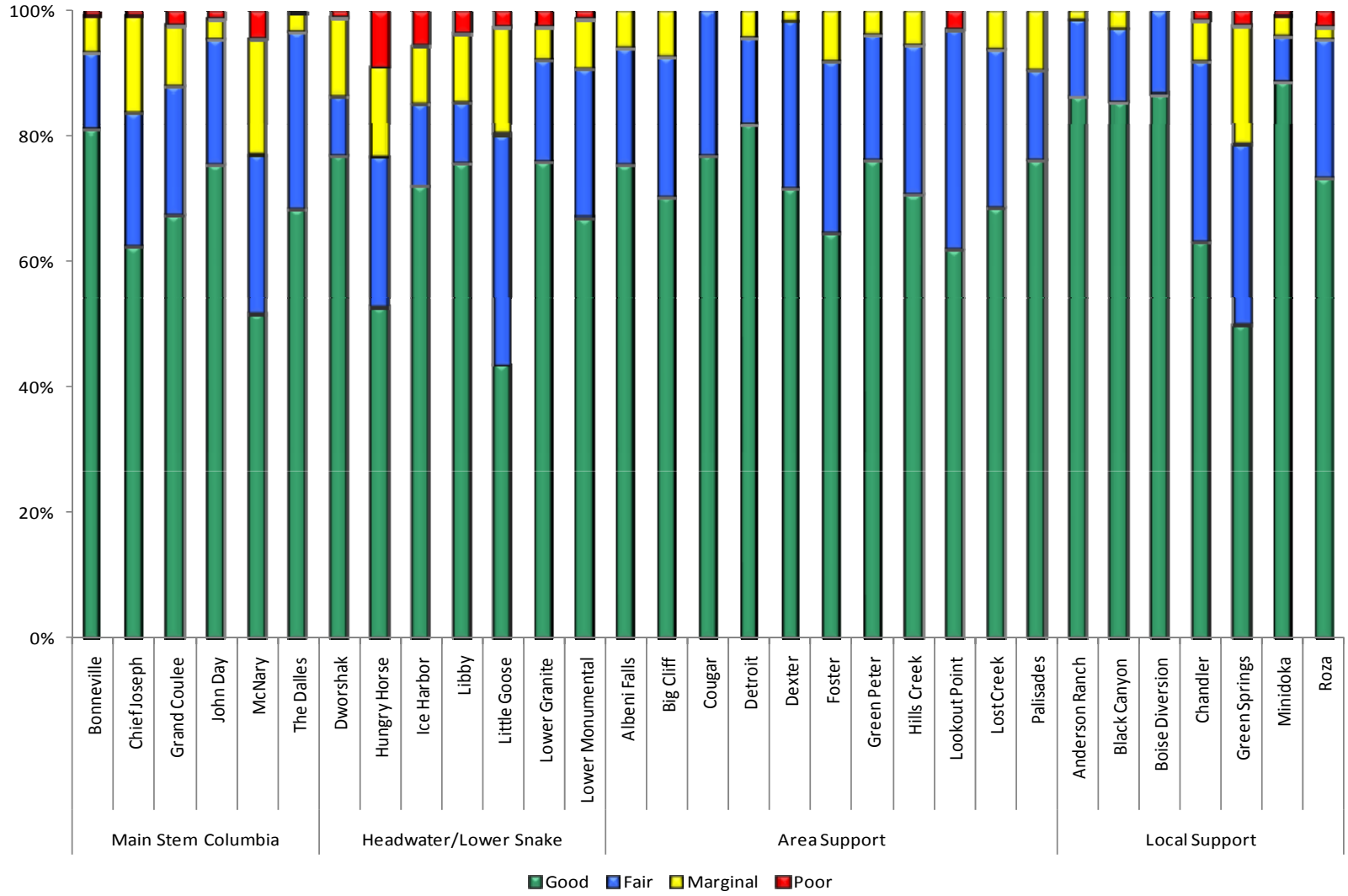
Condition by Strategic Class: About 85 percent of all equipment at Main Stem Columbia and Headwater/Lower Snake plants is currently in Good or Fair condition. Area Support and Local Support plants as a group have somewhat higher condition ratings.

Condition by Plant: Average condition rating by plant varies, with three critical plants – Chief Joseph, Grand Coulee, and McNary – having below average ratings.

Current Condition by Strategic Class: All Equipment



Current Condition by Plant: All Equipment



Component Condition

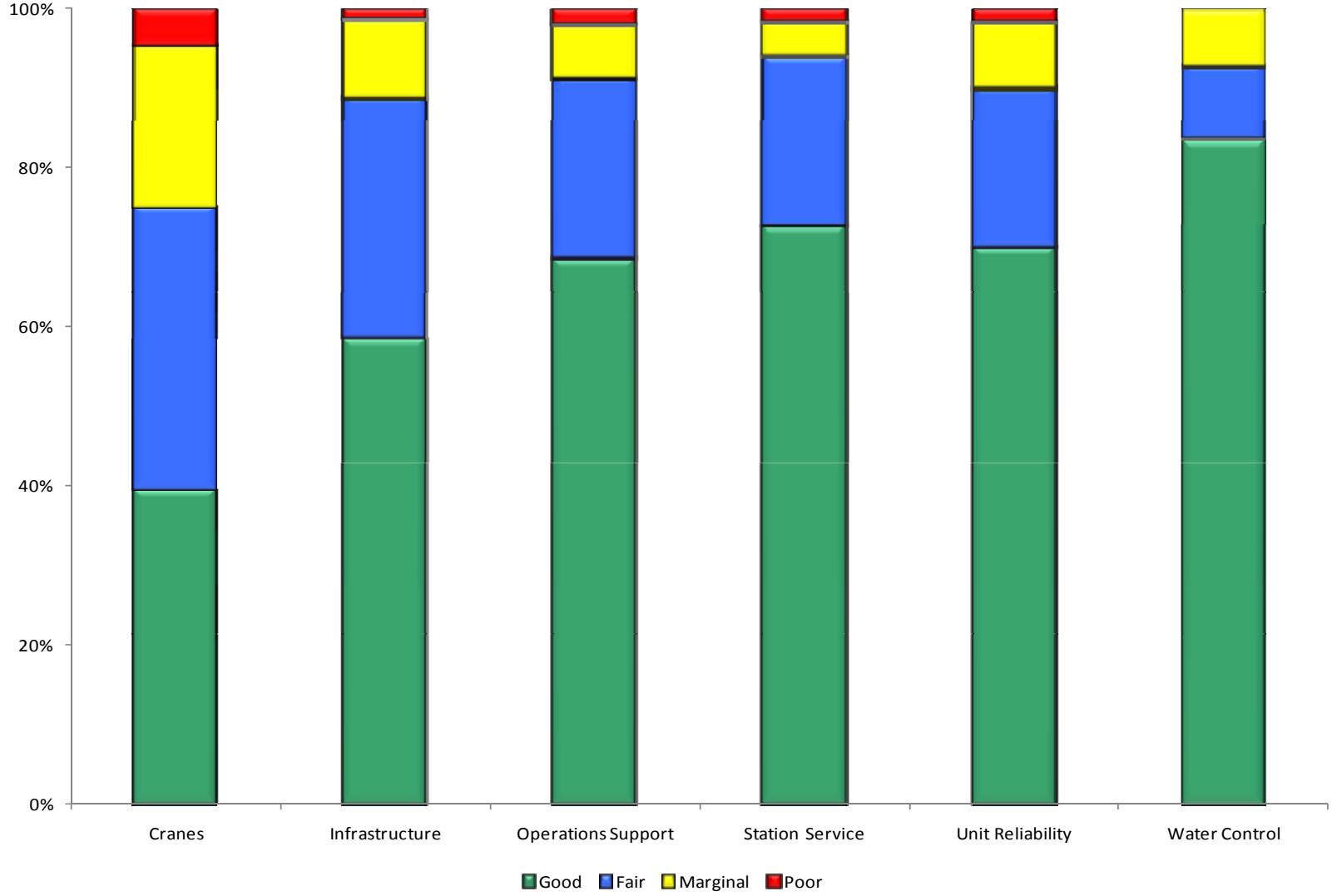
Condition by Component Type: Cranes have the lowest overall condition rating among equipment types, followed by infrastructure and operations support. Because cranes are needed to lift heavy equipment (including generation affecting equipment) and present considerable safety risk, satisfactory condition is a priority.

Station service, unit reliability and water passage systems have relatively higher condition ratings.

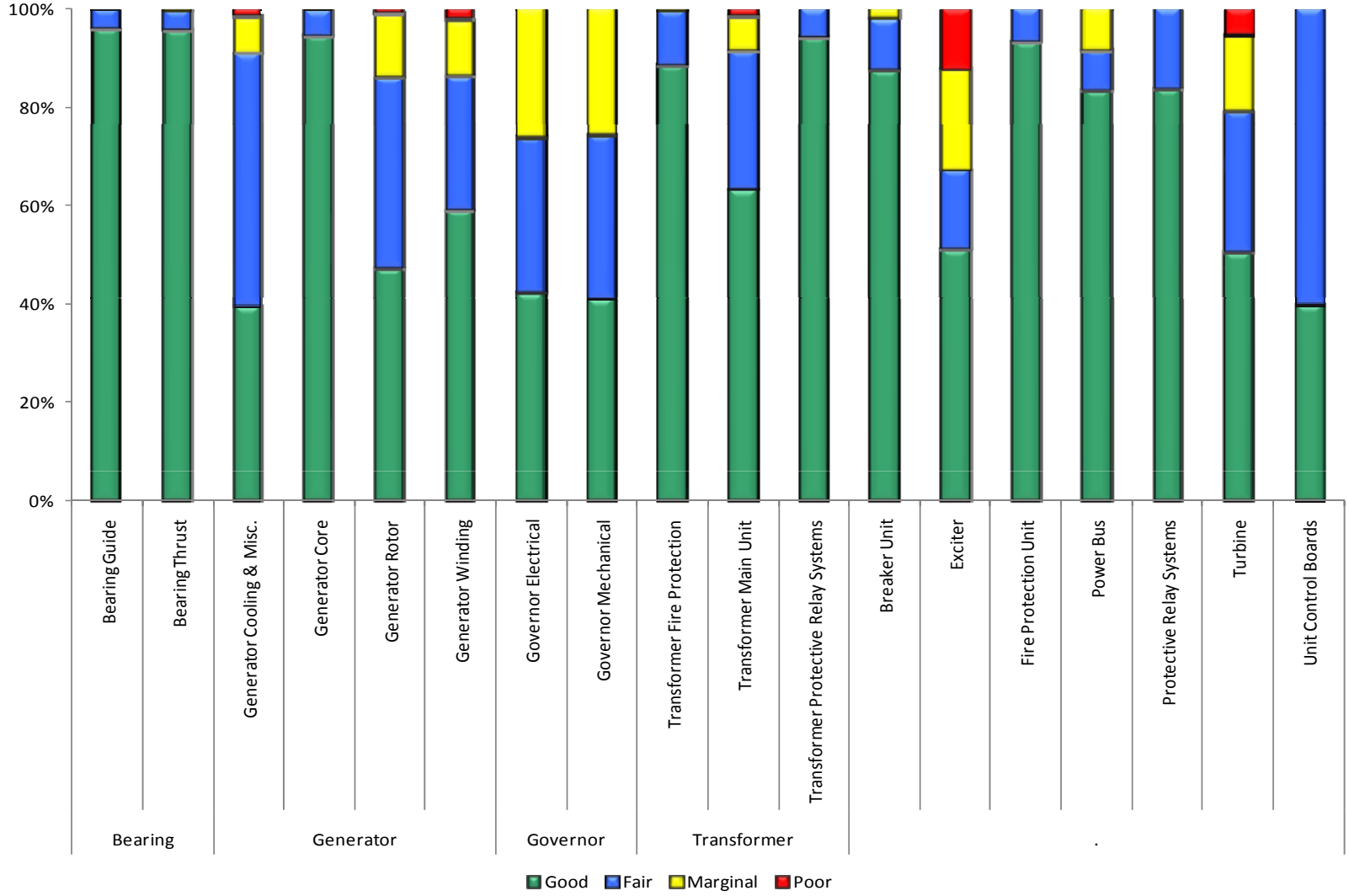
Unit Reliability: This strategy identifies 18 equipment types related to unit reliability.

- The condition of transformers, generator rotors, and stators has declined slightly since the 2009 plan.
- The condition of exciters and turbines has improved.
- The condition of governors and unit breakers is essentially unchanged.
- Most other unit reliability equipment is in Good or Fair condition.
- Generally, hydroAMP rated equipment types have lower condition ratings than equipment without hydroAMP guides. This results in an average rating for unit reliability equipment in this 2012 strategy that is higher than the average for hydroAMP rated equipment in the 2009 plan.

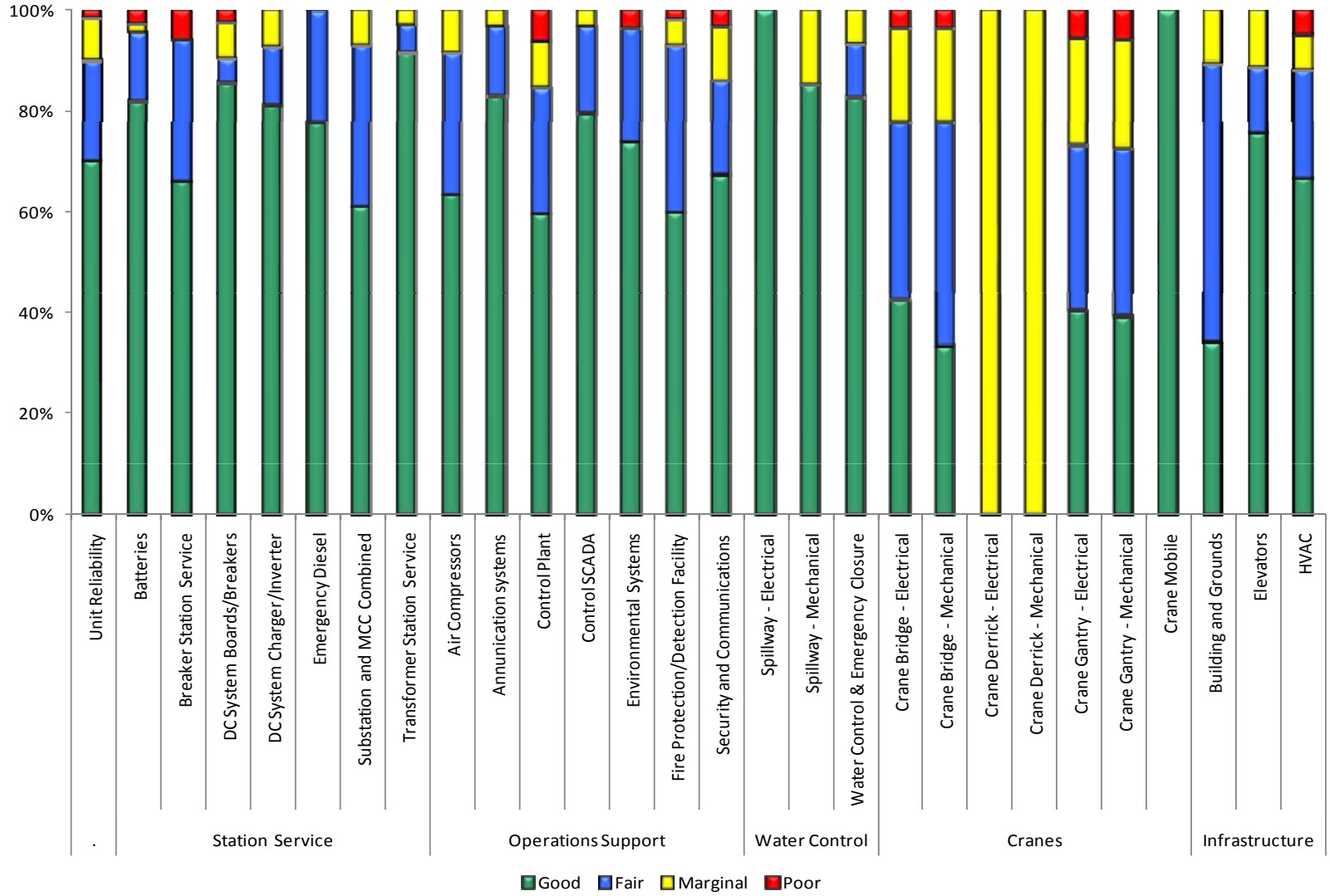
Current Condition by Equipment Type



Current Condition: Unit Reliability Equipment



Current Condition: All Equipment



Age of Equipment

Background: Near term investment needs are driven primarily by component condition and risk.

However, understanding component age helps to establish if equipment is nearing the end of its useful life and may soon present a risk to asset performance.

Furthermore, when age is profiled for the entire equipment portfolio it can become a tool to identify if near-term investment strategies could result in future investment needs that create unacceptable financial pressures or resource constraints.

The FCRPS has created age profiles of its facilities using “percent of design life” as a primary measure. For example, a 30 year old component with a design life of 40 years is represented as being at 75 percent of design life.

This allows comparison across component types, recognizing that design life can vary considerably across component types or designs.

Age of Equipment

For presentation purposes, component ages have been grouped into four categories to create asset profiles. These categories are as follows:

- Less than 50 percent of design life;
- 50 to 100 percent of design life;
- 100 to 150 percent of design life, and
- Greater than 150 percent of design life.

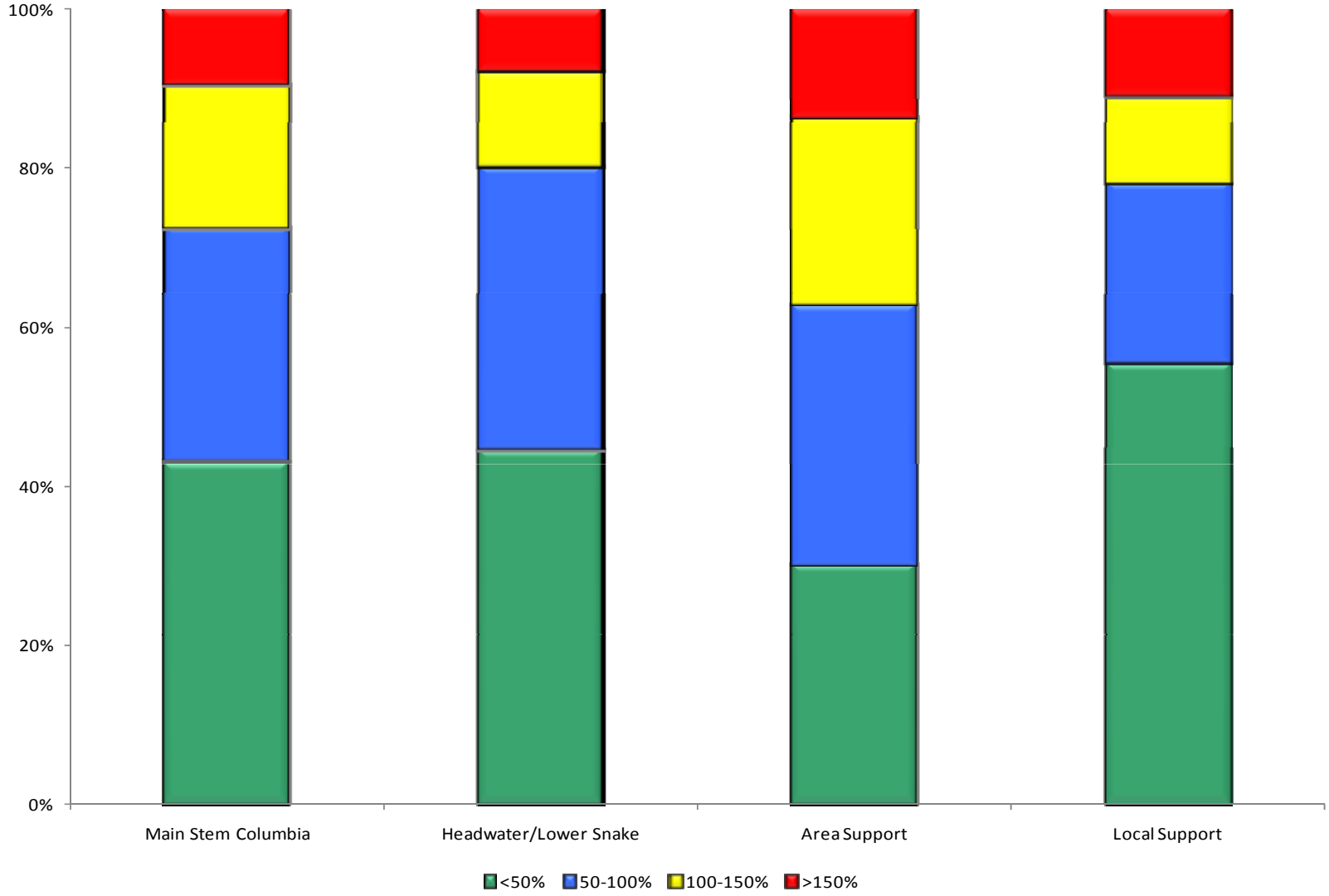
Current Age by Strategic Class:

- 25 percent of all equipment has exceeded its design life in the Main Stem, Headwater/Lower Snake and Local Support classes.
- For the Area Support class, nearly 40 percent of equipment has exceeded design life.

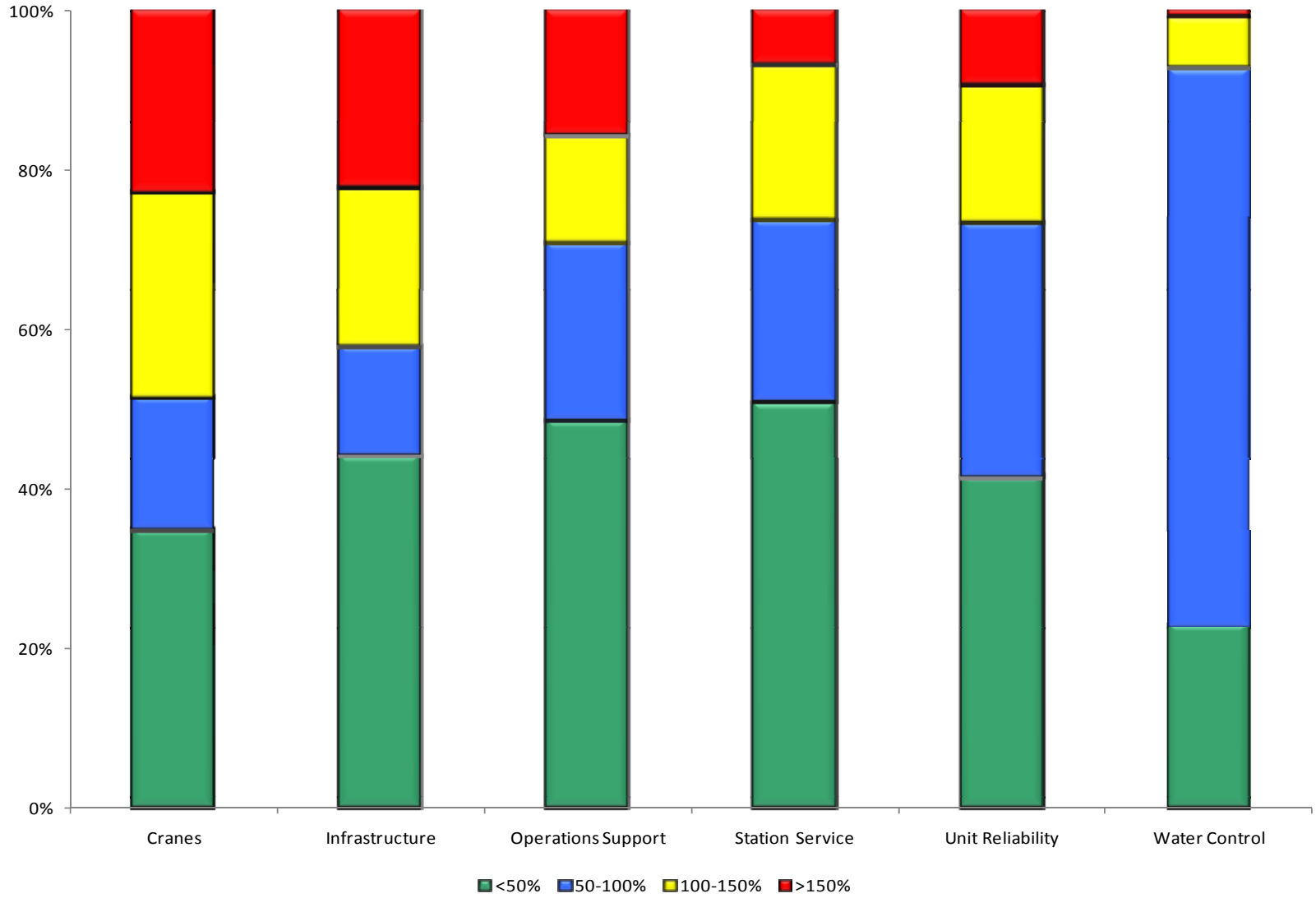
Current Age by Equipment Type:

- Nearly 50 percent of cranes and infrastructure equipment has exceeded design life. The combination of condition and age make cranes a likely candidate for re-investment.
- Water control equipment (spillway electrical/mechanical and emergency closure) has the fewest percentage of components exceeding design life.

Current Age by Strategic Class: All Equipment
(Percent of Design Life)



Current Age by Equipment Type
(Percent of Design Life)



Risk Assessment

FCRPS hydro asset management related risks are managed collaboratively by Bonneville's Federal Hydro Projects organization, the Bureau of Reclamation and Corps of Engineers. Asset management is the collective and collaborative efforts of these organizations.

Key requirements related to Bonneville's long-term outcomes are that the FCRPS:

- Meets equipment availability requirements (machine availability);
- Meets generation reliability standards, including compliance with WECC/NERC standards;
- Meets environmental requirements, particularly as related to management of water resources and equipment for fisheries purposes; and,
- Meets safety and security requirements.

Risk areas that could affect the long-term outcomes include the following:

- Failure of power train components;
- Failure of other generating station components not directly tied to the power system;
- Failure of Transmission assets;
- Effectiveness of security systems;
- Acts of nature; and
- Legal, regulatory and policy decisions that affect hydro operations or investment needs.

Failure of Hydro Plant Equipment

Loss of hydro plant equipment can lead to a number of negative consequences, including:

- Economic losses as a result of the need to replace components;
- Economic losses as a result of the need to purchase replacement power to meet contractual obligations, or lost opportunities to sell power to the market;
- Safety issues, should the catastrophic failure of a component cause injury or death;
- Environmental impacts such as the off-site release of oil;
- Regulatory violations through an inability to meet preferred unit operation, temperature controls, or Total Dissolved Gas (TDG) limits;
- Operational and Transmission support impacts such as unplanned spill or inability to provide reserves, voltage support, or capacity at peak periods, and
- Other stakeholder impacts such as lost pumping ability for Reclamation's irrigation customers.

The risk of equipment failure is assessed using two tools:

- Risk maps for safety, environmental and financial risk, and
- By quantifying lost generation risk.

Risk: Condition Index vs. Likelihood of Failure

The hydro program correlates a condition rating with the likelihood of equipment failing to perform as expected. An equipment component with a low condition rating has a higher likelihood of failure than one with a higher rating. The correlation is shown below.

Likelihood	Condition Index	Description
Almost Certain	0 to 0.9	Poor
	1 to 1.9	
Likely	2 to 2.9	
	3 to 3.9	Marginal
Possible	4 to 4.9	
	5 to 5.9	
Unlikely	6 to 6.9	Fair
	7 to 7.9	
Rare	8 to 8.9	Good
	9 to 10	

Safety and Environmental Risk Maps

Risk is the product of likelihood and consequence. Two items with the same potential consequence will have different levels of risk if the likelihood of occurrence differs.

On the following maps, both safety and environmental risks are identified as being high, medium, or low.

- Safety consequences range from a low of “first aid required” to a high of “multiple fatalities”.
- Environmental consequences range from “no impact” to “detrimental or catastrophic off-site impact”.

Safety: There are currently few high risk items in this area:

- Water control (1)
- Operations support (4)

Environmental: Similarly, there are currently only six items at high risk:

- Water control (1)
- Operations support (5)

Current Safety Risk Map

Likelihood							Condition Index
	Almost Certain	22 Unit Reliability 2 Infrastructure	8 Station Service 2 Operations Support 2 Cranes	3 Operations Support			0 to 0.9 1 to 1.9
	Likely	60 Unit Reliability 6 Station Service 1 Operations Support 5 Infrastructure	11 Unit Reliability 1 Station Service 2 Operations Support 9 Cranes	6 Unit Reliability 1 Station Service 7 Operations Support 12 Cranes	1 Operations Support	1 Water Control	2 to 2.9 3 to 3.9
	Possible	257 Unit Reliability 19 Station Service 7 Operations Support 4 Infrastructure	13 Unit Reliability 3 Station Service 1 Operations Support 3 Water Control 15 Cranes 7 Infrastructure	16 Unit Reliability 2 Station Service 12 Operations Support 16 Cranes	3 Operations Support	1 Unit Reliability 14 Water Control	4 to 4.9 5 to 5.9
	Unlikely	525 Unit Reliability 96 Station Service 26 Operations Support 40 Infrastructure	136 Unit Reliability 40 Station Service 25 Operations Support 43 Cranes 8 Infrastructure	72 Unit Reliability 5 Station Service 30 Operations Support 34 Cranes	19 Operations Support	28 Unit Reliability 23 Water Control	6 to 6.9 7 to 7.9
	Rare	1858 Unit Reliability 264 Station Service 59 Operations Support 6 Water Control 47 Infrastructure	363 Unit Reliability 125 Station Service 111 Operations Support 17 Water Control 45 Cranes 46 Infrastructure	161 Unit Reliability 87 Station Service 99 Operations Support 41 Cranes	34 Operations Support	282 Unit Reliability 183 Water Control	8 to 8.9 9 to 10
		No or minor injury, first aid	Treatment by medical professional	Lost time Accident - temporary disability	Lost Time Accident - permanent disability/fatality	Multiple fatalities	

Consequence

Risk Level	Low	Medium	High

Current Environmental Risk Map

Likelihood							Condition Index
	Almost Certain	18 Unit Reliability 2 Cranes 2 Infrastructure	4 Unit Reliability 8 Station Service	3 Operations Support	2 Operations Support		0 to 0.9 1 to 1.9
	Likely	41 Unit Reliability 6 Station Service 1 Operations Support 9 Cranes 5 Infrastructure	30 Unit Reliability 1 Station Service 1 Operations Support	6 Unit Reliability 1 Station Service 9 Operations Support 12 Cranes		1 Water Control	2 to 2.9 3 to 3.9
	Possible	195 Unit Reliability 19 Station Service 7 Operations Support 15 Cranes 11 Infrastructure	75 Unit Reliability 3 Station Service	17 Unit Reliability 2 Station Service 16 Operations Support 3 Water Control 16 Cranes		14 Water Control	4 to 4.9 5 to 5.9
	Unlikely	408 Unit Reliability 96 Station Service 26 Operations Support 43 Cranes 48 Infrastructure	253 Unit Reliability 40 Station Service 5 Operations Support	100 Unit Reliability 5 Station Service 57 Operations Support 34 Cranes	12 Operations Support	23 Water Control	6 to 6.9 7 to 7.9
	Rare	1652 Unit Reliability 264 Station Service 59 Operations Support 45 Cranes 93 Infrastructure	569 Unit Reliability 125 Station Service 23 Operations Support	443 Unit Reliability 87 Station Service 182 Operations Support 23 Water Control 41 Cranes	39 Operations Support	183 Water Control	8 to 8.9 9 to 10
		No impact	Impact to on-site environment (simple remediation)	Limited impact off-site (localized remediation required)	Detrimental impact on- or off-site (long-term remediation required)	Detrimental or catastrophic impact off-site (mitigation impossible)	

Consequence

Risk Level	Low	Medium	High

Current Financial Risk Map

The financial risk map is segmented into high, medium-high, medium, and low risk areas.

Financial consequences are a result of two factors in the event of a failure:

- The cost of replacement power for any lost generation, and
- Incremental direct costs for collateral damage, procurement, and scheduling/workforce inefficiencies.

There are currently 263 equipment items on the high risk area of the map. Of these, 171 are in marginal or poor condition (condition index of less than 6.0)

The majority of high risk items are unit reliability related (233), which are generation affecting and therefore include a cost for replacement power. Of these, 149 are in marginal or poor condition.

Current Financial Risk Map

Likelihood		Insignificant	Minor	Moderate	Major	Extreme	Condition Index
	Almost Certain		8 Station Service 1 Operations Support	4 Operations Support 2 Cranes 2 Infrastructure	17 Unit Reliability	5 Unit Reliability	0 to 0.9 1 to 1.9
	Likely	1 Operations Support	2 Operations Support	9 Unit Reliability 2 Station Service 7 Operations Support 9 Cranes 3 Infrastructure	46 Unit Reliability 6 Station Service 1 Operations Support 1 Water Control 12 Cranes 2 Infrastructure	22 Unit Reliability	2 to 2.9 3 to 3.9
	Possible	7 Operations Support	3 Operations Support	9 Unit Reliability 7 Station Service 13 Operations Support 13 Water Control 17 Cranes 11 Infrastructure	219 Unit Reliability 17 Station Service 4 Water Control 14 Cranes	59 Unit Reliability	4 to 4.9 5 to 5.9
	Unlikely	26 Operations Support	55 Unit Reliability 37 Station Service 19 Operations Support 19 Infrastructure	153 Unit Reliability 26 Station Service 50 Operations Support 7 Water Control 41 Cranes 25 Infrastructure	469 Unit Reliability 71 Station Service 5 Operations Support 15 Water Control 36 Cranes 4 Infrastructure	84 Unit Reliability 7 Station Service 1 Water Control	6 to 6.9 7 to 7.9
	Rare	59 Operations Support 2 Infrastructure	369 Unit Reliability 83 Station Service 68 Operations Support 9 Water Control 3 Cranes 6 Infrastructure	425 Unit Reliability 184 Station Service 152 Operations Support 116 Water Control 47 Cranes 79 Infrastructure	1584 Unit Reliability 198 Station Service 20 Operations Support 74 Water Control 36 Cranes 6 Infrastructure	286 Unit Reliability 11 Station Service 4 Operations Support 7 Water Control	8 to 8.9 9 to 10
		< $ 10K	$ 10K to $ 100K	$ 100K to $ 1 M	$ 1 M to $ 10 M	> $ 10 M	

Consequence

Risk Level	Low	Medium	Medium High	High

Current Lost Generation Risk

Failure likelihood and consequence information is further evaluated to quantify the expected value of lost generation as Lost Generation Risk.

- Equipment condition correlates to a probability of failure for each component.
- These probabilities are multiplied by the lost generation consequence for each component to calculate the Lost Generation Risk (LGR), i.e., the replacement power cost risk associated with a run-to-failure strategy.

The current LGR for the system is about 508 aMW ($249 million), about 50 percent higher than in the 2009 plan (334 aMW).

- The 2009 plan identified LGR for only seven equipment categories, whereas in this strategy, 21 equipment categories have a lost generation consequence.
- For the seven categories evaluated in the 2009 plan, the corresponding LGR in this strategy is nearly unchanged (336 aMW), indicating that improvements in condition of some equipment over the past two years have been largely offset by declines in the condition of other equipment.

Current Lost Generation Risk by Class and Plant

Nearly two thirds of current LGR is in the Main Stem Columbia class ($161 million, 328 aMW).

McNary has 144 aMW of LGR, or $71 million, driven by several factors:

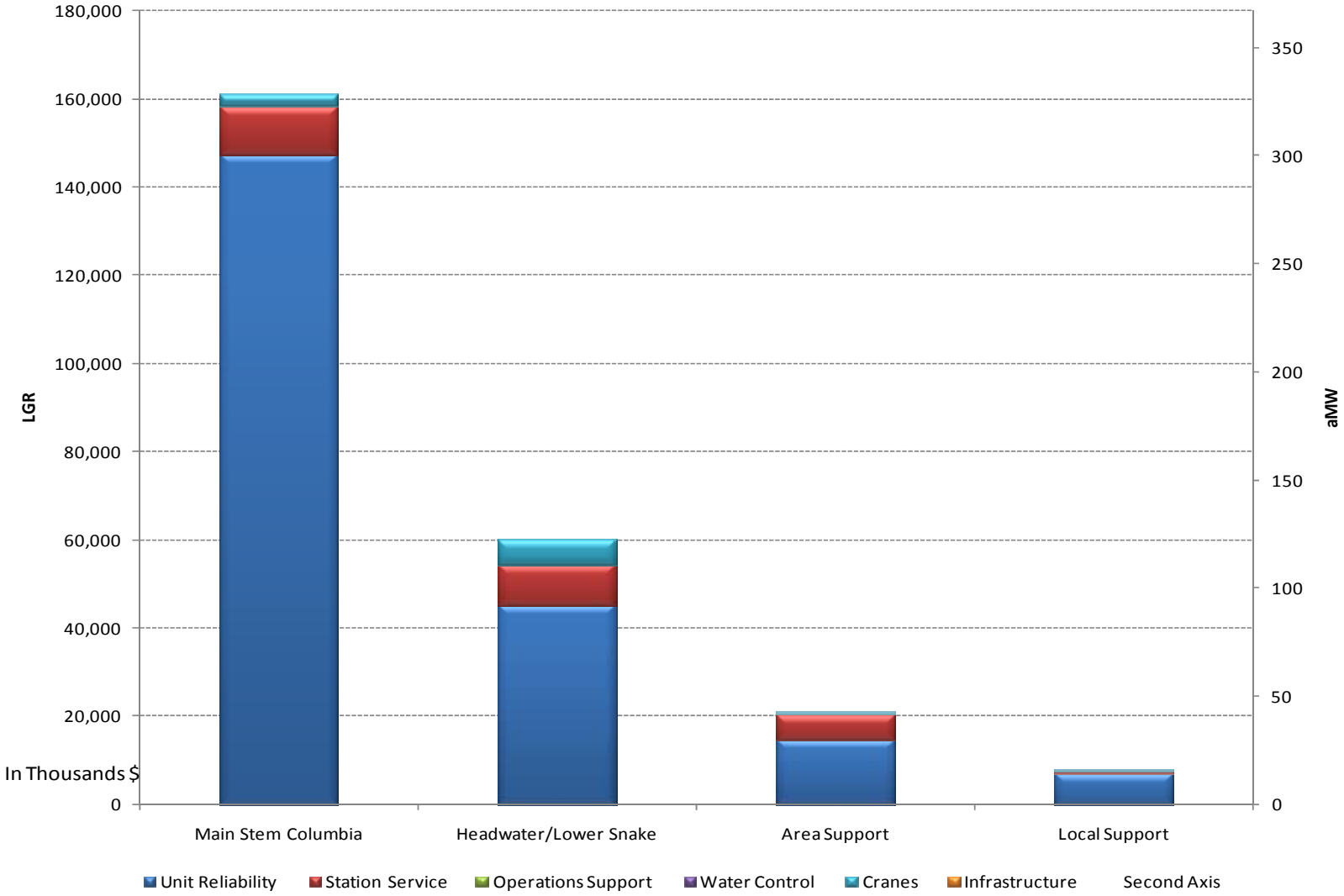
- Generally poor condition of generator stators, turbines, governors, and exciters;
- Many pieces of equipment at risk; and,
- It is a hydraulic bottleneck on the lower river, which results in high lost generation in the event of an outage.

Grand Coulee has 94 aMW of LGR ($47 million), attributable mostly to generator windings, transformers, and exciters.

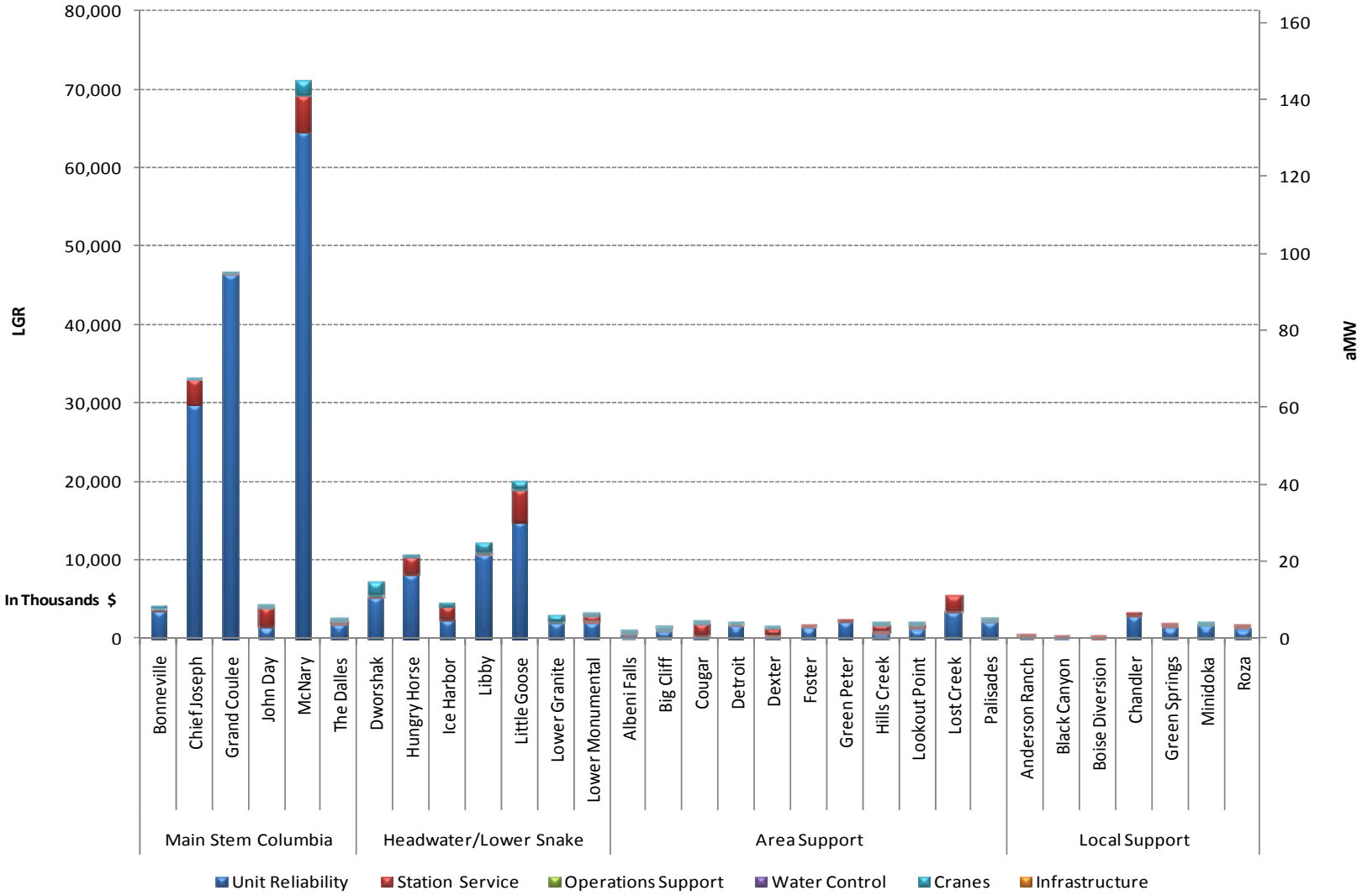
Chief Joseph has 67 aMW of LGR ($33 million) driven mostly by the condition of turbines, governors, and exciters.

Most other plants have LGR of less than 10 aMW.

Current Lost Generation Risk by Strategic Class



Current Lost Generation Risk by Plant



4. O&M Program

Routine Operations
Routine Maintenance
Non-Routine Maintenance
Small Capital

O&M Program
(from 2008 Integrated Program Review)

O&M Program costs included here are from the 2008 Integrated Program Review and were not updated for this 2012 strategy.

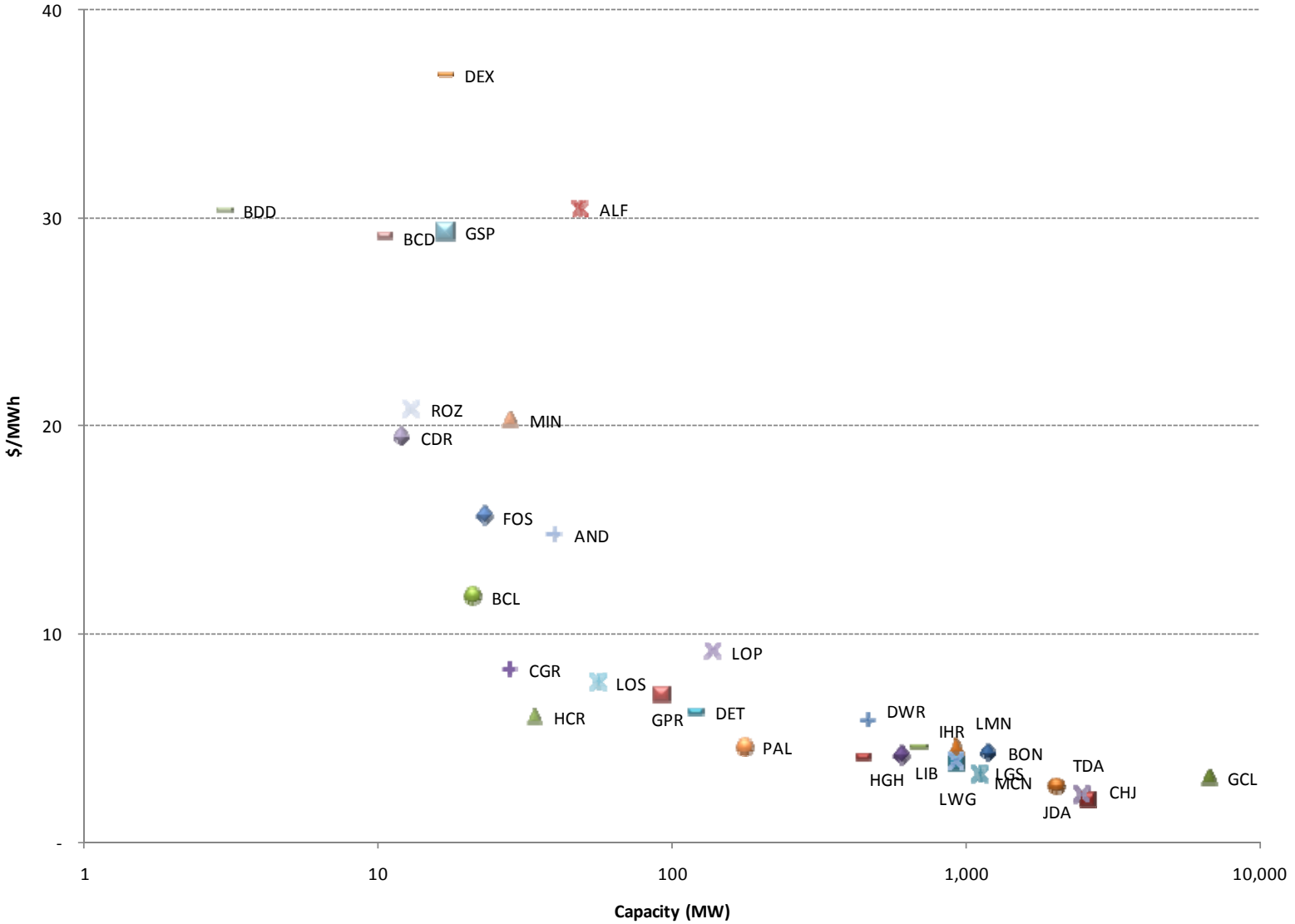
The O&M Program reflects core funding for maintenance, operations, and minor equipment replacements, and is largely driven by the staffing needs of each facility. Typically, there is an economy of scale where larger plants have a lower unit cost of production than smaller plants.

O&M forecast for FY2012 – FY2013:

- Ranges from about $2/MWh at Chief Joseph to $36/MWh at Dexter.
- Twenty plants have an O&M forecast of less than $10/MWh.
- The forecast for the entire system is about $3.50/MWh of production ($273 million).

This strategy does not address the sensitivity of key O&M Program inputs on the performance, condition, and risk of the hydro system. O&M costs are included here only to reflect the total cost of the hydro program when evaluating plan economics.

O&M Forecast for FY2012 – FY2013
(from 2008 Integrated Program Review)



O&M Program Forecast
(from 2008 Integrated Program Review)

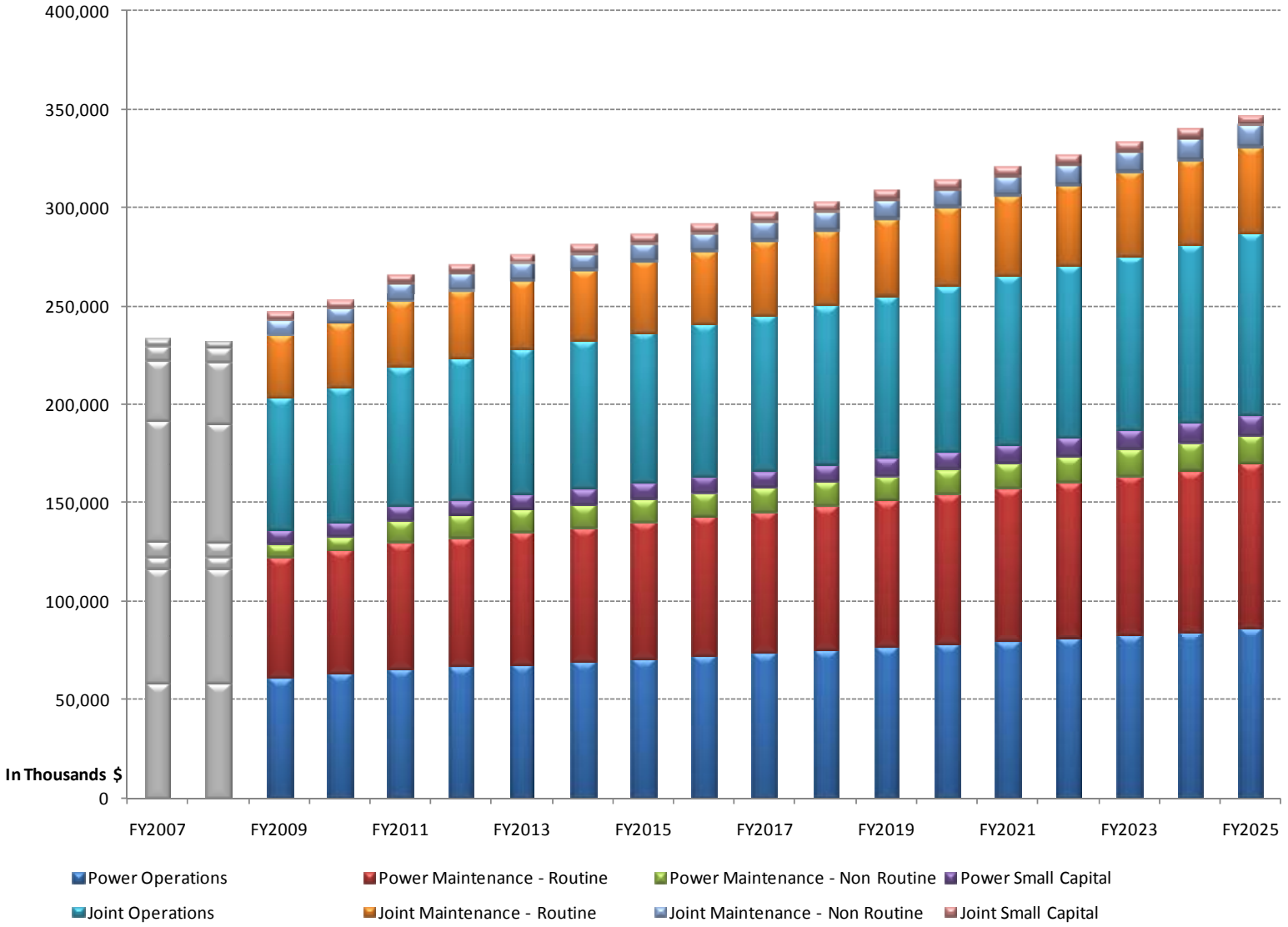
As stated in section 2, the direct funded Operations and Maintenance (O&M) Program is segmented into Power (for spending on hydropower components) and Joint (for spending on equipment that serves multiple purposes which are partially funded by Bonneville through Direct Funding arrangements). Power and Joint costs are further segmented accordingly:

- **Operations**: day-to-day costs for operating power and joint-use facilities;
- **Routine Maintenance:** day-to-day costs for inspection, preventive maintenance, and unscheduled repairs;
- **Non-Routine Maintenance**: recurring maintenance that is performed on a cycle greater than one year, and
- **Small Capital:** allowances for maintenance-related replacement of small components but by virtue of accounting treatment is capitalized.

About 70 percent of O&M Program costs are for labor, therefore, absent any strategic initiative related to labor, program costs should increase at about the rate of inflation.

- Forecasts for FY2009 to FY2011 increase at 3 percent per year to account for wage rate increases.
- From FY2012 to FY2027, forecasts increase with inflation, forecasted at 1.7 percent per year.

O&M Program Forecast
(from 2008 Integrated Program Review)



5. Currently Committed Investment Program

Large Capital
Extraordinary Maintenance Expense

Committed Large Capital

The Large Capital Program includes:

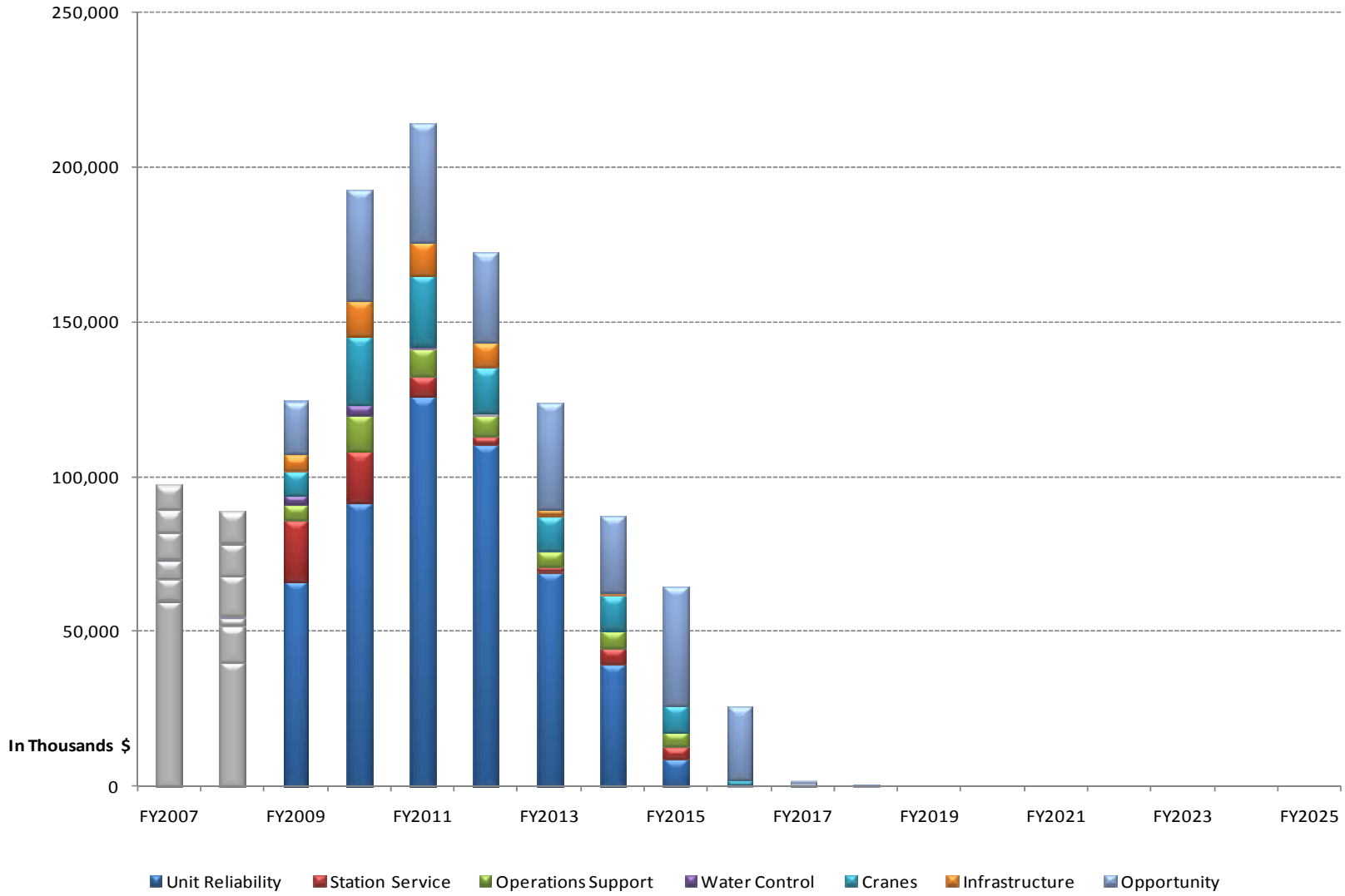
- Reliability driven replacement of capital components, with the exception of smaller, "maintenance capital" replacements that are funded within the O&M Program;
- Economic opportunity investments to existing assets that are undertaken to improve system performance (e.g., turbine runner replacements to improve efficiency), and
- Investment in new assets at existing facilities, also based on economic opportunities.

Committed Large Capital Program: The currently committed capital program is work that has been identified, agreed to, and initiated, primarily through the Capital Program business process, but also by analyses conducted for the 2009 Hydro Asset Plan.

Committed Large Capital by Equipment Category: The currently committed Large Capital Program is $881 million for FY2010 – FY2017. The breakdown of commitments by equipment category is as follows:

• Unit reliability	$446 million
• Station service	$37
• Operations support	$43
• Water control	$5
• Cranes	$91
• Infrastructure	$34
• Opportunity	$224

Committed Large Capital by Equipment Category



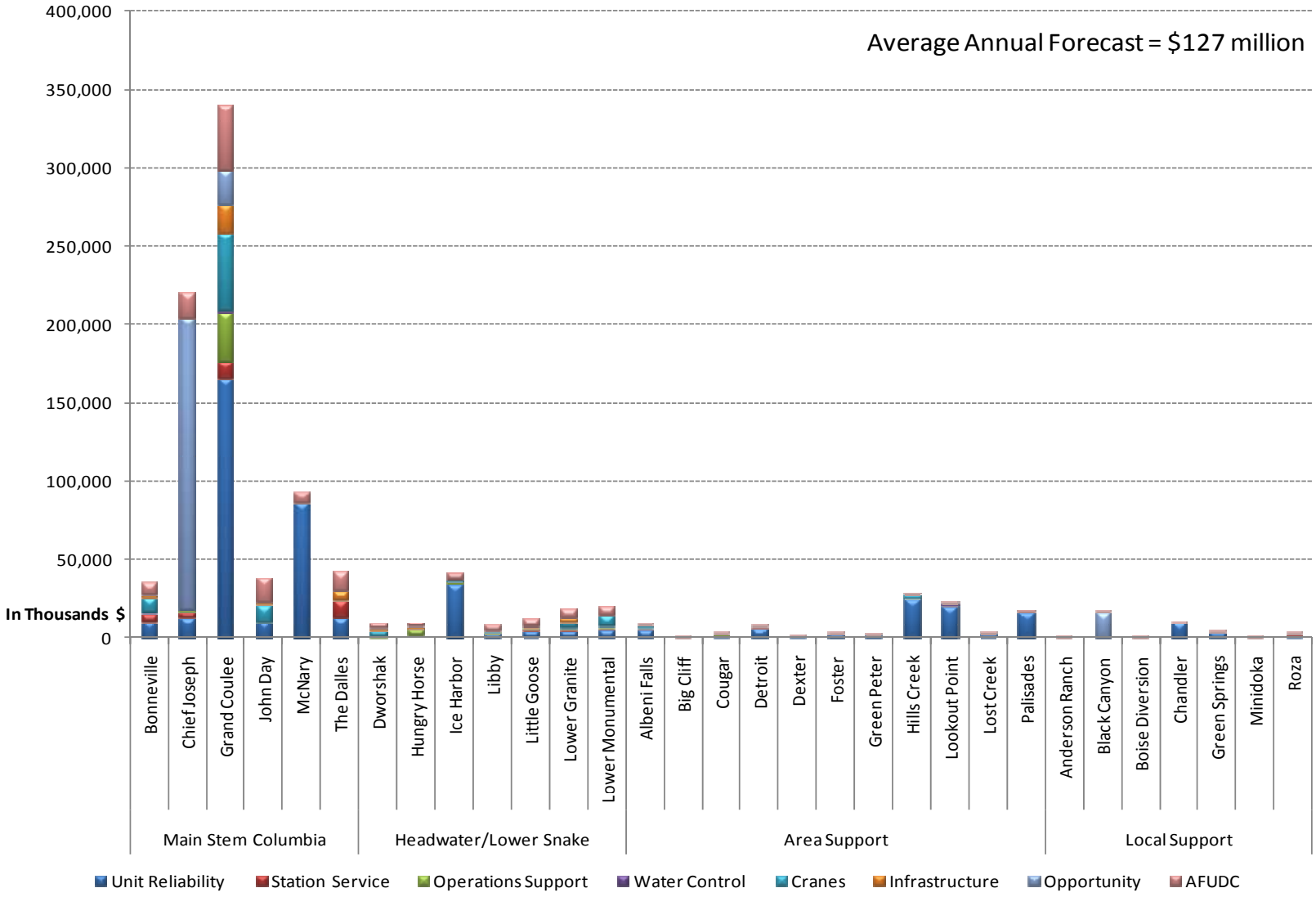
Committed Large Capital by Plant

Two-thirds ($588 million) of the committed Large Capital Program is directed at the three plants with the highest risk: Grand Coulee, Chief Joseph, and McNary.

- $264 million is targeted at unit reliability improvements.
- $208 million is for economic opportunity, primarily runner replacements at Chief Joseph ($185 million), but also for the remaining runner replacements for Grand Coulee 1 – 18.
- Additional commitments at Grand Coulee include $31 million for operations support (SCADA replacement), $49 million for crane upgrades to support major overhauls in the Third Powerplant starting in 2013, and $18 million for infrastructure refurbishments.

The remainder of the committed program at the other 28 plants includes $186 million for unit reliability, $37 million for a third generating unit at Black Canyon, investments in station service and cranes, and to a lesser extent, operations support, water control, and infrastructure.

Committed Large Capital by Plant
(FY2010 – FY2017)



Committed Extraordinary Maintenance Expense
(from 2008 Integrated Program Review)

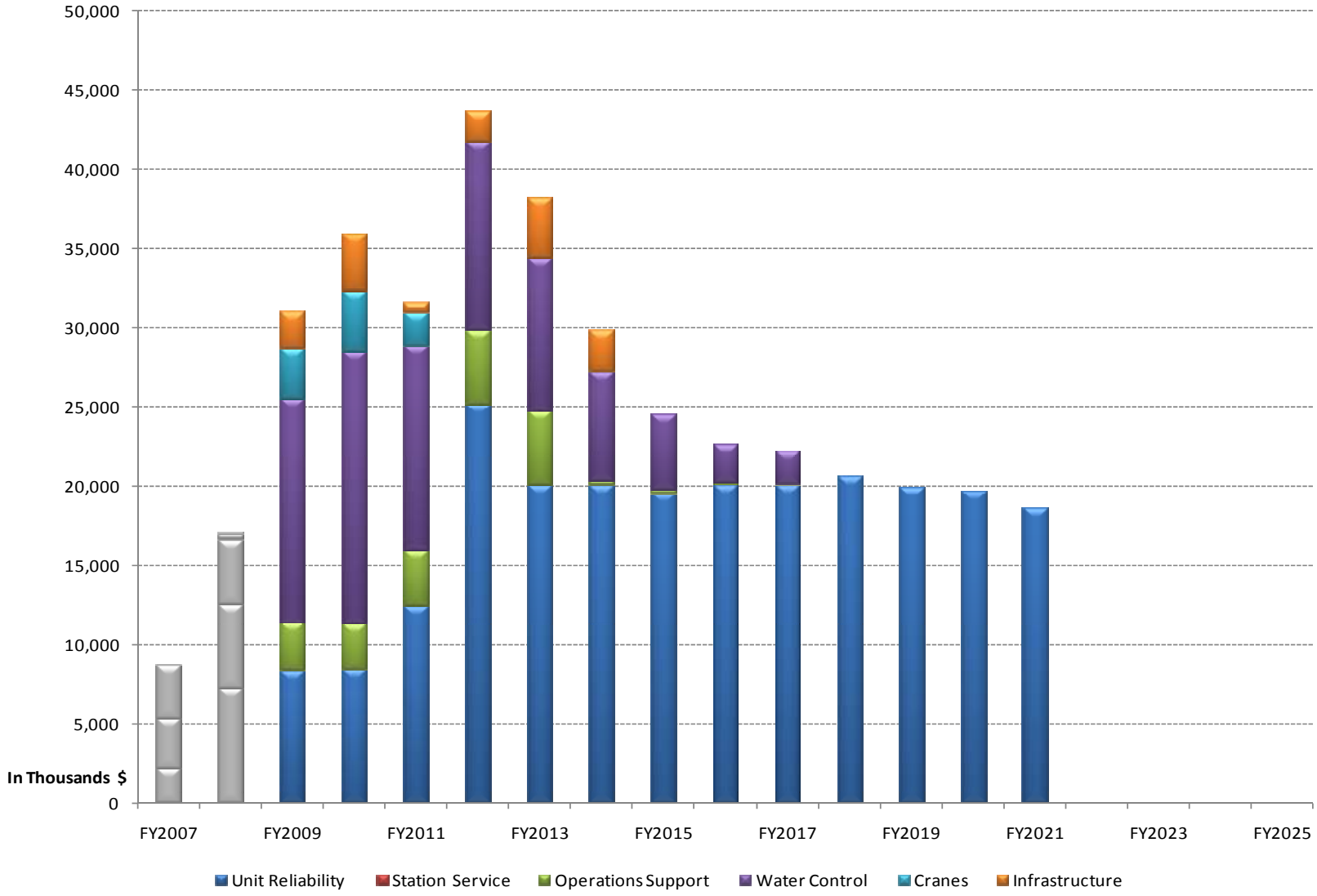
Extraordinary Expense costs included here are from the 2008 Integrated Program Review and were not updated for this 2012 strategy.

The Extraordinary Maintenance Program provides funding for large, infrequent work activities that are categorized as expense following accounting standards.

Committed Extraordinary Maintenance by Category: The currently committed program is $249 million for the FY2010 – 2017 period. By equipment category, expenses break down as follows:

- Unit reliability: $146 million
- Station service: $0
- Operations support: $16
- Water control: $68
- Cranes: $6
- Infrastructure: $12

Committed Extraordinary Maintenance by Equipment Category
(from 2008 Integrated Program Review)



Committed Extraordinary Maintenance by Plant

(from 2008 Integrated Program Review, FY2010 – FY2017)

Grand Coulee: The majority of extraordinary maintenance work is at Grand Coulee ($145 million), primarily for unit overhauls in the Third Powerplant, but also for bypass value repair, piping replacement, penstock painting, and crane refurbishment.

- Unit reliability: $125 million
- Water control: $14
- Cranes: $6

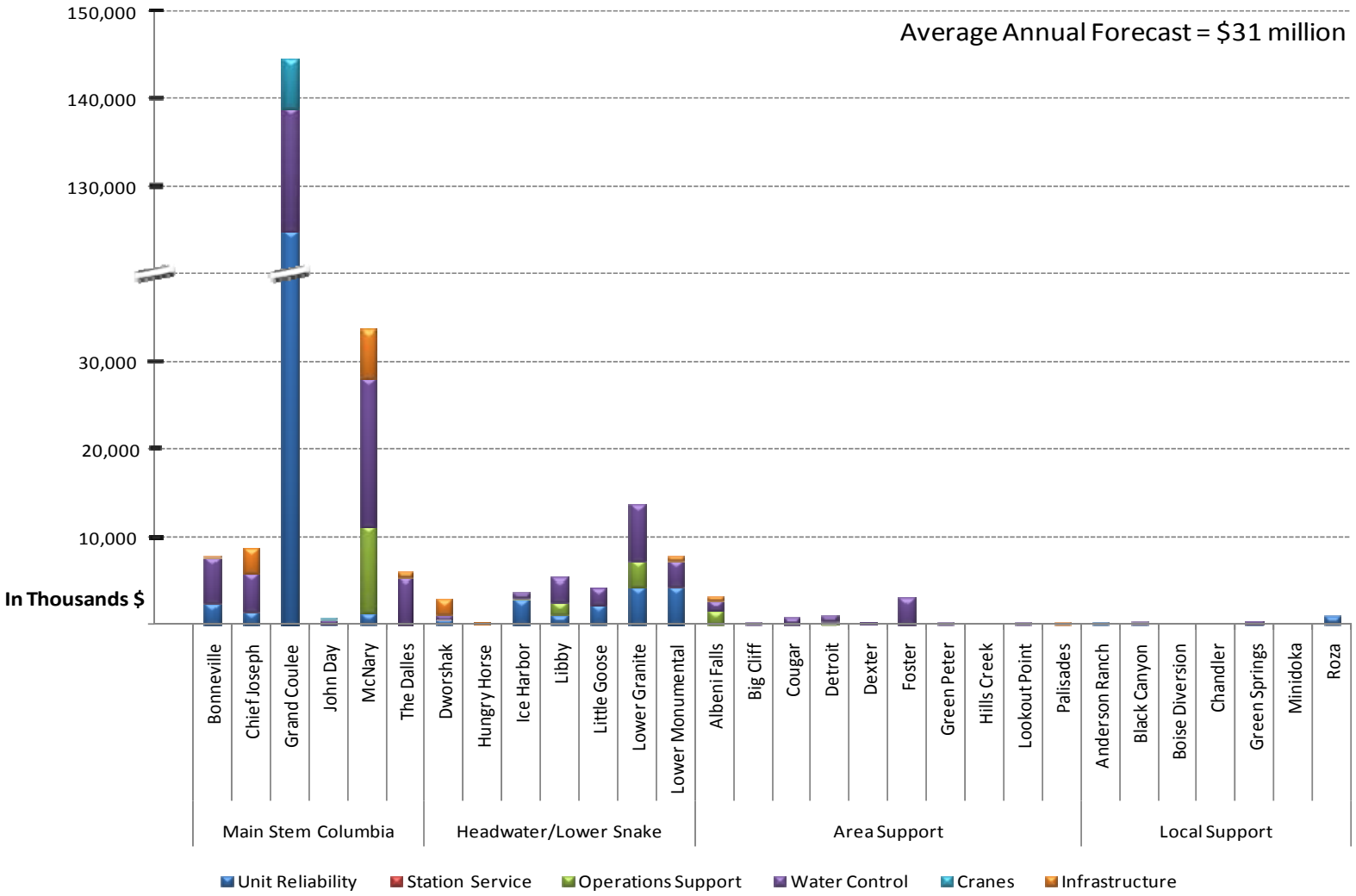
McNary: $34 million in extraordinary expense, about half of which is for water control work on spillway gates, headgates, and emergency intake bulkheads. The remainder is for operations support (fish screen rehabilitation) and infrastructure (roofs and access roads).

Lower Granite: $14 million is committed, primarily for water control (headgates cylinder rehabilitation, intake gate rehabilitation, and replacement of trash boom cable anchors), unit reliability (cavitation repair), and operations support (fish screen rehabilitation).

All other plants have less than $10 million for extraordinary maintenance.

Committed Extraordinary Maintenance by Plant

(from 2008 Integrated Program Review, FY2010 – FY2017)



Projected Condition in 2022
(With Currently Committed Program)

Equipment condition is not static – it degrades over time, even with normal maintenance.

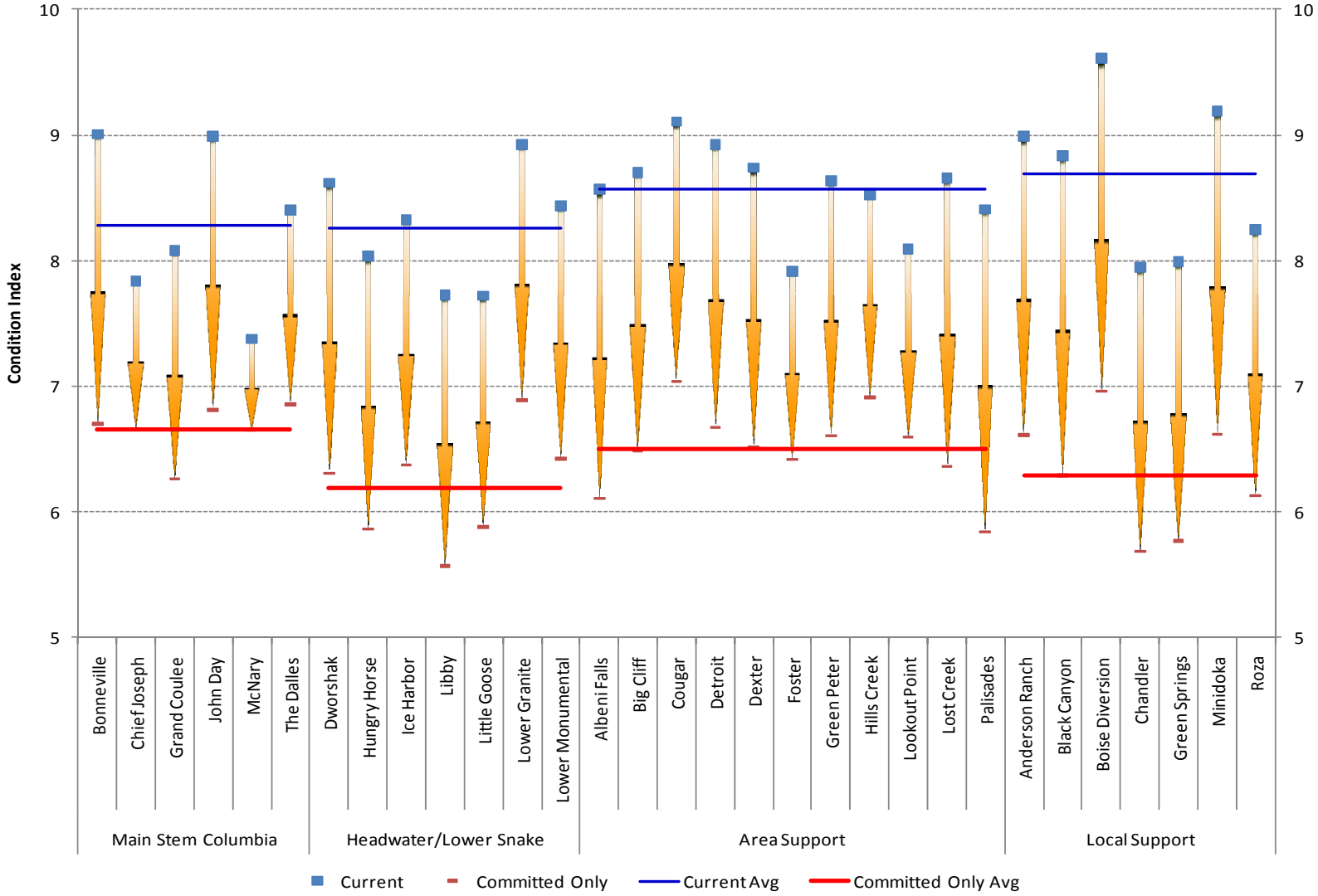
The following charts show current and projected condition ratings in 2022 for each plant as a result of the committed program. No additional investments are reflected. The first chart addresses unit reliability equipment only. The second chart includes all equipment in the plant.

Four items are shown on each chart:

- The current average condition for rated components at the plant (e.g., the average condition rating for unit reliability components at Grand Coulee is about 8.1; for all components at Grand Coulee, it's about 8.2);
- The projected average condition rating for each plant at the start of 2022 if only currently committed investments are made to improve condition (about 6.3 for Grand Coulee unit reliability components, 6.2 for all Grand Coulee components);
- The current average condition rating for components in each strategic class, and
- The projected average condition rating in 2022 by strategic class with currently committed investments.

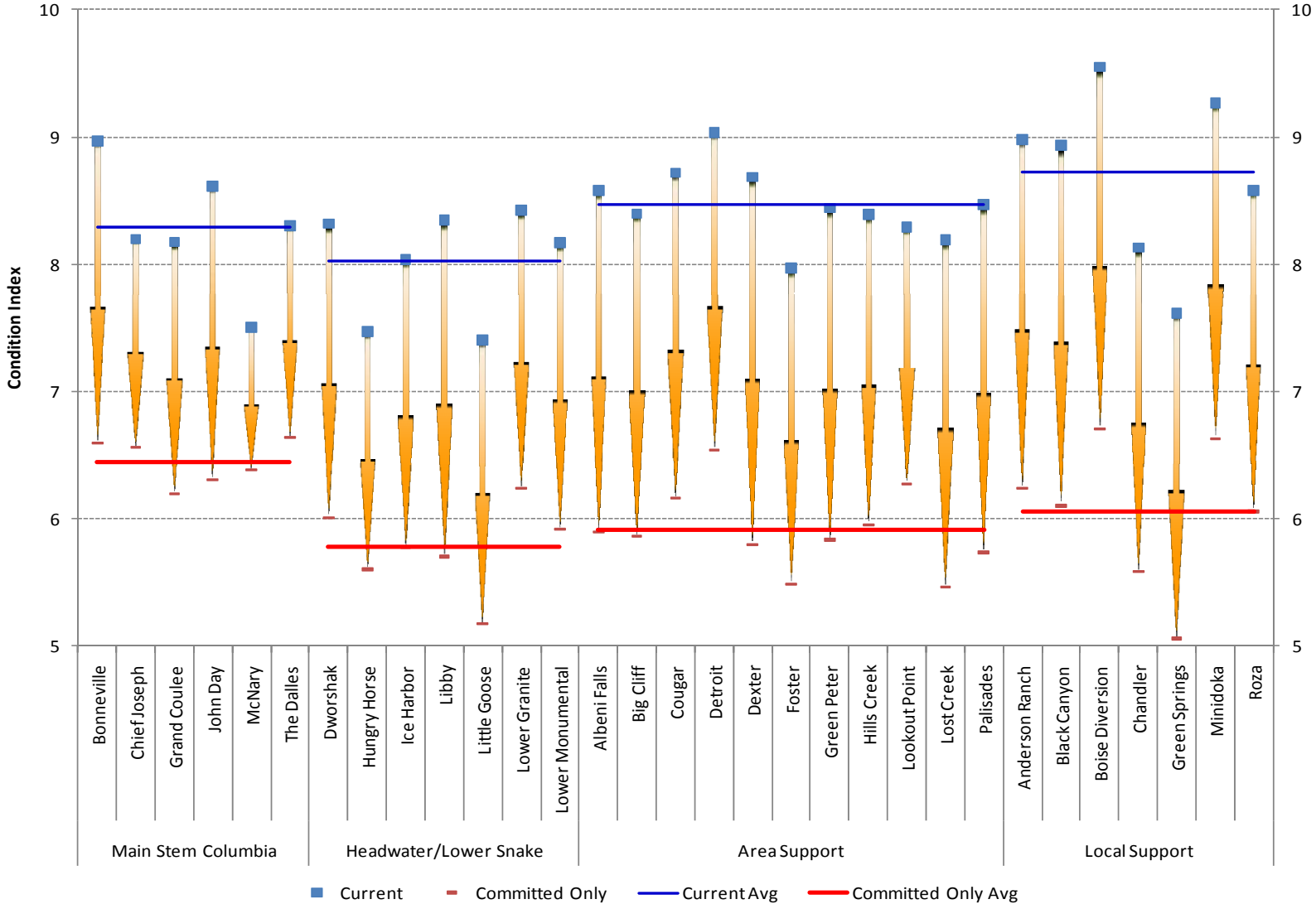
Projected Condition in 2022: Unit Reliability Equipment

(With Currently Committed Program)



Projected Condition in 2022: All Equipment

(With Currently Committed Program)



Projected Age in 2022
(With Currently Committed Program)

Design Life by Strategic Class: With only currently committed investments, the percentage of components exceeding design life will increase in 2022.

- Nearly 30 percent of equipment in the Main Stem Columbia and Headwater/Lower Snake classes will have exceeded its design life in 2022, up from 25 percent today.
- About 55 percent of equipment in the Area Support class and 40 percent in Local Support will have exceeded its design life in 2022.

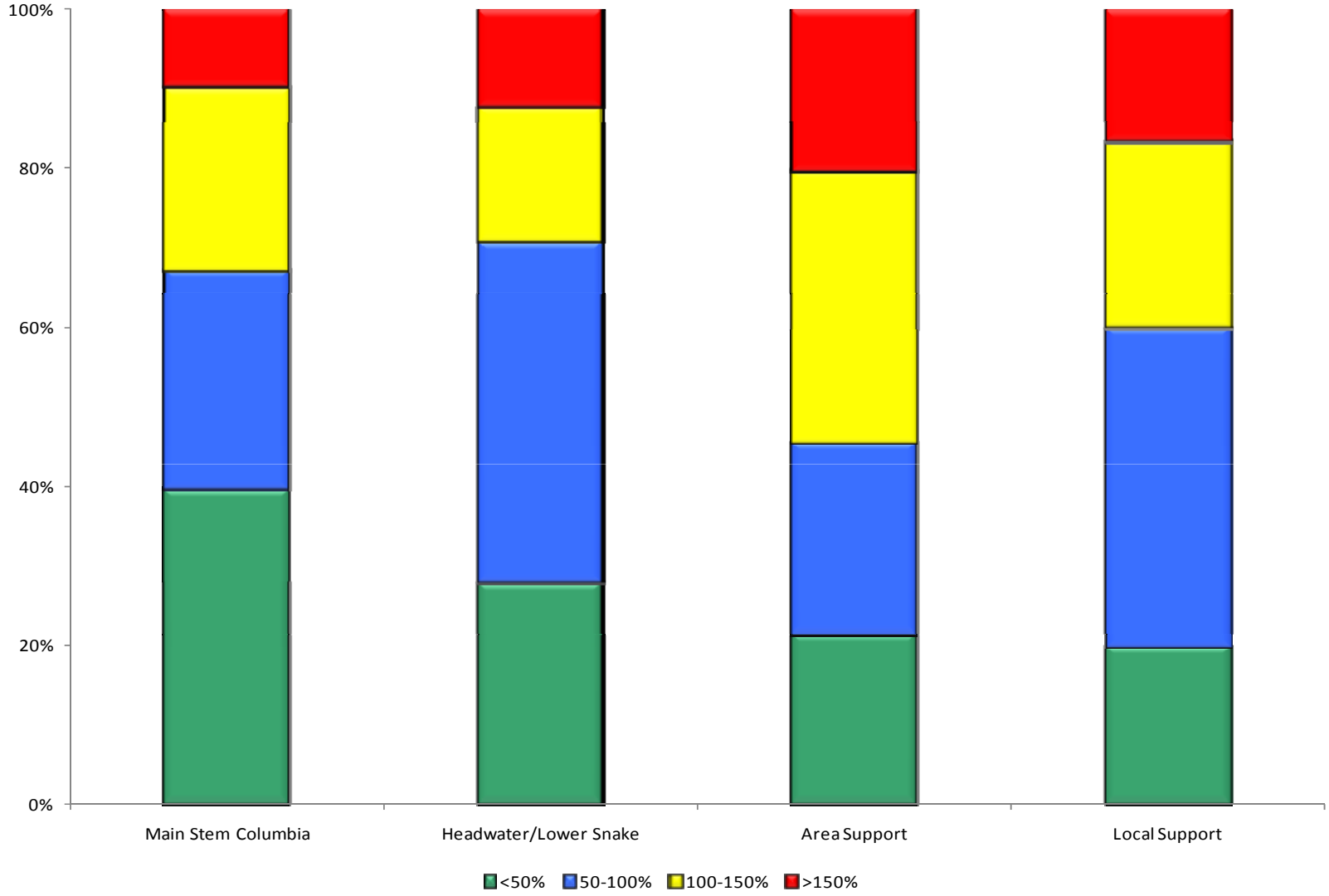
Age of Unit Reliability Equipment: At five plants, the average age of unit reliability equipment will decrease in 2022 if only currently committed investments are made.

- By strategic class, the average age increases the least in the Main Stem and the most in Local Support.

Age of All Equipment: If only committed investments are made, the average age of all equipment increases in 2022 at all plants except for McNary, where average age decreases slightly.

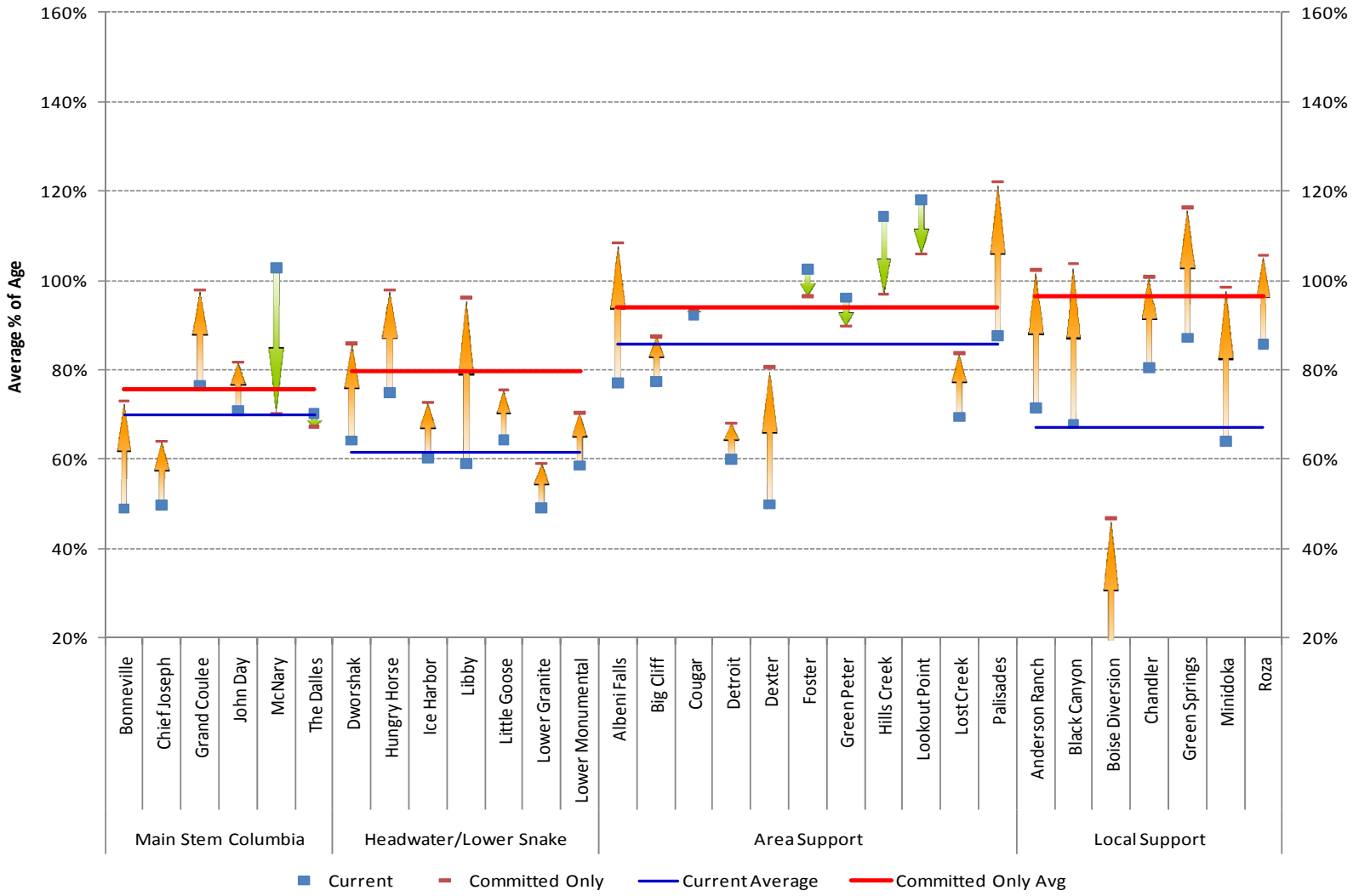
Average Age in 2022 by Strategic Class: All Equipment

(With Currently Committed Program)

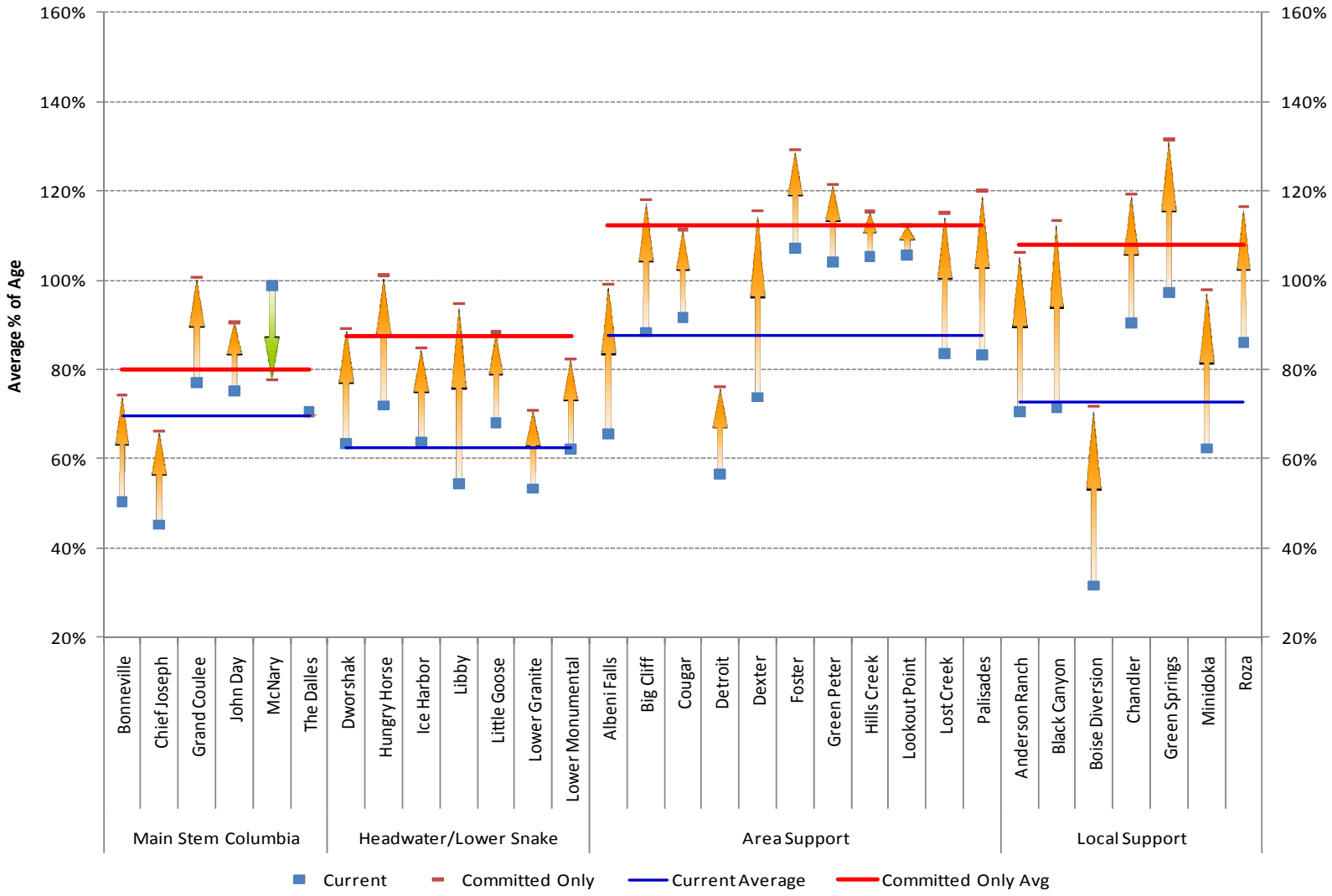


Projected Age in 2022: Unit Reliability Equipment

(With Currently Committed Program)



Projected Age in 2022: All Equipment
(With Currently Committed Program)



Safety and Environmental Risk Maps in 2022
(With Currently Committed Program)

If only currently committed investments are made, the number of high risk safety and environmental items is projected to increase in 2022:

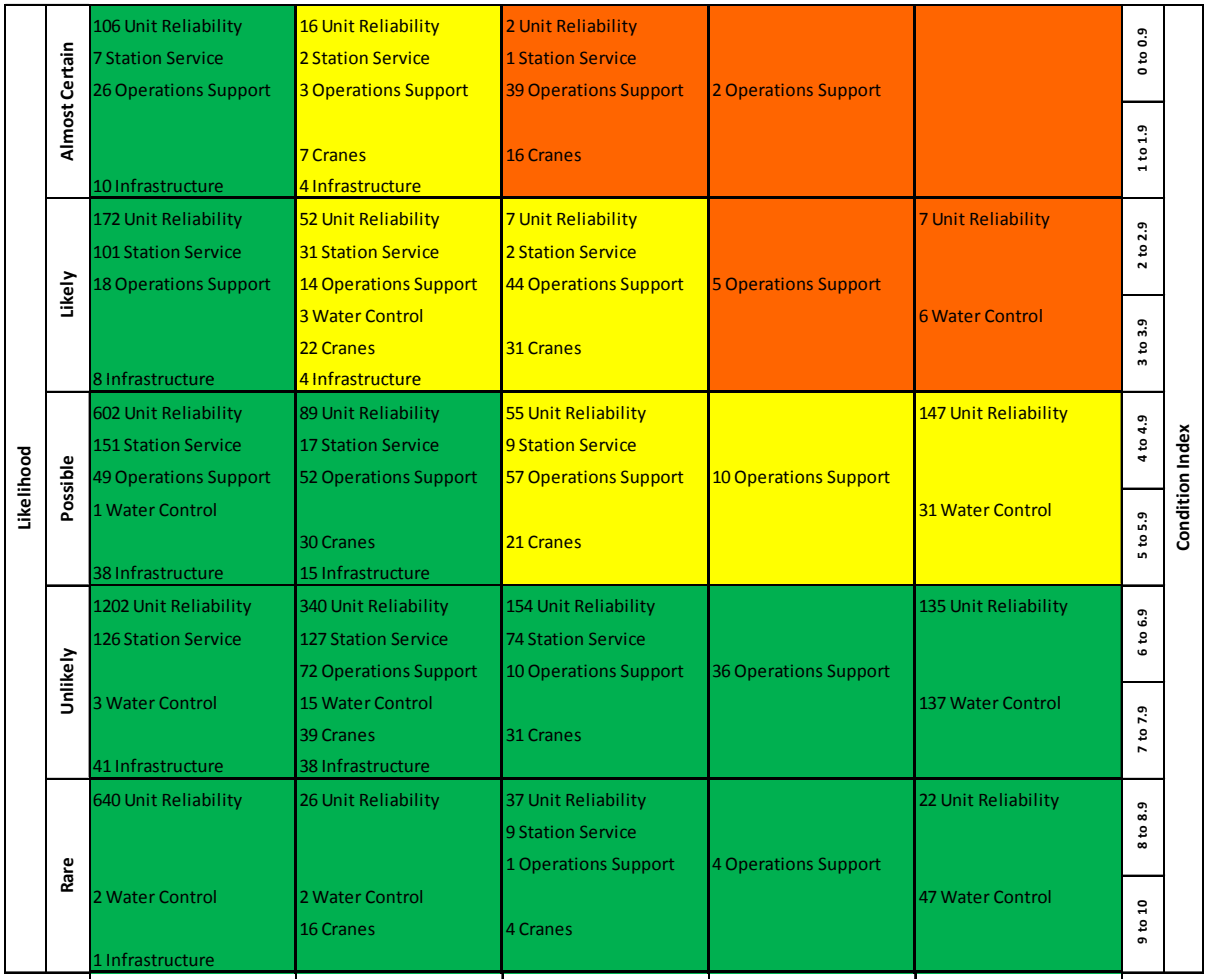
Safety (78)

- Unit reliability (9)
- Station service (1)
- Operations support (46)
- Cranes (16)
- Water control (6)

Environmental (68)

- Unit Reliability (2)
- Station Service (1)
- Operations Support (43)
- Cranes (16)
- Water Control (6)

Safety Risk Map in 2022
(With Currently Committed Program)



Likelihood	No or minor injury, first aid	Treatment by medical professional	Lost time Accident - temporary disability	Lost Time Accident - permanent disability/fatality	Multiple fatalities	Condition Index
Almost Certain	106 Unit Reliability 7 Station Service 26 Operations Support 10 Infrastructure	16 Unit Reliability 2 Station Service 3 Operations Support 7 Cranes 4 Infrastructure	2 Unit Reliability 1 Station Service 39 Operations Support 16 Cranes	2 Operations Support		0 to 0.9 1 to 1.9
Likely	172 Unit Reliability 101 Station Service 18 Operations Support 8 Infrastructure	52 Unit Reliability 31 Station Service 14 Operations Support 3 Water Control 22 Cranes 4 Infrastructure	7 Unit Reliability 2 Station Service 44 Operations Support 31 Cranes	5 Operations Support	7 Unit Reliability 6 Water Control	2 to 2.9 3 to 3.9
Possible	602 Unit Reliability 151 Station Service 49 Operations Support 1 Water Control 38 Infrastructure	89 Unit Reliability 17 Station Service 52 Operations Support 30 Cranes 15 Infrastructure	55 Unit Reliability 9 Station Service 57 Operations Support 21 Cranes	10 Operations Support	147 Unit Reliability 31 Water Control	4 to 4.9 5 to 5.9
Unlikely	1202 Unit Reliability 126 Station Service 3 Water Control 41 Infrastructure	340 Unit Reliability 127 Station Service 72 Operations Support 15 Water Control 39 Cranes 38 Infrastructure	154 Unit Reliability 74 Station Service 10 Operations Support 31 Cranes	36 Operations Support	135 Unit Reliability 137 Water Control	6 to 6.9 7 to 7.9
Rare	640 Unit Reliability 2 Water Control 1 Infrastructure	26 Unit Reliability 2 Water Control 16 Cranes	37 Unit Reliability 9 Station Service 1 Operations Support 4 Cranes	4 Operations Support	22 Unit Reliability 47 Water Control	8 to 8.9 9 to 10

Consequence

Risk Level	Low	Medium	High

Environmental Risk Map in 2022

(With Currently Committed Program)

Financial Risk Map in 2022
(With Currently Committed Program)

As with safety and environment, the number of high risk financial items is projected to increase in 2022, if only committed projects are completed.

- Total number of high risk items increases from 263 to 745.
- The number of high risk items in marginal or poor condition increases to 530.
- A total of 578 unit reliability items are projected to be at high risk, 380 of which are in marginal or poor condition.

While the committed program improves the condition and reduces the risk of many equipment components, the net effect is that risk increases for the system as a whole unless additional investment is made.

This result is driven largely by the fact that investment in the committed program peaks at about $215 million in 2011, then declines to near zero in 2017. It is an indication that additional investment is needed prior to 2022 to sustain reliability and manage risk.

Financial Risk Map in 2022

(With Currently Committed Program)

Likelihood	Insignificant	Minor	Moderate	Major	Extreme	Condition Index
Almost Certain	26 Operations Support	11 Unit Reliability 6 Operations Support	24 Unit Reliability 2 Station Service 37 Operations Support 9 Cranes 12 Infrastructure	70 Unit Reliability 8 Station Service 1 Operations Support 14 Cranes 2 Infrastructure	19 Unit Reliability	0 to 0.9 1 to 1.9
Likely	18 Operations Support	22 Unit Reliability 27 Station Service 23 Operations Support 6 Infrastructure	29 Unit Reliability 18 Station Service 35 Operations Support 5 Water Control 30 Cranes 6 Infrastructure	167 Unit Reliability 82 Station Service 5 Operations Support 4 Water Control 23 Cranes	20 Unit Reliability 7 Station Service	2 to 2.9 3 to 3.9
Possible	49 Operations Support	241 Unit Reliability 14 Station Service 20 Operations Support 13 Infrastructure	150 Unit Reliability 42 Station Service 76 Operations Support 14 Water Control 22 Cranes 35 Infrastructure	398 Unit Reliability 121 Station Service 20 Operations Support 17 Water Control 29 Cranes 5 Infrastructure	104 Unit Reliability 3 Operations Support 1 Water Control	4 to 4.9 5 to 5.9
Unlikely	2 Infrastructure	150 Unit Reliability 87 Station Service 44 Operations Support 7 Water Control 3 Cranes 6 Infrastructure	287 Unit Reliability 148 Station Service 73 Operations Support 93 Water Control 41 Cranes 67 Infrastructure	1196 Unit Reliability 81 Station Service 50 Water Control 26 Cranes 4 Infrastructure	198 Unit Reliability 11 Station Service 1 Operations Support 5 Water Control	6 to 6.9 7 to 7.9
Rare		2 Water Control	106 Unit Reliability 9 Station Service 5 Operations Support 24 Water Control 14 Cranes	504 Unit Reliability 23 Water Control 6 Cranes 1 Infrastructure	115 Unit Reliability 2 Water Control	8 to 8.9 9 to 10
	< $ 10K	$ 10K to $ 100K	$ 100K to $ 1 M	$ 1 M to $ 10 M	> $ 10 M	

Consequence

Risk Level	Low	Medium	Medium High	High

Lost Generation Risk in 2022
(With Currently Committed Program)

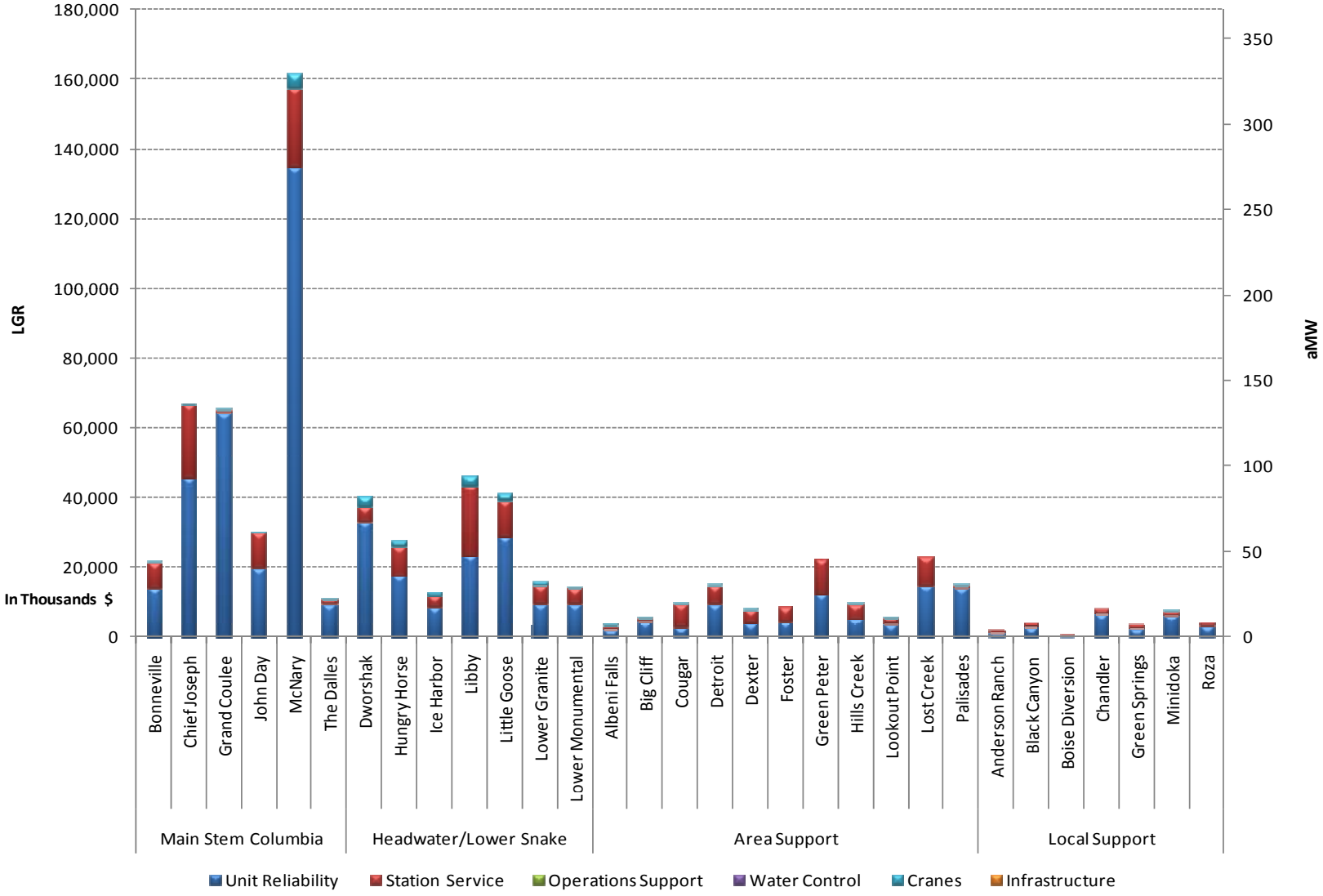
Lost Generation Risk by Plant: If only currently committed investments are made, lost generation risk in 2022 is projected to increase at all plants.

- McNary increases to 330 aMW.
- Grand Coulee and Chief Joseph increase to about 140 aMW each.
- Dworshak, Little Goose and Libby increase to more than 80 aMW each.
- All other plants are projected to stay below 50 aMW.

LGR increases 50 percent in the Main Stem class and more than doubles in other classes.

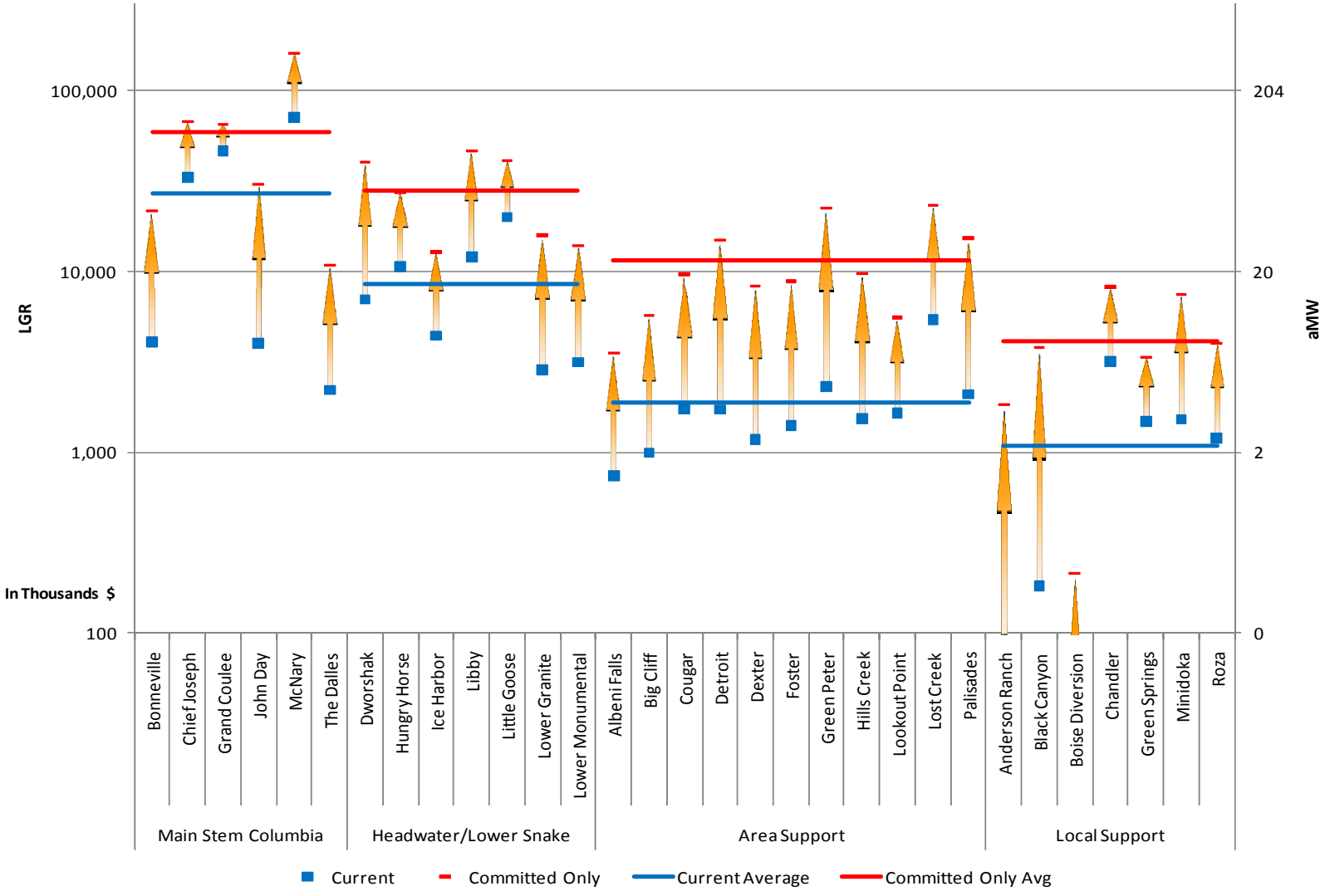
Lost Generation Risk by Plant in 2022

(With Currently Committed Program)



Lost Generation Risk in 2022

(With Currently Committed Program)



6. Hydro Investment Plan

Hydro Investment Plan

The Hydro Investment Plan covers forecasted O&M, the committed investment program, and new investments to maintain and improve the reliability of hydro plant equipment.

Because O&M costs are primarily labor related, and the currently committed investment program is already vetted and underway, the focus of the Hydro Investment Plan is on new investments not yet decided upon.

This strategy takes a risk-based approach to identifying the optimum time for making these new investments.

The strategy is consistent with Bonneville's asset management policy, which states:

- *BPA will invest in, maintain, and operate assets to:*
  - *Meet reliability standards, availability requirements, regional adequacy guidelines, efficiency needs, environmental requirements, safety and security standards, and other requirements; and*
  - *Minimize the life cycle costs of assets when practical.*

Economics of Risk Intervention at Different Points in Time

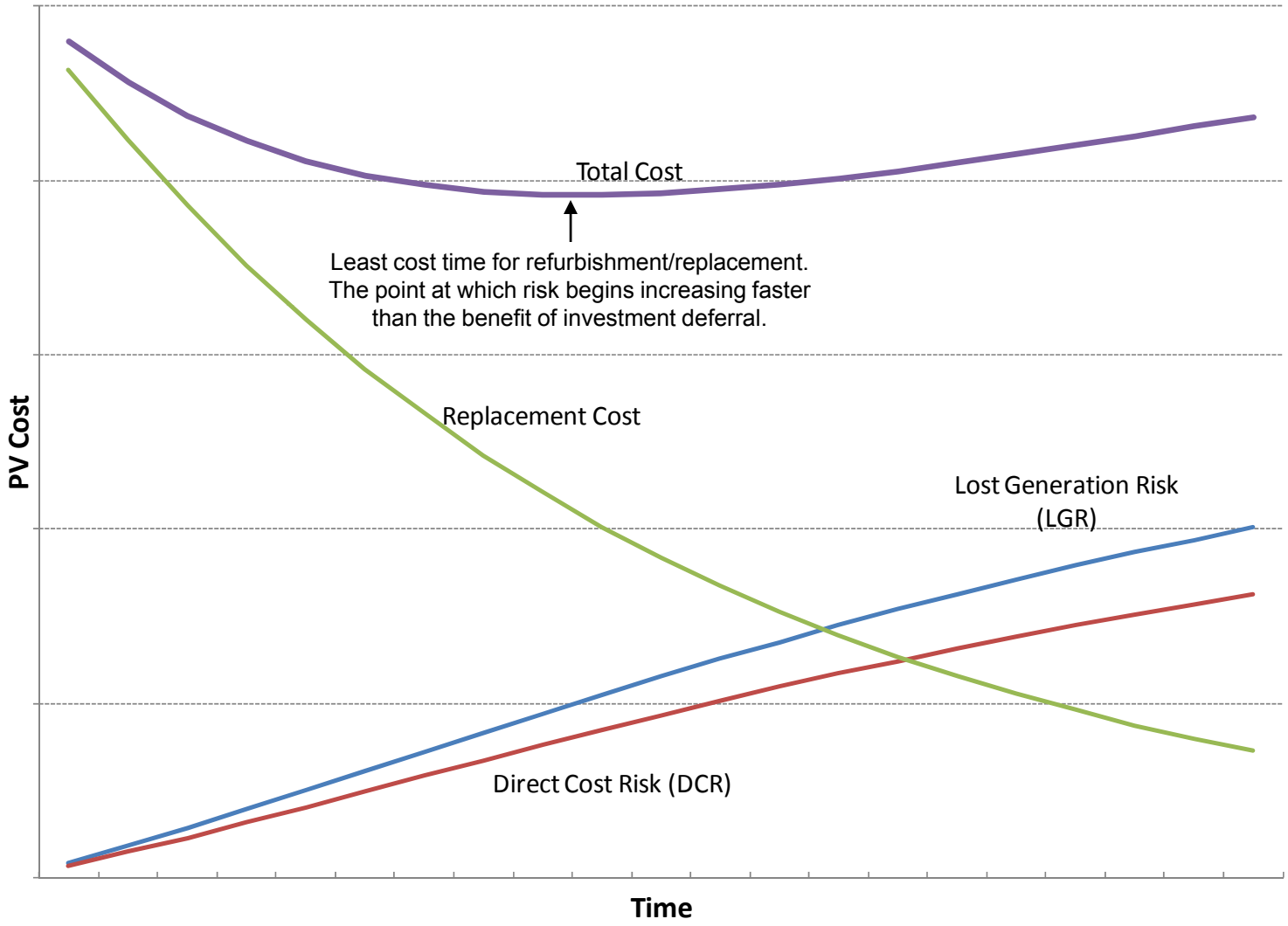
Without corrective action (intervention), equipment condition degrades over time. As equipment condition degrades, the likelihood (and risk) of equipment failing to perform as expected increases.

Three factors that influence the economics of risk intervention are outlined in the following diagram. All curves show the 2009 present value of costs over time.

- **Replacement Cost** – Typically, the longer the replacement can be deferred, the lower the present value of its cost.
- **Direct Cost Risk (DCR)** – If equipment fails during the deferral period, intervention costs may be incrementally higher for collateral damage and planning, procurement, and scheduling inefficiencies. This cost risk increases as equipment condition degrades over time.
- **Lost Generation Risk (LGR)** – Equipment failure may also result in longer outages and, thus, more lost generation than if replaced on a planned basis. LGR also increases as equipment condition degrades over time.

The **Total Cost** is the present value sum of replacement and risk costs. The cost minima on this curve is the point at which risk is growing faster than the benefit of investment deferral and represents the optimum time for replacement to minimize lifecycle cost. This objective function is applied to each of the 5,500 equipment items modeled to derive an investment plan.

Cost of Intervention at Different Points in Time

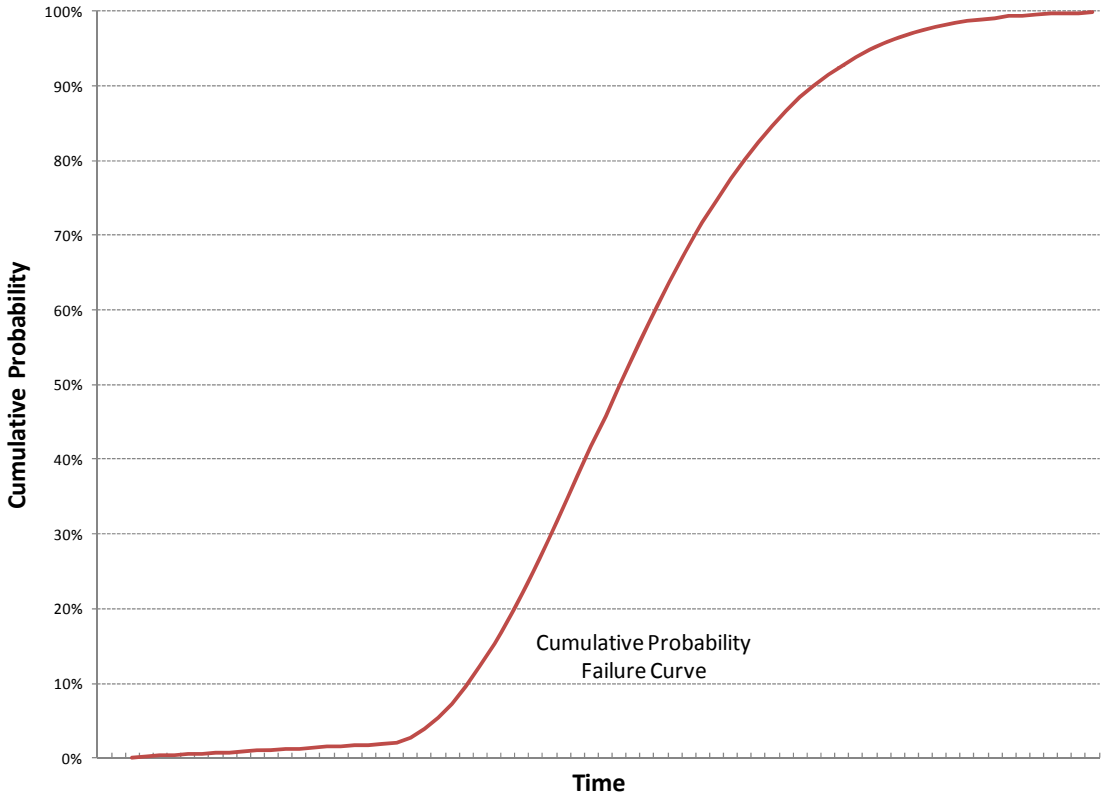


Assumptions Used in Modeling

Assumption	Value	Source	Comment
Discount rate	12.0 percent	BPA Finance	
Inflation rate	1.7 percent	BPA Finance	Average annual rate based on 20-yr forecast
Forward energy prices	20-yr, by month, HLH, LLH, flat	BPA Marketing	Levelizes to $56/MWh in 2009$ (flat)
Equipment cost	Varies by equipment type	FCRPS hydro program	Based on industry cost data
Real cost escalation	0 percent	BPA Finance	Global Insight
Failure curves	Varies by equipment type	BPA Federal Hydro	Based on industry data for certain equipment
Outage duration for LGR	Varies by equipment type	FCRPS hydro program	Based on industry experience
Environment and safety	Risk	BPA Federal Hydro	Treats all high risk items as “must do”
Value of avoided CO2	$45/ton	BPA Corporate Strategy	Based on Council’s 6th power plan
Alternative resource for hydro lost generation	CCCT: 0.4 ton/MWh Coal: 1.0 ton/MWh	EIA	

Generic Failure Curve

A failure curve was derived for each equipment type modeled. Each curve has the general shape shown below where early in the equipment life, the cumulative probability of failure is low (few in the population fail during this period). Later, as the condition nears Marginal, the cumulative probability of failure increases (more failures tend to occur in the population).



Modeling Approach

The base case modeling runs assume funding is constrained to the current budget forecast for FY2010 – FY2017, consistent with levels identified in the 2008 Integrated Program Review. Available funding for prioritizing new projects is reduced by the amount for currently committed projects.

- (Note, over programming in FY2010 – FY2012 results in an investment forecast that exceeds current budget levels. Actual results may differ.)

Each equipment component is evaluated in yearly time steps and selected for refurbishment/replacement if it meets either of the following criteria:

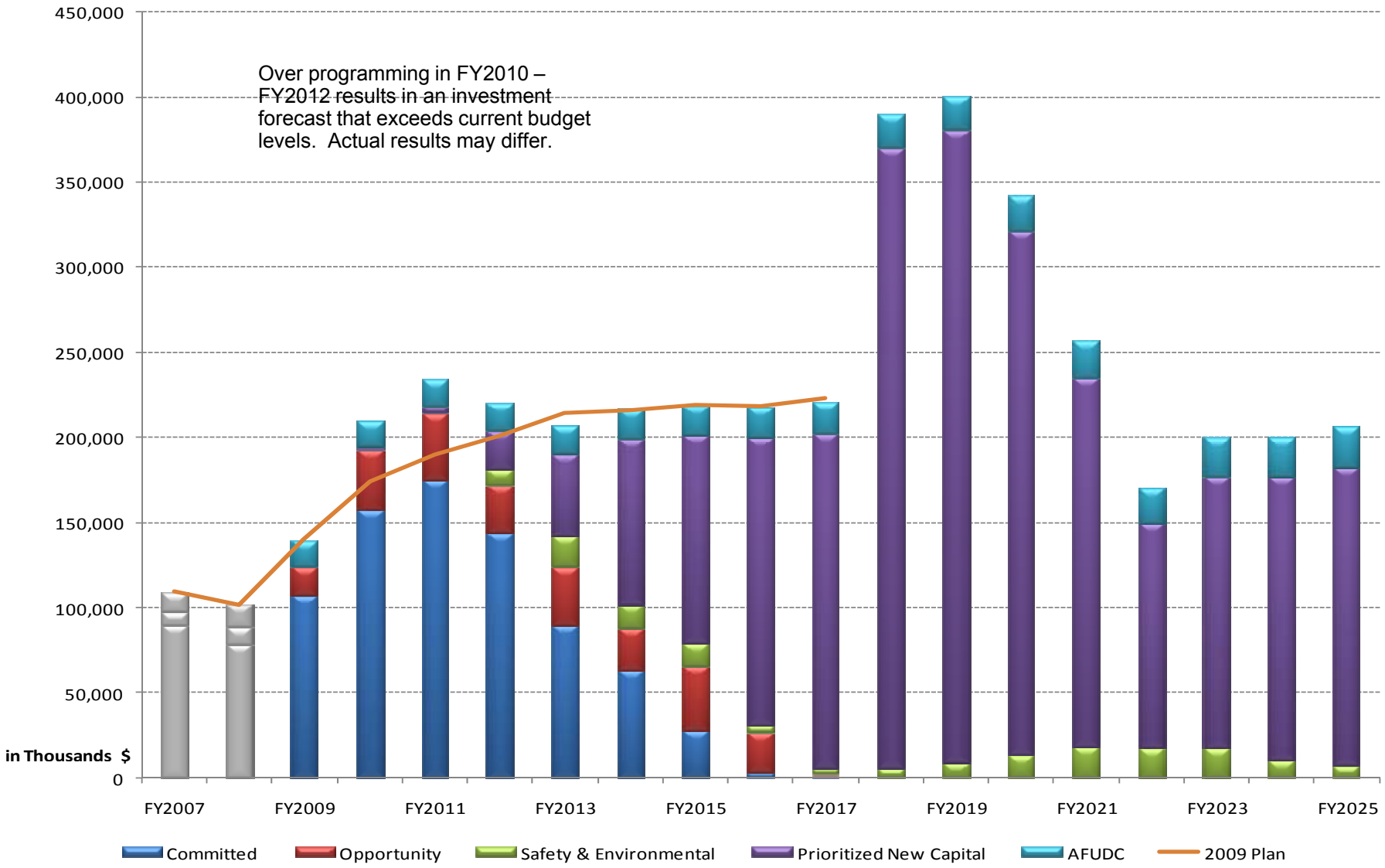
- First, if its condition places it into a high risk category for safety or environment.
- Second, if risk costs are increasing faster than investment deferral benefits, i.e., it is at the cost minima.
- If an annual funding limitation is reached, investment in equipment in which risk is increasing the least is deferred until the following year, where it is re-evaluated using the same prioritization logic.

Once the equipment item is selected for investment, its condition resets to 10 at the end of the investment period. Its condition then begins to degrade at the identified degradation rate.

The following graph shows the results of the base case modeling run overlaid on the current large capital budget.

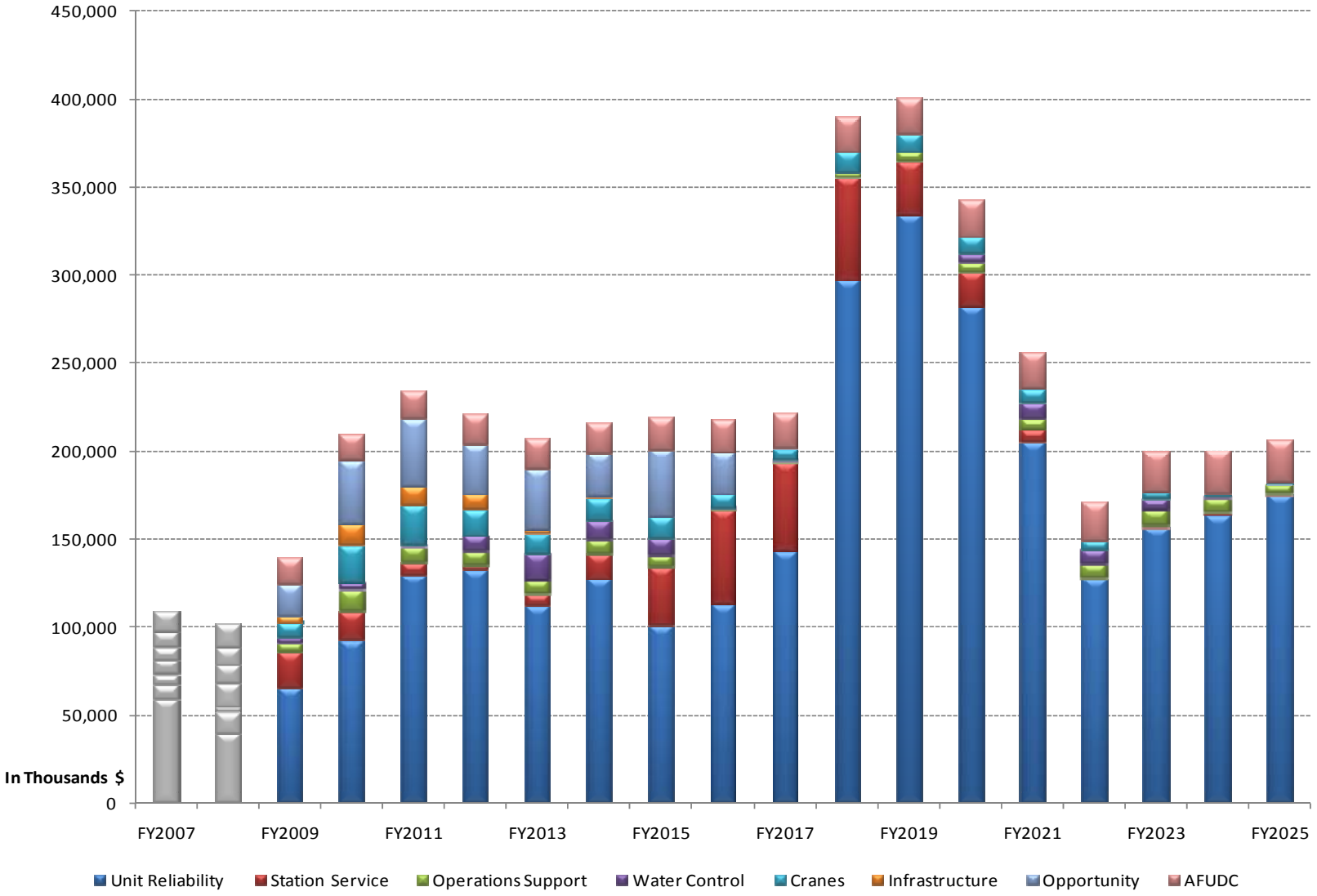
Large Capital Forecast

(Base Case: Constrained to Current Program Budget Through FY 2017)



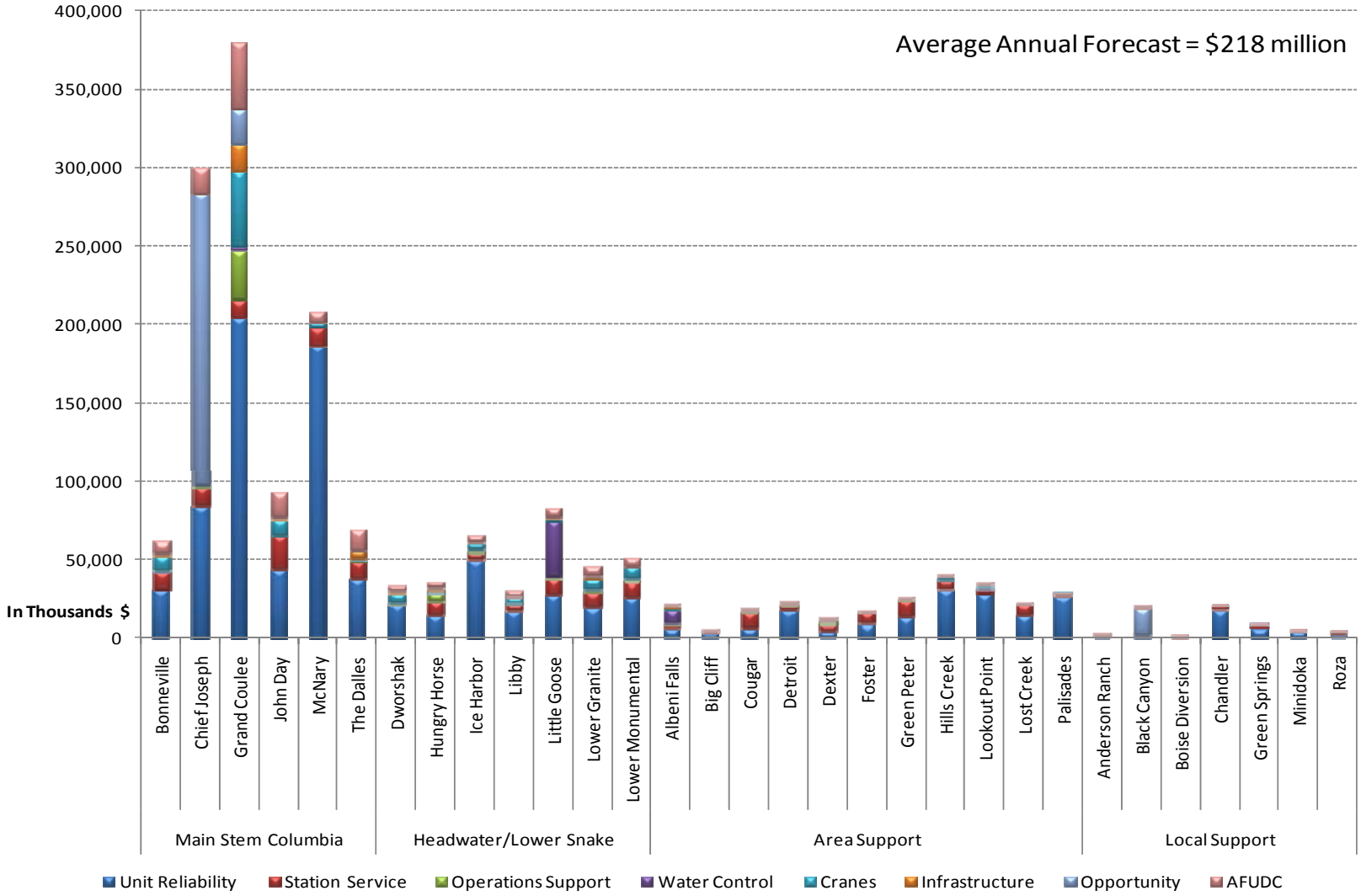
Large Capital Forecast by Equipment Category

(Base Case: Constrained to Current Program Budget Through FY2017)



Large Capital Forecast by Plant

(Base Case: Constrained to Current Program Budget Through FY2017)



Base Case Results

(Base Case: Constrained to Current Program Budget Through FY2017)

FY2010 – FY2017: The base case identifies an average annual large capital program of $218 million for the FY2010 – FY2017 period. Total investment for the 8-year period is $1.75 billion.

The majority of investment is for maintaining or improving generating unit reliability ($953 million), followed by economic opportunity ($224 million) and station service refurbishment ($184 million).

Half of the investment is targeted at the three plants with the highest level of risk: Grand Coulee ($380 million), Chief Joseph ($299 million), and McNary ($208 million).

Post FY2017: Beginning in FY2018, identified investment need increases to over $350 million per year for three years, then decreases to a level of about $200 million per year thereafter.

Sensitivity Analyses of Variables
(Constrained to Current Program Budget Through FY2017)

Several analyses were run to determine the sensitivity of certain variables on model results. Sensitivities were run on the following variables:

- Discount rate
- Inflation rate
- Energy forward price curve
- Avoided CO2 value per ton
- Equipment cost
- Real cost escalation
- Avoided CO2 per MWh of generation
- Safety and environment risk matrix

. Results identified are:

- Present value of new capital (prioritized new capital spending only);
- Present value of direct cost risk;
- Present value of lost generation risk;
- Present value of total cost (new capital, DCR, and LGR); and,
- Average annual forecast for FY2010 – FY2017 (includes committed program plus prioritized new capital).

Sensitivity Analyses Results: Increase in Variable Amounts

(Constrained to Current Program Budget Through FY2017)

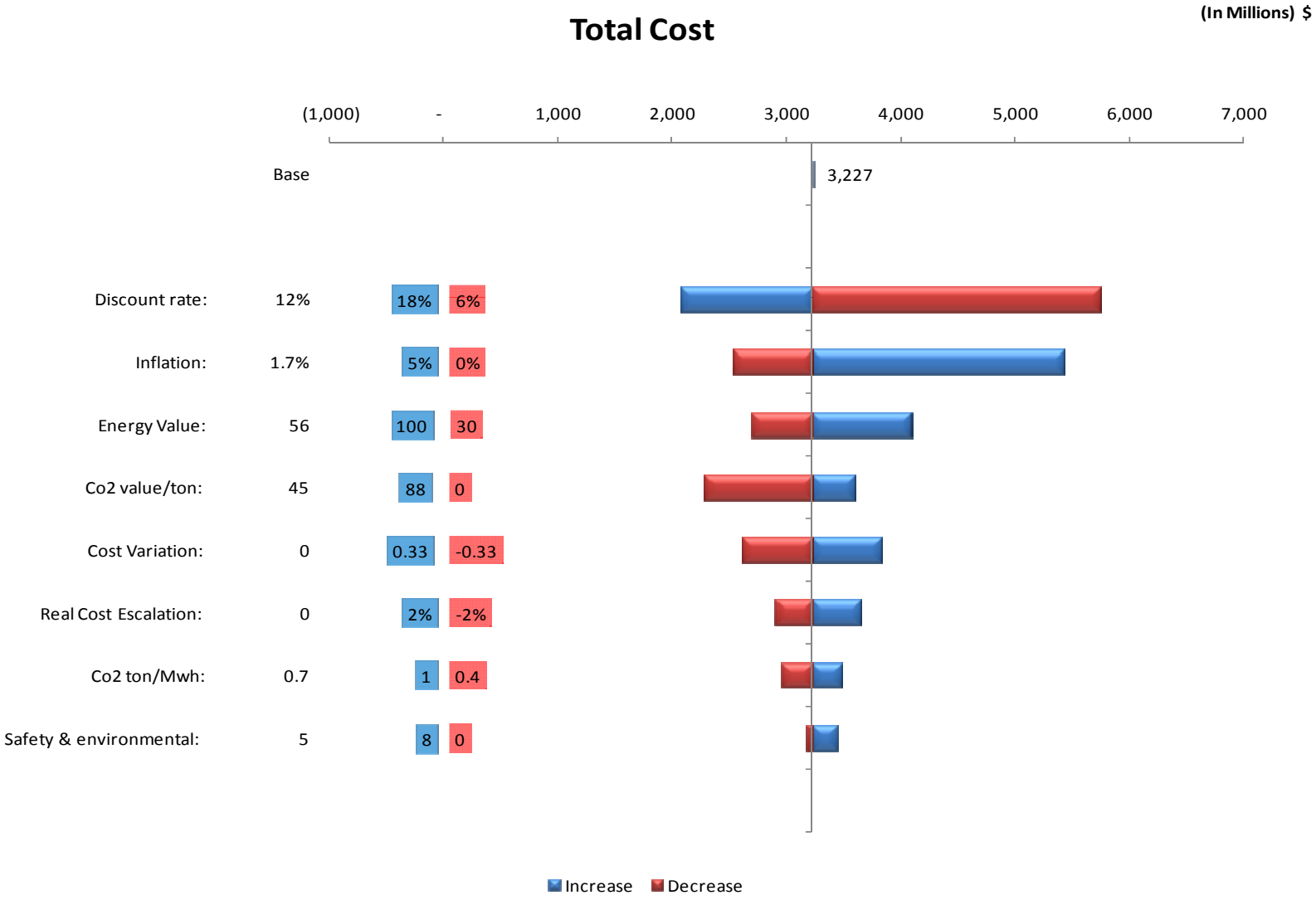
			Present Value of Costs ($millions)				($millions)
Variable	**Base Case Value**	**Sensitivity Value**	**Identified New Capital**	**Direct Cost Risk**	**Lost Generation Risk**	**Total Cost**	**Average Annual Forecast FY10-17 (Committed Program and New Capital)**
Base Case (Constrained to current budget forecast)			806	784	1,637	3,227	218
Sensitivity							
Discount Rate	12%	18%	306	506	1,264	2,076	214
Inflation Rate	1.7%	5%	1,511	1,422	2,486	5,419	219
Energy Value ($/MWh)	56	100	965	763	2,369	4,097	218
Avoided CO2 Value ($/ton)	45	88	868	775	1,958	3,601	218
Replacement Cost Variation	0%	33%	911	1,078	1,842	3,830	220
Real Cost Escalation	0.0%	2.0%	932	988	1,727	3,647	219
Avoided CO2 (ton/MWh)	0.7	1.0	855	777	1,864	3,496	218
Safety and Environmental	High Risk	High Risk +	921	749	1,779	3,449	223

Sensitivity Analyses Results: Decrease in Variable Amounts

(Constrained to Current Program Budget Through FY2017)

			Present Value of Costs ($millions)				($millions)
Variable	**Base Case Value**	**Sensitivity Value**	**Identified New Capital**	**Direct Cost Risk**	**Lost Generation Risk**	**Total Cost**	**Average Annual Forecast FY10-17 (Committed Program and New Capital)**
Base Case (Constrained to current budget forecast)			806	784	1,637	3,227	218
Sensitivity							
Discount Rate	12%	6%	2,563	1,072	2,113	5,747	218
Inflation Rate	1.7%	0%	634	577	1,331	2,542	218
Energy Value ($/MWh)	56	30	694	804	1,201	2,699	218
Avoided CO2 Value ($/ton)	45	0	489	848	953	2,290	213
Replacement Cost Variation	0%	-33%	683	496	1,436	2,615	216
Real Cost Escalation	0.0%	-2.0%	732	624	1,551	2,907	217
Avoided CO2 (ton/MWh)	0.7	0.4	752	792	1,410	2,954	218
Safety and Environmental	High Risk	None	759	808	1,603	3,171	215

Sensitivity Analyses Results: Variables
(Constrained to Current Program Budget Through FY2017)



Sensitivity Analyses Results: Variables
(Constrained to Current Program Budget Through FY2017)

Net present value results are most sensitive to changes in the discount rate, followed by changes in inflation assumptions.

Identified FY2010 – FY2017 spending levels are nearly identical for all sensitivity analyses, indicating that the current program budget forecast is robust across a wide range of assumptions.

Lowering the risk tolerance for safety and environment increases the FY2010 – FY2017 present value of investment costs by $115 million and LGR by $142 million, a result of picking more safety and environmental driven projects early in the period and deferring generation risk projects, in some cases beyond FY2017. The average annual spending level is $5 million higher than in the base case.

Sensitivity Analyses of Funding Levels
(Constrained Funding Through FY2017)

Several sensitivities were run on available funding levels to determine the effect on long term funding needs and risk.

Using the current budget forecast as a baseline, available funding was either increased or decreased by a percentage amount to establish a new funding constraint for the FY2010 – FY2017 period. The model was then re-run to develop a prioritized investment plan with the new constraint.

Results of the funding sensitivities are summarized on the following table.

Sensitivity Analysis Results: Funding Levels

(Constrained Funding Availability Through FY2017)

	Present Value of Costs ($millions)				($millions)
Variable	**Identified New Capital**	**Direct Cost Risk**	**Lost Generation Risk**	**Total Cost**	**Average Annual Forecast FY10-17 (Committed Program and New Capital)**
Base Case (Constrained to current budget forecast)	806	784	1,637	3,227	218
Sensitivity					
Unconstrained funding availability	955	745	1,411	3,110	304
Funding constrained to 140 percent of current forecast	904	756	1,452	3,113	280
Funding constrained to 130 percent of current forecast	881	762	1,476	3,120	265
Funding constrained to 125 percent of current forecast	869	765	1,492	3,127	257
Funding constrained to 120 percent of current forecast	854	770	1,514	3,137	248
Funding constrained to 110 percent of current forecast	824	777	1,575	3,177	230
Funding constrained to 90 percent of current forecast	786	792	1,741	3,319	206
Funding constrained to 80 percent of current forecast	773	796	1,834	3,403	196

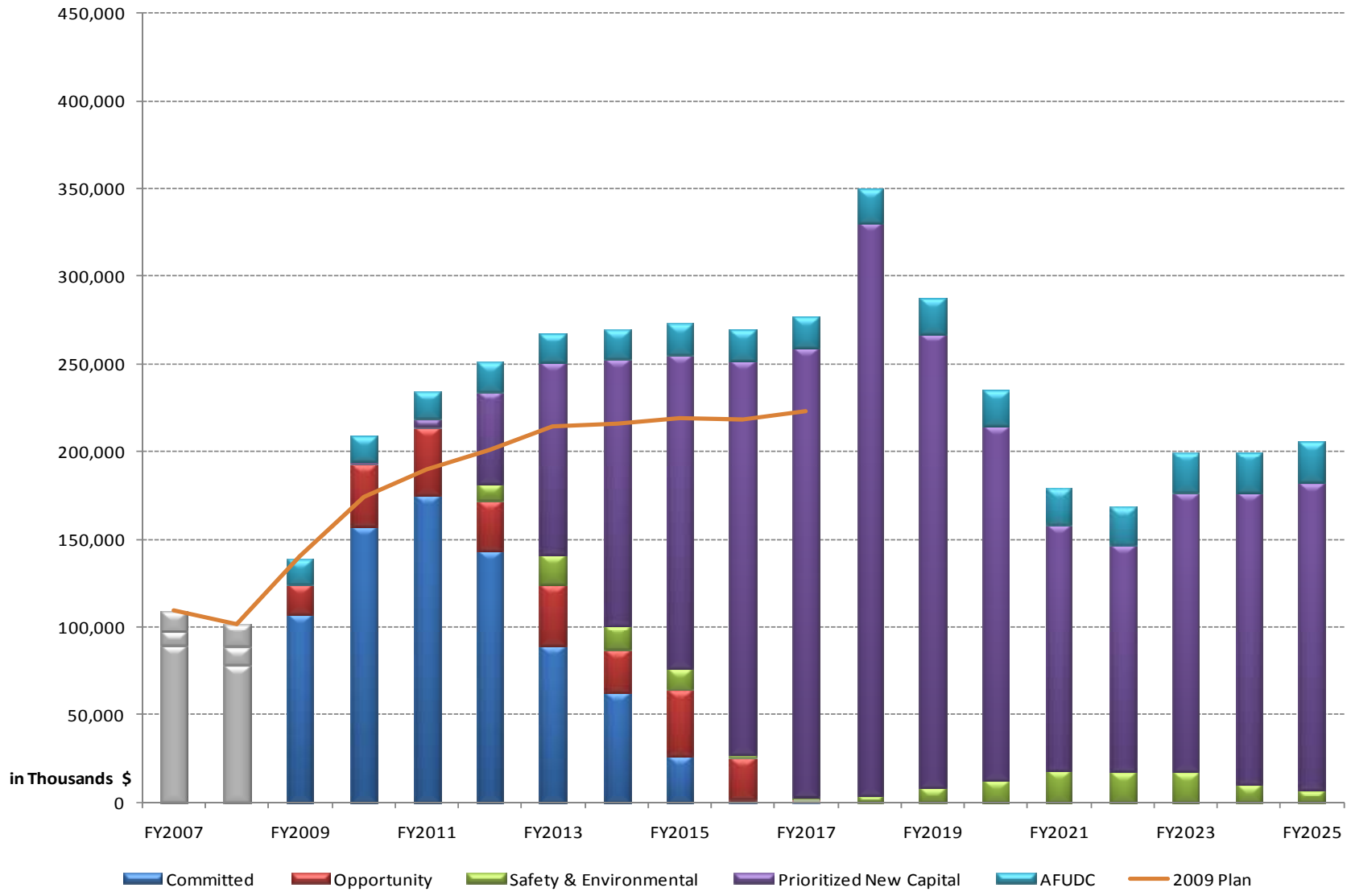
Recommended Investment Plan

From the sensitivity analysis, a recommended plan of plus 25 percent from the current budget forecast was selected that yields a relatively stable program level both during and after the constrained funding period, and which identifies a resource capability that can be sustained for a decade or more.

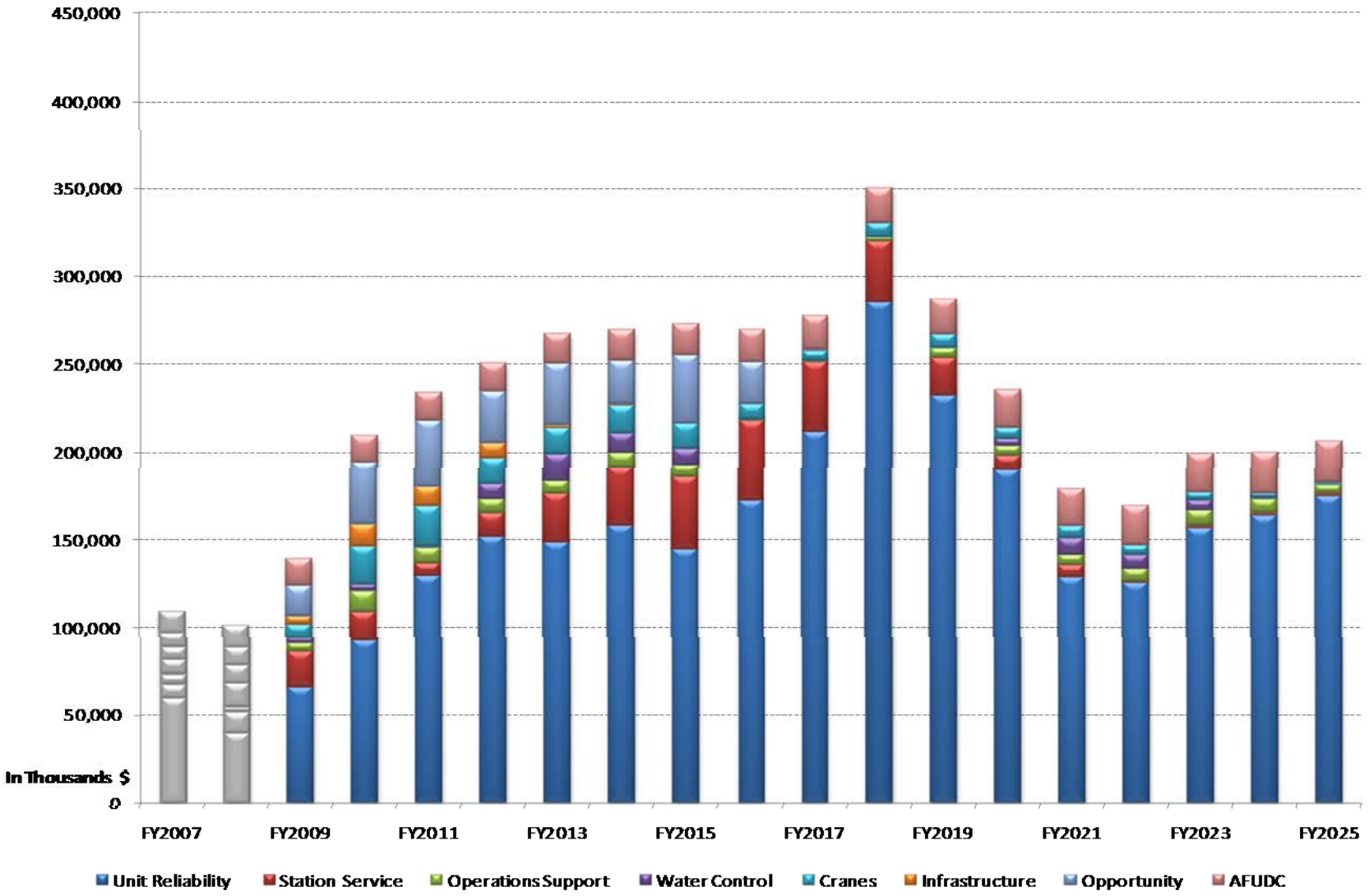
Because of over programming in FY2010 and FY2011, the net effect of the recommended plan is a program that is 18 percent higher than the base case for the FY2010 – FY2017 period ($257 million per year versus $218 million per year)

In 2009 present value, the recommended plan costs $63 million more than the base case, but reduces its risk by $164 million.

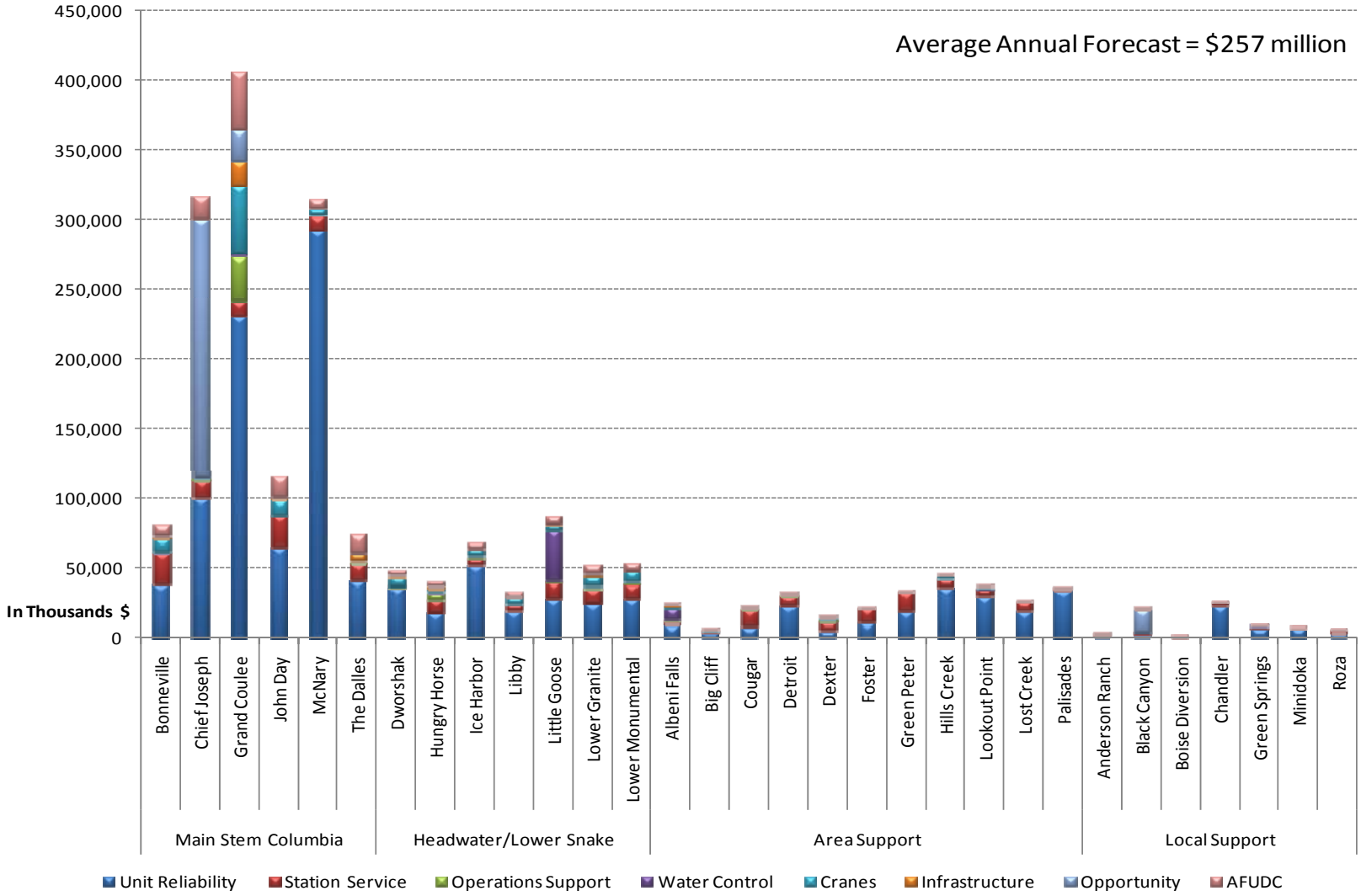
Large Capital Forecast
(Recommended Plan)



Large Capital Forecast by Equipment Category
(Recommended Plan)



Large Capital Forecast by Plant
(Recommended Plan)



The Recommended Plan has the Following Effects:

Condition

- The average condition in 2022 declines for all plants except McNary. Most plants have an average condition rating that decreases from 8 or better (Good) to 7 or better (Fair).
- A decrease in the average condition should not be viewed as a bad outcome. Within these averages, equipment that is high risk generally has its condition improved, while condition is declining on other equipment with a lower risk level.

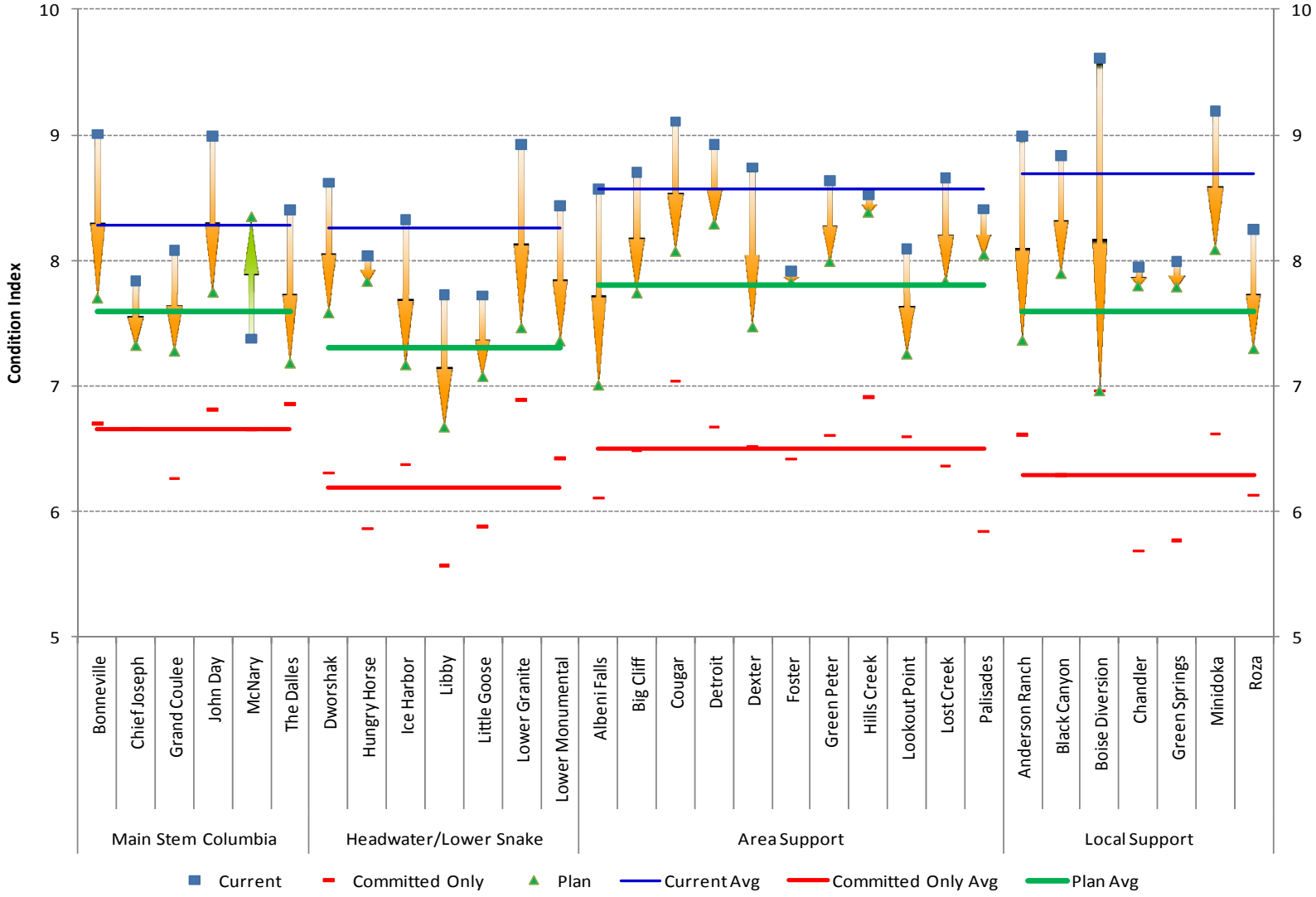
Age

- In 2022, the average age as a percent of design life decreases for unit reliability, station service and crane equipment categories. It increases for all other categories.

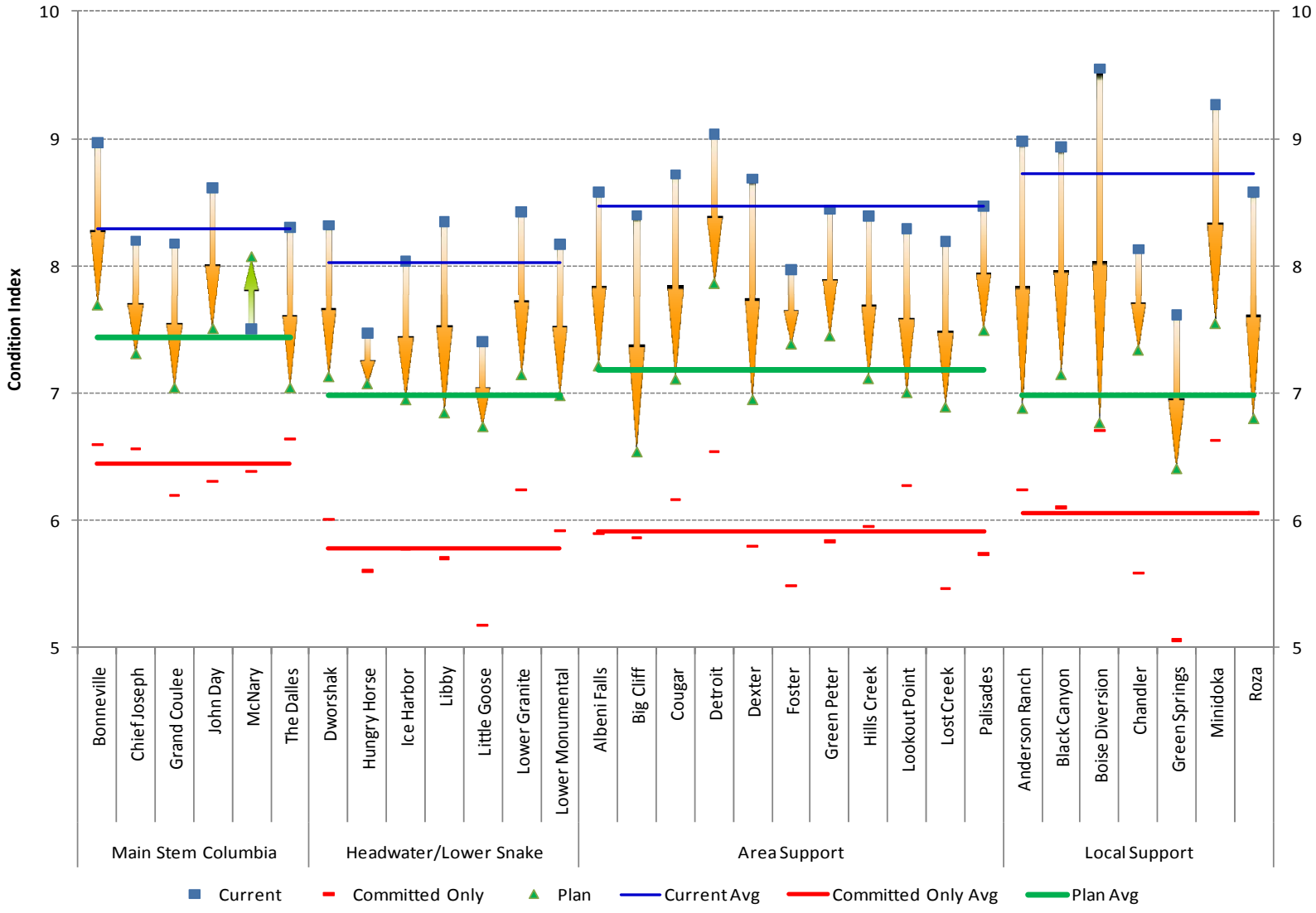
Risk

- **Safety and Environment**: All high risk items are addressed.
- **Financial**: The number of high risk items in marginal or poor condition is projected to decline from 171 in 2009 to 128 in 2022.
- **Lost Generation Risk** is projected to decline from 508 aMW ($249 million) in 2009 to 259 aMW ($127 million) in 2022. LGR for McNary, the plant currently with the highest level of risk, is reduced to 14 aMW.

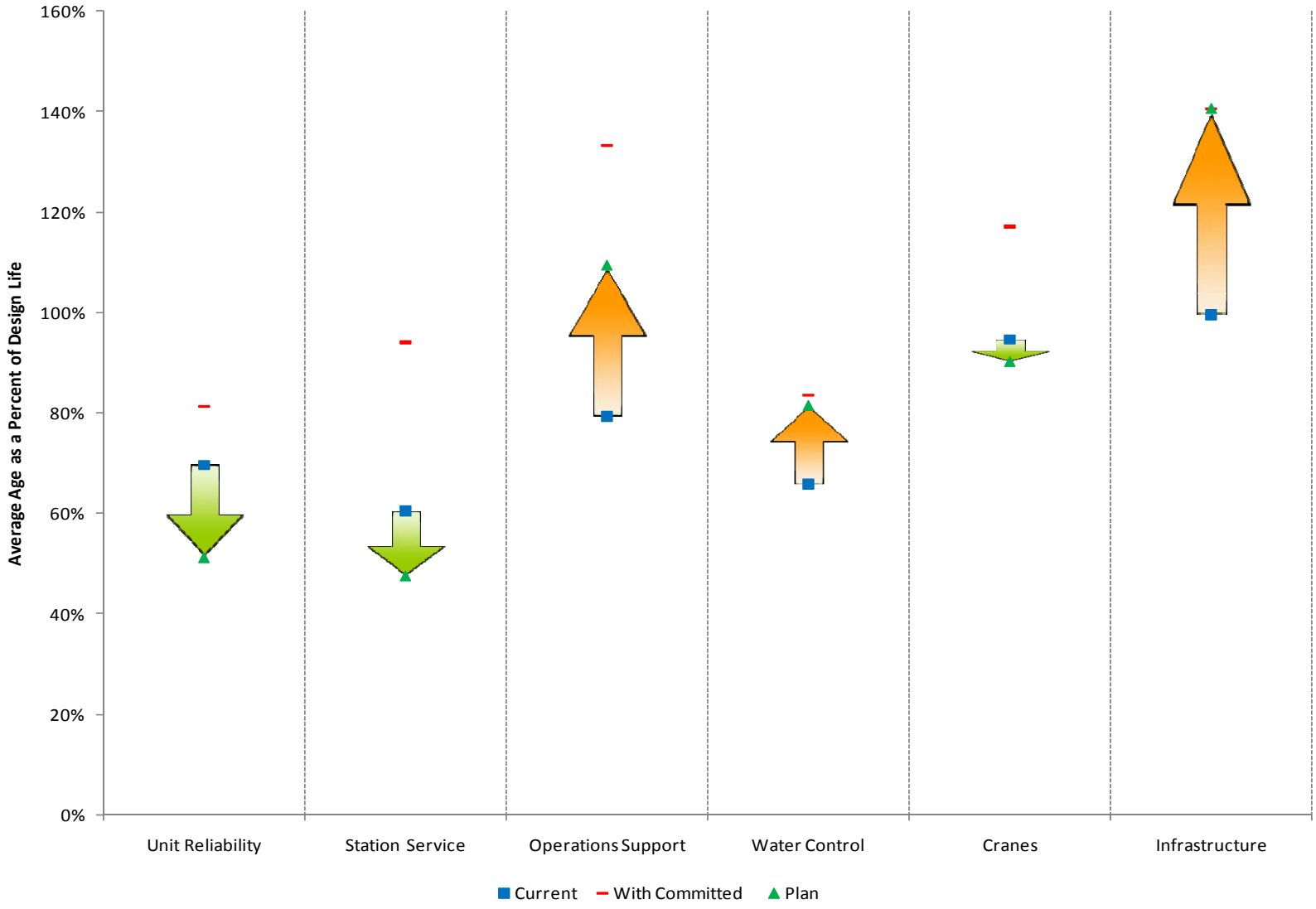
Condition by Plant in 2022: Unit Reliability Equipment
(Recommended Plan)



Condition by Plant in 2022: All Equipment
(Recommended Plan)



Average Age in 2022: All Equipment
(Recommended Plan)



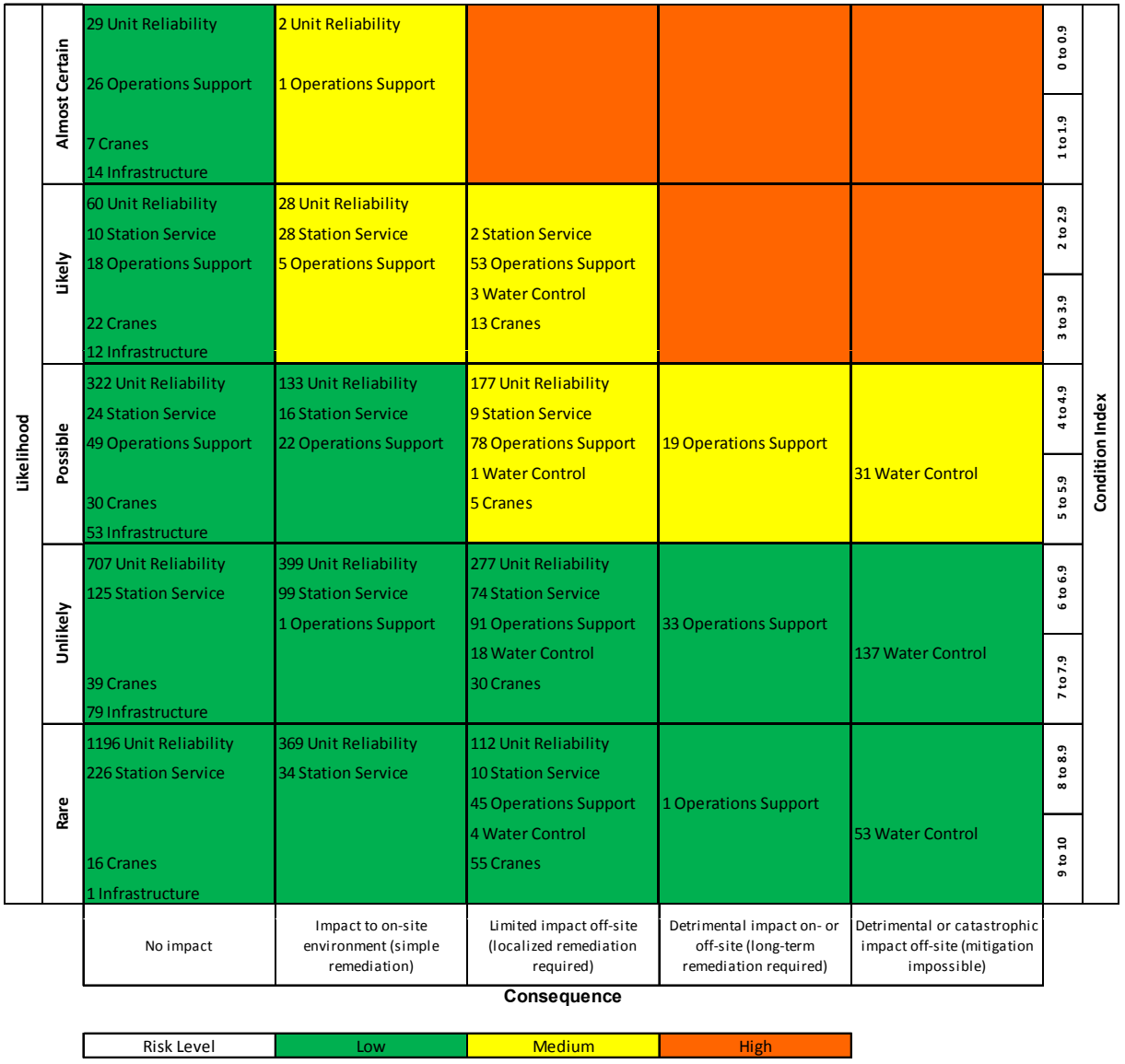
Safety Risk Map in 2022
(Recommended Plan)

Likelihood		No or minor injury, first aid	Treatment by medical professional	Lost time Accident - temporary disability	Lost Time Accident - permanent disability/fatality	Multiple fatalities	Condition Index
	Almost Certain	31 Unit Reliability 26 Operations Support 10 Infrastructure	1 Operations Support 7 Cranes 4 Infrastructure				0 to 0.9 1 to 1.9
	Likely	88 Unit Reliability 10 Station Service 18 Operations Support 8 Infrastructure	28 Station Service 14 Operations Support 3 Water Control 22 Cranes 4 Infrastructure	2 Station Service 44 Operations Support 13 Cranes			2 to 2.9 3 to 3.9
	Possible	439 Unit Reliability 24 Station Service 49 Operations Support 1 Water Control 38 Infrastructure	16 Unit Reliability 16 Station Service 52 Operations Support 30 Cranes 15 Infrastructure	30 Unit Reliability 9 Station Service 57 Operations Support 5 Cranes	10 Operations Support	147 Unit Reliability 31 Water Control	4 to 4.9 5 to 5.9
	Unlikely	853 Unit Reliability 125 Station Service 3 Water Control 41 Infrastructure	253 Unit Reliability 99 Station Service 72 Operations Support 15 Water Control 39 Cranes 38 Infrastructure	142 Unit Reliability 74 Station Service 17 Operations Support 30 Cranes	36 Operations Support	135 Unit Reliability 137 Water Control	6 to 6.9 7 to 7.9
	Rare	1311 Unit Reliability 226 Station Service 2 Water Control 1 Infrastructure	254 Unit Reliability 34 Station Service 2 Operations Support 2 Water Control 16 Cranes	83 Unit Reliability 10 Station Service 33 Operations Support 55 Cranes	11 Operations Support	29 Unit Reliability 53 Water Control	8 to 8.9 9 to 10

Consequence

Risk Level	Low	Medium	High

Environmental Risk Map in 2022
(Recommended Plan)

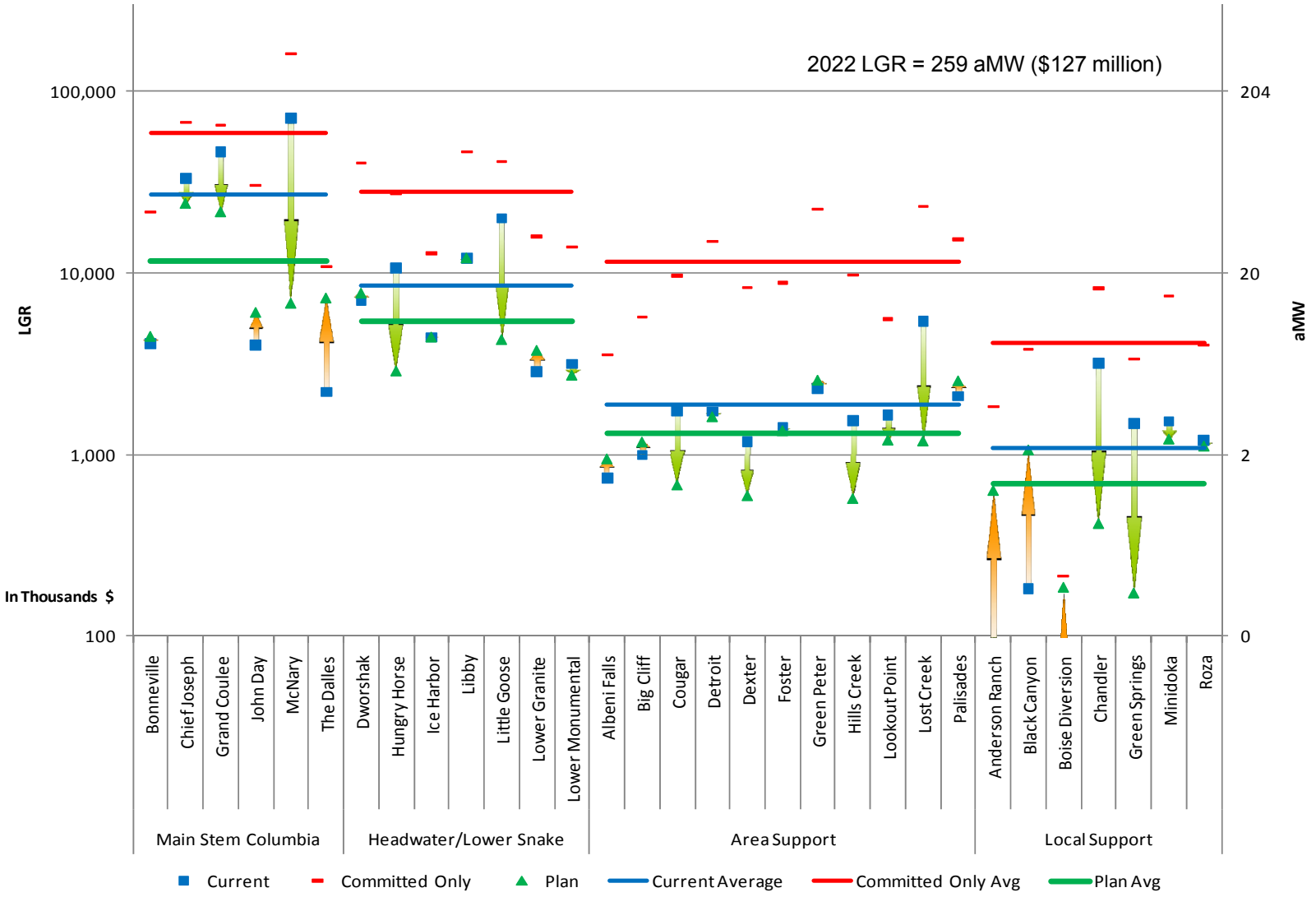


Financial Risk Map in 2022
(Recommended Plan)

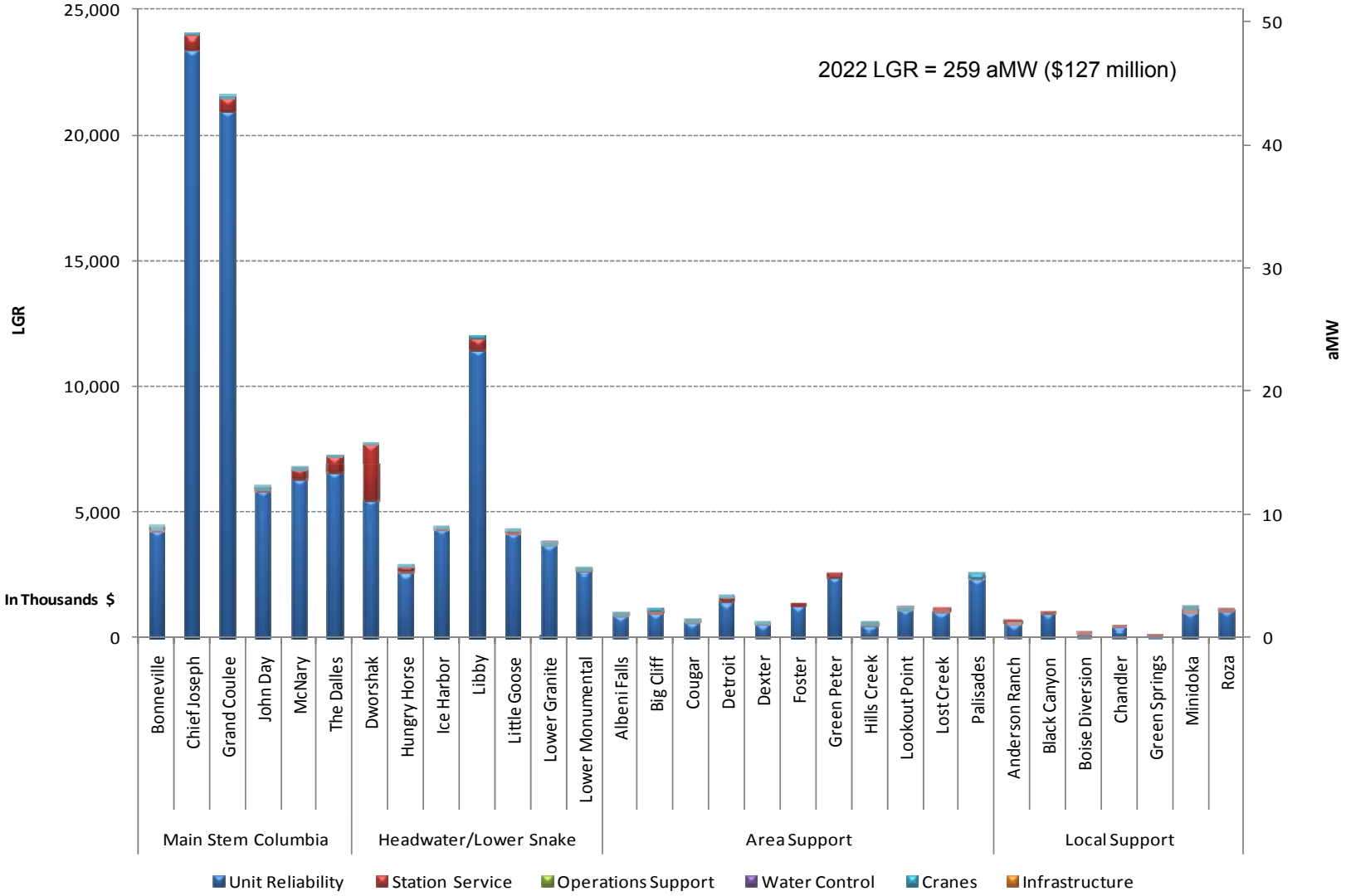
Likelihood		Insignificant	Minor	Moderate	Major	Extreme	Condition Index
	Almost Certain	26 Operations Support	11 Unit Reliability	10 Unit Reliability 7 Cranes 12 Infrastructure	8 Unit Reliability 1 Operations Support 2 Infrastructure	2 Unit Reliability	0 to 0.9 1 to 1.9
	Likely	18 Operations Support	16 Unit Reliability 27 Station Service 23 Operations Support 6 Infrastructure	7 Unit Reliability 13 Station Service 30 Operations Support 3 Water Control 29 Cranes 6 Infrastructure	52 Unit Reliability 5 Operations Support 6 Cranes	13 Unit Reliability	2 to 2.9 3 to 3.9
	Possible	49 Operations Support	241 Unit Reliability 14 Station Service 20 Operations Support 13 Infrastructure	102 Unit Reliability 34 Station Service 76 Operations Support 14 Water Control 22 Cranes 35 Infrastructure	254 Unit Reliability 1 Station Service 20 Operations Support 17 Water Control 13 Cranes 5 Infrastructure	35 Unit Reliability 3 Operations Support 1 Water Control	4 to 4.9 5 to 5.9
	Unlikely	2 Infrastructure	150 Unit Reliability 87 Station Service 44 Operations Support 7 Water Control 3 Cranes 6 Infrastructure	276 Unit Reliability 151 Station Service 80 Operations Support 93 Water Control 41 Cranes 67 Infrastructure	832 Unit Reliability 58 Station Service 50 Water Control 25 Cranes 4 Infrastructure	125 Unit Reliability 2 Station Service 1 Operations Support 5 Water Control	6 to 6.9 7 to 7.9
	Rare		6 Unit Reliability 6 Operations Support 2 Water Control	201 Unit Reliability 21 Station Service 40 Operations Support 26 Water Control 17 Cranes	1189 Unit Reliability 233 Station Service 27 Water Control 54 Cranes 1 Infrastructure	281 Unit Reliability 16 Station Service 2 Water Control	8 to 8.9 9 to 10
		< $ 10K	$ 10K to $ 100K	$ 100K to $ 1 M	$ 1 M to $ 10 M	> $ 10 M	
		Consequence					

Risk Level	Low	Medium	Medium High	High

Lost Generation Risk by Plant in 2022
(Recommended Plan)



Lost Generation Risk by Plant in 2022
(Recommended Plan)



Economics of the Recommended Plan

Levelized Incremental Cost (excludes sunk costs)

- The levelized cost of incremental O&M and Investment is $5 per MWh for the entire hydro system.
- 21 plants have a levelized incremental cost of less than $20 per MWh and none has a cost greater than the levelized value of energy produced.

Levelized Fully Allocated Cost (includes sunk costs)

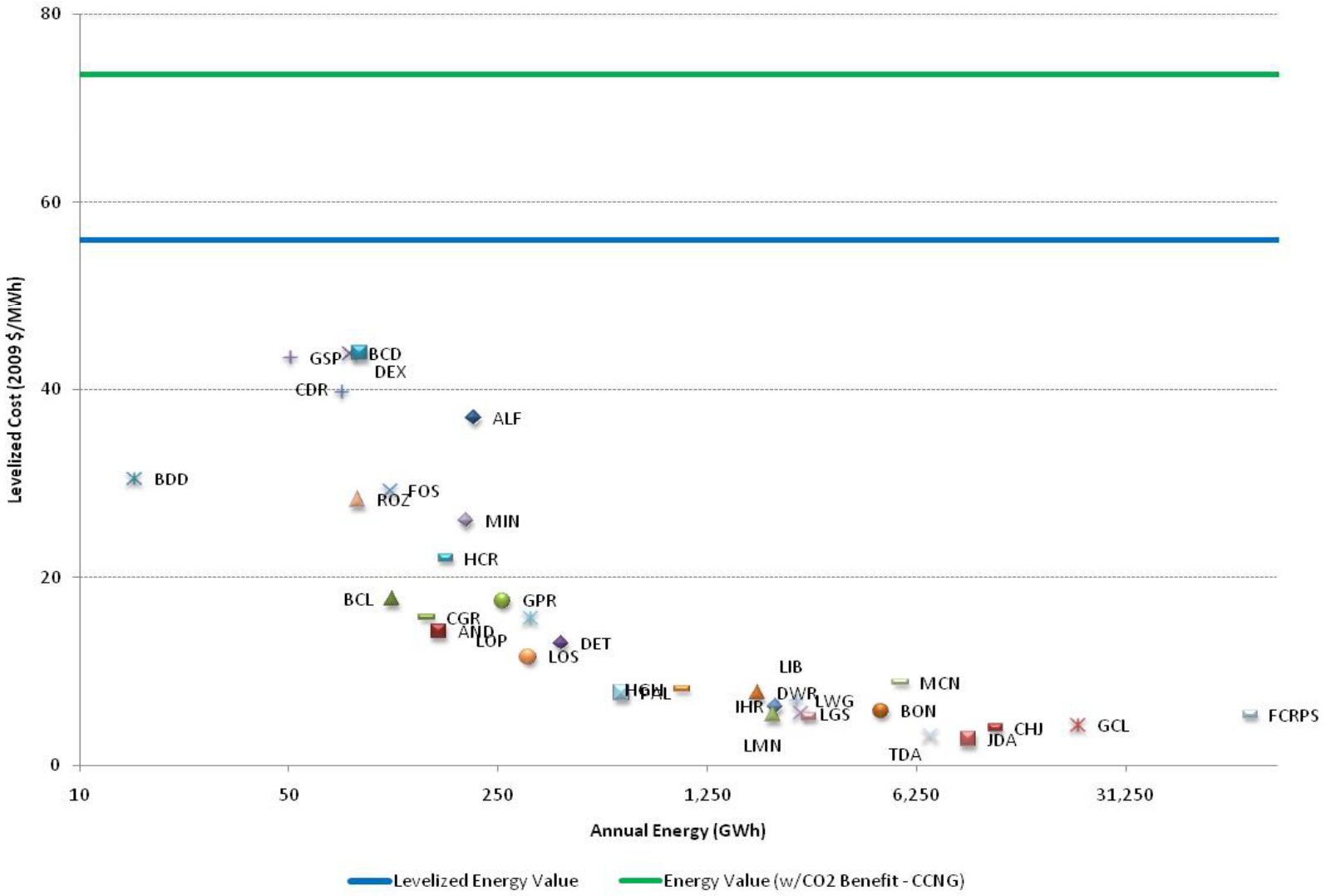
- When adding the sunk investment in the hydro system to incremental O&M and investment costs, the levelized fully allocated cost is $9 per MWh.
- With sunk investment, more than half the plants have a levelized fully allocated cost of less than $20 per MWh with none having a cost greater than the value of energy produced.

Levelized Marginal Unit Cost

- With avoided CO2 benefits, identified incremental costs attributable to the “least used” generating unit are less than or equal to the value of energy produced by that unit at all plants except Lookout Point.
- If avoided CO2 benefits are excluded, the projected incremental cost for the marginal unit at The Dalles and Albeni Falls are also not cost effective.
- Note that the marginal unit analysis does not include value for ancillary services.

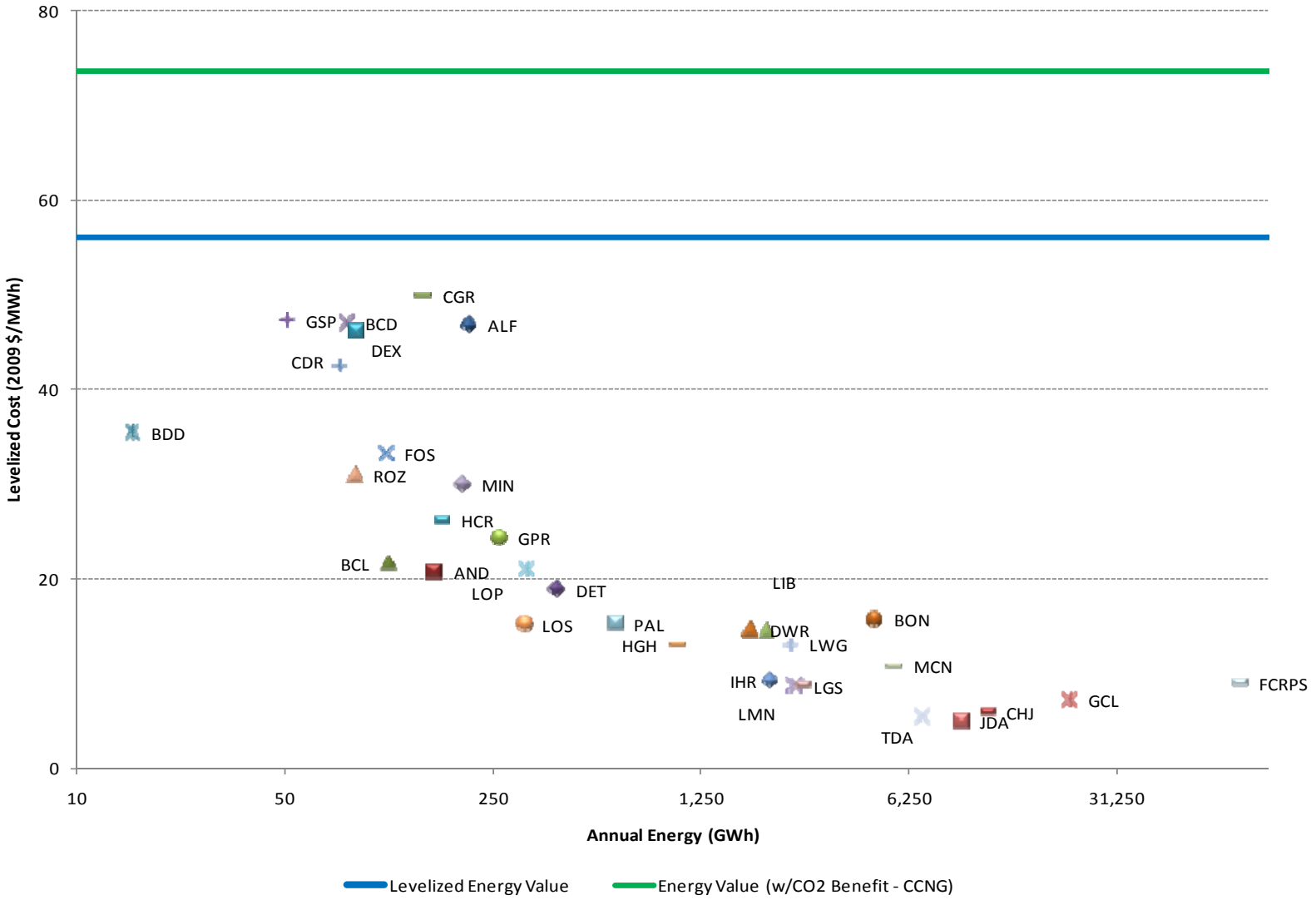
Levelized Incremental Cost

(FY2010 – FY2025 O&M and Investment Programs)



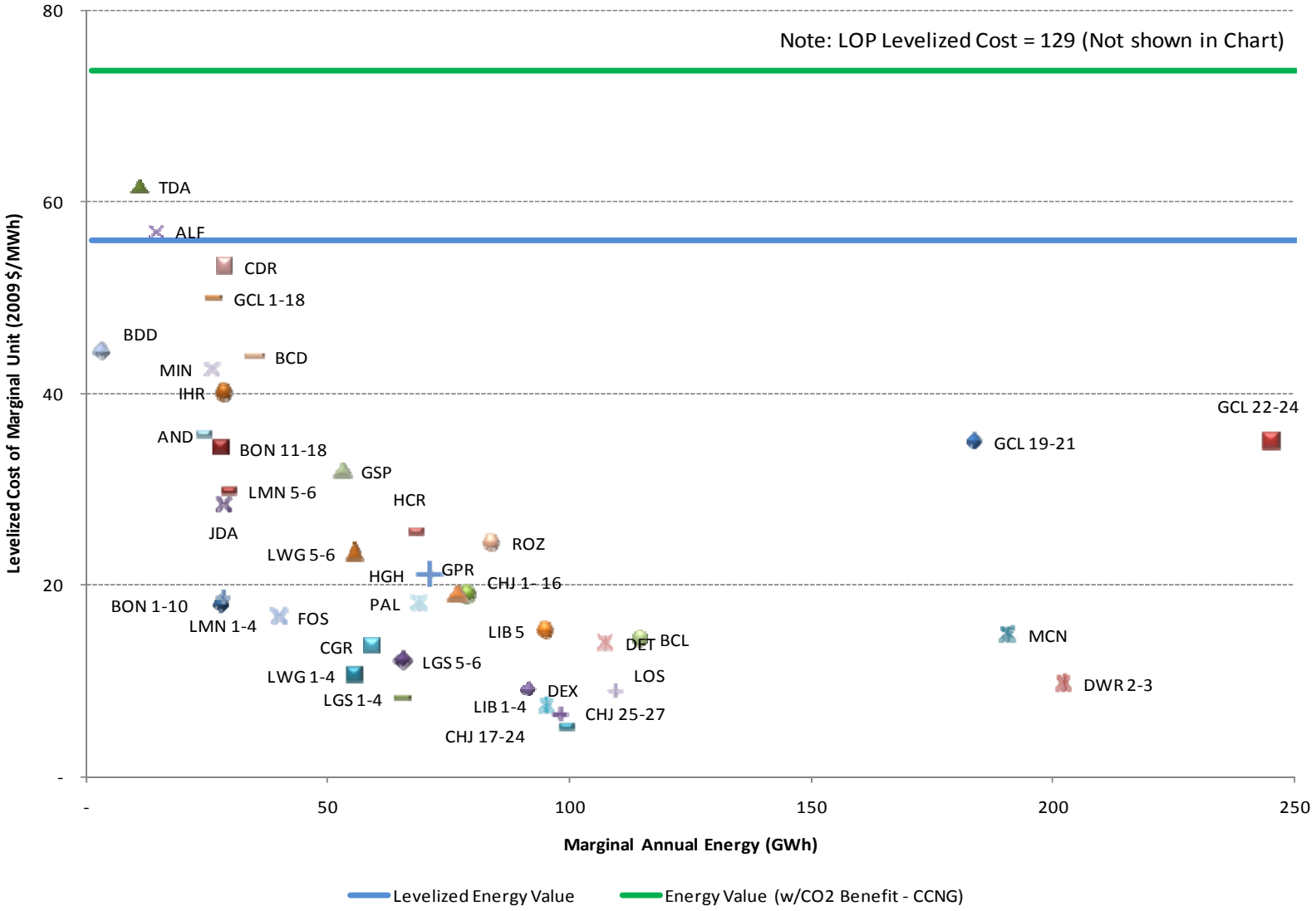
Levelized Fully Allocated Cost

(Net Utility Plant plus FY2010 – FY2025 O&M and Investment Programs)



Levelized Marginal Unit Cost

(Includes Power Maintenance and Generating Unit Incremental Investment)



Summary

The strategy identifies condition and risk implications of the currently committed hydro investment program and new investments prioritized around minimizing lifecycle cost.

It represents a reasonable level and timing of future investment to maintain the production capability of the FCRPS hydro system at a cost effective level of reliability.

The strategy includes hydropower specific and joint-use features, but excludes costs for Columbia River Fish Mitigation and Lower Snake Compensation Plan.

Results are precise and directionally correct, but not prescriptive. Significant additional effort is needed to develop resource plans for implementing this strategy.

The strategy does not include an evaluation of specific issues that may result in new strategic initiatives, e.g., expansion opportunities, pumped storage, procurement mechanisms, automation, staffing, etc.

Summary (continued)

The recommended investment plan identifies a relatively flat program level over a 10 year period (FY2012 – FY2021), which results in a $63 million increase in present value of costs relative to the base case (2008 Integrated Program Review budget), but reduces the present value of risk by $164 million.

The recommended plan has an average annual capital cost of $257 million during the FY2010 – FY2017 period, representing an 18 percent increase to the base case.

The plan results in a levelized fully allocated cost for the hydro system of $9 per MWh (2009 dollars).

Over half of the plants have levelized costs of less than $20 per MWh (2009 dollars), with each plant having a cost below the value of energy it produces.

Appendix

Recommended Plan

Main Stem Expenditures by Year in Thousands (FY2010 – FY2017)

Strategic class	Expenditure Category	Expenditure Type	Equipment Category	FY10-17	2010 (PR)	2011 (PR)	2012 (PR)	2013 (PR)	2014 (PR)	2015 (PR)	2016 (PR)	2017 (PR)
Main Stem Columbia												
	Committed											
		Capital										
			Cranes	68,603	11,109	14,006	10,668	10,995	11,375	8,875	1,575	
			Infrastructure	26,952	6,357	9,340	8,255	2,000	1,000			
			Operations Support	33,129	7,063	6,756	5,495	4,690	5,201	3,924		
			Station Service	30,068	13,815	4,514	1,200	1,527	4,847	4,165		
			Unit Reliability	299,002	61,697	86,693	83,578	41,351	20,154	5,529		
			Water Control	3,264	2,550	239	246	133	96			
		Expense										
			Cranes	5,830	3,721	2,109	0	0	0	0	0	0
			Infrastructure	9,359	992	100	1,867	3,800	2,600	0	0	0
			Operations Support	10,000	2,500	2,500	2,500	2,500	0	0	0	0
			Unit Reliability	130,034	5,044	6,280	19,395	19,445	19,945	19,575	20,175	20,175
			Water Control	45,941	10,326	10,220	6,736	6,317	5,535	4,687	2,120	0
	Opportunity											
		Capital										
			Unit Reliability	207,556	35,321	38,294	27,215	33,867	23,859	29,900	18,600	500
	Safety & Environmental											
		Capital										
			Cranes	1,164			122	235	166	253	228	161
			Operations Support	1,596			238	460	382	375	78	64
	Prioritized New Investment											
		Capital										
			Cranes	5,504			412	794	677	1,039	1,230	1,351
			Station Service	62,221			3,264	7,281	6,448	9,930	16,575	18,722
			Unit Reliability	468,276	1,555	4,252	26,167	49,147	69,740	78,282	98,649	140,485
		Expense										
			Unit Reliability	6,362			262	505	1,055	1,911	1,481	1,148
	AFUDC											
		Capital										
			AFUDC	100,239	11,273	11,611	11,959	12,318	12,687	13,068	13,460	13,864
	O&M Program											
		Capital										
			Small Capital	49,888	5,572	5,971	6,093	6,214	6,331	6,447	6,569	6,691
		Expense										
			O&M	1,311,898	149,443	157,013	159,786	163,003	166,033	169,003	172,196	175,421
Main Stem Columbia Total				**2,876,887**	**328,337**	**359,898**	**375,459**	**366,583**	**358,132**	**356,963**	**352,936**	**378,580**

Recommended Plan

Headwater/Lower Snake Expenditures by Year in Thousands (FY2010 – FY2017)

Strategic class	Expenditure Category	Expenditure Type	Equipment Category	FY10-17	2010 (PR)	2011 (PR)	2012 (PR)	2013 (PR)	2014 (PR)	2015 (PR)	2016 (PR)	2017 (PR)
Headwater/Lower Snake												
	Committed											
		Capital										
			Cranes	18,937	6,846	8,215	3,877					
			Infrastructure	6,969	5,427	1,542	0					
			Operations Support	8,603	3,155	2,285	1,429	589	653	492		
			Station Service	3,467	840	2,552	75					
			Unit Reliability	51,455	8,318	16,334	5,781	12,312	7,985	448	153	124
			Water Control	300	300							
		Expense										
			Cranes	35	35							
			Infrastructure	2,550	2,550	0	0	0	0	0	0	0
			Operations Support	4,614	100	1,000	1,564	1,561	161	135	55	38
			Unit Reliability	15,312	2,502	6,225	5,735	700	150	0	0	0
			Water Control	15,314	2,182	2,353	4,817	2,567	1,295	0	100	2,000
	Safety & Environmental											
		Capital										
			Cranes	1,162			117	225	159	253	239	169
			Operations Support	4,598			477	1,141	1,190	1,050	473	266
			Water Control	35,746			6,548	12,618	8,989	7,400	105	86
	Prioritized New Investment											
		Capital										
			Cranes	17,693			383	2,236	3,408	3,982	4,707	2,977
			Station Service	48,678			4,878	9,426	7,509	10,899	8,965	7,000
			Unit Reliability	152,456			9,990	18,647	29,145	31,470	34,793	28,411
	AFUDC											
		Capital										
			AFUDC	30,828	3,467	3,571	3,678	3,788	3,902	4,019	4,140	4,264
	O&M Program											
		Capital										
			Cranes	100	100	0	0	0	0	0	0	0
			Station Service	40	40	0	0	0	0	0	0	0
			Small Capital	29,143	3,285	3,484	3,552	3,627	3,693	3,763	3,833	3,906
		Expense										
			O&M	496,537	57,410	59,232	60,348	61,569	62,711	63,882	65,083	66,302
Headwater/Lower Snake Total				**944,538**	**96,556**	**106,792**	**113,250**	**131,007**	**130,950**	**127,794**	**122,646**	**115,542**

Recommended Plan

Area Support Expenditures by Year in Thousands (FY2010 – FY2017)

Strategic class	Expenditure Category	Expenditure Type	Equipment Category	FY10-17	2010 (PR)	2011 (PR)	2012 (PR)	2013 (PR)	2014 (PR)	2015 (PR)	2016 (PR)	2017 (PR)
Area Support												
	Committed											
		Capital										
			Cranes	3,785	3,750	35	0					
			Operations Support	1,712	1,712							
			Station Service	1,982	1,982							
			Unit Reliability	81,404	18,043	16,661	15,832	15,644	11,448	2,706	240	830
			Water Control	1,788	753	580	455					
		Expense										
			Infrastructure	575	75	500	0	0	0	0	0	0
			Operations Support	1,768	253		565	562	161	135	55	38
			Water Control	6,110	4,610	100	400	800	0	0	200	0
	Safety & Environmental											
		Capital										
			Operations Support	3,116			228	439	659	924	477	390
			Water Control	8,279			1,535	2,957	2,088	1,699	0	0
	Prioritized New Investment											
		Capital										
			Cranes	2,009						334	764	911
			Infrastructure	1,173	217	419	296	241	0	0		
			Station Service	68,766			1,939	9,415	13,776	14,582	17,563	11,491
			Unit Reliability	115,553			4,893	9,582	17,188	21,220	31,721	30,949
	AFUDC											
		Capital										
			AFUDC	4,642	522	538	554	570	588	605	623	642
	O&M Program											
		Capital										
			Small Capital	12,189	1,388	1,455	1,484	1,513	1,545	1,572	1,600	1,632
		Expense										
			O&M	211,469	24,506	25,234	25,694	26,212	26,701	27,192	27,709	28,221
Area Support Total				**526,319**	**57,811**	**45,522**	**53,874**	**67,934**	**74,153**	**70,970**	**80,952**	**75,103**

Recommended Plan

Local Support Expenditures by Year in Thousands (FY2010 – FY2017)

Strategic class	Expenditure Category	Expenditure Type	Equipment Category	FY10-17	2010 (PR)	2011 (PR)	2012 (PR)	2013 (PR)	2014 (PR)	2015 (PR)	2016 (PR)	2017 (PR)
Local Support												
	Committed											
		Capital										
			Station Service	1,600		100	1,500					
			Unit Reliability	14,207	3,332	5,815	5,060					
		Expense										
			Unit Reliability	1,035	935	0	100	0	0	0	0	0
			Water Control	350	100	250	0	0	0	0	0	0
	Opportunity											
		Capital										
			Unit Reliability	16,535	125		1,627	614	776	8,242	4,927	224
	Safety & Environmental											
		Capital										
			Unit Reliability	55								55
			Water Control	802					149	286	202	165
	Prioritized New Investment											
		Capital										
			Station Service	7,573			13	43	925	1,997	2,137	2,459
			Unit Reliability	28,818			991	2,116	2,566	5,021	7,295	10,829
	AFUDC											
		Capital										
			AFUDC	761	86	88	91	94	96	99	102	105
	O&M Program											
		Capital										
			Station Service	25	25	0	0	0	0	0	0	0
			Small Capital	4,086	415	496	505	514	523	534	545	554
		Expense										
			O&M	108,839	12,210	13,246	13,336	13,595	13,723	13,979	14,244	14,506
Local Support Total				**184,687**	**17,228**	**19,995**	**23,223**	**16,975**	**18,757**	**30,159**	**29,453**	**28,897**
Grand Total				**4,532,430**	**499,933**	**532,206**	**565,805**	**582,500**	**581,992**	**585,885**	**585,986**	**598,124**

End