Deferred Maintenance Assessment Report

FY16 NASA-Wide Standardized Deferred Maintenance Parametric Estimate (Full Assessment)

Final September 30, 2016

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EXECUTIVE SUMMARY

In Fiscal Year 2016 (FY16), the National Aeronautics and Space Administration (NASA) performed its fifteenth consecutive facilities condition assessment and Deferred Maintenance (DM) cost estimate.

Executive Order (EO) 13327, Federal Real Property Asset Management, requires federal agencies to catalog real property and develop methods to improve operational and financial management of real property. EO 13423, Strengthening Federal Environmental Energy, and Transportation Management, and EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, also provide additional requirements for sustainable design and high performance buildings. The DM assessment is one element of NASA's broader real property management efforts. The DM assessment provides facility condition evaluations that satisfy the Federal Accounting Standards Advisory Board's (FASAB) *Deferred Maintenance Reporting For Federal Facilities, Meeting the Requirements of Federal Accounting Standards Advisory Board Standard Number 6, as Amended, Accounting for Property, Plant and Equipment (PP&E),* June 1996, and Standard Number 42, as amended, Deferred Maintenance and Repairs, April 25, 2012. The assessment results also satisfy NASA's requirement to report on facilities' condition in its annual *Performance and Accountability Report*. Facility condition is one of the four first-tier performance measures established by the Federal Real Property Council (FRPC), which is required to be reported each year to the Federal Real Property Profile (FRPP).

The Facilities Engineering Division and the Comptroller can utilize the DM cost estimate to provide a useful metric of facility requirements during the budget evaluation process. In addition, the results are used as a performance metric for the effectiveness of facility maintenance programs, serve as a guide for investment and budgeting, and play an integral role in meeting the requirements of Executive Orders 13327, 13423, and 13514.

The DM methodology consists of a parametric estimating model, which is populated with data on condition ratings. The condition ratings are based on rapid visual assessments of NASA's facilities and their component systems. The estimating model is designed to provide consistent, auditable DM estimates at the Agency and Center levels, and to provide an assessment of the condition of NASA facilities at the system level. The facility assessments also provide an opportunity for assessors to verify the accuracy of NASA's Real Property Management System (RPMS) data, which contributes to the integrity of the estimating model.

RESULTS

The FY16 assessment yielded the following results:

- The NASA-wide Facility Condition Index (FCI), which is rated on a scale from 5 (excellent) to 1 (non-functional), remained at a 3.7 rating from FY15 to FY16. The FCI for NASA's active assets remained at 3.7 from FY15 to FY16 and the inactive assets' FCI increased from 3.8 to 3.9.
- NASA's DM estimate for all assets increased from $2.33 billion to $2.39 billion between FY15 and FY16, a change of approximately $59.53 million, or 2.56 percent. The DM estimate for active assets increased from $2.16 billion to $2.25 billion, an increase of $0.09 billion, or 4.17 percent. For inactive assets, the DM estimate decreased from $0.17 billion to $0.14 billion, a decrease of 17.64 percent.
- RPMS data continues to be reviewed as part of the DM assessment process. The accurate calculation of the DM estimate is dependent upon continued efforts to

include or remove assets as appropriate. In addition, the NASA Classification Codes and Current Replacement Value (CRV), which are primary factors in the calculation of FCI and DM estimates, would benefit from further refinement.

The following tables provide summary data on the FY16 DM estimate and FCI for NASA by Center (including all component installations). Table 1 provides a summary of the data. Table 2 provides a comparison between the FY15 and FY16 assessments. The "NASA Agency Total" line includes all component installations of the Centers and does not exactly equal the sum of values from component Centers due to rounding.

Table 1. FY16 Summary

Name	2016 CRV ($M)	2016 FCI	2015 DM ($M)	Active CRV ($M)	Active FCI	Active DM ($M)	Inactive CRV ($M)	Inactive FCI	Inactive DM ($M)
NASA Agency Total	**$34,672.52**	**3.7**	**$2,385.68**	**$33,284.16**	**3.7**	**$2,248.50**	**$1,388.36**	**3.9**	**$137.18**
Ames Research Center	$5,081.48	3.7	$485.26	$5,003.91	3.7	$452.37	$77.58	2.8	$32.88
Armstrong Flight Research Center	$442.60	3.9	$24.02	$441.12	3.9	$24.00	$0.10	4.0	$0.02
Glenn Research Center	$3,524.46	3.6	$235.06	$3,421.59	3.6	$227.21	$102.87	4.0	$7.85
Goddard Space Flight Center	$2,982.58	3.7	$183.14	$2,966.80	3.7	$179.41	$15.78	3.0	$3.74
Jet Propulsion Laboratory	$2,199.63	4.1	$66.00	$2,167.98	4.2	$57.87	$31.65	3.4	$8.13
Johnson Space Center	$2,917.95	3.6	$225.99	$2,829.43	3.6	$218.64	$88.52	3.5	$7.36
Kennedy Space Center	$6,326.45	3.7	$469.87	$6,161.99	3.7	$450.46	$164.45	3.2	$19.41
Langley Research Center	$3,573.33	3.7	$261.25	$3,565.96	3.7	$259.71	$7.36	3.3	$1.54
Marshall Space Flight Center	$3,908.05	3.8	$237.60	$3,693.79	3.8	$199.32	$214.26	3.7	$38.28
Stennis Space Center	$3,721.20	3.8	$197.98	$3,036.80	3.7	$180.01	$684.41	4.4	$17.97

Table 2. FY15 to FY16 Comparison

Name	DM 2015	DM 2016	Delta DM ($M)	DM %Change	FCI 2015	FCI 2016	Delta FCI
NASA Agency Total	**$2,326.15**	**$2,385.68**	**$59.53**	**2.56%**	**3.7**	**3.7**	**0.0**
Ames Research Center	$483.14	$485.26	$2.11	0.44%	3.7	3.7	0.0
Armstrong Flight Research Center	$24.55	$24.02	($0.53)	-2.14%	3.8	3.9	0.1
Glenn Research Center	$249.79	$235.06	($14.73)	-5.90%	3.6	3.6	0.0
Goddard Space Flight Center	$164.04	$183.14	$19.10	11.64%	3.7	3.7	0.0
Jet Propulsion Laboratory	$65.69	$66.00	$0.31	0.47%	4.1	4.1	0.0
Johnson Space Center	$218.90	$225.99	$7.10	3.24%	3.6	3.6	0.0
Kennedy Space Center	$480.15	$469.87	($10.28)	-2.14%	3.7	3.7	0.0
Langley Research Center	$194.10	$261.25	$67.15	34.60%	3.6	3.7	0.1
Marshall Space Flight Center	$250.16	$237.60	($12.57)	-5.02%	3.8	3.8	0.0

Name	DM 2015	DM 2016	Delta DM ($M)	DM %Change	FCI 2015	FCI 2016	Delta FCI
Stennis Space Center	$195.62	$197.98	$2.36	1.21%	3.8	3.8	0.0

OBSERVATIONS

There have been no significant changes in in NASA's overall facility condition since the FY15 DM assessment. Assets remain in fair to good condition. Fair condition is defined as “More minor repairs and some infrequent larger repairs required. System occasionally unable to function as intended”, and Good condition is defined as “Some minor repairs needed. System normally functions as intended.” NASA’s staff and contractors continue to maintain the aging systems through diligent application of maintenance practices and the use of technology for tracking maintenance and repairs.

NASA Centers are effectively allocating limited resources to maintain active facilities to support mission operations. The decline of the Agency’s DM estimate reflects NASA’s efforts to prioritize maintenance and repair work with a priority on mission critical facilities, followed by mission support, then Center support. NASA’s repair by replacement efforts are beginning to demonstrate the intended results. Essential parts of the repair by replacement program include the demolition of facilities, and the Construction of Facilities (CoF) Program which in recent years has migrated from new capabilities and renovations to major repair projects. Attaining NASA’s targeted FCI goal of 4.0 by 2020, however, will require a significant and targeted investment in major facility systems and high-value assets, and demolition of Abandoned assets. These improvements also present an opportunity for Centers to replace inefficient and obsolete systems with more energy efficient systems, resulting in operations cost savings and increasing the overall FCI and lowering the DM estimate.

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ACRONYMS LIST

AFRC	Armstrong Flight Research Center
ARC	Ames Research Center
ASTM	American Society for Testing of Materials
BMAR	Backlog of Maintenance and Repair
CERs	Cost Estimating Relationships
CoF	Construction of Facilities
CRV	Current Replacement Value
CSBF	Columbia Scientific Balloon Facility
CSBF -TX	Columbia Scientific Balloon Facility Palestine, TX
CSBF - NM	Columbia Scientific Balloon Facility Fort Sumner, NM
DM	Deferred Maintenance
DSCC	Deep Space Communication(s) Complex
DSN	Deep Space Network
EO	Executive Order
FASAB	Federal Accounting Standards Advisory Board
FCI	Facility Condition Index
FFC	Federal Facilities Council
FIS	Facility Investment Study
FRPC	Federal Real Property Council
FRPP	Federal Real Property Profile
FY	Fiscal Year
GRC	Glenn Research Center
GRC LF	Glenn Research Center Lewis Field
GSFC	Goddard Space Flight Center
HQ	NASA Headquarters
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
KSC CAPE	Kennedy Space Center-Cape Canaveral Air Force Station
LaRC	Langley Research Center
MAF	Michoud Assembly Facility
MOBLAS	Mobile LASER Site
MFA	Moffett Federal Airfield
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NAS	NASA Advanced Supercomputing Facility
NPR	NASA Procedural Requirements
PACES	Parametric Cost Estimating System
PBS	Plum Brook Station
POC	Point of Contact
PP&E	Property, Plant and Equipment
PSE	Program Support Equipment
QA	Quality Assurance
RPAO	Real Property Accountability Officer
RPMS	Real Property Management System
SSFL	Santa Susana Field Laboratory
STDN	Space Flight Tracking and Data Network
SOW	Statement of Work

SSC	Stennis Space Center
SCI	System Condition Index
TDRSS	Tracking and Data Relay Satellite System
USACE	United States Army Corps of Engineers
VLBI	Very Long Baseline Interferometry
WFF	Wallops Flight Facility
WSGT	White Sands Ground Terminal
WSTF	White Sands Test Facility

1.0 INTRODUCTION

1.1 PURPOSE

This report presents the results of the Fiscal Year 2016 (FY16) NASA facilities condition assessment and Deferred Maintenance (DM) cost estimate using the NASA DM Parametric Estimating Method. The DM method enables a rapid, low-cost, consistent assessment of the condition of NASA assets worldwide, and is designed for application to a large population of facilities.

The trending of DM and other metrics help guide decision makers toward spending priorities for these assets in support of the Agency's mission. DM, when applied correctly, can be an excellent overall indicator of the condition of Center facilities and collateral equipment as a group. It reflects the cumulative effects of underfunding facilities maintenance and repair. Review of DM trends and comparison of DM with the CRV and facilities maintenance funding provide indications of the adequacy of the resources devoted to facilities maintenance.

The DM assessment provides facility condition evaluations as recommended by the Federal Accounting Standards Advisory Board's (FASAB) *Deferred Maintenance Reporting For Federal Facilities, Meeting the Requirements of Federal Accounting Standards Advisory Board Standard Number 6, as Amended, Accounting for Property, Plant and Equipment (PP&E),* June 1996. Additional guidance has been provided by FASAB, Standard Number 42, as Amended, Deferred Maintenance and Repairs, April 25, 2012. Executive Order 13327, Federal Real Property Asset Management, requires federal agencies to catalog real property and develop methods to improve operational and financial management of real property inventory. EO 13423, Strengthening Federal Environmental Energy, and Transportation Management, and EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, also provide additional requirements for sustainable design and high performance buildings.

The DM assessment, accordingly, is one element of NASA's broader real property management efforts. NASA reports the condition and DM for each facility as required by the Federal Real Property Council annual Real Property Inventory Reporting Requirements. The assessment results also satisfy NASA's requirement to report on facilities' condition in its annual *Performance and Accountability Report*. The Facilities Engineering Division and the Comptroller can utilize the DM cost estimate to provide useful metrics of facilities condition and requirements during the budget evaluation process.

All facilities located on NASA Sites, and all facilities on-site or off-site that are owned, leased, occupied, or used by NASA (NASA Programs or Contactors) are assessed via the Deferred Maintenance assessment.

1.2 BACKGROUND

The FASAB Standard Number 6 provided guidance to federal agencies to report on asset conditions and the estimated cost to remedy the DM of plant, property, and equipment in their Annual Accountability Reports. NASA Procedural Requirement (NPR) 8831.2E, *Facilities Maintenance and Operations Management*, defines DM as:

> The total of essential, but unfunded, facilities maintenance work necessary to bring facilities and collateral equipment to the required acceptable facilities maintenance standards. It is the total work that should be accomplished but that cannot be

achieved within available resources. It does not include new construction, additions, or modifications. DM does include unfunded maintenance requirements, repairs, ROI and CoF repair projects.

Within NASA, the DM estimates have been historically used as a vehicle to support the Agency's Annual Accountability Report by providing both a functional performance metric trended over time and a reference point for reviewing annual maintenance budgets.

In 1997, NASA developed an Agency-wide DM estimate known as the Facility Investment Study (FIS). The FIS estimated both Backlog of Maintenance and Repair (BMAR) and alteration requirements. From 1997 through 2001, NASA updated the FIS to form the basis for the Agency's facilities condition estimate referenced in the Annual Accountability Reports. Auditors of the FY01 Accountability Report indicated that a new, more consistent method for estimating DM was required for the FY02 Accountability Report.

Due to a broad interest in FASAB Standard Number 6, the Federal Facilities Council (FFC) Standing Committee on Operations and Maintenance initiated a study to identify issues related to the reporting of DM for facilities. This report, entitled *Deferred Maintenance Reporting for Federal Facilities: Meeting the Requirements of Federal Accounting Standards Advisory Board Standard Number 6, as Amended*, reviewed alternative options, including parametric estimates, for developing credible, consistent, auditable, and cost-effective DM estimates. The FFC report can be viewed online at *http://books.nap.edu/catalog/10095.html*.

Concurrent with the FFC study, NASA leadership supported a parametric cost estimating system for estimating DM. In addition to expediting the development of cost estimates, parametric techniques provide accurate and supportable contractor estimates, lower cost proposal processes, and more cost-effective estimating systems. The parametric methodology is appropriate when discrete estimating techniques would require inordinate amounts of time and resources without leading to significant improvements in accuracy or probability.

The NASA facilities condition assessment methodology involves an independent, rapid visual assessment of nine different systems within each facility. These systems are:

- Structure
- Exterior
- Roof
- HVAC
- Electrical
- Plumbing
- Interior Finishes
- Conveyance
- Program Support Equipment

Teams of independent assessors, including architects, engineers, and facility specialists, all trained in NASA's DM methodology, performed the condition assessments. The assessment teams inspected each asset and rated each system visually, taking into account input from facilities management staff and building managers. Staff input is particularly valuable for electrical, plumbing, and HVAC systems, where significant portions of the system are not visible. The assessors entered condition ratings into the parametric estimating model, which produces a System Condition Index (SCI), a FCI, and a DM cost estimate.

The parametric estimating model uses each asset's CRV and DM Category as its basis. The CRV is apportioned among each of the nine facility systems based on the unique System CRV Percentage model defined for each of the 43 DM facility categories. The condition rating for each system determines the percentage of system CRV that results in the estimated DM cost. The sum of these costs is used to produce DM cost estimates at the asset, installation, site, Center, and Agency level. Appendix A provides a detailed explanation of the parametric estimating process.

All references to Center results in this report include combined totals for the main Center site and all component installations, unless otherwise stated. The detailed results for each installation are located in Section 4.0: Assessment Results of this report, and throughout the Lessons Learned Report.

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2.0 OBSERVATIONS AND RECOMMENDATIONS

The FY16 DM assessment implemented the parametric estimating method that has been applied by NASA since 2002. The successful application of this method depends on a collaborative effort between Center staff and the assessment teams. Center staff provides logistical support, access to facilities, and essential system condition knowledge. Assessors provide independent technical expertise and apply ratings according to the prescribed methodology.

Teams of assessors performed the FY16 condition assessments under the direction of designated team leaders. Team leaders were responsible for coordinating their respective team's efforts with Center representatives and overseeing the overall consistency and quality of the assessment team's application of the assessment process on-site. Teams were assembled to include both assessors with prior experience at the site and assessors new to the site. Site-experienced assessors provided a historical perspective and facilitated logistics on-site, while new assessors viewed each asset uninfluenced by previous years' site visits.

2.1 FACILITY CONDITION INDEX

2.1.1 Observations

Based on the ratings obtained during the condition assessment, the Agency-wide FCI for FY16 has been calculated at 3.7, unchanged from FY15. The FY16 FCI for active assets remained at 3.7, since FY15, and the FY16 FCI for inactive assets (Abandoned, Mothballed, or Standby) increased to 3.9. Two Centers experienced a change in FCI as the result of observations made during the FY16 DM assessment. Armstrong Flight Research Center (AFRC), and Langley Research Center both increased by 0.1.

The evaluation of facility conditions by building type (DM Category Code) indicates that the Agency continues to focus maintenance and repair on direct mission-related facilities and infrastructure. The assessment identifies higher condition ratings (≥ 4.0) by DM codes for potable water facilities, communication and tracking facilities, fueling facilities, and mission control operations buildings. Lower condition ratings (≤3.5) occur for infrastructure and site-related systems such as pavement, electrical distribution, lighting, storm drain systems, and small antennas.

Assets in five of the 43 DM Facility Category Codes averaged an FCI rating at or above the targeted 4.0, one more than FY15. This indicates that the Agency is striving to achieve its goal, but is held back by aging facilities and the lack of funding for major repairs and renovations. The three lowest DM Category Codes in terms of FCI/SCI are: small antennas (2.8 for 8 assets), storm drains, ditches, dams, and retaining walls (2.9 for 49 assets), and Lighting (3.0 for 48 assets).

2.1.2 Recommendation

The FY16 FCI of 3.7 is lower than NASA's targeted goal of 3.8 for FY16, and 4.0 by 2020. Even with a scheduled increase in maintenance, repair, rehabilitation, and construction funding, it will be difficult for NASA to reach its goal within current budget limitations. Any approach will require an Agency-wide, strategic phased plan that accounts for transitions to future missions, while minimizing interruptions to current missions.

A key strategy to increase NASA's FCI is the construction of new facilities through repair by replacement. The construction of new assets adds buildings with typically larger CRVs and high FCIs to the RPMS. Through the weighted calculations of the DM methodology, these assets should have a positive impact on the Centers' FCI. Also increasing NASA's FCI is the current Demolition Program. The demolition of deteriorated, under-utilized or Abandoned assets removes low FCIs from the Center-wide calculations.

Another approach to increasing FCI without additional funding would be to perform whole building or system renovations of fewer buildings, rather than partial building or system renovations of more buildings. On several occasions, assessors noted areas or systems of a building that had been recently upgraded, but the improved condition of the limited area was not enough to offset the condition of the rest of the building, therefore the rating was not changed. This issue is exacerbated when multiple buildings share one building number, and assessors must assign one rating to the entire system for each asset. When planning for upgrades, Centers should consider making changes to enough of the building or system to achieve critical mass and merit a rating increase under the DM methodology. This strategy would have to be weighed against funding models and mission priorities.

These approaches represent strategies that can yield the largest increases in FCI with the least amount of money. They should be used in conjunction with the Centers' ongoing facilities maintenance practices to maintain the facilities in working condition.

2.2 DEFERRED MAINTENANCE ESTIMATED COST COMPARASON

2.2.1 Observations

The NASA FY16 DM estimate increased by approximately $59.53 million, or 2.56 percent from the FY15 estimate. Larger variations in DM at individual sites occurred for various reasons including changes to high-value assets, continued deterioration of certain Center-wide systems and the demolition of facilities. (see Section 5.3).

The four Centers with the highest DM estimates, Ames Research Center (ARC), Marshall Space Flight Center (MSFC), Kennedy Space Center (KSC), and Langley Research Center (LaRC), account for 60.95 percent of the Agency-wide DM and 54.48 percent of the NASA CRV. All four of these large Centers have high-value assets, including wind tunnels, launch facilities, and test stands with aging or non-operational program support equipment.

Six Centers had increases in DM estimates, ranging from $0.31 million to $67.15 million, for a total DM estimate increase of $98.13 million. Four Centers had decreases in DM estimates ranging from $0.53 million to $14.73 million, for a total DM estimate decrease of $38.11 million.

The Centers with the greatest increases in DM estimates were: LaRC by $67.15 million (34.60%), Goddard Space Flight Center (GSFC) by $19.10 million (11.64%), and Johnson Space Center by $7.10 million (3.24%).

The DM increases at these Centers were generally related to the standard CRV escalation that occurs annually between DM assessments combined with normal deterioration across multiple assets. More information on DM increases can be found in section 5.2.

The Centers with the greatest decreases in DM estimate values were: GRC by $14.73 million (5.90%), Marshall Space Flight Center (MSFC) by $12.57 million (5.02%), and Kennedy Space Center by $10.28 million (2.14%). The decrease in the DM estimate at these Centers can be partially attributed to a repair by replacement program by which new facilities are constructed and abandoned facilities are demolished. Additional decreases in DM result from improvements to high-value assets at KSC, and the ongoing demolition of the Santa Susana Field Laboratory (SSFL), which falls under MSFC.

Facility systems will continue to age and deteriorate while obsolete equipment and lack of available spare parts will eventually require whole system replacements. Whole system replacements provide opportunities to upgrade to more energy-efficient and more reliable systems.

2.2.2 Recommendation

There are two primary ways to reduce DM. One is major system improvements and the other is demolition - particularly for high-value assets. In order for these strategies to be reflected in the results of the annual DM assessment, the RPMS, particularly the CRV, must be consistently updated to reflect these changes. Pursuing a targeted program of facility demolition and consolidation is a coordinated means to meet Agency goals for DM growth reduction. Such a program would eliminate older facilities with high DM values and introduce newer buildings with low or no DM values.

The NASA staff has been reviewing alternative approaches to increase FCI and reduce DM value growth for the Agency. All alternatives include varying levels of demolition of abandoned facilities, new construction, and targeted improvements to active high-value assets. Preliminary studies indicate that a significant reduction in DM growth could be achieved with current planned levels of demolition combined with an additional $50 million worth of new construction annually. Based on this approach, an aggressive, coordinated, facility consolidation program may be the most feasible way to achieve NASA's real property objectives. Additional existing older buildings would be targeted for demolition in conjunction with major renovation, new construction, and other consolidation programs that compare the efficiency of existing building configurations to program requirements.

In the absence of any funding increases for major facility improvements, Centers should continue to focus efforts on maintaining and improving mission-critical assets with both functionality and safety in mind. Centers should continue efforts in reliability-centered maintenance and sustainability upgrades.

2.3 BUILDING SYSTEMS

2.3.1 Observations

Agency-wide Electrical ($534.87 million), Structure ($509.66 million), and HVAC ($354.40 million) systems continue to have the highest DM values. Together they comprise $1,398.93 million (58.57 percent) of NASA's total DM value of $2,388.63 million (see Table 4-2); this represents an increase of 2.56 percent since FY15. Centers continue to combat the deterioration of HVAC and Electrical systems due to age, climate, diminished availability of replacement parts, incompatibility with newer automated control systems, and other technology-related issues.

Program Support Equipment (PSE) ($200.58 million), Interior Finish ($148.34 million), and Plumbing ($212.15 million) systems comprise $561.07 million (23.49 percent) of the NASA total DM value. The remaining Agency-wide DM values include Roof ($248.80 million), Exterior ($156.00 million), and Conveyance ($23.84 million) systems.

The building system with the lowest NASA-wide SCI rating is Plumbing, which received an SCI of 3.5, an increase of 0.1 since FY15. The NASA wide Plumbing system experienced a DM decrease of $11.23 million from FY15 to FY16. The increase in the overall Plumbing rating, and subsequent decline in system DM resulted from several large projects to restore site-wide systems.

The only other facility system to change in FY16 was Conveyance which increased 0.1 to 3.8. All other systems showed no change in SCI.

This data is summarized in Table 5-2: NASA-wide DM and SCI by Building System, in section 5.1 of this document.

2.3.2 Recommendation

Upgrades to each system produce varying amounts of change to the SCI and DM system values as prescribed by the DM model. Since resources and funds are limited, focusing on a specific system or systems would help lower the DM estimate while working toward Agency-wide goals and priorities. Individual Centers have their own priorities (e.g., roofing initiative or HVAC replacement) based on critical missions, new programs or projects, climate, or other factors.

Electrical and HVAC systems have the ability to greatly impact NASA operations, as failures in either system can place programs and missions in jeopardy. Both systems have relatively low SCI ratings and high DM values. Upgrades to these systems may have high initial costs, but they provide the greatest opportunity for reductions in energy use and improvements to indoor environmental quality.

The Plumbing system continues to have the lowest SCI rating (3.5). Most Plumbing system problems relate to the aging of entire systems, including individual facilities and Center-wide potable water, sanitary sewer, and sprinkler systems. These age-related problems include more frequent line breaks and backups, corrosion, and water quality issues. Plumbing affects mission-critical facilities, which require the successful operation of all components of this system to function.

2.4 ABANDONED ASSETS

2.4.1 Observations

In FY16, 301 assets were listed as Abandoned in the RPMS, down from 307 in FY15. The systems and technology for programs and facilities are constantly evolving, which occasionally results in the abandonment of underutilized or obsolete facilities. These Abandoned facilities, although no longer needed, still contribute to NASA’s maintenance liability. The largest numbers of Abandoned assets are listed at KSC, and SSFL.

The CRV for assets listed in the RPMS as Abandoned is $448.79 million and their DM is $77.75 million. The number of Abandoned assets and their DM estimates have decreased since FY15. The reason that the DM is relatively low compared to its CRV is because several of the Abandoned assets are demolished and have a DM of $0.

Of all the Abandoned assets identified during the site visit, 79 were noted as being demolished and as such, do not require maintenance. The CRV of these demolished assets is $83.43 million, and their collective FY15 DM was $14.80 million.

2.4.2 Recommendation

The 301 assets listed as Abandoned and not yet demolished present some maintenance liability, as many have structural, roofing, or interior deficiencies. By implementing an aggressive program to demolish and remove these assets, NASA could reduce the DM estimate by approximately $77.75 million (excluding assets that are already demolished). An added benefit of demolition is providing a safer work environment with less opportunity for liability, as well as clearing areas for future use by NASA or its tenants.

2.5 REAL PROPERTY MANAGEMENT SYSTEM DATABASE ACCURACY

2.5.1 Observations

The assessors continue to identify RPMS anomalies during the site visit and work closely with the Centers' Real Property Accountability Officer (RPAO) to recommend improvements to update and refine the RPMS database. The RPAOs have made many updates since the FY15 assessment; however the assessors noted similar RPMS anomalies and questions again this year, as discussed in detail in the FY16 RPMS Report. The discrepancies and omissions noted in the report may be the result of the inherent lag between the initiation of a real property action such as acquisition, demolition, maintenance, or other activities, and the project's financial close-out that prompts an update to the RPMS. In some cases, the discrepancies had been corrected during the time lag between receipt of RPMS data in March 2016 and the assessment site visit.

2.5.2 Recommendation

The DM assessment process provides an excellent opportunity to field check the accuracy of RPMS information. NASA should continue to incorporate the review of real property records into the DM process. The primary focus of this effort should be the identification of what should or should not be contained in the RPMS database, including the identification of assets that have been demolished or removed, and providing information on assets that were found by the assessors, but are not in the RPMS. In some cases, these assets should be added to the RPMS whereas other assets are specifically not listed in the RPMS because they are contractor-held or personal properties, or owned and operated by another agency including state and local governments. These assets have historically been listed together under "Not in RPMS but Found". Since FY09, a new real property category called "**Miscellaneous Facilities—Not in RPMS but Found**" is now maintained as a separate list of assets that should not be added to the RPMS but should still be included as part of the annual DM assessment. These assets, although they are not eligible for inclusion in the RPMS, still potentially represent a maintenance liability for the Center.

A secondary focus should be on reviewing and updating NASA Classification Codes, which directly affect the FCI and DM estimates. In some cases, buildings have been modified to accommodate new uses, but the NASA Classification Codes have not been updated to reflect the new use. In other cases, a general rather than specific NASA Classification Code is used. NASA Classification Codes that more accurately reflect the configuration and use of the building will provide more accurate FCI and DM estimates.

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3.0 ASSESSMENT INFORMATION

3.1 ASSESSMENT PROCESS

The FY16 DM assessment site visits were conducted over a period of four months from March through July of 2016. A total of 25 installations were visited, and 6,350 assets were assessed. The assessment included 18 remote or low-value installations, which were not visited but assessed through a review of RPMS records and interviews with the program managers responsible for the sites.

In FY16 the following sites were assessed via interview with facility managers: Madrid Deep Space Communication Complex (DSCC), Canberra Deep Space Communications Complex (CDSCC), Kokee Park Geophysical Observatory (KGPO), Hawaii Infrared Telescope Facility (Hawaii IRTF), Columbia Scientific Balloon Facility Palestine TX (CSBF-TX), and the Santa Susana Field Laboratory (SSFL). FY16 was the first year that The Columbia Scientific Facility at Ft. Sumner, NM (CSBF-NM) was assessed in person.

A team of 15 assessors, including engineers, architects, and facilities experts performed the DM assessment. All assessors were trained in the purpose, goals, and methodology of the DM assessment prior to the assessment site visits. The training included a safety module to reinforce the importance of safety issues on site. To ensure a consistent application and understanding of all aspects of the assessment methodology, training for new assessors included a practical application case study at Goddard Space Flight Center.

The DM assessment task manager worked with NASA Headquarters (HQ) in early 2016 to solicit each Center's availability for site visits. Based on Center availability, the task manager developed a master schedule that met most Centers' first preference for site visit dates. Centers in hurricane-prone areas and Centers with known launch or testing dates were given priority for earlier site visits.

Team leaders assigned to each site coordinated the details and logistics of the site visit with the site's point of contact (POC) in order to ensure availability of appropriate staff during the assessment. The POC generally arranged for escorts during the site visit and coordinated availability with facility managers to ensure they would be available or have an alternate available. Each site visit began with an in-brief meeting during which the assessment team reviewed the purpose of the DM assessment visit, and Center staff provided updates on facility or system changes since the previous year, including recurring maintenance issues, completed or upcoming demolition and repair projects, and high-value CRV assets.

Prior to the site visit, the assessment team prepared a site visit itinerary for efficiently and effectively assessing the site's assets, based on the previous years' experience. Center staff reviewed the itinerary and made any necessary revisions based on the availability of facility and systems experts, testing, and any other factors that would affect the schedule. This itinerary was used as a basis for site visit execution.

In most cases, multiple teams of two assessors, accompanied by one or more Center staff, performed the visual inspections, recording each system's rating and noting any RPMS discrepancies for each asset. A member of the assessment team was designated as the RPMS analyst and met with the RPAO to review changes since the previous year. Assessors entered their ratings and RPMS recommendations in an electronic DM assessment spreadsheet.

At the conclusion of the site visit, the assessors generally reconvened as a team to review general findings from the site visit, then met with available Center staff for an out-brief meeting. During the out-brief meeting, the assessors presented significant observations, reviewed condition changes to high-value assets, and discussed any outstanding RPMS issues. If needed, assessors followed up after the site visit with the RPAO and other Center staff on any issues that were not resolved at the time of the site visit.

Details on the logistics, assessment process, and observations for each site visit are provided in the FY16 Lessons Learned Report.

3.1.1 Sites not Visited but Assessed

Worldwide, there are 13 small, remote, and low-value sites that are owned by NASA. As it is not cost effective to send an assessment team to these remote sites, assessors interview remote site program managers and review RPMS records and other relevant information in order to determine the condition ratings for these sites. This is In accordance with the techniques outlined in the *Parametric Estimating Guide version 5*.

The FCI for the remote sites decreased to 3.9 in FY16 from 4.2 in FY15. The estimated DM for the remote sites increased by 48.30 percent to $0.80 million this year. This decrease in FCI and increase in DM is the result of changes made to the Remote Sites group. The Poker Flat Research Range was assessed in person in FY16 and was removed from the Remote Site calculations. Additionally the Columbia Scientific Balloon Facility in Palestine, TX was assessed remotely in FY16, and was reinserted into the Remote Sites group. Both sites have a CRV greater than the combined CRV of the remaining Remote sites, and their addition/removal from the group has a large effect on the overall FCI and DM.

3.1.2 Assets with Current Replacement Value Over $100 million

The RPMS lists 57 assets with a CRV of $100 million and over, the same as in FY15.

Assets with a CRV of $100 million and higher have the potential to dramatically impact the Center DM estimate, and in some cases, the NASA-wide DM estimate. For this reason, assessors paid special attention to these assets. Two separate teams performed independent assessments of each of these assets and consolidated results in order to determine accurate ratings for all nine systems. In addition to the benefit of independent assessments, when two teams review assets of this size they are able to see more areas and gain more insight from multiple escorts. Assessment results for these assets were discussed in detail with Center staff at each out-brief meeting. These high-value assets are identified in Table 3-1 below.

Table 3-1. Assets with Current Replacement Value over $100 Million

Center/ Site	Number	Name	Status	CRV 2016	DM 2016
ARC	N206	12 FT PRESSURE WIND TUN.	ACTIVE	$241,644,082	$2,948,058
ARC	N221	40X80 WIND TUNNEL	ACTIVE	$366,665,904	$13,676,638
ARC	N221B	80X120 FT.SUBSONIC WT.	ACTIVE	$208,871,013	$1,650,081
ARC	N226	ADMIN/EDUCATION FACILITY	ACTIVE	$140,533,370	$7,926,082
ARC	N227	UNITARY PLAN WT.BUILDING	ACTIVE	$218,135,333	$8,310,956
ARC	N227A	11 FT.TRANSONIC WT	ACTIVE	$135,122,041	$1,229,611

Center/ Site	Number	Name	Status	CRV 2016	DM 2016
ARC	N227B	9X7 FT.SUPERSONIC WIND TUNNEL	ACTIVE	$107,659,166	$3,746,539
ARC	N227C	8X7 FT.SUPERSONIC WIND TUNNEL (STORAGE)	ACTIVE	$108,275,422	$51,788,134
ARC	N229	EXPER.FLUID DYNAMICS FAC.	ACTIVE	$158,762,543	$5,937,719
ARC	N243	FLT.&GUIDANCE SIMULA.LAB.	ACTIVE	$122,956,283	$19,377,910
ARC	N258	NASA ADVANCED SUPERCOMPUTING FACILITY (NAS)	ACTIVE	$106,967,144	$5,284,177
ARC/MFA	001	HANGAR ONE	ACTIVE	$201,464,135	$2,760,059
ARC/MFA	047	AIRCRAFT MAINTENANCE HANGAR 3	ACTIVE	$155,401,948	$80,746,852
ARC/MFA	MF1002	AIRCRAFT PARKING APRON	ACTIVE	$213,362,238	$2,133,622
GRC/LF	0005	ENGINE RESEARCH BUILDING	ACTIVE	$207,092,837	$25,513,838
GRC/LF	0064	CENTRAL AIR EQUIPMENT BUILDING	ACTIVE	$249,680,688	$44,343,290
GRC/LF	0085	ABE SILVERSTEIN 10X10 SWT	ACTIVE	$114,900,580	$4,469,633
GRC/LF	0090	10X10 SWT MAIN COMP. & DRIVE BUILDI	ACTIVE	$106,560,001	$7,427,232
GRC/PBS	1411	SPACE POWER FACILITY (SPF) TEST BUILDING	ACTIVE	$340,446,268	$19,916,107
GRC/PBS	3211	B2 TEST BUILDING	ACTIVE	$109,120,617	$1,920,523
GSFC/WFF	S-0003	RUNWAYS - AFLD PAVEMENTS - STAT	ACTIVE	$188,469,472	$18,846,947
JPL	230	SPACE FLIGHT OPERATIONS COMMAND FAC	ACTIVE	$109,377,211	$1,126,585
JPL/GDSCC	G-80	70 METER AZ/EL ANTENNA (230 FT.)	ACTIVE	$130,494,992	$1,200,554
JSC	029	LONG DURATION EVALUATION FACILITY	ACTIVE	$112,658,784	$867,473
JSC	030	CHRISTOPHER C. KRAFT, JR. MISSION CONTROL CENTER	ACTIVE	$163,821,815	$12,090,050
JSC	032	SPACE ENVIRONMENT SIMULATION LAB.	ACTIVE	$349,412,618	$69,253,581

Center/ Site	Number	Name	Status	CRV 2016	DM 2016
KSC	J7-0337	LAUNCH PAD 39B	ACTIVE	$302,807,869	$5,329,418
KSC	J8-1708	LAUNCH PAD 39A	ACTIVE	$470,747,154	$7,673,179
KSC	K6-0848	VEHICLE ASSEMBLY BUILDING	ACTIVE	$1,402,916,173	$219,836,964
KSC	K6-0894	ORBITER PROCESSING FACILITY (OPF)	ACTIVE	$135,344,906	$3,627,243
KSC	K6-0900	LAUNCH CONTROL CENTER	ACTIVE	$125,185,764	$1,652,452
KSC	M6-0399	KSC HEADQUARTERS	ACTIVE	$107,942,415	$6,498,133
KSC	M7-0355	NEIL ARMSTRONG OPERATIONS & CHECKOUT BUILDING	ACTIVE	$428,637,082	$8,915,651
KSC	M7-0360	SPACE STATION PROCESSING FACILITY	ACTIVE	$119,050,106	$3,476,263
KSC	UK-004	BITUMINOUS ROADS	ACTIVE	$178,216,909	$17,821,691
KSC	UK-005	COMMUNICATIONS & ELECTRICAL DUCT BANK	ACTIVE	$214,223,519	$24,978,462
KSC	UK-021	GN2 LINE - NITROGEN	ACTIVE	$109,518,811	$1,259,466
KSC	UK-025	SECONDARY UNDERGROUND	ACTIVE	$137,229,784	$16,110,777
LaRC	648	TRANSONIC DYNAMICS TUNNEL COMPLEX	ACTIVE	$149,387,356	$11,353,439
LaRC	1212C	14 X 22 FOOT SUBSONIC TUNNEL	ACTIVE	$102,606,392	$1,754,569
LaRC	1236	NTF COMPLEX	ACTIVE	$427,301,143	$9,699,736
LaRC	1247B	1247 COMPLEX	ACTIVE	$118,969,415	$12,075,396
LaRC	1247D	1247 COMPLEX	ACTIVE	$153,336,599	$5,642,787
LaRC	1251	1251 RESEARCH COMPLEX	ACTIVE	$335,438,535	$88,186,791
LaRC	1265	1265 COMPLEX	ACTIVE	$135,093,602	$4,539,145
MSFC	4487	LABORATORY & OFFICE BUILDING	ACTIVE	$122,425,488	$8,447,359
MSFC	4670	ADVANCED ENGINE TEST FACILITY	ACTIVE	$139,716,627	$13,887,833
MSFC	4708	ENGINEERING & DEVELOPMENT LABORATORY	ACTIVE	$106,692,100	$5,740,035

Center/ Site	Number	Name	Status	CRV 2016	DM 2016
MSFC/MAF	103	MANUFACTURING BLDG	ACTIVE	$555,182,940	$24,761,159
MSFC/MAF	110	VERTICAL ASSEMBLY BLDG	ACTIVE	$109,987,868	$2,199,757
MSFC/MAF	207	BOILER HOUSE	ACTIVE	$108,904,242	$3,757,196
SSC	4120	TEST STAND A-1	ACTIVE	$195,180,814	$14,111,573
SSC	4122	TEST STAND A-2	MOTHBALLED	$211,304,920	$13,544,645
SSC	4123	A-3 TEST STAND	MOTHBALLED	$334,467,042	$301,020
SSC	4220	TEST STAND B-1	ACTIVE	$279,234,810	$23,371,954
SSC	4221	TEST STAND B-2	ACTIVE	$173,824,543	$30,506,207
SSC/Area 9	9101	WAREHOUSE/SECURE PRODUCTION/ASSEMBLY FACILITY	ACTIVE	$137,351,018	$6,606,584

These high-value assets account for $12.30 billion in CRV, or 35.46 percent of NASA's total CRV. Their DM estimate is $1,012 million—or 42.43 percent of the Agency-wide DM estimate. The DM estimate for these assets represents 8.23 percent of the assets' CRV, up from 7.83 percent in FY15. The proportion of the DM to CRV is also known as the maintenance to replacement cost.

The FY16 results are consistent with results from previous years' assessments, continuing a trend that indicates the condition of high-value assets has the ability to impact NASA-wide DM estimates. Table 3-2 provides an overview of trends since the FY12 assessment.

Table 3-2: High-Value Assets: FY12-FY16 Comparison

	FY12	FY13	FY14	FY15	FY16
Number of Assets	46	54	55	57	57
CRV ($B)	$9.99	$11.10	$11.39	$12.11	$12.30
% of NASA CRV	32%	35%	35%	36%	35%
DM Estimate ($M)	$846	$953	$978	$948	$1,012
% of NASA DM	36%	42%	41%	41%	42%

3.1.3 Assets not Accessible but Assessed

There were very few assets that the assessors were unable to assess during the FY16 site visits. This was due to thorough preparation by Center staff and coordination with the schedule to avoid potentially hazardous activity and other conflicting events. When assessors were unable to gain access because the assets were leased to another entity, the keys were unavailable, or access was unsafe, the FY16 assessment ratings were based on FY15 ratings supplemented by anecdotal information from Center staff and tenants. Assessors had access to all major assets.

3.1.4 Assessment of In/Out Grant Facilities

All in/out grant facilities were assessed for this report. Although some non-NASA entities have current maintenance agreements, NASA must account for the condition of the facility because the responsibility for maintenance reverts back to NASA at the conclusion or termination of any such agreement

At the direction of HQ, assets not built, operated, or maintained by NASA were briefly inventoried, with the understanding that if those tenants should decide to leave anytime in the future, those facilities would become NASA's responsibility. While the real property information and condition of these assets was noted, the assets were not included in the FCI and DM calculations because they do not represent a current DM liability for the agency.

3.1.5 Demolition of Assets since FY15 DM Assessment

The FY16 assessment identified 101 assets that have been demolished since the FY15 DM assessment. The 101 demolished assets account for an overall CRV of $57.00 million and an FY15 DM estimate of approximately $15.35 million. The DM estimate is based on DM values for FY15 because the DM estimates are not calculated for demolished facilities. In most cases, the contract close-out process has not been completed in time to complete the RPMS close-out process prior to the DM site visit. Since FY10, demolished assets have been excluded from all FCI and DM calculations. Excluding these assets reduces the overall DM estimate and has the potential to impact the FCI, as the overall CRV is reduced, affecting the weighting of individual assets against the site, Center, or Agency as a whole.

Table 3-3 lists by Center the number of demolished assets and their CRV and DM values. Appendix C shows a detailed list of demolished assets for the past fiscal year. KSC had the largest amount off assets demolished between FY15 and FY16. The 27 demolished assets at KSC represented a CRV of $24.01 million and a DM of $2.27 million.

Table 3-3: Number of Assets Demolished since FY15 DM Assessment

Center/Site	Number of Assets	FY16 CRV	FY15 DM
AFRC	27	$5,213,558	$510,795
ARC	2	$418,751	$155,180
ARC/MFA	4	$514,745	$35,041
GRC/LF	2	$3,278,903	$30,793
GSFC	4	$398,256	$12,706
GSFC/WFF	3	$1,866,335	$186,528
JSC/EF	2	$171,180	$12,590
JPL/CDSCC	1	$91,068	$90
KSC	27	$24,007,938	$2,267,169
KSC/CAPE	5	$867,668	$68,280
MSFC/SSFL	21	$18,404,968	$12,029,344
SSC/Area 9	3	$1,768,640	$36,954
Total	**101**	**$57,002,010**	**$15,345,470**

Another method of evaluating the demolition of assets is to consider the value of assets that Center staff have identified as being scheduled for demolition in the near future (whether funded or not). There are 393 assets currently scheduled for demolition with a combined CRV of $2.08 billion. The total DM for these assets is $287.03 million, representing significant potential savings to the Agency-wide DM after they are demolished. Table 3-4 lists the assets scheduled for demolition at the time of the FY16 assessment by installation.

Table 3-4. Assets Scheduled for Demolition

Center/Site	Number of Assets	FY16 CRV	FY16 DM Estimate
AFRC	4	$5,697,706	$938,607
ARC	3	$637,132	$81,562
ARC/Crows Landing	14	$20,729,776	$9,560,623
ARC/MFA	34	$29,009,177	$4,236,800
GRC/LF	5	$28,854,016	$1,919,156
GSFC	16	$50,822,824	$4,138,551
GSFC/WFF	29	$111,547,143	$6,927,330
JPL	29	$25,541,715	$1,993,383
JSC	23	$160,771,060	$24,789,027
JSC/WSTF	3	$715,011	$218,482
KPGO	1	$2,451,780	$101,013
KSC	37	$217,878,123	$15,817,075
KSC/CAPE	27	$105,90,272	$15,001,266
LaRC	44	$905,042,499	$140,028,824
MSFC	15	$107,611,030	$16,621,821
MSFC/MAF	1	$1,276,561	$194,037
MSFC/SSFL	88	$109,723,973	$35,406,680
SSC	14	$129,843,558	$7,799,769
SSC/Area 9	3	$57,590,383	$805,619
SSC/Tenants	3	$8,411,934	$446,662
TOTALS	**393**	**$2,080,055,673**	**$287,026,288**

3.2 ASSESSMENT QUALITY ASSURANCE (QA)

The assessment team implemented a variety of Quality Assurance (QA) measures before, during and after each site visit to ensure assessments were consistent between years, and ensure system ratings were an accurate, fair representation of their current condition.

- The team placed high importance on the establishment of training and tools in order to promote a consistent application of the DM methodology. Assessors attended a training session to review the DM methodology and safety practices. Once onsite, teams employed the common practice of assessing one or two buildings together, followed by a review and discussion of the results to “calibrate” consistency of ratings between different assessors and different asset types.
- Assessment teams were comprised of a range of disciplines and organized with a unique combination of knowledge, background, and experience. Teams included assessors with familiarity to the site to ensure consistency in the assessment process with the previous year’s efforts.
- During the site visit and prior to the out-brief meeting, team leaders reviewed condition ratings with a particular focus on the site’s highest value assets. At the out-brief meeting, the assessment team discussed findings with Center staff to ensure all the required information had been obtained and that the preliminary results accurately reflected asset conditions.

- Following the site visit, the team leader compiled the findings and provided draft site visit summary reports to each Center and HQ. The Centers were given the opportunity to review and comment on this data for clarification.

3.2.1 Consistency Analysis of the FY16 Ratings

Analysis and comparison of the 4,456 assets that appear in both the FY15 and FY16 reports show that 83.12 percent had no change in FCI, a decrease from 88.23 percent in FY15.

Based on the normal distribution analysis, 4,369 assets fall within +/- 3 standard deviations (**σ**) of the mean for all FCI deltas. That is, 98.05 percent of the differences in FCI observed for the assets compared change within +/- 0.57 of the FCI from the previous year. The standard deviation has remained at +/- 0.19 in FY16.

The FCI for 3,704 assets did not change when compared to last year, and an additional 500 assets changed by 1 **σ**, or +/- 0.19.

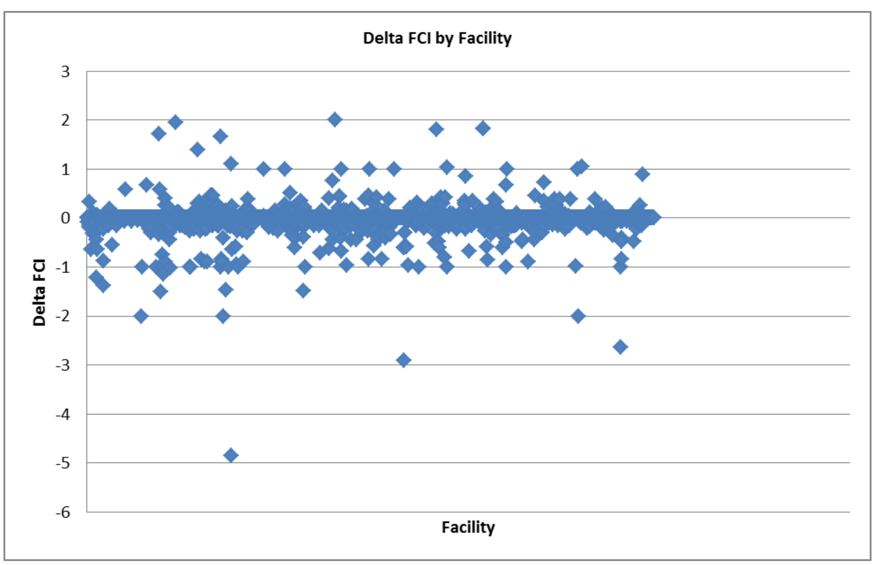
Table 3-5 explains the content of each statistical bin in Figure 3-2.

Table 3-5. Distribution of Delta Facility Condition Index between FY15 and FY16

Standard Deviation Bins	Number of Assets	Percent of Total
Assets less than -3σ	61	1.37%
Assets between -3σ and -2σ	24	0.54%
Assets between -2σ and -1σ	73	1.64%
Assets between -1σ and No Change	300	6.73%
Assets with No Change	3704	83.12%
Assets between No Change and 1σ	200	4.49%
Assets between 1σ and 2σ	45	1.01%
Assets between 2σ and 3σ	23	0.52%
Assets greater than 3σ	26	0.58%

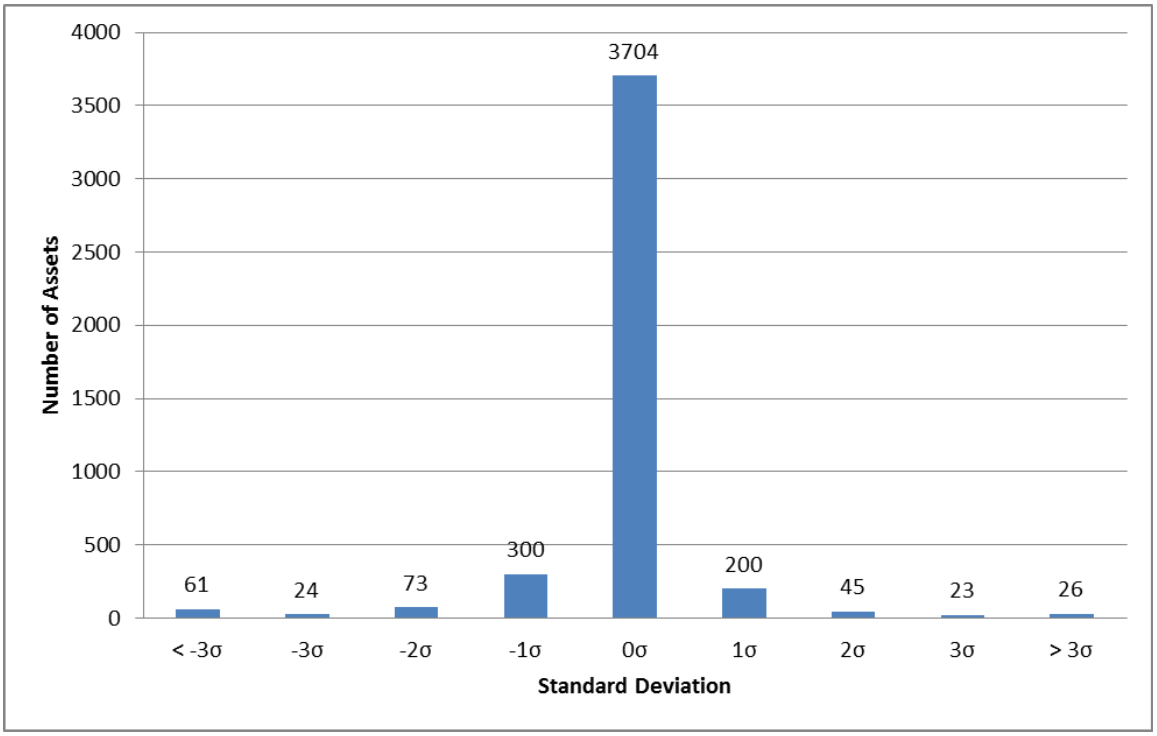
Figure 3-1 shows the variability of FCI deltas for facilities compared in this report.

Figure 3-1. Variability of Facility Condition Index Delta Points between FY15 and FY16



The histogram presented in Figure 3-2 graphically shows the number of assets that fall within each bin and was created to show whole variations in ratings from zero as whole standard deviation bins.

Figure 3-2: Distribution of Delta Facility Condition Index between FY15 and FY16



In FY16, 10.28 percent of the compared assets experienced a decrease in FCI, compared to FY15, when 6.82 percent of assets experienced a decrease in FCI. In FY16, 6.60 percent of the compared assets experienced an increase in FCI, compared to FY15, when 4.95 percent experienced an increase in FCI. In FY16, 83.12 percent of the compared assets showed no change in FCI, while in FY15 88.23 percent of assets showed no change in FCI. The variations observed between the FY15 and FY16 are consistent with the greater percentage of assets which showed no significant change in FCI.

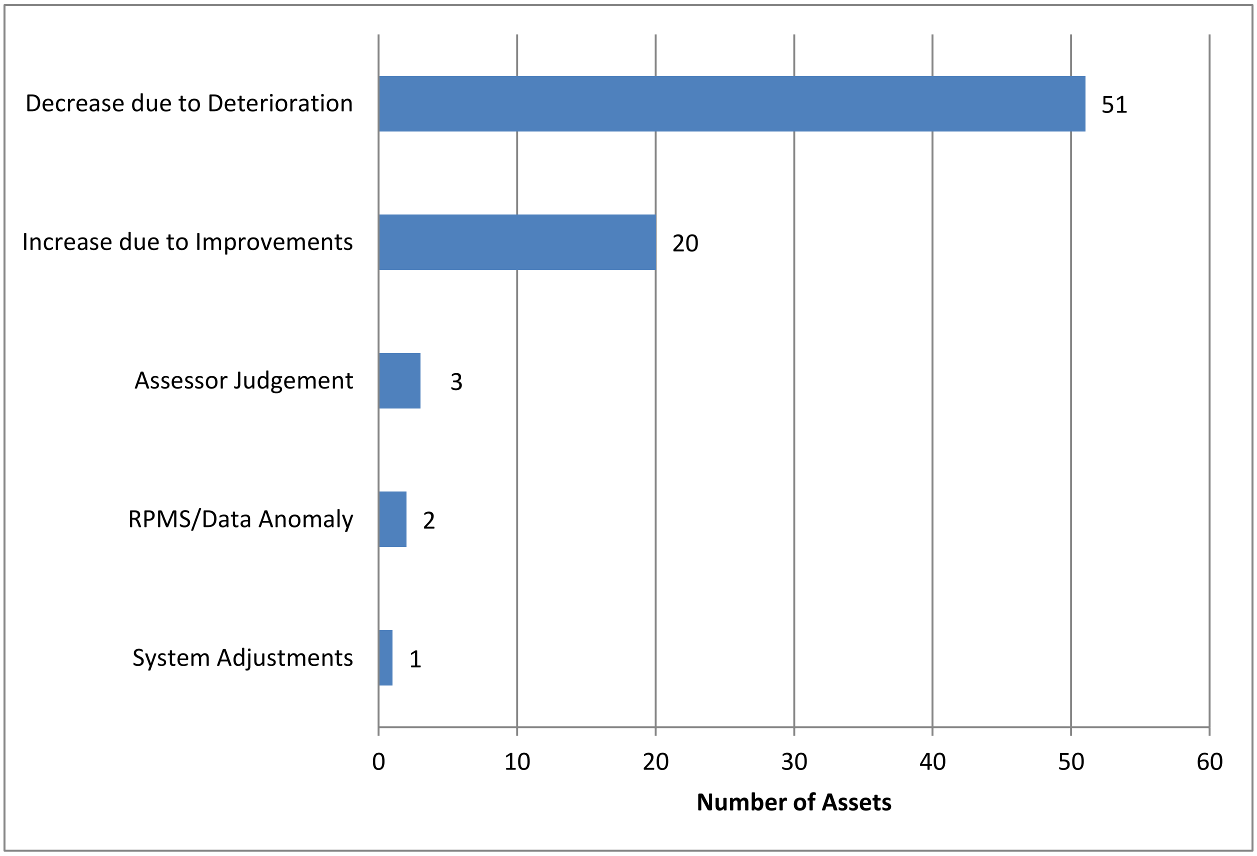
The analysis is not complete without considering the 87 assets whose FCI changed by more than 3σ, or +/- 0.57, from last year's rating. In FY16, 19 more assets showed a variation in FCI greater than 3σ than in FY15.

These wider variations can be generally attributed to one of the following reasons:

- Decrease in FCI due to deterioration
- Increase in FCI due to improvement
- Assessor Judgment
- System adjustments
- RPMS/DM assessment spreadsheet anomalies

Figure 3-3 summarizes the five reasons for the observed variation in FCI rating for these 87 assets; these reasons are described in more detail below.

Figure 3-3: Assets with Facility Condition Index Change Greater than 3σ



The anomalous ratings can be attributed to one of the five following cases:

1. **Decrease in FCI due to deterioration.** Fifty-one assets showed a greater than +/- 3σ variation in FCI rating from last year due to deterioration of one or more asset systems. Several of these assets, such as pavements, have only one system, so a single point change in SCI rating results in a difference greater than +/- 3σ in FCI.

Table 3-6: Assets with Greater than +/- 3σ Variation Due to Deterioration

Center	Installation	Number	Name
AFRC	Armstrong Flight Research Center	4828	LOGISTICS DISPOSAL FACILITY
AFRC	Armstrong Flight Research Center	4859	OFFICE & LABS
AFRC	Armstrong Flight Research Center	4864	OFFICE
AFRC	Armstrong Flight Research Center	NB058	VEHICLE PARKING AREA (BITUMINOUS)
AFRC	Armstrong Flight Research Center	NB128	SUBSTATION NO. 27
ARC	Ames Research Center	NA282	ROADS AND WALKS
ARC	Ames Research Center	NA293	SIDEWALKS
ARC	Moffett Federal Airfield	105	AIRFIELD LIGHTING VAULT
ARC	Moffett Federal Airfield	167	WHARF/FUELING PIER
ARC	Moffett Federal Airfield	444	GENERAL PUMP/BERTHING WHARF
ARC	Moffett Federal Airfield	MF1001	INSTRUMENT RUNWAY 32R/14L
ARC	Moffett Federal Airfield	MF1008	AIRFIELD TAXIWAY LIGHTING
ARC	Moffett Federal Airfield	MF1014	COMPRESSED AIR DISTRIBUTION SYSTEM
ARC	Moffett Federal Airfield	MF1027	RAILROAD

Center	Installation	Number	Name
GSFC	Goddard Space Flight Center	035	LOGISTICS FACILITY BUILDING
GSFC	Goddard Space Flight Center	408	STORAGE
GSFC	Goddard Space Flight Center	948	OPTICAL TRACKING FAC/AREA 200 UTILITIES-OTS
GSFC	Poker Flat Research Range	PF006/1621	1018-NASA PROP/CONT HELD - TELEMETRY BLDG ANNEX
GSFC	Wallops Flight Facility	S-0002	ACFT PARKING APRONS -STATION
GSFC	Wallops Flight Facility	S-0018	RUNWAY RUNOFF STORM DRAINAGE SYS
GSFC	Wallops Flight Facility	W-045	LAUNCH AREA #5
GSFC	Wallops Flight Facility	X-091	FIRE PUMP HOUSE
GSFC	Wallops Flight Facility	Y-035	LAUNCH AREA 2 (PADS A,B,C)
GSFC	Wallops Flight Facility	Y-038	LAUNCHER EQUIP SHELTER
GSFC	Wallops Flight Facility	Y-038A	LAUNCH COMPLEX FIRE CNTL SHELTER
GSFC	Wallops Flight Facility	Z-035	TRKG CAMERA TWR W/DOME
JPL	Canberra DSCC	010	RIVER PUMP CONTROL BLDG
JPL	Goldstone Deep Space Communications Complex	G-208(A-8)	9 METER ANT. COLLIMATION TOWER
JPL	Goldstone Deep Space Communications Complex	GS-303	SEWAGE/INDUSTRIAL WASTE
JPL	Jet Propulsion Laboratory	35	SECRURITY RADIO EQUIPMENT
JPL	Jet Propulsion Laboratory	EAST LOT	WEST ARROYO LOT
JSC	Ellington Field	E264	SUPPLIES & EQUIPMENT SHED
JSC	Johnson Space Center	221	138 KV ELECTRICAL SUBSTATION
JSC	Johnson Space Center	207U	PLAYGROUND FACILITIES
JSC	Johnson Space Center	350F	AIR COMPRESSOR SHED
JSC	White Sands Test Facility	818	SUBSTATION
KSC	CAPE	80800	HYPERGOLIC OXIDIZER TANKER PARKING
KSC	Kennedy Space Center	J8-2075	GUARD SHACK
KSC	Kennedy Space Center	K6-0588A	KENNEDY PKWY S. BOX CULVERT
KSC	Kennedy Space Center	K7-0806	GUARD SHACK
KSC	Kennedy Space Center	M6-0508	HAZARDOUS WASTE STORAGE FACILITY
KSC	Kennedy Space Center	M6-0509	FLAMMABLE STORAGE BUILDING
KSC	Kennedy Space Center	M6-0798A	HEAVY EQUIPMENT STORAGE SHED
KSC	Kennedy Space Center	TR1-710	BOXCAR
KSC	Kennedy Space Center	UK-029	STABILIZED AREAS
LaRC	Langley Research Center	1275	CF4 TUNNEL COMPLEX
MSFC	Michoud Assembly Facility	075	SECURITY LIGHTING SYSTEM
SSC	Stennis Space Center	0026	MOORING DOLPHINS
SSC	Stennis Space Center	0302	BOOSTER TRANSFER DOCK
SSC	Stennis Space Center (Area 9)	9741	RAILROAD BRIDGE
SSC	Stennis Space Center (Area 9)	9769	POL PIPE UNDERGROUND

2. **Increase in FCI due to improvement**. Twenty assets showed a greater than +/- 3σ variation in FCI compared to last year's ratings due to improvement or repairs. Many of these assets had only one system (Structure) to evaluate and as a result any changes to the system rating would immediately place the asset FCI outside of +/- 3σ.

Table 3-7: Assets with Greater than +/- 3σ Variation Due to Improvement

Center	Installation	Number	Name
AFRC	Armstrong Flight Research Center	4853	FIRE WATER PUMP HOUSE
AFRC	Armstrong Flight Research Center	NB034	SANITARY SEWER (GRAVITY)
ARC	Ames Research Center	N123A	GENERATOR STORAGE (JCM)
ARC	Moffett Federal Airfield	036	SENTRY HOUSE/MAIN GATE
ARC	Moffett Federal Airfield	MF1007	AIRFIELD APPROACH LIGHTING
GRC	Glenn Research Center	3918	ROADS, DRIVES, BRIDGE
GRC	Plum Brook Station	9340	ROADS
GSFC	Wallops Flight Facility	S-0147	WATER SUPPLY MAINS & PUMP SYSTEM
GSFC	Wallops Flight Facility	X-007	RADAR ELECT EQUIP SHELTER
JPL	Goldstone DSCC	G-37	SEISMIC LABORATORY
JPL	Goldstone DSCC	G-502	PARKING LOTS (VENUS)
JPL	Goldstone DSCC	GR-326	ROADS
JSC	White Sands Test Facility	852	PARKING AREA (BITUMINOUS)
KSC	Kennedy Space Center	K6-0696	COMMERCIAL CREW & CARGO PROCESSING FACILITY
KSC	Kennedy Space Center	K7-0405	MAGAZINES NO. 4, 5 AND 6 (ORDNANCE STORAGE)
KSC	Kennedy Space Center	UK-031	WATER SYSTEM
MSFC	Marshall Space Flight Center	4480	STORAGE BUILDING
MSFC	Michoud Assembly Facility	480	BARGE DOCK
SSC	Stennis Space Center	0040	HPIW DISTRIBUTION SYSTEM
SSC	Stennis Space Center	2311	LOCK WATER SUPPLY PUMP STATION

3. **Assessor Judgment**. Three assets showed a greater than +/- 3σ variation in FCI compared to last year's ratings, not from improvement or deterioration in condition, but the assessor rated the system higher or lower based on observed condition. In these cases, acknowledgement of rating variation based on assessor judgment is expected.

Table 3-8: Assets with Greater than +/- 3σ Variation Due to Assessor Judgment

Center	Installation	Number	Name
JSC	Johnson Space Center	831	BRIDGE, THIRD STREET EXIT
KSC	Kennedy Space Center	J7-0584	CAMERA PAD NO. 4
KSC	Kennedy Space Center	UK-054	NATURAL GAS LINE

4. **Real Property Management System/Deferred Maintenance assessment worksheet Anomalies**. Two of the assets in which the change in FCI is outside the +/- 3σ boundary were determined to be the result of suspect data in either the RPMS or the Data.

Table 3-9: Assets with Greater than +/- 3σ Variation Due to DM Assessment Spreadsheet Anomaly

Center	Installation	Number	Name
GSFC	Goddard Space Flight Center	025X	ANTENNA FOUNDATION
GSFC	Goddard Space Flight Center	025Y	DISH ANTENNA ON STANCHION

5. **System adjustments**. Assessors found or removed ratings for systems in one case that caused the FCI difference between last year's ratings and this year's ratings to be greater than +/- 3σ. The FCI and DM are affected when building systems are added or

subtracted. Assessors may have found systems during the assessment that were not previously noted for that asset, or found that systems previously rated for that asset, were not present. Table 3-9 shows the total of systems added or removed from all assets.

Finding or removing systems did not always result in a variation of asset FCI greater than +/- 3σ. Table 3-10 summarizes assets where a system found or not found resulted in a variation in FCI greater than +/- 3σ.

Table 3-9: Asset Systems Removed or Added in FY16

	Structure	Exterior	Roof	HVAC	Electrical	Plumbing	Conveyance	Interior Finishes	Prog Support Equipment
Removed	0	0	0	3	4	6	3	0	2
Added	0	14	0	22	0	0	4	0	5

Table 3-10: Assets with Greater than +/- 3σ Variation Due to System Adjustments

Center	Installation	Number	Name
AFRC	Armstrong Flight Research Center	0703	ARMSTRONG AIRCRAFT OPERATIONS FACILITY

Based on the statistical analysis and QA review of the SCI and FCI data, the observed ratings and variation during the FY16 NASA-wide DM assessment are reasonable and compatible with previous year’s assessments.

3.3 REAL PROPERTY MANAGEMENT SYSTEM QUALITY ASSURANCE

The RPMS is a dynamic database that is constantly being updated by the RPAOs in order to record ongoing real property changes at each Center. Therefore, the data used for the DM assessment varies somewhat from year to year as a result of record-keeping improvements, capital improvement activities, demolition, and continued analysis of data. The real property data used for the DM assessment was downloaded from the RPMS in March 2016. The data may have been updated by the RPAOs since then, possibly while the DM assessment was underway. As a result, some RPMS discrepancies noted during the site visits may have already been corrected or updated in the RPMS database. Discrepancies and omissions noted in this report also result from the inherent lag between the initiation of a real property action, such as acquisition, demolition, maintenance, or other activities, and the project’s financial close-out that prompts an update to the RPMS.

Because of the way DM and FCI are calculated, the following issues observed by assessors have the potential to significantly impact the results of the annual DM assessment:

- **Assets not in the RPMS but Found**: This category includes assets that have not previously been entered into the RPMS. This list includes new assets and existing assets that were found on site but are not in the RPMS. Some of the assets found do not qualify for inclusion in the RPMS because they are personal or contractor-held property. Since FY09, these assets have been accounted for on a separate “Miscellaneous Facilities” list.

- **Assets in the RPMS but not Found**: This category includes assets that were not found for a variety of reasons: the asset was moved (trailers or antennas), the location of the asset was not correct, the location was unknown, or the asset was demolished and removed from the site.
- **Assets Recommended for Update or Removal from the RPMS**: This category includes assets that have been removed or demolished; in some cases only a minor portion of the structure, such as a concrete slab, remains. Additional assets have transferred ownership to other agencies, or were determined to be maintenance or repair projects, which should not be recorded as RPMS assets. Several assets have been transferred into other property records or were consolidated utility system assets. In some cases, the paperwork for removing the asset from the RPMS may have been in process, but not fully completed or closed out at the time of the assessment.
- **Assets with Suspect NASA Classification Code**: The application of the appropriate NASA Classification Code affects the DM because it maps directly to the DM Category Code to determine the correct apportionment of the CRV in calculating the DM for an asset. Incorrect NASA Classification Codes can affect the DM and FCI results at the asset, installation, Center and Agency level.
- **Assets with Questionable CRV**: This category includes assets listed in the RPMS with suspect CRV, which includes zero values and CRVs that were determined to be too low or too high. CRVs are a critical component of the DM estimate and must therefore reflect, as accurately as possible, the true cost of replacing an asset. The CRVs, however, are calculated based on book value, improvements and escalation over time, and cannot be changed manually.

After a thorough analysis of all field data, the following anomalies were found:

Table 3-11: Real Property Management System Anomalies FY12 to FY16

Category	2012	2013	2014	2015	2016
Assets not in RPMS but Found	628	707	890	2045	838
Add to RPMS	195	279	302	1011	356
Miscellaneous Facilities	433	428	588	1034	482
Assets in RPMS but not Found	18	15	23	0	3
Assets Recommended for Update or Removal	221	191	191	141	201
Assets with a Questionable CRV	20	1	6	18	31
Assets with a Suspect Classification Code	11	7	55	17	15
Assets with a Suspect Capacity	110	0	4	6	15

The findings of the FY16 RPMS analysis indicate results similar to previous years', with the exceptions of "Assets in RPMS but Found". Between the FY15 and FY16 DM assessment, there was a concerted effort by RPAOs to add previously found facilities to the RPMS, resulting in significantly fewer assets found on site that are not in the RPMS.

Assessors worked with RPAOs while on site to review and address these anomalies, particularly for those categories that affect the DM calculations. The RPAOs provided information for each asset, both found and not found, that had recently been demolished, moved, destroyed, transferred, or added.

Assessors identified suspect Classification Codes after observing the type and use of each asset, and by analyzing the NASA Classification Code definitions provided in the January 31, 2006 *NASA Real Property Classification Guide*. In those cases where the assessors found an apparent discrepancy, a more appropriate NASA Classification Code was suggested. New assets with suspect classification codes were discovered, most likely due to discussions with the RPAO, facility changes, or assessor observation.

Assessors identified assets with questionable CRV based on observation and experience. While at the site, assessors noted any assets that did not seem to have reasonable CRVs and sought input from the site RPAO or escort. Records for assets with questionable CRVs should be reviewed to ensure that they reflect any improvements, upgrades, or demolition that could be updated in the RPMS and adjust the CRV. When creating records for new assets or assets newly found, RPAOs should ensure those values reflect an accurate CRV.

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4.0 ASSESSMENT RESULTS

4.1 CALCULATION METHODOLOGY

The DM and FCI calculations were performed according to the methodology outlined in the Parametric Estimating Guide. The RPMS data was generally taken to be the current, correct record of NASA's facilities, with the exception of assets recommended for addition or removal. The calculations were performed using the following criteria:

- Include newly found assets—except those newly found assets which are constructed, operated, and maintained by other entities and are not expected to become part of NASA’s RPMS
- Base the FY16 CRV on the RPMS CRV
- Map NASA Classification Codes from the RPMS to their assigned DM Category Codes
- Exclude all land assets
- Exclude all demolished assets

4.2 RESULTS

For FY16, the Agency FCI is 3.7 on a scale from 5 (excellent) to 1 (non-functional), as shown in Table 4-1. This result indicates that NASA facilities continue to require many minor repairs, some larger repairs, and that systems normally function satisfactorily but occasionally are unable to function as intended.

The FCI for active assets is 3.7, and ranges from 1.7 to 4.5 at the installation level. The FCI for inactive assets is 3.9, and ranges from 0 to 4.8 at the installation level. These ranges for both types of assets indicate substantial variations in conditions between sites.

The Agency-wide FY16 DM estimate is approximately $2,385.68 million, which represents 6.88 percent of NASA’s CRV. The DM estimate for active assets is approximately $2,248.50 million, and the DM estimate for inactive assets is approximately $137.18 million.

The following data tables provide more detailed information on the assessment results for each installation. Note that some of the Center totals in the tables may not add up exactly, due to rounding.

- Table 4-1 compares site, Center, and Agency DM results for active and inactive assets.
- Table 4-2 shows the DM estimates for each of the nine systems by site, Center, and the Agency.
- Table 4-3 shows the SCI for each of the nine systems by site, Center, and the Agency.
- Table 4-4 shows the FCI and DM estimates by DM facility category.

Table 4-1. FY16 Deferred Maintenance Summary Table ($M)

Name	CRV ($M)	FCI	DM ($M)	Active CRV ($M)	Active FCI	Active DM ($M)	Inactive CRV ($M)	Inactive FCI	Inactive DM ($M)
NASA Agency Total	**$34,672.52**	**3.7**	**$2,385.68**	**$33,284.16**	**3.7**	**$2,248.50**	**$1,388.36**	**3.9**	**$137.18**
Ames Research Center	**$5,081.48**	**3.7**	**$485.26**	**$5,003.91**	**3.7**	**$452.37**	**$77.58**	**2.8**	**$32.88**
Ames Research Center	$3,402.41	3.9	$205.84	$3,399.69	3.9	$205.76	$2.72	4.0	$0.08
Crows Landing	$20.73	2.1	$9.56	$11.98	1.7	$7.08	$8.75	2.6	$2.49
Moffett Federal Airfield	$1,658.34	3.3	$269.86	$1,592.24	3.4	$239.54	$66.10	2.8	$30.32
Armstrong Flight Research Center	**$442.60**	**3.9**	**$24.02**	**$441.12**	**3.9**	**$24.00**	**$0.10**	**4.0**	**$0.02**
Armstrong Flight Research Center	$442.60	3.9	$24.02	$441.12	3.9	$24.00	$1.48	4.0	$0.02
Glenn Research Center	**$3,524.46**	**3.6**	**$235.06**	**$3,421.59**	**3.6**	**$227.21**	**$102.87**	**4.0**	**$7.85**
Lewis Field	$2,681.37	3.6	$196.06	$2,638.06	3.6	$193.63	$43.31	4.3	$2.43
Plum Brook Station	$843.09	3.8	$39.00	$783.53	3.8	$33.57	$59.56	3.8	$5.43
Goddard Space Flight Center	**$2,982.58**	**3.7**	**$183.14**	**$2,966.80**	**3.7**	**$179.41**	**$15.78**	**3.0**	**$3.74**
Goddard Space Flight Center	$1,648.81	3.7	$111.08	$1,648.81	3.7	$111.08	$0.00	0.0	$0.00
Hawaii STDN	$30.36	3.5	$2.20	$25.24	3.5	$1.92	$5.13	3.6	$0.27
Hawaii IRTF	$18.18	3.9	$0.56	$18.18	3.9	$0.56	$0.00	0.0	$0.00
Wallops Flight Facility	$1,049.27	3.7	$60.58	$1,038.71	3.7	$57.12	$10.56	2.7	$3.46
- White Sands Testing Facility (WFF)	$12.12	3.9	$0.42	$12.12	3.9	$0.42	$0.00	0.0	$0.00
White Sands Complex	$207.58	4.2	$7.19	$207.52	4.2	$7.19	$0.06	4.7	$0.00
- White Sands TDRSS 1	$108.00	4.1	$4.19	$107.94	4.1	$4.19	$0.06	4.7	$0.00
- White Sands TDRSS 2	$99.58	4.3	$3.00	$99.58	4.3	$3.00	$0.00	0.0	$0.00
Poker Flat Research RGE, AK	$8.93	4.3	$0.33	$8.93	4.3	$0.33	$0.00	0.0	$0.00
CSBF - Fort Sumner, NM	$0.01	4.0	$0.00	$0.01	4.0	$0.00	$0.00	0.0	$0.00
Remote Sites	$19.43	3.9	$0.80	$19.40	3.9	$0.80	$0.03	3.0	$0.00
- CSBF – Palestine, TX	$10.96	4.0	$0.48	$10.96	4.0	$0.48	$0.00	0.0	$0.00
- Ponce de Leon STDN, FL	$1.71	3.5	$0.04	$1.71	3.5	$0.04	$0.00	0.0	$0.00
Jet Propulsion Laboratory	**$2,199.63**	**4.1**	**$66.00**	**$2,167.98**	**4.2**	**$57.87**	**$31.65**	**3.4**	**$8.13**
Jet Propulsion Laboratory	$1,306.34	4.1	$38.41	$1,305.83	4.1	$38.19	$0.51	2.8	$0.23
Deep Space Network	$880.83	4.3	$26.87	$849.69	4.3	$18.97	$31.13	3.4	$7.90
- DSN Canberra	$221.37	4.5	$3.46	$216.62	4.5	$3.26	$4.75	4.3	$0.20
- DSN Goldstone	$429.29	4.1	$18.99	$402.90	4.2	$11.29	$26.38	3.3	$7.70
- DSN Madrid	$230.17	4.3	$4.43	$230.17	4.3	$4.43	$0.00	0.0	$0.00
Table Mountain Observatory	$12.46	3.8	$0.70	$12.46	3.8	$0.70	$0.00	0.0	$0.00
Johnson Space Center	**$2,917.95**	**3.6**	**$225.99**	**$2,829.43**	**3.6**	**$218.6**	**$88.52**	**3.5**	**$7.36**
Johnson Space Center	$2,395.54	3.6	$198.77	$2,333.03	3.6	$193.57	$62.51	3.5	$5.20
Ellington Field	$170.02	3.9	$6.63	$170.02	3.9	$6.63	$0.00	0.0	$0.00
White Sands Test Facility	$352.38	3.8	$20.59	$326.38	3.9	$18.44	$26.00	3.5	$2.16
Kennedy Space Center	**$6,326.45**	**3.7**	**$469.87**	**$6,161.99**	**3.7**	**$450.5**	**$164.45**	**3.2**	**$19.41**
Kennedy Space Center	$6,082.43	3.7	$444.06	$6,038.94	3.7	$441.65	$43.50	3.7	$2.41
CAPE	$244.01	3.3	$25.82	$123.06	3.6	$8.81	$120.96	3.0	$17.01
Langley Research Center	**$3,573.33**	**3.7**	**$261.25**	**$3,565.96**	**3.7**	**$259.71**	**$7.36**	**3.3**	**$1.54**
Langley Research Center	$3,573.33	3.7	$261.25	$3,565.96	3.7	$259.71	$7.36	3.3	$1.54
Marshall Space Flight Center	**$3,908.05**	**3.8**	**$237.60**	**$3,693.79**	**3.8**	**$199.32**	**$214.26**	**3.7**	**$38.28**
Marshall Space Flight Center	$2,004.89	3.8	$120.65	$1,979.66	3.8	$117.53	$25.22	3.2	$3.12
Michoud Assembly Facility	$1,793.44	3.9	$81.54	$1,708.23	3.8	$81.28	$85.21	4.8	$0.26
Santa Susana Field Laboratory	$109.72	2.9	$35.41	$5.89	3.3	$0.51	$103.83	2.9	$34.89
Stennis Space Center	**$3,721.20**	**3.8**	**$197.98**	**$3,036.80**	**3.7**	**$180.01**	**$684.41**	**4.4**	**$17.97**
Stennis Space Center	$2,997.37	3.8	$172.13	$2,372.68	3.6	$155.23	$624.69	4.4	$16.90
Stennis Space Center (Tenants)	$363.30	4.2	$11.16	$361.73	4.2	$11.14	$1.57	4.3	$0.02
Stennis Space Center (Area 9)	$360.54	4.1	$14.69	$302.39	4.0	$13.63	$58.15	4.4	$1.06

Table 4-2. FY16 Deferred Maintenance ($M) by System for NASA as a Whole

Name	Structure ($M)	Exterior ($M)	Roof ($M)	HVAC ($M)	Electric ($M)	Plumbing ($M)	Conveyance ($M)	Interior ($M)	PSE ($M)
NASA Agency Total	**$509.66**	**$156.00**	**$248.80**	**$354.40**	**$534.87**	**$212.15**	**$23.84**	**$148.34**	**$200.58**
Ames Research Center	**$92.04**	**$31.01**	**$43.77**	**$59.53**	**$148.09**	**$24.63**	**$2.35**	**$25.35**	**$58.48**
Ames Research Center	$10.25	$10.39	$22.54	$30.81	$52.70	$5.91	$1.98	$12.78	$58.48
Crows Landing	$6.21	$0.30	$0.05	$0.30	$1.72	$0.77	$0.00	$0.21	$0.00
Moffett Federal Airfield	$75.58	$20.33	$21.18	$28.42	$93.67	$17.95	$0.37	$12.36	$0.00
Armstrong Flight Research Center	**$3.21**	**$1.92**	**$5.48**	**$4.17**	**$6.04**	**$1.37**	**$0.10**	**$1.48**	**$0.12**
Armstrong Flight Research Center	$3.21	$1.92	$5.48	$4.17	$6.04	$1.37	$0.23	$1.48	$0.12
Glenn Research Center	**$42.95**	**$21.58**	**$33.50**	**$39.99**	**$60.16**	**$12.66**	**$1.09**	**$14.48**	**$8.65**
Lewis Field	$36.88	$19.42	$31.03	$32.33	$44.22	$9.34	$0.98	$13.33	$8.53
Plum Brook Station	$6.08	$2.15	$2.47	$7.66	$15.93	$3.31	$0.11	$1.16	$0.13
Goddard Space Flight Center	**$63.88**	**$13.20**	**$22.47**	**$20.98**	**$34.65**	**$10.17**	**$1.04**	**$16.36**	**$0.41**
Goddard Space Flight Center	$21.49	$7.45	$17.52	$17.22	$26.18	$7.30	$1.01	$12.53	$0.38
Hawaii STDN	$0.62	$0.23	$0.24	$0.42	$0.33	$0.08	$0.00	$0.27	$0.00
Hawaii IRTF	$0.03	$0.03	$0.07	$0.05	$0.07	$0.01	$0.00	$0.27	$0.01
Wallops Flight Facility	$40.59	$2.60	$4.42	$2.21	$5.81	$2.46	$0.02	$2.45	$0.01
- White Sands Testing Facility (WFF)	$0.03	$0.17	$0.12	$0.02	$0.03	$0.03	$0.00	$0.02	$0.00
White Sands Complex	$0.41	$2.76	$0.08	$0.81	$2.07	$0.29	$0.00	$0.78	$0.00
- White Sands TDRSS 1	$0.13	$1.84	$0.00	$0.18	$1.25	$0.07	$0.00	$0.72	$0.00
- White Sands TDRSS 2	$0.28	$0.92	$0.08	$0.63	$0.82	$0.22	$0.00	$0.06	$0.00
Poker Flat Research RGE, AK	$0.22	$0.04	$0.06	$0.09	$0.06	$0.01	$0.00	$0.01	$0.00
CSBF - Fort Sumner, NM	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Remote Sites	$0.33	$0.07	$0.10	$0.11	$0.14	$0.01	$0.00	$0.03	$0.00
- CSBF – Palestine, TX	$0.07	$0.01	$0.05	$0.15	$0.02	$0.01	$0.00	$0.02	$0.00
- Ponce de Leon STDN, FL	$0.01	$0.00	$0.01	$0.00	$0.01	$0.00	$0.00	$0.01	$0.00
Jet Propulsion Laboratory	**$10.89**	**$5.08**	**$7.21**	**$9.73**	**$20.73**	**$5.92**	**$0.66**	**$5.57**	**$0.19**
Jet Propulsion Laboratory	$6.08	$2.45	$4.17	$6.11	$10.42	$4.23	$0.66	$4.09	$0.19
Deep Space Network	$4.58	$2.56	$2.92	$3.57	$10.19	$1.67	$0.00	$1.39	$0.00
- DSN Canberra	$4.67	$4.39	$3.82	$4.31	$4.44	$3.76	$0.00	$4.45	$0.00
- DSN Goldstone	$1.69	$2.09	$1.45	$2.82	$8.41	$1.41	$0.00	$1.12	$0.00
- DSN Madrid	$1.74	$0.32	$0.45	$0.41	$1.19	$0.10	$0.00	$0.22	$0.00
Table Mountain Observatory	$0.24	$0.07	$0.12	$0.05	$0.12	$0.02	$0.00	$0.08	$0.00
Johnson Space Center	**$39.03**	**$15.66**	**$23.30**	**$67.64**	**46.7**	**$13.0**	**$1.84**	**$17.22**	**$4.58**
Johnson Space Center	$31.76	$14.29	$20.53	$64.79	$38.51	$10.89	$1.42	$16.48	$3.06
Ellington Field	$0.83	$0.33	$1.26	$1.63	$1.65	$0.69	$0.03	$0.20	$0.00
White Sands Test Facility	$6.44	$1.04	$1.51	$1.22	$6.56	$1.38	$0.39	$0.54	$1.53
Kennedy Space Center	**$114.08**	**$11.05**	**$41.37**	**$102.96**	**64.2**	**$106.5**	**$1.01**	**$27.83**	**$0.83**
Kennedy Space Center	$105.66	$9.05	$38.38	$100.09	$57.21	$105.12	$0.75	$27.13	$0.67
CAPE	$8.42	$2.00	$3.00	$2.87	$6.99	$1.41	$0.26	$0.70	$0.16
Langley Research Center	**$23.56**	**$18.47**	**$23.87**	**$17.53**	**44.4**	**$7.6**	**$0.10**	**$14.18**	**$109.05**
Langley Research Center	$23.56	$18.47	$23.87	$17.53	$44.43	$7.60	$2.57	$14.18	$109.05
Marshall Space Flight Center	**$31.05**	**$26.82**	**$30.48**	**$22.09**	**$77.57**	**$21.21**	**$3.62**	**$21.71**	**$3.05**
Marshall Space Flight Center	$11.55	$18.55	$8.67	$14.33	$38.23	$10.86	$1.11	$14.39	$2.96
Michoud Assembly Facility	$15.22	$6.60	$21.29	$7.28	$14.60	$9.14	$0.68	$6.72	$0.00
Santa Susana Field Laboratory	$4.28	$1.66	$0.53	$0.48	$24.74	$1.22	$1.82	$0.60	$0.09
Stennis Space Center	**$88.98**	**$11.28**	**$17.47**	**$9.84**	**$32.35**	**$9.18**	**$9.43**	**$4.25**	**$15.21**
Stennis Space Center	$85.08	$7.87	$7.19	$7.68	$28.49	$8.01	$9.38	$3.27	$15.16
Stennis Space Center (Tenants)	$1.17	$2.26	$3.14	$1.12	$2.19	$0.81	$0.06	$0.36	$0.04
Stennis Space Center (Area 9)	$2.72	$1.15	$7.14	$1.03	$1.67	$0.36	$0.00	$0.61	$0.00

Table 4-3. FY16 NASA System Condition Index as a Whole

Name	Structure	Exterior	Roof	HVAC	Electric	Plumbing	Conveyance	Interior	PSE
NASA Agency Total	**3.8**	**3.9**	**3.8**	**3.6**	**3.7**	**3.5**	**3.8**	**3.7**	**3.9**
Ames Research Center	**3.9**	**3.7**	**3.4**	**3.3**	**3.4**	**3.4**	**3.9**	**3.6**	**4.1**
Ames Research Center	4.3	3.8	3.7	3.4	3.5	3.6	3.8	3.6	4.1
Crows Landing	2.3	1.0	2.0	1.0	1.0	1.5	0.0	1.0	0.0
MoffettFederal Airfield	3.5	3.3	3.0	3.1	3.0	3.3	4.3	3.7	4.0
Armstrong Flight Research Center	**4.0**	**3.9**	**3.5**	**3.5**	**4.0**	**3.7**	**0.1**	**3.8**	**4.1**
Armstrong Flight Research Center	4.0	3.9	3.5	3.5	4.0	3.7	3.5	3.8	4.1
Glenn Research Center	**3.7**	**3.7**	**3.5**	**3.4**	**3.5**	**3.5**	**3.8**	**3.7**	**3.9**
Lewis Field	3.6	3.6	3.4	3.4	3.5	3.4	3.7	3.6	3.9
Plum Brook Station	3.9	4.0	4.1	3.4	3.4	3.6	4.0	4.0	4.7
Goddard Space Flight Center	**3.7**	**3.9**	**3.8**	**3.7**	**3.7**	**3.7**	**3.9**	**3.8**	**4.7**
Goddard Space Flight Center	3.7	3.9	3.6	3.6	3.6	3.6	3.8	3.8	4.4
Hawaii STDN	3.5	3.5	3.9	3.7	3.7	3.9	0.0	3.0	0.0
Hawaii IRTF	4.0	4.0	4.0	4.0	4.0	4.0	5.0	3.0	4.0
Wallops Flight Facility	3.5	3.9	4.1	4.1	4.0	3.9	4.6	3.9	4.7
- White Sands Testing Facility (WFF)	4.1	3.1	4.0	4.0	4.0	4.0	0.0	4.0	0.0
White Sands Complex	4.6	3.4	4.8	3.9	3.9	3.6	0.0	3.5	5.0
- White Sands TDRSS 1	4.6	3.2	5.0	4.2	3.6	4.0	0.0	3.1	5.0
- White Sands TDRSS 2	4.6	3.7	4.6	3.3	4.2	3.2	0.0	4.0	5.0
Poker Flat Research RGE, AK	4.0	3.9	3.9	4.0	4.0	4.1	3.0	4.5	4.0
CSBF - Fort Sumner, NM	4.0	4.0	4.0	4.0	4.0	2.6	3.0	4.0	0.0
Remote Sites	3.8	3.9	3.9	4.0	3.9	4.0	3.7	4.2	4.0
- CSBF – Palestine, TX	4.4	4.4	4.6	2.8	4.4	4.0	0.0	4.5	0.0
- Ponce de Leon STDN, FL	3.3	4.0	4.0	4.3	3.9	3.8	0.0	3.2	0.0
Jet Propulsion Laboratory	**4.3**	**4.2**	**4.3**	**4.0**	**4.0**	**3.8**	**4.1**	**4.0**	**4.5**
Jet Propulsion Laboratory	4.1	4.2	4.4	4.0	4.0	3.7	4.1	4.0	4.5
Deep Space Network	4.4	4.1	4.0	4.0	4.2	4.0	0.0	4.1	0.0
- DSN Canberra	4.7	4.4	3.8	4.3	4.4	3.8	0.0	4.4	0.0
- DSN Goldstone	4.4	3.8	3.8	3.8	3.9	3.5	0.0	3.7	0.0
- DSN Madrid	4.2	4.2	4.4	4.1	4.3	4.4	0.0	4.2	0.0
Table Mountain Observatory	3.6	4.0	3.7	4.0	4.0	3.9	4.0	3.7	4.0
Johnson Space Center	**3.7**	**3.7**	**3.7**	**3.3**	**3.6**	**3.6**	**3.7**	**3.6**	**3.6**
Johnson Space Center	3.6	3.7	3.7	3.3	3.5	3.5	3.7	3.6	3.5
Ellington Field	4.0	4.0	3.8	3.4	3.9	3.5	4.0	4.0	5.0
White Sands Test Facility	3.9	3.8	3.9	3.8	3.6	4.1	3.3	3.7	3.8
Kennedy Space Center	**3.7**	**4.3**	**3.9**	**3.3**	**3.8**	**3.0**	**4.1**	**3.6**	**4.0**
Kennedy Space Center	3.7	4.3	4.0	3.3	3.8	3.0	4.1	3.6	4.0
CAPE	3.3	3.5	3.3	3.3	3.1	3.4	3.2	3.8	3.0
Langley Research Center	**3.9**	**3.7**	**3.6**	**3.7**	**3.6**	**3.6**	**0.1**	**3.6**	**3.3**
Langley Research Center	3.9	3.7	3.6	3.7	3.6	3.6	3.8	3.6	3.3
Marshall Space Flight Center	**3.9**	**3.8**	**3.8**	**3.9**	**3.7**	**3.6**	**3.8**	**3.6**	**4.3**
Marshall Space Flight Center	4.0	3.7	4.2	4.0	3.6	3.4	4.0	3.7	4.3
Michoud Assembly Facility	4.0	3.8	3.6	3.9	3.9	3.7	3.9	3.5	3.0
Santa Susana Field Laboratory	3.5	2.3	2.3	1.1	1.6	2.4	1.0	1.9	1.0
Stennis Space Center	**3.7**	**3.9**	**3.9**	**3.9**	**3.9**	**4.0**	**3.2**	**4.1**	**4.1**
Stennis Space Center	3.6	3.8	4.0	3.8	3.9	4.0	3.1	4.0	4.1
Stennis Space Center (Tenants)	4.4	4.0	4.0	4.2	4.2	4.0	4.2	4.3	4.2
Stennis Space Center (Area 9)	4.1	4.0	3.6	4.0	4.1	4.1	0.0	4.3	5.0

Table 4-4. Facility Condition Index and Deferred Maintenance by DM Facility Category

Category	Description	2016 CRV ($M)	2016 FCI	2016 DM ($M)	Facility Count
0	Uncategorized	$0.00	0.0	$0.00	0
1	R&D and Test Buildings	$8,560.54	3.7	$554.69	500
2	R&D Structures and Facilities	$371.84	3.8	$19.20	66
3	Wind Tunnels	$3,458.90	3.8	$251.23	46
4	Engine/Vehicle Static Test Facilities	$2,272.41	3.7	$189.72	176
5	Administrative Buildings	$3,308.88	3.9	$156.18	316
6	Training Buildings	$154.56	3.9	$7.00	18
7	Trailers	$12.16	3.8	$0.78	88
8	Storage Buildings	$730.60	4.0	$34.69	679
9	Storage Facilities	$224.18	4.0	$10.75	511
10	Fuel Storage Tanks	$420.89	3.8	$22.02	135
10.1	Specialize Liquid Storage Tanks	$12.63	3.6	$0.66	4
10.2	Fueling Stations & Systems	$12.23	4.1	$0.50	21
11	Magazines	$97.32	3.9	$3.48	87
12	Communication and Tracking Buildings	$660.32	3.8	$43.28	256
13	Communication and Tracking Facilities	$752.64	4.4	$18.55	207
13.1	Large Antennas	$101.71	4.6	$1.75	9
13.2	Small Antennas	$1.36	2.8	$0.34	8
14	Mission Control Operations Buildings	$126.89	4.2	$1.85	3
15	Lighting	$86.75	3.0	$17.57	48
16	Electrical Distribution System	$1,222.17	3.4	$125.67	81
16.1	Power Generation/Power Plant	$46.04	3.8	$1.82	27
16.2	Electric Substations, Switchgear & Transformer Yards	$531.07	3.8	$24.86	183
17	HVAC Distribution	$430.82	3.6	$36.67	71
17.1	HVAC Generation	$705.91	4.0	$29.14	66
18	Waste Water Collection & Disposal System	$174.97	3.6	$14.19	81
18.1	Waste Water Facilities & Treatment Plants	$150.71	3.7	$8.33	85
18.2	Storm Drains, Ditches, Dams, Retaining walls	$226.09	2.9	$18.99	49
19	Potable Water Distribution System	$545.70	3.9	$24.67	215
19.1	Potable Water Facilities & Treatment Plants	$58.28	4.4	$1.23	37
20	Launch Pads	$850.85	4.0	$16.62	19
20.1	Launch support camera pads	$8.01	3.5	$0.56	39
20.2	Launch propellant & high pressure gas facilities	$130.23	3.9	$3.54	17
21	Pavement	$2,017.75	3.4	$137.85	207
22	Rail	$0.00	0.0	$0.00	0
23	Maintenance Facilities and Public Work Shops	$569.61	3.7	$38.54	185
23.1	Operational maintenance facilities	$1,997.75	3.7	$200.11	89
24	Other Buildings	$3,041.82	3.7	$346.27	524
25	Other Facilities	$597.76	3.9	$22.38	241
26	Land & Easements	$0.00	0.0	$0.00	109
27	Compressed Air Distribution	$0.00	0.0	$0.00	0
27.1	Compressed Air Generation	$0.16	4.0	$0.00	1
28	Prefabricated buildings, various uses	$0.00	0.0	$0.00	1
29	Berthing & Housing	$0.00	0.0	$0.00	0

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5.0 COMPARISON OF RESULTS BETWEEN FY15 AND FY16

5.1 RESULTS

Since the FY15 assessment, the Agency FCI remained at 3.7. The DM estimate for the Agency increased from $2,326.15 million to $2,385.68. This represents an increase of $59.53 million, or 2.56 percent.

Overall, assets remain in fair to good condition. NASA's staff and contractors continue to focus their efforts on active and mission-critical assets, sustaining aging systems through diligent maintenance and the use of technology for tracking maintenance and repairs. An increased focus on demolition of Abandoned assets and replacement with newer, energy-efficient buildings is contributing to the lowering of maintenance liability.

Table 5-1 provides a comparison of results from the FY15 and FY16 assessments.

Table 5-1. Comparison between FY15 and FY16 Assessments

Name	DM 2015 ($M)	DM 2016 ($M)	Delta DM ($M)	DM Change %	FCI 2015	FCI 2016	Delta FCI
NASA Agency Total	**$2,326.15**	**$2,385.68**	**$59.53**	**2.56%**	**3.7**	**3.7**	**0.0**
Ames Research Center	**$483.14**	**$485.26**	**$2.11**	**0.44%**	**3.7**	**3.7**	**0.0**
Ames Research Center	$206.22	$205.84	($0.38)	-0.18%	3.9	3.9	0.0
Crows Landing	$9.62	$9.56	($0.06)	-0.60%	2.1	2.1	0.0
MoffettFederal Airfield	$267.31	$269.86	$2.55	0.95%	3.4	3.3	0.0
Armstrong Flight Research Center	**$24.55**	**$24.02**	**($0.53)**	**-2.14%**	**3.8**	**3.9**	**0.1**
Armstrong Flight Research Center	$24.55	$24.02	($0.53)	-2.14%	3.8	3.9	0.0
Glenn Research Center	**$249.79**	**$235.06**	**($14.73)**	**-5.90%**	**3.6**	**3.6**	**0.1**
Lewis Field	$199.39	$196.06	($3.33)	-1.67%	3.6	3.6	0.0
Plum Brook Station	$50.40	$39.00	($11.40)	-22.62%	3.6	3.8	0.2
Goddard Space Flight Center	**$164.04**	**$183.14**	**$19.10**	**11.64%**	**3.7**	**3.7**	**0.0**
Goddard Space Flight Center	$104.23	$111.08	$6.85	6.57%	3.7	3.7	0.0
Hawaii STDN	$2.13	$2.20	$0.06	2.86%	3.5	3.5	0.0
Hawaii IRTF	$0.55	$0.56	$0.01	1.34%	3.9	3.9	0.0
Wallops Flight Facility	$50.96	$60.58	$9.61	18.86%	3.8	3.7	-0.1
- White Sands Testing Facility (WFF)	$0.42	$0.42	$0.00	1.34%	3.9	3.9	0.0
White Sands Complex	$5.30	$7.19	$1.89	35.61%	3.7	4.2	0.5
- White Sands TDRSS 1	$3.18	$4.19	$1.01	31.75%	3.6	4.1	0.5
- White Sands TDRSS 2	$2.12	$3.00	$0.88	41.39%	3.7	4.3	0.6
Poker Flat Research RGE, AK	$0.22	$0.33	$0.11	51.13%	4.6	4.3	-0.3
CSBF - Fort Sumner, NM	$0.00	$0.00	$0.00	0.02%	0.0	4.0	4.0
Remote Sites	$0.54	$0.80	$0.26	49.34%	4.2	3.9	-0.3
- CSBF – Palestine, TX	$0.32	$0.48	$0.16	49.32%	4.2	4.0	-0.2
- Ponce de Leon STDN, FL	$0.03	$0.04	$0.01	32.01%	3.8	3.5	-0.2
Jet Propulsion Laboratory	**$65.69**	**$66.00**	**$0.31**	**0.47%**	**4.1**	**4.1**	**0.1**
Jet Propulsion Laboratory	$38.04	$38.41	$0.38	1.01%	4.0	4.1	0.1
Deep Space Network	$26.98	$26.87	($0.10)	-0.38%	4.2	4.3	0.0
- DSN Canberra	$3.44	$3.46	$0.02	0.54%	4.4	4.5	0.1
- DSN Goldstone	$19.24	$18.99	($0.26)	-1.33%	4.1	4.1	0.0
- DSN Madrid	$4.29	$4.43	$0.14	3.15%	4.3	4.3	0.0
Table Mountain Observatory	$0.67	$0.70	$0.03	4.34%	3.8	3.8	0.0

Table 5-1. Comparison between FY15 and FY16 Assessments (continued)

Name	DM 2015	DM 2016	Delta DM ($M)	DM %Change	FCI 2014	FCI 2015	Delta FCI
Johnson Space Center	**$218.90**	**$225.99**	**$7.10**	**3.24%**	**3.6**	**3.6**	**0.0**
Johnson Space Center	$193.24	$198.77	$5.52	2.86%	3.6	3.6	0.0
Ellington Field	$6.40	$6.63	$0.23	3.61%	3.8	3.9	0.0
White Sands Test Facility	$19.26	$20.59	$1.34	6.96%	3.8	3.8	0.0
Kennedy Space Center	**$480.15**	**$469.87**	**($10.28)**	**-2.14%**	**3.7**	**3.7**	**0.0**
Kennedy Space Center	$449.31	$444.06	($5.25)	-1.17%	3.7	3.7	0.0
CAPE	$30.85	$25.82	($5.03)	-16.31%	3.3	3.3	0.0
Langley Research Center	**$194.10**	**$261.25**	**$67.15**	**34.60%**	**3.6**	**3.7**	**0.1**
Langley Research Center	$194.10	$261.25	$67.15	34.60%	3.6	3.7	0.0
Marshall Space Flight Center	**$250.16**	**$237.60**	**($12.57)**	**-5.02%**	**3.8**	**3.8**	**0.0**
Marshall Space Flight Center	$118.28	$120.65	$2.37	2.00%	3.8	3.8	0.0
Michoud Assembly Facility	$80.29	$81.54	$1.25	1.56%	3.9	3.9	0.0
Santa Susana Field Laboratory	$51.59	$35.41	($16.18)	-31.37%	2.8	2.9	0.1
Stennis Space Center	**$195.62**	**$197.98**	**$2.36**	**1.21%**	**3.8**	**3.8**	**0.0**
Stennis Space Center	$166.23	$172.13	$5.90	3.55%	3.8	3.8	0.0
Stennis Space Center (Tenants)	$10.83	$11.16	$0.33	3.06%	4.2	4.2	0.0
Stennis Space Center (Area 9)	$18.56	$14.69	($3.87)	-20.87%	3.9	4.1	0.2

Table 5-2: NASA-wide DM and SCI by Building System

	DM ($M)				SCI	
	2015	**2016**	**Change**	**% Change**	**2015**	**2016**
Structure	$505.66	$509.66	$4.00	0.79%	3.8	3.8
Exterior	$156.11	$156.00	($0.11)	-0.07%	3.9	3.9
Roof	$241.76	$248.80	$7.04	2.91%	3.8	3.8
HVAC	$350.91	$354.40	$3.49	0.99%	3.6	3.6
Electrical	$533.44	$534.87	$1.43	0.27%	3.7	3.7
Plumbing	$223.38	$212.15	($11.23)	-5.03%	3.4	3.5
Conveyance	$26.33	$23.84	($2.49)	-9.46%	3.7	3.8
Interior Finish	$153.23	$148.34	($4.89)	-3.19%	3.7	3.7
Program Equipment	$135.32	$200.58	$65.26	48.23%	3.9	3.9
Total	**$2,326.15**	**$2,385.68**	**$59.53**	**2.56%**	**3.7**	**3.7**

Table 5-3. Maintenance to Replacement Cost

Category	Description	2016 CRV ($M)	2016 FCI	2016 DM ($M)	Facility Count	DM/CRV
13.2	Small Antennas	$1.36	2.8	$0.34	8	24.95%
15	Lighting	$86.75	3.0	$17.57	48	20.25%
24	Other Buildings	$3,041.82	3.7	$346.27	524	11.38%
16	Electrical Distribution System	$1,222.17	3.4	$125.67	81	10.28%
23.1	Operational maintenance facilities	$1,997.75	3.7	$200.11	89	10.02%
17	HVAC Distribution	$430.82	3.6	$36.67	71	8.51%
18.2	Storm Drains, Ditches, Dams, Retaining walls	$226.09	2.9	$18.99	49	8.40%
4	Engine/Vehicle Static Test Facilities	$2,272.41	3.7	$189.72	176	8.35%
18	Waste Water Collection & Disposal System	$174.97	3.6	$14.19	81	8.11%
3	Wind Tunnels	$3,458.90	3.8	$251.23	46	7.26%

Table 5-3 shows the ten DM categories with the highest maintenance to replacement costs ratios.

While categories 15, 13.2, 18, and 18.2 have a high maintenance to replacement cost ratio and lower FCI, Categories 16, 17, 24, 23.1, and 4 represent a greater number of assets and much larger total DM and CRV. Category 3—Wind Tunnels represents a relatively few number of assets that typically have a high CRV.

Assets categorized in DM Category 24 (Other Buildings) show a relatively high DM to CRV ratio of 11.38 percent when compared to the NASA-wide 6.88 percent. This category includes a large number of assets that could be assigned to a more specific category. It also includes unique facilities that do not fit into another category, such as K6-0848—Vehicle Assembly Building at KSC, for which the CRV comprises almost half of the value of all of the assets in this DM category, and is responsible for 63.84 percent of the DM in this category.

The DM Category 4 (Engine/Vehicle Static Test Facilities) contains a high number of assets with a high DM/CRV ratio at 8.35 percent, when compared to the NASA average. DM Category 3 (Wind Tunnels) represents fewer assets, but has a large CRV. Test Stand and Wind Tunnel CRV distribution is weighted heavily towards Structure, Electrical, and PSE systems in the NASA DM Parametric Estimating Method. Each of these systems is generally more costly to maintain according to the model, resulting in a high DM. The high DM could also be attributed to the fact that many of these test facilities are in transition between the shuttle program and future missions and have deteriorated while unused and awaiting decisions regarding future programs for space exploration.

5.2 EXPLANATION OF SIGNIFICANT CHANGES IN FACILITY CONDITION INDEX AND DEFERRED MAINTENANCE ESTIMATES BETWEEN FY15 AND FY16

At eleven installations, the DM estimate changed by more than 10 percent. Six of those eleven installations had DM estimates that changed by more than $2.5 million, as shown in Table 5-4. Plum Brook Station and SSC Area 9 both experienced increased in FCI of 0.2. The FCI at LaRC and SSFL increased by 0.1. The FCI at WFF decreased by 0.1. There was no change in SCI at KSC/CAPE. The installations where the DM estimate changed by more than 20 percent and $2.5 million are: Langley Research Center, Stennis Space Center (Area 9), KSC CAPE, GRC Plum Brook Station, and the Santa Susana Field Laboratory.

Table 5-4. Comparison of Deferred Maintenance Estimate ($M) between FY15 and FY16, by Percentage Variation (Greater than 10 Percent and More than $2.5 Million)

Name	DM 2015 ($M)	DM 2016 ($M)	Delta DM ($M)	DM Change %	FCI 2015	FCI 2016	Delta FCI
Langley Research Center	$194.10	$261.25	$67.15	34.60%	3.6	3.7	0.1
Wallops Flight Facility	$50.96	$60.58	$9.61	18.86%	3.8	3.7	-0.1
Stennis Space Center (Area 9)	$18.56	$14.69	($3.87)	-20.87%	3.9	4.1	0.2
CAPE	$30.85	$25.82	($5.03)	-16.31%	3.3	3.3	0.0
Plum Brook Station	$50.40	$39.00	($11.40)	-22.62%	3.6	3.8	0.2
Santa Susana Field Laboratory	$51.59	$35.41	($16.18)	-31.37%	2.8	2.9	0.1

The following section provides a more detailed analysis of the significant changes at each installation.

5.2.1 Langley Research Center

The FCI for LaRC increased from 3.6 to 3.7 from FY15 to FY16. The DM increased from $194.10 million to $261.25 million, or 34.60 percent.

The increase in FCI with a corresponding increase in DM is unusual as an increase in FCI normally results in a decrease in DM. The increase in FCI is the result of the addition of more than 40 assets to the RPMS. These assets typically received higher than average ratings for their individual systems, resulting in the overall increases in SCI to the Structure, Exterior, and Interior Finishes systems and the increase in FCI overall.

These increases in SCI would normally decrease DM. However, issues observed and the resulting ratings changes at high value asset 1251—1251 Research Complex were responsible for the increase in DM. The ratings for the Roof system were lowered due to leaks. The Conveyance system was rated lower as all the cranes in the facility were uncertified. The PSE system was also lowered as issues were reported with controls, drives, and motor equipment resulting in the equipment being inoperable. As 1251—1251 Research Complex is a high value asset with a CRV in excess of $100 million, any changes to system ratings may result in large changes to DM.

5.2.2 Wallops Flight Facility

The FCI for WFF decreased from 3.8 to 3.7 from FY15 to FY16. The DM increased from $50.96 million to $60.58 million, or 18.86 percent.

The overall Structure SCI decreased from 3.6 to 3.5 in FY16, with a corresponding 28.71 percent increase in DM to $40.59 million. This change in SCI was the result of the observed condition and resulting down rating of S-0002—ACFT Parking Aprons - Station.

The airfield pavements include facilities S-0001—Taxiways – AFLD Pavements, S0002—ACFT Parking Aprons – Station, and S-0003—Runways – AFLD Pavements. These facilities are currently in condition ranging from fair to poor and account for nearly 25% of the entire site's CRV. As they represent such a large percentage of the site's CRV, they have a great impact on the final DM and FCI calculations. There are multi-phase/multi-year projects in various levels of completion to repair and resurface these facilities; however in their current condition there are portions of taxiways, runways, and other aircraft pavements that are unusable.

5.2.3 Stennis Space Center (Area 9)

The FCI for Area 9 increased from 3.9 to 4.1 from FY15 to FY16. The DM decreased from $18.56 million to $14.69 million, or 20.87 percent.

The largest changes in SCI were observed in the Structure, Roof, Plumbing, and Interior Finish systems. The Structure SCI increased by 0.3 and the Plumbing SCI increased by 0.1, while the Roof and Interior Finish SCIs decreased by 0.1. The Structure SCI increased primarily as a result of the removal of approximately 40 assets from the RPMS, many of which were demolished. The removal of demolished and unused assets, which typically had deteriorated components, led to an increase in system SCIs.

5.2.4 Kennedy Space Center – Cape Canaveral Air Force Station

The FCI for KSC CAPE remained at 3.3 from FY15 to FY16. The DM decreased from $30.85 million to $25.82 million, or 16.31 percent.

Several facility systems experienced an overall change in SCI. The Roof SCI increased 0.3 to 3.3; The HVAC SCI increased 0.2 to 3.3; The Electrical SCI increased 0.1 to 3.1; The Plumbing SCI increased 0.1 to 3.4; The Conveyance SCI decreased 0.1 to 3.2. All of these changes an SCI, and their corresponding changes in DM were the result of changes to the RPMS, not from facilities specific rating changes. As facilities are no longer needed at KSC CAPE, they have been demolished, returned to the Air Force, or otherwise removed from the RPMS

5.2.5 Glenn Research Center Plum Brook Station

The FCI at PBS increased from 3.6 to 3.8 from FY15 to FY16. The DM decreased from $50.40 million to $39.00 million, or 22.6 percent.

The largest change in SCI was for the Structure system, which increased from 3.5 to 3.9 in FY16. Other systems increased by 0.1 from FY15: Roof to 4.1, Electrical to 3.4, and Interior Finish to 4.0. These changes in SCI resulted from changes to the RPMS between FY15 and FY16 that included the removal of demolished and excessed facilities. These facilities included the offsite pump stations and site-wide system 8170—Raw Water Piping, which had a CRV of $37.4 million and DM of $3.7 million alone.

Improvements to SCIs were also aided by the addition of the new main gate facilities: 7148—Main Gate Truck Scale, 7235—Main Gatehouse, 7236—North Guard Booth, and 7237—South Guard Booth.

5.2.6 Santa Susana Field Laboratory

The FCI increased from 2.8 to 2.9 from FY15 to FY16. The DM decreased from $51.59 million to $35.41 million, or 31.37 percent.

All the significant changes in SCI, FCI, and DM are related to the demolition program underway on site, as no improvement projects were undertaken in the past year. With the removal of demolished facilities from the SCI and DM calculations, the remaining facilities have a greater weighted effect on the site’s maintenance assessment. In addition to recently demolished facilities, other assets were in the process of being demolished at the time of assessment. Furthermore, other facilities were being prepared for their eventual demolition. The remainder of the facilities onsite are scheduled for demolition in the next fiscal year.

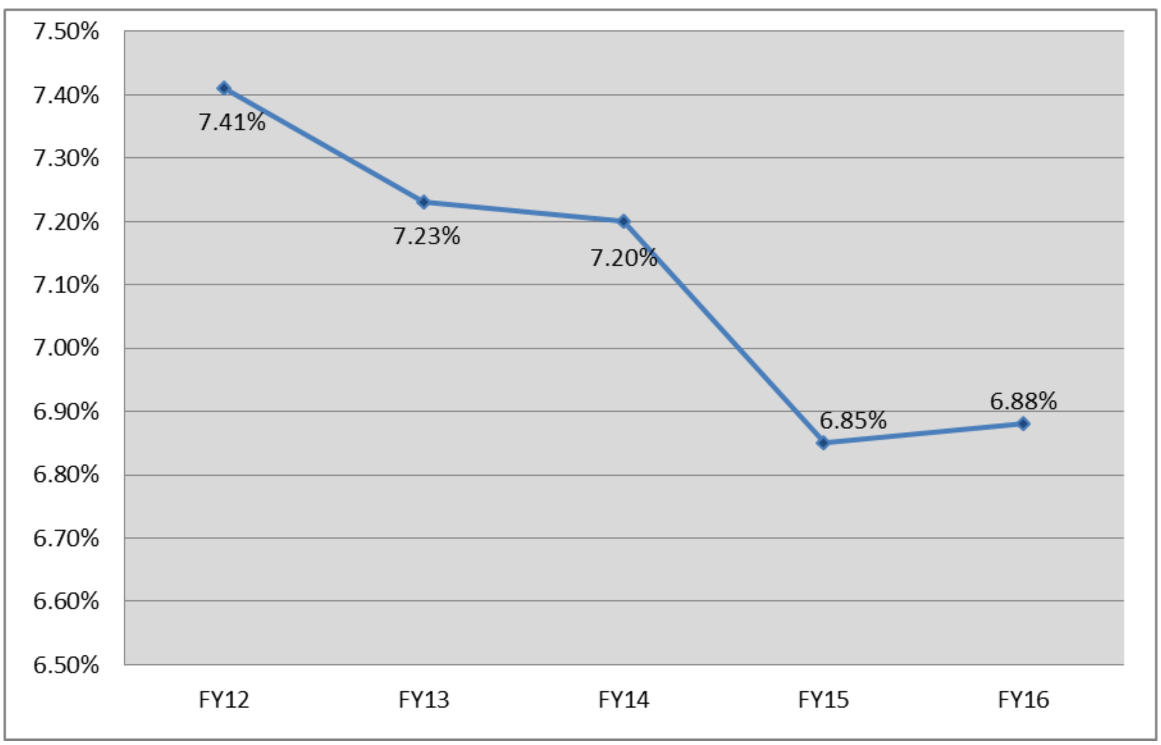
5.3 TREND ANALYSIS

Summary results from the last five years of DM assessments are listed in Table 5-5 and are illustrated in Figure 5-1.

Table 5-5. Trending of Facility Condition Index, Deferred Maintenance and Current Replacement Value

	FY12	FY13	FY14	FY15	FY16
FCI	3.7	3.7	3.7	3.7	3.7
DM ($B)	$2.33	$2.30	$2.35	$2.33	$2.39
CRV ($B)	$31.49	$31.76	$32.66	$33.98	$34.67
DM as % of CRV	7.41%	7.23%	7.20%	6.85%	6.88%

Figure 5-1. Deferred Maintenance as a Percentage of Current Replacement Value



In FY16, the FCI of NASA assets remained constant at 3.7. NASA's CRV continues to increase each year due to cost escalation, facility improvements, lack of demolition funds, and new construction. The DM as a percentage of CRV increased in FY16 to 6.88 percent.

Operations and maintenance staff continue to focus limited resources on maintaining and improving actively used, mission-critical, and other high-value assets through the employment of logical preventive maintenance practices, and targeted repairs and upgrades. Consequently, in FY16, active assets comprise 96.00 percent of total CRV, which is an increase from 95.18 percent in FY15. These assets account for 94.25 percent of the Agency's DM liability, an increase from 92.75 percent in FY15.

Though the DM to CRV ratio increased slightly in FY16, the overall trend of decreasing DM to CRV ratio and increasing Active assets' CRV and DM as percentage of the whole indicates NASA's repair by replacement efforts are yielding the intended results.

In order to attain NASA's targeted FCI goal of 4.0 by 2020, Centers need to continue being funded at an increased level for the replacement of aging electrical, HVAC, and plumbing systems; and the demolition of Abandoned assets, which are major contributing factors toward the overall facility condition ratings and DM estimate. The replacement of these major systems with newer, more efficient systems also provides an opportunity for the Centers to meet federal government and NASA mandates for high performance and sustainable buildings.

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APPENDIX A: THE NASA-WIDE STANDARDIZED DEFERRED MAINTENANCE METHOD

1.0 INTRODUCTION

The NASA DM Parametric Estimating Method was adopted in August 2001. NASA commissioned a pilot of the DM method at MSFC in late 2001. Three two-person teams completed the MSFC assessments. The analysis from that test resulted in minor adjustments to the method. During the full assessment, the DM method was further refined as the data from various inspections was analyzed.

2.0 THE THEORETICAL MODEL

This process of documenting DM is designed to be a simplified approach based on existing empirical data. The method assumes that:

- Condition assessments are performed at the system level rather than the component level;
- Simple condition levels are used;
- There are a limited number of systems to assess; and
- The CRV of the systems and the facility they support are available.

For additional information, please refer to *The NASA Deferred Maintenance Parametric Estimating Guide, Version 5, Sept. 05.*

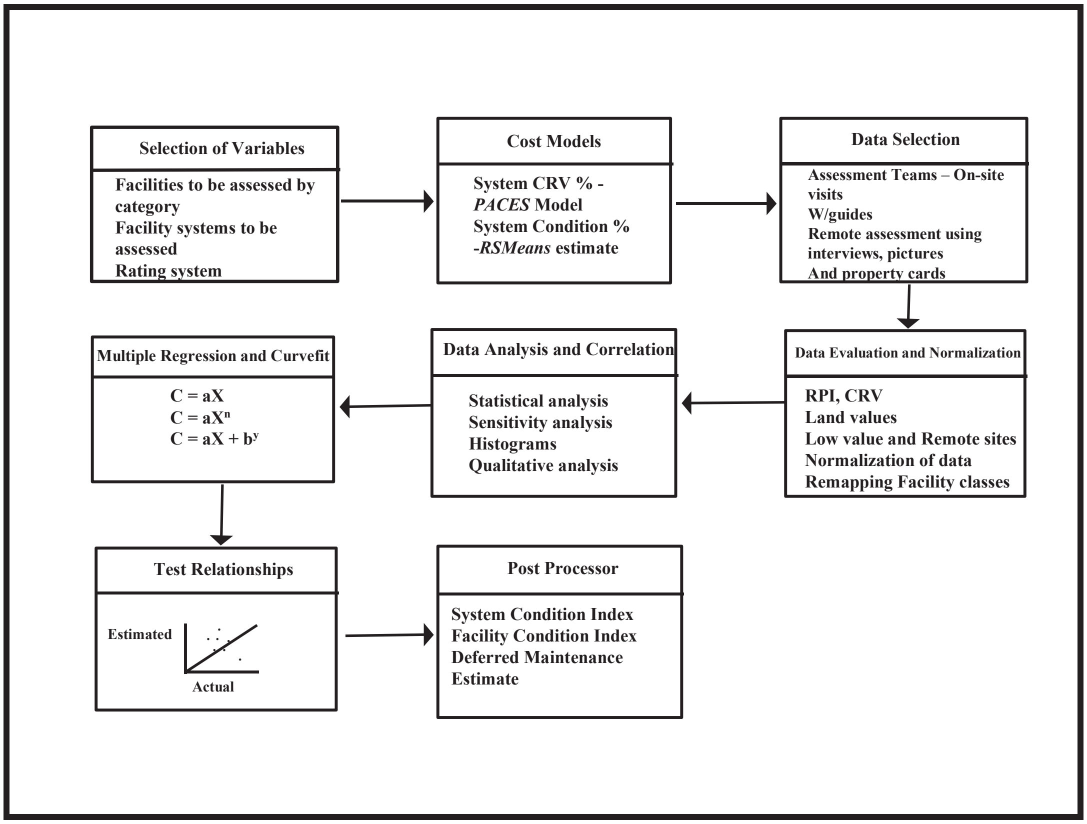
2.1 ESTABLISH DEFERRED MAINTENANCE FACILITY CATEGORY CODES

The first steps in the process are to determine the facilities to be assessed and to group them by categories. The category codes group facilities whose systems are similar and have the same approximate relative system CRV percentage values. For example, one category may be administrative buildings. These are facilities that function like office buildings and have a structure, a roof, exterior and interior finishes, and typical mechanical systems (HVAC, electrical, and plumbing). Another category may be laboratories. Laboratories have the same systems as an administrative building, with Structure, Roof, Exterior and Interior Finishes, and mechanical systems. The percent contribution to the CRV will be different for each category, so these building types need to be separate in the model. Other facilities may include antennas, fueling stations, and other structures that have correspondingly different cost models for purposes of estimating DM. Correct mapping of like facilities is essential to ensuring that all systems' contributions to the CRV, and thus the DM, are accounted for.

To perform the deferred maintenance estimate, a parametric cost estimate model similar to Figure A-1 is used. This model uses cost estimating relationships (CERs) based on existing engineering data and associated algorithms to establish cost estimates. For example, detailed cost estimates for the repair of a building system (e.g. Plumbing system) can be developed using very precise work measurement standards. However, if history has demonstrated that repairs normally cost about 25 percent of the original value, then a detailed estimate need not be performed and can simply be computed at the 25 percent (CER) level. Any CERs used in the computations must be carefully tested for validity using standard statistical approaches.

Parametric techniques focus on the cost drivers, not the miscellaneous details. The drivers are the controllable system design or planning characteristics that dominate system cost. This technique uses the few important parameters that have the most significant cost impact on the deferred maintenance of systems within a facility.

Figure A-1. Theoretical Model for Parametric Estimates



2.2 DETERMINE SYSTEM CURRENT REPLACEMENT VALUE PERCENTAGE

Each system is assigned representative cost factors based on the estimated percent contribution of the major system to total CRV of the facility within a facility category. For example, in a simple administrative building the structure may contribute 35 percent to the CRV, the Roof 15 percent, the Exterior 10 percent, the Interior Finishes 10 percent, and the mechanical systems 30 percent, which together equal 100 percent of the CRV. In complex laboratory and testing facilities, Electrical systems account for a larger percentage of the overall building cost, so the breakdown might be Structure 25 percent, Roof 15 percent, Exterior 10 percent, Interior Finishes 10 percent, and the mechanical systems 40 percent. The system CRV percentages are derived from existing engineering data and adjusted, if necessary, to meet unique facility types.

2.3 ESTABLISH CONDITION ASSESSMENT RATING SCHEME

The NASA condition rating scheme is a simple five-tiered condition code system shown in Table A-6. The DM model divides a facility into nine major components. An inspector will rate each of the nine facility components with a condition rating between 1 and 5. The rating is entered into the database and, depending on the asset class of the facility (a launch pad, for example, would have more Structure system weighting than a substation), it computes the DM.

<u>Condition Assessment Level</u>

- **5: Excellent.** Only normal scheduled maintenance required.
- **4: Good.** Some minor repairs needed. System normally functions as intended.
- **3: Fair**. More minor repairs and some infrequent larger repairs required. System occasionally unable to function as intended.
- **2: Poor.** Significant repairs required. Excessive wear and tear clearly visible. Obsolete. System not fully functional as intended. Repair parts not easily obtainable. Does not meet all codes.
- **1: Non-functional.** Major repair or replacement required to restore function. Unsafe to use.
- **0: Non-existent.** The zero rating identifies that this system does not exist within the facility.

2.4 DETERMINE SYSTEM CONDITION CURRENT REPLACEMENT VALUE PERCENTAGE

A significant component of the DM estimate is the application of a system condition CRV percentage, based on the assigned condition rating for each system. The system condition CRV percentages, based on existing engineering data, increase as the condition of the system gets lower ratings creating a larger DM estimate. For example (for reference see Table A-6), if the Structure of a facility receives a 5 rating, its contribution to DM is 0 percent of the system CRV because there is typically no deferred maintenance for this rating. However, if the Structure receives a 3 rating its contribution to the DM will be 10 percent of the CRV of the system. The system condition percentages also vary by system. Continuing with the example, in the same building, a 3 rating for the electrical system would contribute 13 percent of the Electrical system CRV, while a 3 rating for the Roof system would contribute 38 percent of the system CRV to the facility's overall DM.

2.5 FACILITY CONDITION INDEX CALCULATIONS

After the condition rating scheme was established, teams went to the field to assess the facilities using the rating system above. The teams rated each system in each facility and entered that information into the database from which is generated a SCI for each system, and a FCI for each facility, site, and the Agency as a whole. The SCI is calculated by first determining the CRV of the system in question by multiplying the facility CRV by the percent system CRV. The value of these system CRVs are then totaled. Next, the system CRV for each facility is normalized or weighted by dividing the system CRV by the sum of all the system CRVs. This quotient is then multiplied by its respective assessment rating. These "weighted" SCIs are then added together to determine the facilities' SCI. The SCI calculation can be calculated for the site, installation, Center, Mission Directorate, or Agency levels.

The FCI is the CRV normalized sum of the condition ratings for each system within each facility. The building FCI is a simple calculation that weights each of the nine system condition ratings by its associated system CRV percentage per DM category. In each system, the rating is multiplied by its system CRV percentage to get a weighted SCI. The sum of the nine weighted SCIs equals the facility's FCI.

Table A-1 is an example. If a facility does not have one of the nine system components, that component is rated 0 and will have no weighting and does not contribute to FCI and DM.

Table A-1. Facility FCI Example

		STRUC		EXT		ROOF		HVAC		ELEC		PLUMB		CONV		INTF		EQUIP		FCI
Facility Description	Facility CRV $	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	Insp Rate	% Sys CRV	
WAREHOUSE	1,172,019	4	0.40	3	0.19	2	0.06	0	0.18	3	0.20	0	0.02	0	0	3	0.15	0	0	**3.3**
COVERED STORAGE	102,267	5	0.63	5	0.22	5	0.11	0	0.03	5	0.04	0	0.01	0	0	0	0.04	0	0	**5.0**
EQUIPMENT STORAGE SHED	92,789	5	0.48	5	0.17	5	0.05	0	0.15	5	0.15	0	0.15	0	0	5	0.15	0	0	**5.0**
GENERAL WAREHOUSE	7,781,631	4	0.60	4	0.15	4	0.10	3	0.04	3	0.06	4	0.01	0	0	4	0.04	0	0	**3.9**
ADMINISTRATION BUILDING	12,166,903	5	0.19	5	0.17	3	0.06	4	0.16	4	0.18	4	0.05	5	0.03	5	0.16	0	0	**4.4**
AUDITORIUM	6,306,944	3	0.22	4	0.17	4	0.06	4	0.16	2	0.18	4	0.05	0	0.03	2	0.16	0	0	**3.1**
MAIN LIBRARY	5,716,090	5	0.19	4	0.17	4	0.06	4	0.16	4	0.18	4	0.05	4	0.03	4	0.16	0	0	**4.2**
PHOTOTECHNOLOGY LAB.	10,960,633	4	0.18	3	0.19	4	0.04	3	0.15	4	0.20	4	0.04	5	0.01	5	0.15	5	0.04	**3.9**

Table A-2 is an example of an FCI for a Center. The Center FCI value is a sum of each facility's CRV normalized FCI. Each facility CRV is divided by the total Center CRV. That quotient is then multiplied by each facility's FCI producing a CRV normalized FCI (Weighted FCI = (Facility CRV ÷ Center CRV) × Facility FCI). The sum of these weighted facility FCIs provides a total Center FCI.

Table A-2. Center FCI Example

Center "A"		Facility FCI	Weighted FCI
Facility Description	Facility CRV $		
WAREHOUSE	1,172,019.00	3.3	0.1
COVERED STORAGE	102,267.00	5.0	0.0
EQUIPMENT STORAGE SHED	92,789.00	5.0	0.0
GENERAL WAREHOUSE	7,781,631.00	3.9	0.7
ADMINISTRATION BUILDING	12,166,903.00	4.5	1.2
AUDITORIUM	6,306,944.00	3.1	0.4
MAIN LIBRARY	5,716,090.00	4.2	0.5
PHOTOTECHNOLOGY LAB.	10,960,633.00	3.9	1.0
Center "A" Totals	**44,299,276.00**		**3.9**

2.6 DEFERRED MAINTENANCE CALCULATION

The facility DM estimate is determined by adding the DM estimates of the nine facility systems. Table A-3 provides a sample DM estimate for an administrative facility (DM category 5) with a CRV of $10 million.

Table A-3. Sample Deferred Maintenance Calculation

System	System %	CRV Total $	System Rating	System Condition CRV Factor	DM $
Structure	19	1,900,000	5	0.00	0
Exterior	17	1,700,000	4	0.01	17,000
Roofing	6	600,000	4	0.09	54,000
HVAC	16	1,600,000	3	0.13	208,000
Electrical	18	1,800,000	4	0.02	36,000
Plumbing	5	500,000	3	0.10	50,000
Conveyance	3	300,000	5	0.00	0
Interior Finishes	16	1,600,000	3	0.10	160,000
Prog Support Eqpt	0	0	0	0.00	0
Total	**100**	**$10,000,000**			**$525,000**

3.0 THE MODEL AS USED

3.1 DEFERRED MAINTENANCE FACILITY CATEGORY CODES

Using the NASA RPMS, the first step in building the DM database was to map each of the over 400 NASA Classification Codes into 43 DM Facility Categories, as shown in Table A-4. This step was necessary in order to reduce the number of NASA Classification Codes to simplify data management. The development of the correct facility category is important to provide a more complete reflection of the system CRV percentages in the different facility types, ultimately creating a more representative DM estimate. The categories were determined based on facility similarity. For example, DM category 12, Communication and Tracking Buildings, includes NASA Classification Codes 131 and 140. Category 13, Communications and Tracking Facilities, includes NASA Classification Codes 132 and 141. These facilities may include antennas, fueling stations, or other structures that have correspondingly different cost models for purposes of estimating DM from those in category 12.

Table A-4. Mapping of NASA Classification Codes into Deferred Maintenance Category

Facility Type	NASA Facility Category Class
R&D and Test Buildings	220-11, 220-12, 220-13, 310-10, 310-15, 310-20, 310-21, 310-22, 310-30, 310-40, 310-41, 310-50, 310-60
R&D Structures and Facilities	320-10, 320-20, 320-21, 320-22, 320-30, 320-40, 320-41, 320-50, 320-70, 390-00
Wind Tunnels	330-10, 330-20, 330-30, 330-40, 330-60, 330-70, 331-10, 331-20, 331-30, 331-40, 331-60, 331-70
Engine/Vehicle Static Test Facilities	340-10, 340-20, 345-10, 345-50, 350-10, 350-20, 355-10, 355-20, 355-30, 355-40, 355-50

Table A-4. Mapping of NASA Classification Codes into Deferred Maintenance Category (continued)

Facility Type	NASA Facility Category Class
Administrative Buildings	141-20, 610-10, 610-20, 610-90
Training Buildings	171-00, 179-00
Trailers	630-30, 630-31, 630-32, 630-34, 630-36, 630-37
Storage Buildings	153-10, 153-90, 442-10, 610-30
Storage Facilities	345-20, 421-30, 432-10, 432-90, 442-20, 442-30, 442-40, 442-50, 442-60, 442-90, 452-10, 452-11, 452-12, 471-10, 471-20, 471-30, 471-40
Fuel Storage Tanks	126-90, 411-10, 411-20, 411-30, 411-40, 411-50, 411-60, 411-90, 423-10, 423-20, 423-90, 461-10, 461-20, 461-30, 461-90
Specialized Liquid Storage Tanks	
Fueling Stations and Systems	121-10, 121-20, 121-90, 122-10, 122-20, 122-90, 123-10, 123-90
Magazines	421-90, 422-15, 422-20, 422-30, 422-90, 424-10, 424-20, 424-30
Communication and Tracking Buildings	131-10, 131-15, 131-20, 131-25, 131-30, 131-35, 131-40, 131-45, 131-50, 131-90, 140-10, 140-20, 140-30, 140-40, 140-50, 140-90
Communication and Tracking Facilities	132-10, 132-20, 132-30, 132-40, 132-50, 132-90, 141-30, 141-40, 141-50, 141-90
Large Antennas	
Small Antennas	320-60
Mission Control Operations Buildings	381-10
Lighting	136-10, 136-20, 136-30, 136-50, 136-90, 812-20, 812-40, 812-50, 812-70, 812-80
Electrical Distribution System	382-70, 811-90, 812-30, 812-35, 812-90
Power Generation/Power Plant	811-10, 811-20, 811-30, 811-40, 811-50, 811-60, 811-70, 811-80
Electric Substations, Switchgear & Transformer Yards	812-10, 812-60
HVAC Distribution	822-10, 822-20, 823-20, 823-30, 824-10, 824-20, 824-30, 824-40, 842-10, 890-10, 890-15, 890-20, 890-25, 890-30, 890-35, 890-45, 890-50, 890-60, 890-65, 890-70, 890-85, 890-90
HVAC Generation	821-10, 821-20, 821-30, 821-40, 821-50, 890-40, 890-55, 890-75, 890-80
Waste Water Collection & Disposal System	831-20, 832-10, 832-20, 832-30, 832-40, 832-90, 871-60
Waste Water Facilities & Treatment Plants	831-10, 831-30, 831-40, 831-50, 831-90
Storm drains, Ditches, Dams, Retaining walls	871-10, 871-20, 871-30, 871-40, 871-50, 871-90
Potable Water Distribution System	345-40, 841-20, 841-30, 841-35, 841-40, 841-45, 841-50, 841-55, 842-12, 842-15, 842-30, 842-35, 843-10, 843-20, 843-30, 843-40, 843-50, 843-60
Potable Water Facilities & Treatment Plants	841-10, 841-70
Launch Pads	382-10, 382-11, 382-14, 382-60, 382-80
Launch support camera pads	382-13
Launch propellant & high pressure gas facilities	382-30, 382-31
Pavement	111-10, 111-11, 111-12, 111-20, 111-21, 111-22, 112-10, 112-11, 112-12, 113-20, 113-21, 113-22, 141-10, 851-10, 851-11, 851-12, 851-20, 851-22, 851-90, 851-91, 851-92, 852-10, 852-11, 852-12, 852-20, 852-21, 852-22, 852-30, 852-31, 852-32, 852-90, 852-91, 852-92, 860-10, 860-30, 860-40
Rail	

Table A-4. Mapping of NASA Classification Codes into Deferred Maintenance Category (continued)

Facility Type	NASA Facility Category Class
Maintenance Facilities and PW Shops	219-10, 219-11, 219-20, 220-10
Operational maintenance facilities	212-10, 212-20, 212-30, 212-40, 212-50, 220-14
Other Buildings	381-20, 381-30, 381-40, 381-50, 381-60, 382-15, 510-00, 641-10, 641-20, 641-30, 641-40, 711-00, 712-00, 730-10, 730-20, 730-25, 730-40, 730-65, 730-70, 730-90, 740-18, 740-26, 740-30, 740-33, 740-40, 740-43, 740-46, 740-53, 740-54, 740-56, 740-73, 740-76, 740-83, 740-88, 740-90, 740-95, 872-20, 872-30, 872-90
Other Facilities	126-10, 152-20, 152-40, 152-60, 152-90, 154-10, 154-20, 154-30, 154-90, 163-10, 163-20, 163-30, 163-90, 164-10, 164-20, 164-30, 164-90, 361-10, 361-20, 361-30, 361-40, 631-10, 631-20, 631-30, 631-40, 690-10, 690-20, 690-90, 750-10, 750-20, 750-30, 750-40, 750-50, 750-60, 750-90, 750-95, 833-10, 833-20, 833-30, 833-40, 833-90, 860-20, 860-50, 860-90, 872-10, 872-40, 872-50, 880-10, 880-20, 880-30, 880-40, 880-50, 880-90, 890-95
Land & Easements	911-10, 911-20, 911-21, 911-22, 911-30, 911-31, 911-32, 911-33, 911-40, 911-50, 912-10, 912-11, 912-13, 912-20, 913-10, 913-20, 913-30, 913-40, 913-50, 913-60, 913-61, 913-62, 913-63, 914-10, 914-20, 921-10, 921-20, 921-30, 921-40, 921-50, 921-60, 921-90, 922-10, 922-20, 922-30, 923-10, 923-20, 923-40, 923-50, 923-60, 932-10, 932-20, 932-30, 932-40, 932-50, 932-60, 932-90
Compressed Air Distribution	
Compressed Air Generation	
Prefabricated buildings, various uses	620-10, 620-90, 630-10, 630-11, 630-12, 630-14, 630-16, 630-17, 630-20, 630-21, 630-22, 630-24, 630-26, 630-27
Berthing and Housing	

3.2 FACILITY SYSTEMS

The DM facility systems were developed from a review of other DM estimating methods for facilities and the American Society for Testing of Materials (ASTM) UNIFORMAT II Classification for Building Elements. The following nine systems were selected for the NASA DM method:

- **Structure**: foundations, superstructure, slabs and floors, and pavements that are adjacent to, and considered part of, the facility.
- **Exterior**: wall coatings, windows, doors, and exterior sealants.
- **Roofing**: roof coverings, openings, gutters, and flashing.
- **HVAC**: heating, ventilating, air conditioning systems including controls and balancing devices.
- **Electrical**: service and distribution, lighting, communications, security, and fire protection wiring and controls.
- **Plumbing**: water, sewer, and fire protection piping, or piping for steam, gas, or water distribution in specialty systems (e.g., tanks, generation plants, etc.).
- **Conveying**: elevators, escalators, cranes, and other lifts.
- **Interior Finishes**: all interior finishes including wall coverings, flooring, and ceilings.
- **Program Support Equipment**: equipment installed in the facility to provide support for operational testing or research. For example, additional ventilation equipment or separate HVAC systems required only to support special testing or programs.

3.3 CURRENT REPLACEMENT VALUE AND FACILITY SYSTEM CRV PERCENTAGES

The NASA RPMS system contains the CRV for each facility. Table A-5 shows how the CRV is apportioned between each of the nine facility systems for each of the NASA DM Categories. The CRV System percentages are derived from the Parametric Cost Estimating System, (PACES) [1] which is an accepted estimating tool for federal construction projects. The PACES method was derived from an evaluation of more than $40 billion dollars of federal facilities projects.

Table A-5. Deferred Maintenance Categories with CRV Percent Values

DM Cat	NASA_BLDG	STRUC	EXT	ROOF	HVAC	ELEC	PLUMB	CONV	INTF	EQUIP	SUM
1	R&D and Test Buildings	0.18	0.19	0.04	0.15	0.20	0.04	0.01	0.15	0.04	1.00
2	R&D Structures and Facilities	0.40	0.17	0.01	0.06	0.25	0.02	0.02	0.03	0.04	1.00
3	Wind Tunnels	0.30	0.05	0.01	0.01	0.15	0.01	0.01	0.01	0.45	1.00
4	Engine/Vehicle Static Test Facilities	0.38	0.03	0.01	0.04	0.26	0.01	0.03	0.02	0.22	1.00
5	Administrative Buildings	0.19	0.17	0.06	0.16	0.18	0.05	0.03	0.16	0.00	1.00
6	Training Buildings	0.18	0.20	0.05	0.12	0.21	0.05	0.01	0.18	0.00	1.00
7	Trailers	0.20	0.19	0.06	0.18	0.20	0.02	0.00	0.15	0.00	1.00
8	Storage Buildings	0.60	0.15	0.10	0.04	0.06	0.01	0.00	0.04	0.00	1.00
9	Storage Facilities	0.55	0.22	0.11	0.03	0.04	0.01	0.00	0.04	0.00	1.00
10	Fuel Storage Tanks	0.70	0.13	0.02	0.00	0.10	0.05	0.00	0.00	0.00	1.00
10.1	Specialized Liquid Storage Tanks	0.51	0.13	0.02	0.00	0.14	0.20	0.00	0.00	0.00	1.00
10.2	Fueling Stations & Systems	0.40	0.10	0.05	0.05	0.15	0.20	0.00	0.05	0.00	1.00
11	Magazines	0.33	0.30	0.05	0.06	0.15	0.02	0.00	0.09	0.00	1.00
12	Comm. & Tracking Buildings	0.21	0.20	0.05	0.16	0.18	0.05	0.00	0.15	0.00	1.00
13	Comm. & Tracking Facilities	0.55	0.10	0.02	0.05	0.26	0.00	0.00	0.02	0.00	1.00
13.1	Large Antennas	0.20	0.20	0.02	0.05	0.15	0.02	0.01	0.02	0.33	1.00
13.2	Small Antennas	0.50	0.30	0.00	0.00	0.10	0.00	0.00	0.00	0.10	1.00
14	Mission Control Operations Buildings	0.22	0.13	0.05	0.15	0.20	0.04	0.02	0.10	0.09	1.00
15	Lighting	0.17	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	1.00
16	Electrical Distribution System	0.39	0.03	0.00	0.00	0.58	0.00	0.00	0.00	0.00	1.00
16.1	Power Generation/Power Plant	0.30	0.10	0.05	0.10	0.39	0.01	0.00	0.05	0.00	1.00
16.2	Electric Substations, Switchgear & Transfer Yards	0.10	0.07	0.00	0.00	0.83	0.00	0.00	0.00	0.00	1.00
17	HVAC Distribution	0.30	0.10	0.00	0.00	0.33	0.27	0.00	0.00	0.00	1.00

[1] *PACES* is an integrated PC-based parametric budgeting and cost estimating system developed by Earth Tech that prepares parametric cost estimates for new facility construction and renovation. It was developed for military facility application and will soon be commercialized for use in the general building, industrial facilities, and transportation industries. *PACES* is available to military personnel via the U.S. Air Force. A U.S. Government employee can obtain a copy of the current military version of *PACES* by contacting the Air Force Civil Engineer Support Agency.

Table A-5. Deferred Maintenance Categories with CRV Percent Values (continued)

DM Cat	NASA_BLDG	STRUC	EXT	ROOF	HVAC	ELEC	PLUMB	CONV	INTF	EQUIP	SUM
17.1	HVAC Generation	0.20	0.10	0.05	0.35	0.10	0.15	0.00	0.05	0.00	1.00
18	Waste Water Collection & Disposal System	0.50	0.02	0.02	0.00	0.05	0.41	0.00	0.00	0.00	1.00
18.1	Waste Water Facilities & Treatment Plants	0.34	0.10	0.05	0.03	0.15	0.32	0.00	0.01	0.00	1.00
18.2	Storm drains, Ditches, Dams, Retaining walls	0.90	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.00	1.00
19	Potable Water Distribution System	0.38	0.05	0.02	0.00	0.05	0.50	0.00	0.00	0.00	1.00
19.1	Potable Water Facilities & Treatment Plants	0.25	0.05	0.05	0.03	0.24	0.37	0.00	0.01	0.00	1.00
20	Launch Pads	0.51	0.10	0.03	0.03	0.25	0.04	0.02	0.02	0.00	1.00
20.1	Launch support camera pads	0.80	0.10	0.00	0.00	0.10	0.00	0.00	0.00	0.00	1.00
20.2	Launch propellant & high pressure gas facilities	0.48	0.05	0.02	0.00	0.20	0.25	0.00	0.00	0.00	1.00
21	Pavement	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
22	Rail	0.95	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	1.00
23	Maintenance Facilities & PW Shops	0.20	0.14	0.06	0.13	0.30	0.09	0.00	0.08	0.00	1.00
23.1	Operational maintenance. facilities	0.20	0.14	0.06	0.13	0.28	0.09	0.02	0.08	0.00	1.00
24	Other Buildings	0.22	0.15	0.12	0.10	0.15	0.11	0.00	0.15	0.00	1.00
25	Other Facilities	0.71	0.10	0.02	0.05	0.10	0.01	0.00	0.01	0.00	1.00
26	Land & Easements	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
27	Compressed Air Distribution	0.50	0.00	0.00	0.00	0.10	0.40	0.00	0.00	0.00	1.00
27.1	Compressed Air Generation	0.25	0.10	0.05	0.05	0.15	0.35	0.00	0.05	0.00	1.00
28	Prefab buildings, various uses	0.18	0.17	0.05	0.15	0.15	0.15	0.00	0.15	0.00	1.00
29	Berthing & Housing	0.15	0.17	0.09	0.16	0.18	0.07	0.02	0.16	0.00	1.00

3.4 ESTIMATED REPAIR COST AS A PERCENTAGE OF CRV BY SYSTEM CONDITION

Each condition rating has a corresponding system condition CRV percentage. These percentages vary by system type and are provided in Table A-6. This table is crucial to the applicability of the DM method and, as such, it was analyzed by several engineering sources. Through the use of a survey of major and minor repairs at KSC, combined with an estimated original construction cost using R.S. Means[2] estimating tools, system condition percentages have been developed for each of the nine systems for each of the five ratings. Actual repair costs for a variety of facilities at KSC such as Landing Aids Control Building, the Cafeteria (Multi-Function Facility), Electromagnetic Lab, Operations Building #1, and Logistics Facility,

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[2] R.S. Means. CostWorks 2003 Version 6.1; 1996-2003. *RSMeans* is North America's leading supplier of construction cost information. A product line of Reed Construction Data, *RSMeans* provides accurate and up-to-date cost information that helps owners, developers, architects, engineers, contractors, and others to carefully and precisely project and control the cost of both new building construction and renovation projects.

were used to establish the repair costs. The CRVs of these facilities ranged from $602,000 to $22 million.

The estimates for the various levels of repair work were compared to an estimated cost for the system construction. These comparisons (expressed as percentages) translate into the DM Condition Percentages used in the DM model. The process began with the 1 rating, where the cost for a major repair was established. That cost was then compared to the estimated original construction cost, producing a maximum system condition percentage. For example, a 1 rating in Structure equates to 150 percent of the maximum repair cost of the Structure of a facility including some demolition and disposal cost. The system condition percentages for 2 through 4 were then established using the same method.

Table A-6. System Condition Percentages

SYSTEM	5	4	3	2	1*
STRUC	**0**	**1**	**10**	**25**	**150**
EXT	**0**	**1**	**10**	**50**	**101**
ROOF	**0**	**9**	**38**	**75**	**150**
HVAC	**0**	**2**	**13**	**63**	**133**
ELEC	**0**	**2**	**13**	**63**	**133**
PLUMB	**0**	**2**	**10**	**57**	**121**
CONV	**0**	**2**	**13**	**50**	**100**
INTF	**0**	**1**	**10**	**50**	**101**
EQUIP	**0**	**2**	**13**	**50**	**100**

*Percentages over 100 account for demolition and disposal costs

However, according to the U.S. Army Corps of Engineers (USACE), 50 percent of the replacement value is the decision point as to whether a system should be repaired or replaced. Because a 2 rating is where this decision point falls, the USACE standard was applied as a rule and 2 ratings were set at a maximum of 50 percent of the 1 rating system percentage.

For example, even though the calculated value for 2 in the system category of roofing was 90 percent, the highest the rating it could be is half of the calculated value for the 1 rating (150 percent in this case), which equals 75 percent because that is when the replacement of the roof would most likely occur. The 5 rating was left at 0 percent because what small DM would occur in this rating would be negligible.

APPENDIX B: REMOTE AND LOW-VALUE SITES NOT VISITED BUT ASSESSED

A more detailed description of the assessment of remote and low-value sites is provided in the Remote Sites section of the Lessons Learned Report.

Table B-1. Remote and Low-Value Sites not Visited but Assessed

Name	2015 CRV ($M)	2016 CRV ($M)	Delta CRV ($M)	DM 2015 ($M)	DM 2016 ($M)	Delta DM ($M)	DM % Change	FCI 2015	FCI 2016	Delta FCI
Remote Sites	**$17.24**	**$19.43**	**$2.19**	**$0.54**	**$0.80**	**$0.26**	**48.30%**	**4.2**	**3.9**	**-0.3**
American Samoa BRT Fac	$0.03	$0.03	$0.00	$0.00	$0.00	$0.00	0.00%	3.0	3.0	0.0
Ascension BRT Facility	$0.01	$0.01	$0.00	$0.00	$0.00	$0.00	0.00%	3.0	3.0	0.0
Ft. Davis MOBLAS	$0.08	$0.08	$0.00	$0.02	$0.02	$0.00	17.66%	2.7	2.7	0.0
Hawaii Maui MOBLAS	$0.05	$0.05	$0.00	$0.01	$0.01	$0.00	-40.50%	3.0	3.0	0.0
Haystack MOBLAS	$0.12	$0.13	$0.01	$0.01	$0.01	$0.00	30.48%	3.0	3.0	0.0
Kwajalein MOBLAS	$0.15	$0.15	$0.00	$0.01	$0.01	$0.00	0.00%	3.0	3.0	0.0
Monument Peak MOBLAS	$0.26	$0.26	$0.00	$0.03	$0.03	$0.00	1.17%	3.0	3.0	0.0
Tahiti MOBLAS	$0.03	$0.03	$0.00	$0.00	$0.00	$0.00	0.00%	3.0	3.0	0.0
Yarragadee MOBLAS	$0.69	$0.70	$0.01	$0.08	$0.08	$0.00	0.83%	3.0	3.0	0.0
Yarragadee STS Facility	$0.03	$0.03	$0.00	$0.00	$0.00	$0.00	0.00%	3.0	3.0	0.0
CSBF - TX	$9.68	$10.96	$1.28	$0.32	$0.48	$0.16	49.32%	4.2	4.0	-0.2
Long Duration Balloon Facility	$5.22	$5.29	$0.07	$0.10	$0.10	$0.00	3.24%	4.0	4.0	0.0
Ponce De Leon STDN Site	$1.69	$1.71	$0.02	$0.03	$0.04	$0.01	22.98%	3.6	3.6	0.0

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APPENDIX C: DEMOLISHED ASSETS

A total of 101 assets were demolished since the FY15 DM Assessment. These assets account for $57.00 million of NASA's CRV and $15.35 million in DM, and were excluded from calculations in FY16.

Table C-1. Demolished Assets since FY15 DM Assessment

Center	Installation	Number	Name	RPMS Status	CRV 2016	DM 2015
AFRC	Armstrong Flight Research Center	4818	GUARD POST NO. 6	ABANDONED	$2,933	$1,191
AFRC	Armstrong Flight Research Center	4821	PAINT SPRAY BUILDING	ABANDONED	$671,007	$243,395
AFRC	Armstrong Flight Research Center	4829	GUARD POST	ABANDONED	$7,107	$2,493
AFRC	Armstrong Flight Research Center	4831	BATTERY MAINTENANCE SHOP	ABANDONED	$257,790	$6,309
AFRC	Armstrong Flight Research Center	4835	PAINT & OIL STORAGE	ABANDONED	$26,372	$632
AFRC	Armstrong Flight Research Center	4839	STRATEGIC COMMUNICATIONS OFFICE	ABANDONED	$1,441,781	$23,474
AFRC	Armstrong Flight Research Center	4841	CALIBRATION FACILITY	ACTIVE	$175,537	$7,933
AFRC	Armstrong Flight Research Center	4842	LEARNING CENTER	ABANDONED	$406,201	$18,798
AFRC	Armstrong Flight Research Center	4844	PROJECT SUPPORT COMPLEX	ABANDONED	$153,333	$17,324
AFRC	Armstrong Flight Research Center	4845	SHUTTLE SUPPORT ADMINISTRATIVE OFFICE - NASA	ABANDONED	$239,887	$17,280
AFRC	Armstrong Flight Research Center	4846	CONTRACTOR ADMINISTRATION FACILITY	ACTIVE	$197,245	$9,868
AFRC	Armstrong Flight Research Center	4863	INSPECTOR GENERAL OFFICE (IG)	ABANDONED	$316,683	$10,593
AFRC	Armstrong Flight Research Center	4866	STORAGE FACILITY	ACTIVE	$10,134	$90
AFRC	Armstrong Flight Research Center	NB012	OPEN STORAGE FACILITIES	ACTIVE	$447,240	$16,549
AFRC	Armstrong Flight Research Center	NB021	DIESEL GENERATOR FOR BLDG 4824 & 4870	ACTIVE	$62,119	$1,459
AFRC	Armstrong Flight Research Center	NB091	SUBSTATION NO. 22	ABANDONED	$21,678	$2,344
AFRC	Armstrong Flight Research Center	NB120	PROPELLANT FUEL& OXIDIZER STORAGE AREA	ABANDONED	$315,226	$7,341
AFRC	Armstrong Flight Research Center	T-13	SHUTTLE SUPPORT (DEBRIS)	ABANDONED	$29,216	$3,722
AFRC	Armstrong Flight Research Center	T-16	SHUTTLE SUPPORT (KSC PAYLOADS)	ABANDONED	$41,672	$5,802
AFRC	Armstrong Flight Research Center	T-17	SHUTTLE SUPPORT (FLIGHT CREW EQUIPMENT)	ABANDONED	$39,688	$7,876
AFRC	Armstrong Flight Research Center	T-28	SUPPORT PERSONNEL OFFICE - B 1623	#	$25,430	$19,518
AFRC	Armstrong Flight Research Center	T-42	INSPECTOR GENERAL OFFICE	ABANDONED	$84,709	$22,652
AFRC	Armstrong Flight Research Center	T-69	ASTRONAUT TRAILER	ABANDONED	$20,937	$6,621
AFRC	Armstrong Flight Research Center	T-70	ASTRONAUT TRAILER	ABANDONED	$149,058	$30,446
AFRC	Armstrong Flight Research Center	T-72	TRAILER M.S.B.L.S. (RUNWAY 22)	ABANDONED	$6,437	$1,248

Center	Installation	Number	Name	RPMS Status	CRV 2016	DM 2015
AFRC	Armstrong Flight Research Center	T-79	SHUTTLE SUPPORT-TEST EQUIP. POOL	ABANDONED	$32,069	$5,139
AFRC	Armstrong Flight Research Center	T-80	SHUTTLE SUPPORT TRAINING	ABANDONED	$32,069	$20,788
ARC	Ames Research Center	N253A	SECURITY STATION	MOTHBALLED	$407,785	$154,153
ARC	Ames Research Center	T39-A	MARSCAPE TRAILER	ABANDONED	$10,966	$1,027
ARC	Moffett Federal Airfield	328	CONTAMINATED FUEL STORAGE TANK	MOTHBALLED	$311,640	$24,355
ARC	Moffett Federal Airfield	360	FUEL ADDITIVE STORAGE TANK	MOTHBALLED	$69,776	$792
ARC	Moffett Federal Airfield	361	CONTAMINATED FUEL STORAGE TANK	MOTHBALLED	$69,788	$5,179
ARC	Moffett Federal Airfield	362	CONTAMINATED FUEL STORAGE TANK	MOTHBALLED	$63,541	$4,715
GRC	Glenn Research Center	0336	GREENLAB RESEARCH FACILITY	ACTIVE	$310,821	$920
GRC	Glenn Research Center	3911	FUEL PIPING	ACTIVE	$2,968,082	$29,873
GSFC	Goddard Space Flight Center	029E	NORTH GATE GUARD HOUSE & CANOPY	ACTIVE	$389,034	$12,706
GSFC	Goddard Space Flight Center	T076	TRAILER AT 076 PARKING LOT	ACTIVE	$5,827	$0
GSFC	Goddard Space Flight Center	X088C	CONEX BOX AT BUILDING 088	ACTIVE	$1,013	$0
GSFC	Goddard Space Flight Center	X095A	SHED AT 095	ACTIVE	$2,382	$0
GSFC	Wallops Flight Facility	A-027	PISTOL RANGE, BUTTS	ABANDONED	$239,301	$59,033
GSFC	Wallops Flight Facility	S-0020	SEPTIC TKS & DRAIN FLD SYS - MB	ACTIVE	$950,821	$93,823
GSFC	Wallops Flight Facility	V-025	INERT PAY ASSEM & CHKOUT BLDG	ACTIVE	$676,213	$33,672
JPL	Canberra DSCC	ST3	MICROWAVE TOWER	ACTIVE	$91,068	$90
JSC	Ellington Field	E134	GASEOUS STORAGE SHED	ACTIVE	$47,174	$880
JSC	Ellington Field	E263	SUPPLIES & EQUIPMENT SHED	ACTIVE	$124,006	$11,710
KSC	CAPE	60540	SOLAR ARRAY TEST BUILDING	ABANDONED	$643,636	$44,267
KSC	CAPE	60687	STORAGE BUILDING	ACTIVE	$68,930	$1,592
KSC	CAPE	66257	BOILER BUILDING	ABANDONED	$155,100	$22,421
KSC	CAPE	60690-1	BOILER TANK	ABANDONED	$1	$0
KSC	CAPE	66257A	FUEL TANK	ABANDONED	$1	$0
KSC	Kennedy Space Center	J5-1246	OBSERVATION PLATFORM	ABANDONED	$1	$0
KSC	Kennedy Space Center	J7-0243A	TEMPORARY BUILDING NO. 35 (2B)	ABANDONED	$75,810	$25,509
KSC	Kennedy Space Center	J7-0337J	HAZARDOUS WASTE STAGING BUILDING/PORTABLE	ACTIVE	$1	$0
KSC	Kennedy Space Center	J8-1862	HYPERGOL OXIDIZER FACILITY	ABANDONED	$1,490,113	$174,975
KSC	Kennedy Space Center	K6-0445	CONTRACTOR SUPPORT BLDG. NO. 4	ABANDONED	$42,919	$8,716
KSC	Kennedy Space Center	K6-0696J	K-BOTTLE STORAGE AREA	ACTIVE	$1	$0
KSC	Kennedy Space Center	K6-1248	BACK-UP GENERATOR BUILDING	ACTIVE	$211,691	$1,149

Center	Installation	Number	Name	RPMS Status	CRV 2016	DM 2015
KSC	Kennedy Space Center	K6-1298	MISSION SUPPORT BUILDING	ABANDONED	$1,118,085	$25,044
KSC	Kennedy Space Center	K6-1896D	STORAGE BUILDING	ABANDONED	$1	$0
KSC	Kennedy Space Center	K6-1996E	SEWAGE TREATMENT PLANT NO. 15	ACTIVE	$283,962	$93,027
KSC	Kennedy Space Center	K6-1996I	HAZARDOUS WASTE STAGING BUILDING/PORTABLE (CONTROLLED WST)	ACTIVE	$1	$0
KSC	Kennedy Space Center	K6-1996L	HAZARDOUS WASTE STAGING BUILDING/PORTABLE	ABANDONED	$1	$0
KSC	Kennedy Space Center	K6-1996U	STORAGE BUILDING	ABANDONED	$1	$0
KSC	Kennedy Space Center	K6-1996V	STORAGE BUILDING	ABANDONED	$1	$0
KSC	Kennedy Space Center	K6-1998	ASTRONAUT VAN GARAGE	ABANDONED	$1	$0
KSC	Kennedy Space Center	L7-0940	CLASSROOM BUILDING	ABANDONED	$243,545	$20,115
KSC	Kennedy Space Center	L7-1557	ENVIRONMENTAL HEALTH BUILDING	ABANDONED	$5,588,036	$859,637
KSC	Kennedy Space Center	L7-1557C	MOTOR GENERATOR BUILDING	ABANDONED	$574,264	$74,799
KSC	Kennedy Space Center	L7-1557D	ASBESTOS TESTING LAB	ABANDONED	$195,283	$23,451
KSC	Kennedy Space Center	L7-1759A	LIGHTNING DETECTION AND RANGING SITE TOWER	ABANDONED	$38,669	$20,254
KSC	Kennedy Space Center	M6-0847	SILVER RECOVERY BUILDING	ABANDONED	$150,602	$28,354
KSC	Kennedy Space Center	M6-1723	PROPERTY DISPOSAL OFFICE	ABANDONED	$79,287	$4,906
KSC	Kennedy Space Center	M7-0433	RECHLORINATION BUILDING	ABANDONED	$116,041	$18,435
KSC	Kennedy Space Center	M7-0458	STORAGE SHED	ABANDONED	$199,059	$4,773
KSC	Kennedy Space Center	M7-0656	PARACHUTE STORAGE BUILDING	ABANDONED	$219,801	$260
KSC	Kennedy Space Center	M7-0657	PARACHUTE REFURBISHMENT FACILITY	ABANDONED	$11,589,055	$763,896
KSC	Kennedy Space Center	M7-1417	ORDNANCE LAB NO. 2	ABANDONED	$1,791,707	$119,869
MSFC	Santa Susana Field Laboratory	818	SKYLINE WATER TANK (IO200180)	ABANDONED	$360,325	$37,546
MSFC	Santa Susana Field Laboratory	819	SKYLINE WATER TANK (IO200181)	ABANDONED	$360,325	$37,546
MSFC	Santa Susana Field Laboratory	820	SKYLINE WATER TANK (IO200116)	ABANDONED	$360,325	$23,324
MSFC	Santa Susana Field Laboratory	821	SKYLINE WATER TANK (IO200117)	ABANDONED	$360,325	$37,546
MSFC	Santa Susana Field Laboratory	822	SKYLINE WATER TANK (IO200118)	ABANDONED	$360,325	$37,546
MSFC	Santa Susana Field Laboratory	823	SKYLINE WATER TANK (IO200119)	ABANDONED	$360,325	$121,635
MSFC	Santa Susana Field Laboratory	824	SKYLINE WATER TANK (IO200120)	ABANDONED	$360,325	$35,484
MSFC	Santa Susana Field Laboratory	825	SKYLINE WATER TANK (IO200121)	ABANDONED	$287,908	$28,353
MSFC	Santa Susana Field Laboratory	826	SKYLINE WATER TANK (IO200122)	ABANDONED	$283,114	$29,501

Center	Installation	Number	Name	RPMS Status	CRV 2016	DM 2015
MSFC	Santa Susana Field Laboratory	827	SKYLINE WATER TANK (IO200123)	ABANDONED	$283,114	$95,152
MSFC	Santa Susana Field Laboratory	828	SKYLINE WATER TANK (IO200443)	ABANDONED	$910,499	$271,239
MSFC	Santa Susana Field Laboratory	829	SKYLINE WATER TANK (IO200378)	ABANDONED	$953,019	$62,913
MSFC	Santa Susana Field Laboratory	IO200105	GN2 DISTRIBUTION LINES (ROADSIDE AREA 2/3 STOP SIGN)	ABANDONED	$507,808	$12,377
MSFC	Santa Susana Field Laboratory	IO200106	FIRE HYDRANTS & SPRINKLERS (VARIOUS LOCATIONS AREA 2)	ABANDONED	$152,429	$14,364
MSFC	Santa Susana Field Laboratory	IO200108	AREA 2 PARKING AREAS	ABANDONED	$6,113,348	$9,048,575
MSFC	Santa Susana Field Laboratory	IO200115	RECLAIM WATER DISTRIBUTION SYSTEM (OPPOSITE SPA)	ABANDONED	$3,582,494	$1,184,241
MSFC	Santa Susana Field Laboratory	IO200170	WATER LINE (SKYLINE)	ABANDONED	$782,185	$308,498
MSFC	Santa Susana Field Laboratory	IO200179	MAINTENANCE YARD INTERIOR FENCE (BETWEEN 206 & 203)	ABANDONED	$20,728	$2,045

APPENDIX D: SITES VISITED AND POINTS OF CONTACT

Table D-1. Sites Visited and Points of Contact

Date	NASA RPAO	NASA Center POC
AMES RESEARCH CENTER		
Ames Research Center		
June13-17, 2016	Tony "Rocci" Caringello (650) 603-9506 Tony.R.Caringello@nasa.gov	Sal Navarro (650) 604-6978 Dagoberto.S.Navarro@nasa.gov
Moffett Federal Airfield and Tenant Facilities		
June 13-17, 2016	Tony "Rocci" Caringello (650) 603-9506 Tony.R.Caringello@nasa.gov	Sal Navarro (650) 604-6978 Dagoberto.S.Navarro@nasa.gov
Armstrong FLIGHT RESEARCH CENTER		
Armstrong Flight Research Center		
May 31 – June 2, 2016	Jin Oh (661) 276-3386 Jin.S.Oh@nasa.gov	William Werner (661) 276-3386 Bill.Werner-1@nasa.gov
GLENN RESEARCH CENTER		
Lewis Field		
June 13-17, 2016	Robert Strunak (216) 433-2199 Robert.T.Strunak @nasa.gov	John DeGreen (216) 433-8812 John.Degreen@nasa.gov
Plum Brook Station		
June15, 2016	Robert Strunak (216) 433-2199 Robert.T.Strunak @nasa.gov	John DeGreen (216) 433-8812 John.Degreen@nasa.gov
GODDARD SPACE FLIGHT CENTER		
Goddard Space Flight Center		
May 24-26, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Everett King (301) 286-5523 Everett.L.King@nasa.gov
Hawaii STDN		
July 2016 **(assessed via interview)**	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Christopher Coughlin (808) 335-6495 Ronald.Curtis@harris.com

Date	NASA RPAO	NASA Center POC
NASA Infrared Telescope Facility		
July 2016 **(assessed via interview)**	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Alan Tokunaga (808) 956-6691 Tokunaga@ifa.hawaii.edu Lars Bergknut (onsite POC) (808) 974-4210 Bergknut@ifa.hawaii.edu
Wallops Flight Facility		
April 19-21, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	John McWilliams (757) 824-2138 John.J.McWilliams@nasa.gov
Poker Flats, AK		
June 20, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Kathe Rich (907) 455-2103 krich@gi.alaska.edu
Columbia Scientific Balloon Facility, NM (WFF)		
May 13, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Janet Letchworth (757) 824-2294 Janet.F.Letchworth@nasa.gov
LC-36 (White Sands Missile Range, NM) (WFF)		
May 10, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Richard Evavold (575) 649-6287 Richard.L.Evavold@nasa.gov Becky Grzelachowski (contact for NASA visitors entrance info) 575-679-9709 rebecca.grzelachowski@nasa.gov Beckm07@comcast.net
White Sands Complex TDRSS 1 and TDRSS 2		
May 10, 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Donald Shinners (575) 527-7001 Donald.W.Shinners@nasa.gov Richard Von Wolff (575) 527-7036 RVonWolff@mail.wsc.nasa.gov Errin Torres (contact for Security Access Requirements) (575) 527-7335 Erin.F.Torres@nasa.gov

Date	NASA RPAO	NASA Center POC
JET PROPULSION LABORATORY		
Jet Propulsion Laboratory		
June 6-8, 2016	Gary Gray (JPL) (818) 354-0701 Gary.R.Gray@jpl.nasa.gov	Robert Develle (818) 354-456 RDevelle@jpl.nasa.gov Steve Rigdon (818) 393-2549
Deep Space Network		
n/a	David L Davis (818) 354-4646 David.l.davis@jpl.nasa.gov	Sam Islas (818) 393-9000 Samuel.V.Islas@nasa.gov
Canberra Deep Space Communication Complex		
July, 2016 **(assessed via interview)**	David L Davis (818) 354-4646 David.l.davis@jpl.nasa.gov	Leon DeBritt 61-2-6201-7802 LDeBritt@cdscc.nasa.gov
Goldstone Deep Space Communication Complex		
June 3, 2016	David L Davis (818) 354-4646 David.l.davis@jpl.nasa.gov	Dennis Mullen (760) 255-8283 DMullen@gdscc.nasa.gov
Madrid Deep Space Communication Complex		
July 2016 **(assessed via interview)**	Chris Owen (818) 354-5990 Christopher.J.Owen@nasa.gov	Federico Martin +34 918 677 080 FMartin@mdscc.nasa.gov
Table Mountain Observatory		
June 9, 2016	Gary Gray (JPL) (818) 354-0701 Gary.R.Gray@jpl.nasa.gov	Pamela Glatfelter (760) 249-4151 Pamela.C.Glatfelter@jpl.nasa.gov
JOHNSON SPACE CENTER		
Johnson Space Center		
May 2-5, 2016	Sandra Tetley (281) 483-8113 Sandra.J.Tetley@nasa.gov	Melissa McKinley (281) 483-3127 Melissa.K.Mckinley@nasa.gov

Date	NASA RPAO	NASA Center POC
White Sands Test Facility		
May 9-12, 2016	Johnny Bernal (575) 524-5140 Johnny.J.Bernal@nasa.gov	Chris Wolf (575) 635-0148 Christopher.W.Wolf@nasa.gov Steve Malarchick (El Paso Airport Hangars) (915) 782-5220 (office) (915) 526-5250 (cell) Steve.Malarchick-1@nasa.gov
KENNEDY SPACE CENTER		
Kennedy Space Center and Cape Canaveral Air Force Station		
March 28 – April 8, 2016	Sheryl Chaffee (321) 867-8047 Sheryl.L.Chaffee@nasa.gov	Gerald (Jay) Green (321) 867-1182 Gerald.E.Green@nasa.gov
LANGLEY RESEARCH CENTER		
Langley Research Center		
April 12-15, 2016	Sherry Johnson (757) 864-3848 Sherry.R.Johnson@nasa.gov	Mike Harrell (757) 864-6402 Michael.T.Harrell@nasa.gov
MARSHALL SPACE FLIGHT CENTER		
Marshall Space Flight Center		
April 18-22, 2016	Debra Cobb (256) 544-1436 DebieCobb@nasa.gov	Jim Durham (256) 544-1394 Jim.E.Durham@nasa.gov Cleve Nilsen (YANG) (256) 544-8081 Cleve.U.Nilsen@nasa.gov
Michoud Assembly Facility		
April 4-6, 2016	Arlan Cochran (504) 257-6204 Claud.Cochran@nasa.gov	Ngoc Phan Nguyen (504) 257-0018 Ngoc.Nguyen@nasa.gov

Date	NASA RPAO	NASA Center POC
Santa Susana Field Laboratory		
July, 2016 **(assessed via interview)**	Debra Cobb (MSFC) (256) 544-1436 DebieCobb@nasa.gov	Peter Zorba (818) 466-843 Peter.Zorba@nasa.gov
STENNIS SPACE CENTER		
Stennis Space Center and Stennis Tenant Facilities		
March 28 – April 1, 2016	Tim Pierce (228) 688-1630 Timothy.l.Poerce@nasa.gov	Catriona M Ladner (228) 688-2579 Catriona.m.ladner@nasa.gov
REMOTE SITES (ASSESSED VIA INTERVIEWS)		
BRT, MOBLAS, STDN, STS, VLBI, (GSFC)		
July 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov
Poker Flats, AK		
July 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Kathe Rich (907) 455-2103 krich@gi.alaska.edu
Columbia Scientific Balloon Facility, Palestine, TX, (WFF)		
July 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Janet Letchworth (757) 824-2294 Janet.F.Letchworth@nasa.gov
Ponce De Leon STDN (GSFC)		
July 2016	Scott Shipman (301) 286-7761 Scott.A.Shipman@nasa.gov	Ken Griffin (757) 824-2478 kenneth.r.griffin@nasa.gov Bruce Thoman (301) 286-3353 Bruce.e.Thoman@nasa.gov

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