NOAA/NESDIS

NESDIS-HBK-1221.1

WORK BREAKDOWN STRUCTURE HANDBOOK

September 2019

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National Oceanic and Atmospheric Administration (NOAA)
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Approval Page

Document Number: NESDIS-HBK-1221.1	
Document Title Block: **NESDIS WORK BREAKDOWN STRUCTURE HANDBOOK**	
Process Owner: David Spencer	**Document Release Date:** September 30, 2019

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29 Sept. '19
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9/30/2019
Date:

Document Change Record

Version	Description	Revised Sections	Date
1.0	Initial Version	All	Sep 27, 2019

TABLE OF CONTENTS

Page

List of Figures

List of Tables

PREFACE

P. 1 PURPOSE

This WBS Handbook provides the NESDIS Standard for Work Breakdown Structures (WBS) and Work Package definitions to be used when planning new NESDIS projects.

P. 2 APPLICABILITY

This handbook is a companion guide to the Project Management Procedural Requirements document NESDIS-PR-1210.1.

P.3 Authority, APPLICABLE, AND REFERENCE DOCUMENTS

Authority Documents are those procedural, process or directive documents that mandate the creation of a document. Such documents usually only apply to policy or procedural directives.

Applicable Documents are those which are incorporated, by reference, into the current document and govern (apply to) its contents. For example, a contractual document that lists "[A-1] Commerce Acquisition Manual" as one of its Applicable Documents means the terms of the Commerce Acquisition Manual apply to the contract, as if it were reproduced in, or incorporated into, the contractual document.

Due to the similarity of purpose and scope between Authority and Applicable Documents, the same convention is adopted for referring to them.

Designation	Document Title	Document Description
A-1	NOAA CWIP Policy	Construction Work-In-Progress Policy (March 2017) and Appendix F: Policy for Reporting Construction Work-In-Progress and Capitalization of NESDIS Satellites, Their Component Sensors and Related Assets
A-2	NESDIS Systems Engineering and Program Management Policy	NESDIS-PD-1110.1
A-3	NESDIS Project Management Procedural Requirement	NESDIS-PR-1210.1
A-4	NESDIS Project Approval Process	NESDIS-PR-1220.1

Reference Documents provide links to "background material" which may provide further information, but do not form part of the document itself.

Designation	Document Title	Document Description
R-1	PMI, 2017: A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (6th Edition). Includes ANSI/PMI 99-001-2017. Project Management Institute, 756 pp.	Project Management standards published by the Project Management Institute
R-2	MIL-STD-881-D	DoD Standard Practice: Work Breakdown Structures for Defense Materiel Items
R-3	NASA/SP-2016-3404 Rev. 1	NASA WBS Handbook: guide and standard for Work Breakdown Structures for all types of NASA projects.

1. Introduction

This WBS Handbook provides the NESDIS standard for Work Breakdown Structures (WBS) and Work Package definitions for use when planning new NESDIS projects.

This WBS covers those activities involved in creating and executing a project, specifically an engineering or system development project that defines and creates an end-product and/or service. Example types of project requiring a WBS include building an instrument for a satellite, installing a new Ground Station, or developing a new software system or science data processing algorithm.

Note that this document does not provide a WBS for “core”, non-project-based NESDIS administrative and managerial activities, for example: generic, non-project-specific services such as budget and fiscal management, general IT infrastructure support, personnel management, Office management and supervisory roles, and other administrative functions. Where a project’s WBS process requires the support of specific NESDIS administrative functions, NESDIS projects can call out the use of NESDIS Common Services. The WBS elements for NESDIS Common Services that directly support projects is defined in this document.

The first iteration of a project’s WBS is created during the Pre-Formulation phase of the project, when the potential new project is presented to the NESDIS councils, unless a waiver is granted by NESDIS Management, in accordance with the Project Formulation Handbook [A-3].

This preliminary WBS, decomposed into specific tasks or disciplines at least two levels down below that of the overall project, will be the basis for the Rough Order of Magnitude (ROM) costing and baseline schedule. This project baseline must be presented to the project’s authorization authority, referred to as the Milestone Decision Authority (MDA) in [A-3].

In support of the project manager and the MDA, he NEAC will examine the WBS, schedule and the associated costing (along with other documents) to validate assumptions from an enterprise perspective. One of the first tasks of a project’s execution phase will be to further decompose and refine the WBS.

For a description of the NEAC and a project’s Pre-Formulation Phase, see document [A-3].

2. Work Breakdown Structures

[R-1], the Project Management Body of Knowledge, defines a WBS as “a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables”.

WBS decomposition is the process of breaking down high-level Program or project objectives into discrete work tasks, grouped hierarchically by discipline, project phases and/or products. WBS decompositions are typically presented in a “tree” structure, with a single top-level (NESDIS WBS Level 0) element representing the complete Program or project, with several Work Packages (WP) branching from it, representing either the constituent projects of the overall Program, or specific functional disciplines within the overall project (for example, WBS Element 1.0: System Engineering).

After initial decomposition of the Program/project into its Level 1 and Level 2 elements, successive levels can capture and decompose each specific task or discipline. Tasks can also be split by project phases, for long-duration projects. The hierarchical structure allows nested levels within the WBS. All WBS levels must eventually decompose until a collection of lowest-level, discrete units of work is obtained, called Work Packages. Each lowest element of the WBS must have at least one individual Work Package. [R-1] defines a Work Package as “the lowest level of the WBS for which cost and duration are individually managed.”

Figure C-1 in Appendix C, taken from [R-3] the NASA WBS Handbook, illustrates a hierarchical organization of a WBS for generic NASA space flight project. NESDIS is adopting a different generic project decomposition, with the NESDIS project being the Level 0 WBS Element, and top-level disciplines being Level 1 WBS Elements.

This NESDIS WBS Handbook restructures the original NESDIS CFO standard WBS template (which was based on NASA’s flight missions WBS template). This WBS Handbook document provides NESDIS-specific WBS elements better suited to systems incorporating acquisition, development and integration of software and hardware. The NESDIS WBS structure also supports iterative lifecycle projects.

The NESDIS WBS template presents a top-down decomposition of a project, starting with disciplines and systems that meet the highest level of project requirements (for example, all projects require some level of Project Management and Systems Engineering). The next step in creating the project’s WBS is breaking down these tasks/disciplines into smaller deliverables and sub-tasks, then further decomposing those into lower-level components. Iterative development projects may instead structure the WBS around successive development lifecycles.

This WBS Handbook standard defines the common NESDIS WBS structure to a minimum of Level 2, with decomposition to Level 3 in some cases. Beyond Level 2 or Level 3, individual WBS Elements can be aligned to any of the following:

- Project phases;
- System hardware/software components;
- Product releases (suited to iterative development lifecycles).

NESDIS Project Managers should follow the NESDIS WBS Standard when creating the WBS breakdown for their project and system. Exceptions can only be granted by the MDA.

Pre-defined NESDIS WBS elements that are not relevant to the specific project can be omitted from the WBS. Additional project WBS elements that are not present in the NESDIS-standard WBS can be added, as long as the pre-defined WBS element numbering scheme is not overwritten.

Further decomposition of the project WBS beyond the NESDIS template is encouraged. Following the Pre-Formulation Phase, the lower-level WBS elements can be defined along functional or phase lines; for example, a generic, high-level “Software Testing” WBS element can be defined into “Prototype Software Testing” and “Final Release Software Testing”.

The project WBS can also include elements dedicated to specific activities that consume a significant amount of resources. For example, a “Critical Design Review Preparation and Conduct” WBS element can capture all the preparation for, and conduct of, a major project milestone, in this case a CDR.

The project WBS should be baselined during the Formulation Phase of the project; further WBS elements and WP can be added later if needed.

2.1. NESDIS Work Breakdown Structure templates

Most NESDIS projects are not major satellite system acquisitions. The majority of projects executed within NESDIS are smaller satellite missions with multiple bus and payload partners managed directly by NOAA, and also include many projects not involving satellite acquisition; for example:

- Projects developing ground and network infrastructure;
- Projects developing an internal software tool or system;
- Projects upgrading and sustaining a Ground system;
- Algorithm design and development, supporting Research to Operations efforts;

The common NESDIS WBS template has been created to suit a wide variety of NESDIS projects, including smaller acquisitions, internal hardware/software developments, and projects following iterative development methodologies. The Level 1 WBS definition appearing in the NASA standard WBS (see Appendix C) has not been adopted by NESDIS. Instead, the NESDIS WBS more accurately reflects the wider range of project types undertaken by NESDIS, spanning a variety of disciplines.

Major acquisitions, for example satellites acquired with NASA as the acquisition agent, and other CWIP (Construction Work In Progress) items, can still be represented in the NESDIS WBS standard. If a project is unsure whether a capital investment of CWIP is involved, the Office of the Chief Financial Officer must be consulted for guidance, as per the NESDIS Cost Estimation Handbook.

This Handbook document in Microsoft® Word format is accompanied by a Microsoft® Excel spreadsheet. The spreadsheet provides the mandatory format for presenting the WBS to the NESDIS Councils, the MDA, NESDIS CFO and any other body reviewing the project work decomposition. The WBS spreadsheet contains a wide variety of pre-defined WBS elements to

help the Project Manager decompose the project, including tasks in such areas as:

- Software development;
- Hardware procurement;
- Facility charges (for example: office space, server room space);
- Testing (validation and verification) activities;
- Documentation activities;
- Personnel training;
- Items procured under contract;
- Data management;
- Algorithm development;
- Services performed via an Inter-Agency Agreement (by entities outside of NOAA) or Intra-Agency Agreement (entities within NOAA or NESDIS).

The goal of the NESDIS WBS is to make it adaptable to suit any type of NESDIS project, while providing a common core of WBS elements that are used across all projects.

The standard WBS template for NESDIS projects appears in Appendix B.

The formal WBS submission for review and approval uses a template Excel spreadsheet file, allowing the WBS for NESDIS projects to be presented in a common format. As additional projects implement the NESDIS Project Management requirements and create their Work Breakdown Structures using the same Excel spreadsheet format, a repository of electronic WBS will be created and available for other Project Managers to examine and use as examples. NESDIS OSAAP will maintain the repository of approved and baseline WBS.

2.2. The Role of the WBS in Project Formulation

A project WBS decomposition to a minimum of WBS Level 2 is required during a project's Pre-Phase A cost estimation activities, when a proposed project is presented to the NESDIS Councils for review and MDA authorization to execute.

Further WBS decomposition will take place after a project is approved by the MDA at KDP-A. The final, baseline WBS is reached when it is decomposed to into discrete Work Packages at the lowest level.

As a guideline, the minimum task size/duration threshold to become a standalone WP should be any task requiring over 20 days of Full Time Equivalent (FTE) labor effort, or costing over $100K of budget. Note that this does not mean that all tasks must be split into WP of 20 days/$100K each, but instead that small tasks consuming less than 20 FTE / $100K should be combined into larger WP.

The WBS must be defined in as much detail as possible before the project begins execution. WBS down to at least Level 2 are mandatory before the project can be granted Authorization To Proceed at the conclusion of the Project Formulation phase. Larger Programs will usually define WBS elements from Level 1 to Level 3 during the Project Formulation Phase, and later fill in the lower-level WBS for constituent projects during the preliminary design phase (Phase A) of the overall Program. High-cost, high-risk and long-duration tasks may require a lower-level WBS decomposition, as directed by the MDA.

After a project has received Authorization To Proceed from the Milestone Decision Authority, further WBS decomposition will be performed during Phase A, until all anticipated WP have been identified and entered into the overall project cost and schedule baseline, along with the system requirements that also define the project's baseline. During this activity, Project Managers and task leaders must decompose their top-level WBS to as many levels as necessary until all stand-alone items of work are identified.

Any large project that decomposes beyond WBS Level 4 potentially indicates a "major investment" category Program, consisting of related but separate sub-projects that could be individually managed. NESDIS projects not decomposed beyond Level 3 could indicate projects where large portions of the work are performed and delivered by external organizations, in the form of assisted acquisitions or direct purchases.

In the case of assisted acquisitions or direct purchases, the partner organization must submit their WBS or Contract WBS to NESDIS, for presentation alongside the NESDIS project's WBS structure at reviews. Partner organizations will manage and track against their own WBS, reporting progress against their WBS and schedule baselines regularly to the NESDIS Project Manager. NESDIS may also requested partners to present their progress in-person at major/Joint Program reviews.

2.3. Creating the Project WBS

WBS tables start at the top-level (Level 1), listing the major project elements such as "WBS Element 1: Project Management"; subsequent tables each of the Level 2 WP under each Level 1 element (for example, all WBS Element 1.x under Project Management). Further decomposition may not be necessary at the cost estimation phase. The Excel format for the WBS file allows new WBS elements to be easily inserted into the structure at a later time.

The NESDIS Project WBS Template, which is an Excel spreadsheet companion to this Word document, provides the NESDIS WBS structure for use by all new projects. The spreadsheet lists the WBS elements in hierarchical order, with numbering used to illustrate the hierarchy of the element within the WBS.

The WBS decomposition exercise helps the project's overall scope of work to be defined, and provides inputs to the project resource cost estimation exercise in terms of funds, labor resources, and schedule. By using WBS elements as the 'building blocks' of a project, the collection of all activities, deliverables, milestones and resource allocation can be created to roll up into a comprehensive picture of the project plan.

A project's baseline is represented by these key components:

- The project's scope or mission statement;
- The Project Management Plan;
- The WBS breakdown;
- The cost estimate;
- The schedule estimate;
- High-level system requirements.

Any subsequent changes to the project baseline must follow a formal change management processes, and the changes must be approved by the project's change control process. This review should examine any updates to the WBS and any affected WP. This ensures that any changes to project scope/cost/schedule are captured in the new project baseline, and appropriately propagated to the project WBS and WP.

Table 2-1 illustrates the structure of a WBS breakdown to Level 3, using the Level 1 Project Management WBS Element as an example. The formal implementation of the WBS document will use Excel spreadsheet tables.

Table 2-1 NESDIS Work Breakdown Structure example: WP1 Project Management

WBS Element Number	WBS Element Name	WBS Element Description
1.1	NOAA Project Manager and PMO	Captures the Project Manager (including technical management) functions and labor performed by the NOAA Federal PM; subtasks are those falling under the Project Management Office (PMO)
1.1.1	Project travel	All project-funded travel accounted under this WP
1.1.2	Contractor Support	All project management support activities by Contractor personnel. Contractor labor for PM functions will be assigned to this WP, including all contractor labor costs. Distinct Contractor subtasks can be numbered as Level 4 activities, example 1.1.2.1, 1.1.2.2 etc.

Note: for common NESDIS WBS Element allocations, see the Work Package Dictionary definitions in Section 3.

3. NESDIS Work Package Dictionary

This section builds upon previous Work Package Dictionary (WPD) standardization efforts undertaken by NESDIS CFO and OPPA. Both previous efforts followed the NASA standard WBS for flight projects documented in the NASA Cost Estimating Handbook and the NASA Work Breakdown Structure Handbook [R-3]. The resulting WBS for "Assisted Acquisition is defined in Section 3.1.

Section 3.2 provides a WBS structure more suitable for NESDIS projects that do not involve assisted acquisition. Accordingly, it redefines common items in the NASA Level 1 WBS and the types of tasks commonly found there. It serves to harmonize the terminology used across NESDIS projects, so that common WBS Element numbering, names and descriptions can be used across multiple NESDIS projects for WP that have similar roles. By consulting this WBS Element description, the Project Manager and the project formulation team can use common terminology for specific tasks, roles and functions across all NESDIS Programs and projects.

For clarity, we refer to the WBS for assisted acquisition as WBS-A, and the WBS for other NESDIS projects as WBS-B. Each project must select one of these two WBS structures to fit their project's need.

This section will address Level 1 WBS element descriptions only; subsequent sections will expand the Level 1 WBS. A collection of WBS elements can also be referred to as a Work Package Dictionary.

The WBS elements described in this chapter are intended to encompass as wide a variety of projects as NESDIS executes. Not all NESDIS projects will use all designated elements of the WBS. Some NESDIS projects may need to create new WBS elements to meet their specific objectives, but the existing "pre-set" WBS element numbering should not be re-used for new WBS elements. The goal is to offer project formulators a common set of NESDIS Level 1 to Level 3 WBS elements, from which the project formulation team can pick those which apply, and not use those which do not apply.

If Project Managers find particular WBS elements that are needed for multiple projects but are not currently included in the standard NESDIS WBS, this should be brought to the attention of OSAAP for inclusion in future NESIDS WBS updates.

3.1. Level 1 Work Package Dictionary for Assisted Acquisitions (WBS-A)

Table 3-1 provides the NESDIS-specific Work Package Dictionary for Level 1 WBS elements, primarily suited to Assisted Acquisitions. Many of these Level 1 WBS elements could also be used, with modifications, for non-NASA space mission development, or projects that have no, (or only a minimal) satellite components, for example developing systems to ingest and process data from an already-flying partner satellite mission.

Certain WBS categories such as Mission Operations and Sustainment can apply to non-satellite projects. “Mission Operations” has elements valid for operations of a new real-time data processing system, for example, or operations of a Ground Station hardware system.

Table 3-1 Level 1 WBS-A Element Description

Level 1 WBS Element	WBS Element Description
1.0 Project Management	WP associated with the project management and non-engineering functions. Includes Project Manager and PM Office; budget analysts, travel costs, contracts and their administrative overheads, all employee benefits, external review teams, support from NESDIS, NOAA and Department of Commerce functions such as legal counsel, Acquisition and Grants Office, International Affairs, IT and office facilities services; the project-independent Mission Assurance function, risk management, configuration and data management, and other general (non-engineering) support functions.
2.0 System Engineering	The top-level technical and engineering tasks from technical requirements definition and management, to ground and flight hardware, software and algorithm design reviews, IT Security, data integrity and network engineering, technology trade studies and development, software development lifecycles, engineering action tracking, verification and validation test plans and procedures, Interface Control Documents, engineering system configuration control, technical action item tracking and disposition.
3.0 Quality and Mission Assurance	An independent team of experts from outside the project who provide personnel and system Quality & Mission Assurance functions in an oversight role; QA/MA includes the adherence to quality control processes, following NOAA or other applicable safety standards, monitoring parts and supplier issues (Product Assurance), effective implementation and recording of verification test results (Quality Assurance)
4.0 Science and Stewardship	The overall research and development (R&D) of science-based technical requirements for a system, research and development of new instrument, satellite, detector or ground system technologies (including algorithm) to enable the fulfillment of the science objectives of the mission or project. This WP also includes other generic science & technology research, or technology maturation exercises, used to support the project. This also includes data stewardship, and the generation of scientific/meteorological products from the collected data sets. Examples include:

	• Research To Operations algorithm development; • Data ingest and validation algorithms; • Archiving and distribution algorithms; • Increasing component Technology Readiness Levels; • Assimilation and impact assessment of new data sources; • Preparing for operational use of new environmental data.
5.0 Payloads/Instrument Acquisition	The specification, design, manufacture/fabrication/procurement, factory testing, acceptance testing, integration, verification, validation, procedure definition, documentation and calibration of all specialized weather payloads essential to the mission. This can include software development of the dedicated algorithms for payload data processing and distribution.
6.0 Satellite Acquisition	All tasks associated with the acquisition of a spacecraft platform, whether directly by NOAA or by NASA on behalf of NOAA, from an industrial satellite manufacturer, or other sources. Satellite Acquisition involves specifying and reviewing bus requirements and satellite design parameters, plus following the design and development lifecycle through all reviews and subsequent build, integration and testing. The task will involve developing/reviewing spacecraft-level test plans and validating test procedures, reviewing results and witnessing/sign-off of testing. The task also involves developing and procurement contracts, and managing spacecraft budgets, interfaces, resources, overseeing the AIT campaign, and managing final buy-off of delivered hardware and systems.
7.0 Mission Operations and Sustainment	The process of preparing the Operations Segment to operate the mission from launch to disposal. This task starts with developing the Concept of Operations as part of the satellite, payload, ground segment and data processing systems; developing all operations documents (Ops Handbooks, User documents) and procedure scripts, reviewing the spacecraft design for operational capability, and organizing and witnessing all spacecraft compatibility testing (Listen-In Test, System Validation Tests). Other elements of Mission Ops include overseeing spacecraft simulator development and integration, S/C telemetry/telecommand database population and validation, and development of flight procedure scripts, processes and procedures. This task also includes Flight Team training & simulation campaign activities, and the post-launch LEOP, Commissioning and Routine Phase nominal and contingency operations, through to disposal of the system. This WP also includes the development of User

	documentation and personnel training material.
8.0 Launch Service Procurement	This encompasses the procurement of launch services, typically contracted by NOAA to US Government agencies such as NASA Launch Services Program, or the US Air Force. The associated services include LV interfaces with the satellite; transportation of the satellite to the launch site, oversight of the satellite at the launch site, launch insurance, and launch site satellite tests and launch preparation operations. The launch vehicle procurement contract will include many additional services such as LV loads and thermal analysis, satellite-LV interface design and testing, LV integration, satellite AIT facilities at launch sites, LV environment definition and analysis, and so on.
9.0 Ground Segment	The mission unique Ground infrastructure necessary to support the Space Segment and enable the end-to-end mission. The Ground Segment infrastructure includes the antennas, communications infrastructure, Mission Control and Planning Systems. It also includes the use of NESDIS Common Services, those not unique to a particular project but offered NESDIS-wide across all projects. Individual projects must include the use of these Common Services where applicable, when the project itself incurs its own additional costs and effort to support their use. Note that instrument cal/val systems and campaign planning, data processing and validation systems, data dissemination and long term archiving/preservation are covered under WP 4.0
10.0 System Integration and Testing	Includes comprehensive end-to-end system integration tests, including those with spacecraft and ground segment in the loop; development and review of test plans and test data sources, identification of instrument calibration targets and development of test campaigns; data flow and network tests under normal and boundary (stress-test) conditions, and security and data integrity tests as files flow through the system.

3.2. Level 1 Work Package Dictionary for NESDIS Internal System Developments (WBS-B)

The following table presents the new NESDIS-centric Level 1 WP, replacing the NASA-standard WBS with NESDIS-specific WBS elements. The Level 1 breakdown of this NESDIS-centric Work Package Dictionary is intended to apply to generic systems and projects, with WP dedicated to hardware and processing system developments. WBS Element 1.0 (Project Management), WBS Element 2.0 (System Engineering) and WBS Element 3.0 (QA/MA)

remain as for Assisted Acquisitions. A NESDIS project may mix and match different Level 1 WBS Elements as needed by the Program/project, with the recommendation to maintain the same numbering scheme wherever possible.

Note: Many of these Level 1 WBS Elements and their Level 2 elements have been recommended by the IT Summit and various other Working Groups within NESDIS.

Table 2-2 Level 1 WBS-B Element Description

Level 1 WBS Element	WBS Element Description
4.0 Science and Stewardship	Effort required to research and develop new, or enhance existing, technologies and techniques required to enable a product or subsystem to support the wider project. Examples include: • Research To Operations algorithm development; • Data ingest and validation algorithms; • Archiving and distribution algorithms; • Increasing component Technology Readiness Levels; • Assimilation and impact assessment of new data sources; • Preparing for operational use of new environmental data.
5.0 Common Services	The use of NESDIS or NOAA Common Services, those not unique to a particular project but offered NESDIS-wide across all projects. Individual projects must include the use of these Common Services where applicable, when the project itself incurs its own additional costs and effort to support their use. Common Services include: • IT Security analysis, systems (s/w and h/w) and audits; • Use of Mission Science Networks or similar for data distribution; • Secure Ingest capability for external data; • Use of Administrative Networks; • Use of Enterprise-level common tools; • Use of NOAA-provided or commercial Cloud Services. General (fixed) project overheads, whereby a project might be charged a fixed percentage of its overall budget as a contribution to overall NESDIS Common Services, do not need a dedicated WBS element, as these costs are covered in the project's top-level budget calculations. Therefore, this Common Services WBS element is not for use in allocating cost overheads associated with all projects, such as the Hollings Tax for example.

6.0 Ground Infrastructure	The acquisition and/or development of ground-based hardware systems to support a project, from Commercial Off The Shelf solutions to customized one-off hardware developments, upgrades to existing hardware, or supplies of hardware components for in-house assembly by NESDIS. Includes the purchase of Information Technology infrastructure. Ground Infrastructure includes: • Satellite communications (Ground Stations) antennas; • Data Management services; • Archiving systems; • Telecommunication systems, network infrastructure, routers, firewalls, switches and so on; • Satellite command and control systems, operations systems; • Data ingest systems.

4. NESDIS WBS-B Level 2

Because WBS-A (Assisted Acquisition) closely follows NASA approaches, the remainder of this document will focus on WBS-B. However, the project manager may find these sections useful for assisted acquisitions as well, particularly for building the common ground elements. Each Level 1 WBS Element has a corresponding set of Level 2 WBS Elements underneath it, created to apply across the entire range of possible NESDIS projects. No project will use all the same Level 2 WBS elements, but the comprehensive list should trigger the Project Management team to consider whether all the suggested tasks are covered in their WBS.

This section provides NESDIS standard decomposition of Level 1 WBS elements into their Level 2 components. As per the Level 1 WBS, project formulation teams developing the Work Breakdown Structure must try to reuse these Level 2 elements wherever applicable, but can add new WBS elements, or not use others, as applicable to the particular project.

The main goal of standardizing the Level 2 and lower WBS elements is to encourage the project management team creating the WBS to think about all possible facets of each project domain, and to use common numbering for tasks that are common across projects.

4.1. WBS Element 1.0: Project Management

This WBS element will be common for all NESDIS projects. It encompasses all tasks related to the programmatic management of project schedule, budget and scope. It encompasses the business process flow of running a project, organizing, directing and coordinating the effort, analyzing and controlling the project tasks. WBS 1.0 includes project reviews, the production and review of project-level documentation, and encompasses tasks not related to specific software or hardware developments. For example, it includes all project-related travel, contract and subcontract management, support functions by NESDIS management groups, NESDIS administrative and facility overheads, and other programmatic functions not associated with specific technical system developments.

The following Level 2 WBS elements, as part of WBS 1.0, are standard for all NESDIS projects, regardless of the project type. Not all functions or WP will be populated for all projects; some projects may have additional Level 2 WBS element under the Level 1: PM WBS element.

The following Level 2 WBS are the structure for the Level 1 Project Management WBS. Projects are able to add other WBS as needed, and ignore those pre-defined WBS that are not relevant to their project.
WBS element 1.0 captures all Project Management (including technical management) functions performed by NOAA Federal and contractor staff. This WBS element is also used to capture administrative overheads including NESDIS taxes. As Work Packages must eventually map to cost items, some WP are purely for capturing cost – for example, a “Travel” WP will provide a WP identifier against which travel costs are charged. The Travel Work Package does not require a lot of information, but creating it reminds the PM and Cost Estimators not to

neglect travel requirements and their costs associated with a project.

Table 4-1 WBS Element 1.0: Project Management WBS Element Description

WBS Element	WBS Element Name	WBS Element Description
1.1	NOAA Project Manager and PMO	Captures the Project Manager functions and labor performed by the NOAA Federal PM; subtasks are those falling under the Project Management Office (PMO)
1.2	NOAA Deputy PM	Functions and labor assigned to the Deputy Project Manager role
1.3	Contracting Officer	Tasks assigned to the Acquisitions and Grants Office, including the Contracting Officer providing oversight of awarding and close-out of contracts. Costs are covered by AGO tax.
1.4	Alternate Contracting Officer	Alternate CO functions supporting the CO, managing C-Requests etc.
1.5	Budget Analyst	The function of performing cost planning and reporting for the project, obligations and grants, monitoring expenditure by project partners and subcontractors, reporting cost expenditure to CFO
1.6	Project Comptroller	The function of monitoring project performance against the established baseline, especially schedule and budget, and provide regular monitoring and controlling of project progress, using methods such as calculation of Earned Value metrics, updating Gantt charts etc.
1.7	Risk Management and Action Tracking	Task of identifying, reviewing, assigning, tracking and dispositioning project-level risks, and any programmatic-level actions.

4.2. WBS Element 2.0: System Engineering

The following Level 2 WBS Elements are suggested for software-centric development projects under the Level 2 System Engineering WBS Element, whether projects employ traditional waterfall or iterative software development lifecycles.

Table 4-2 WBS Element 2.0: System Engineering WBS Element Description

Level 2 WBS Element	WBS Element Description
2.1 Chief Systems Engineer	The definition and validation of high-level requirements for the software system, from Level 1 high-level software system requirements to unit-level software component requirements. Includes requirements management tasks such as entering the requirements into a tracking system, so defining “what” the system will do, and defining tests to verify this.

	In Agile methodologies, these can be considered the Business Epic Stories that define the top-level purpose of the software.
2.2 Requirements Management	The architectural design of the software system; in the waterfall methodology, this would define the decomposition of the software into its object classes, and the general interfaces between them. Use Case Diagrams will also help define the functionality of the system. In Agile methodologies, this can be considered the first development cycle to a preliminary, releasable product for initial delivery for testing.
2.3 System/Product Design Phase	The design phase, and first iteration, of developing any product or service. This Level 2 WP will contain all preliminary, architectural, detailed and/or iterative design phases for waterfall and Agile lifecycle development projects.
2.4 System Delivery and Verification	The tasks associated with delivering a product, service or iterative release for initial QC team or pre-shipment (factory floor) testing against low-level functional requirements.
2.5 System Deployments, Sustainment and Maintenance	The tasks of deploying (including install and interfacing) a system into its final “operational” environment (On Site Acceptance Testing) followed by activities to sustain and maintain the system post-delivery, during warranty phases for example.
2.6 Interface Management	The SE task of managing technical interfaces like data flows, document formats, network interfaces, and holding Technical Interchange Meetings with suppliers
2.7 Use Case Analysis	The software/systems engineering discipline whereby interactions between the User (or external input) and systems under development are conceptually modelled and diagrammed to examine possible external system interactions
2.8 End-to-end System Validation Testing	A crucial part of post-deployment testing, this is when any system – including any satellite and instruments – is connected to all interfaces and “Day In The Life” testing performed to validate all end-to-end functionality and interfaces, in as representative a manner as possible.
2.9 CADM	Configuration and Data Management – the function of controlling and tracking all project Configurable Items, including hardware, software, documentation, processes and data artefacts, through their development lifecycle
2.10 Change Management	Managing project-level change through formal Engineering Change Proposal/Engineering Change Notice processes, overseen by a Program/project or external Change Control Board
2.11 Risk Management	The process of identifying, analyzing, categorizing and managing technical risk items (and issues, opportunities and assumptions) throughout the lifetime of the project.

2.12 Internal QC/PA	Quality Control/Assurance and other Product/Mission Assurance functions undertaken internally by the project. For example, QA/QC personnel may inspect incoming hardware shipments. Product Assurance personnel may act as independent witnesses of formal product testing.

4.3. WBS Element 3.0: Quality and Mission Assurance

Work Package 3 captures all quality control, mission and product assurance, and safety engineering functions, applying to all development projects, whether the function is carried out within NESDIS or externally (for example, NASA typically provide Safety & Mission Assurance functions for Assisted Acquisition projects).

Table 4-3 WBS Element 3.0: Quality and Mission Assurance WBS Element Description

WBS Element	WBS Element Description
3.1 Mission Assurance	The task of maintaining independent, top-level oversight of mission adherence to NOAA and any external safety standards (such as NASA, DoD or any commercial industry standards a project may adopt). MA has direct reporting authority to NESDIS Management. This discipline also extends to internal policies, processes and produces to ensure all safety and security standards are maintained by the project.
3.2 Product Assurance	The task of maintaining Quality Control of all products purchased or developed over the course of a project. Examples include using audits to verify the quality of 3rd party parts, Commercial Off-the-Shelf (COTS) systems, hardware and/or software, any systems manufactured in-house, and monitoring the materials, mechanical parts, processes and electrical components of a mission or system are not subject to any recalls or alerts. PA personnel must ensure that systems are safe, reliable, and maintainable.
3.3 Quality Assurance	A task for independent monitoring of system and subsystem-level test plans and procedures, test conduct and test results, ensuring V&V Plans are comprehensive and conclusive, accurately executed and documented. The QA function reports directly to Mission Assurance personnel. QA personnel must ensure that products are fit-for-purpose, tested appropriately, and meet requirements. QA personnel will sign off test plans, procedures and results.

4.4. WBS Element 4.0: Science and Stewardship

This section describes Level 2 WBS Element 4.0: “Science & Stewardship”. Level 3 WBS are self-explanatory and provided in the WBS spreadsheet. Project Managers can tune the Level 3 breakdown of WBS 4.0 to suit their particular project.

Table 4-4 WBS Element 4.0: Science and Stewardship WBS Element Description

WBS Element	WBS Element Description
4.1 Science Capabilities Definition	This WP captures all the entry-level tasks required to define the scope of science capabilities definition. For example, defining the Level 1 requirements for an enterprise algorithm (so offering a NESDIS-wide service), a science algorithm (for processing weather instrument data, for example), an instrument requirements specification (NESDIS putting instrument specifications to tender, for example), or specifying a full-up observing system, This could be satellite-based, in a particular orbit, with a specific suite of observing domains.
4.2 Algorithm Development	The WP captures a broad scope of tasks required to research, specify and develop a scientific algorithm, implemented in software, intended to process, analyze and transform low-level instrument data into usable environmental data or related products.
4.3 Data Exploitation and Research	Tasks related to utilization of data products made available for assimilation into NWP and other relevant forecast prediction models, or other operational algorithms. New data domains require a period of assimilation and “do no harm” evaluation before approval for operational use, such as NWP or data fusion with other established products.
4.4 Science System Maintenance	The task of maintaining, upgrading and re-calibrating science systems (those running science algorithms, data production and exploitation routines)
4.5 Data Stewardship	The discipline of preparing a long-term archive and data access scheme to enable current and future data users to access the data offline (not low-latency), via catalogs and other interfaces allowing a user to browse through the data and retrieve copies of the files, including related files required for processing, such as data descriptor files.
4.6 Joint Center for Satellite Data Assimilation	Encompasses the work of JCSDA in ingesting new data domains and products, to perform pre-operational evaluation and “do no harm” studies to determine the usefulness of the data set to NESDIS, and the conditions under which the data should be accepted. JCSDA can also prepare code updates for NCEP Central Operations to be able to utilize a new data set in NCEP’s Numerical Weather Prediction routines. JCSDA research new data domains and data sets by comparison against existing data sets, similar instruments and climatology models, including equivalent verified data from

	other instruments providing equivalent physical parameters.
4.7 Cooperative Institutes, Grants, Research Initiatives	Describes tasks that have been allocated to NOAA partners to perform specific, specialized research under a grant, whether administered directly by NOAA, the receiving CI or a body like the National Science Foundation.

4.5. WBS Element 5.0: Common Services

Also considered Enterprise Services, these WBS Elements represent support functions offered by NOAA and NESDIS to all Programs and projects; some may require direct funding contributions, others may be covered from general NOAA/NESDIS funds, or taxes levied on all projects. Even if a project is not directly funding these disciplines, they are included in the WBS so that the Project Manager can describe how relevant services will be accessed and utilized by the project, whether they are generic services or are specific to project needs.

Table 4-5 WBS Element 5.0: Common Services WBS Element Description

WBS Element	WBS Element description
5.1 IT Security Engineering	The task of implementing NOAA and NESDIS IT Security policy, ensuring all internal and external interfaces between IT systems are documented and in compliance with all security policies. Includes ITSec documentation and system audits.
5.2 Mission Science Network	A system under development at STAR for higher-latency distribution of environmental data to national and international subscribers.
5.3 Mission Science Services	*IT Summit placeholder; WP description unknown at this point.*
5.4 Administrative Services and Networks	WP for standard NESDIS administrative services, but worth noting if a Project Manager requires a dedicated service or network, such as a dedicated Admin Assistant or a specific network within a NESDIS facility (for example, a closed LAN to enable hardware testing).
5.5 Enterprise Services	A catch-all for internal enterprise-level common services that NESDIS projects might require in the future, configurable to different project needs; for example, a project might require temporary use of a high-power computing platform provided by NESDIS IT
5.6 Cloud Services	Services a project may require from a commercial cloud services provider, such as secure storage or high-speed data processing

	– these might be arranged through NESDIS, or directly by the project as a contract.
5.7 Network Engineering	The specific discipline of designing an appropriate network infrastructure for a project's system, whether internal or external, involving trades such as network speed, network capacity, and the implementation of networks and associated equipment such as servers, routers and firewalls, implementing the Network Security paradigm.
5.8 Secure Ingest Gateway	An internal enterprise-level NESDIS service used for securely ingesting external data sources, providing all the necessary interfaces and data integrity/security checks required.
5.9 Legal Counsel, OSC, CCRS	Support from NOAA's General Counsel and the Office of Space Commerce when required for contracts, commercial acquisitions, review of communications to US Government entities and so on. The Commercial Remote Sensing Regulatory Affairs office regulates applications for an Earth Remote Sensing license.
5.10 NESDIS IIA	NESDIS Interagency and International Affairs Division handles the formal Agency-to-Agency interactions with other US Government departments (such as NASA and the Department of Defense), ensuring projects document partnerships via Memoranda of Understanding, Letters of Intent and other formal agreement mechanisms at government-to-government level.
5.11 Regulatory Compliance	Services to ensure NOAA complies with all national and international regulations necessary with executing a project, such as ITAR / Export Control considerations, filing for RF spectrum with the DoC's National Telecommunications and Information Agency, monitoring for compliance with international protocols or adherence to international standards like CCSDS, and US Government, DoC, NOAA and NESDIS policies. These may include the following: • RF Spectrum allocation (ITU filings etc.) • Compliance with Earth Remote Sensing Regulations • Compliance with NOAA and Federal IT Security regulations (FISMA) • Compliance with applicable Environmental Protection Agency regulations • Compliance with Space Debris Mitigation Guidelines, and Space Situational Awareness data sharing • Compliance with construction/electrical codes for any building/equipment installations

	• Compliance with Export Control provisions such as EAR, ITAR Other applicable regulations may be included, as required by the project and/or NESDIS as a whole.

4.6. WBS Element 6.0: Ground Infrastructure

These WBS Elements represent the on-ground hardware, software and systems necessary to support satellite missions. They enable ground systems to communicate with in-flight satellite systems, and cover both NOAA and commercially-leased services.

Table 4-6 WBS Element 6.0: Ground Infrastructure WBS Element Description

WBS Element	WBS Element description
6.1 Satellite Communications Infrastructure	Includes tasks related to the development of Ground Station antenna hardware, software systems, and the Partner Antenna Access Network, providing the Ground Stations available to support NOAA and partner missions.
6.2 Data Management Services	Systems and software involved in the low-latency processing and dissemination of satellite data and related weather products.
6.3 Science Application Assessment Support	This task provides Subject Matter Expertise for the development of scientific algorithms and the assessment of their effectiveness, for example when exploring the development of a new data domain or development of processing algorithms for new instruments or data sources.
6.4 Satellite Command and Control Systems (Enterprise Infrastructure)	NOAA may choose to specify and purchase new SCS (Spacecraft Control Systems) or upgrade existing enterprise systems, to provide TT&C functions for new or existing satellites. This WP covers all activities related to SCS-related trade-off studies, requirements analysis and development, SCS architectural design, CONOPS and Use Case Analysis, functional and unit-level testing, integration of SCS components, verification and validation testing, and system-level testing by developers and the End User (Ops Team)
6.5 Short-term Telemetry and Other Satellite Data Archiving	This task focuses on the immediate, short-term archiving and management of Level 0 and Level 1a satellite (platform and payload) and ground system telemetry and data products storage and generation for Mission Ops needs and quick-look State of Health trending and analysis. Data stores and tools will be needed to process, analyze and exploit the short-term data stores, and manage their eventual transfer to long-term archives.

6.6 Mission Telecommunications Network	Tasks related to developing the secure, highly-reliable network links between mission sites, such as Satellite Operations Centers and remote Ground Stations and processing centers. These links must be highly available, high-speed, highly secure and continuously monitored.
6.7 General Ground Systems IT Support Infrastructure	These tasks cover generic ground system infrastructure necessary to support satellite missions and their related services, beyond the specific elements (Control Systems, telecommunications network GS antennas) called out in other WP.
6.8 Enterprise-level Common Ground Systems for Satellite Missions	WP covers common services for satellite missions like a Flight Dynamics System, Observation Planning System, and other services that all missions will use to some extent.

4.7. WBS Element 7.0: Mission Operations and Sustainment

These WBS Elements represent the tasks specific to satellite mission operations, both preparation, conduct, sustainment and system disposal. Mission Operations relies on some prior work carried out under the Ground Infrastructure WBS elements.

Note that terminologies for Flight Operations systems and phases vary across the industry national and international Agencies, and Polar vs. GEO missions. See the Appendix for terminology and equivalency.

Table 4-7 WBS Element 7.0: Mission Operations and Sustainment WBS Element Description

WBS Element	WBS Element description
7.1 Operations Development Plan	The ODP describes how the Operations Teams will be formed, and the tasks they will perform. The ODP will also outline the training program for Ops personnel, and the schedule for integrating all Ground Segment elements and developing Ops products.
7.2 Operations Systems and Tools Development	The task of developing and configuring/populating specific tools for Flight Ops usage, for example, a TM/TC Database editor and conversion tool, a Flight Procedure development environment, a Flight Dynamics tool, a Mission Planning tool, and the configuration of the Control System for operational use.
7.3 Satellite Simulator Procurement	The Satellite Simulator is a dedicated high-fidelity tool specific to the satellite and its instruments. While part of the overall Ground Segment, it can be considered a mission-specific tool whose

	specification, procurement and development should be managed by the end user.
7.4 Flight Plans, Process and Procedure Development	The task of developing flight operations processes and procedures to be used during mission operations. Processes can be documents that describe how to conduct routine and contingency operations. Flight Plans includes mission phases like LEOP, Commissioning and Routine Phase. Flight procedures may be manual or automated scripts for operating the operational system and the satellite.
7.5 Ops Databases	The task of populating the Operations Database – including the telemetry and telecommand databases used by the Control System, the Flight Dynamics DB of satellite physical parameters, thruster performance metrics, Control System displays and other configurable items.
7.6 Ops V&V Tests	Pre-flight verification and validation tests with the satellite and operational Ground Systems in the loop, validating and verifying satellite performance, and the performance and configuration of Control Systems, TM/TC databases, flight procedures, mission planning and telemetry processing systems. Includes Day-In-The-Life, End-to-End and System Operations Validation Testing.
7.7 Exercise & Rehearsal Campaign	The planned series of training exercises using the spacecraft simulator to exercise the Mission Operations Team in the conduct of Launch and Early Orbit Phase (LEOP), commissioning, routine and contingency operations.
7.8 Ops Documentation	The task of developing Operations Handbooks to capture the design and operations of space and Ground subsystems.
7.9 Ops Training	Tracking other training events beyond the E&R Campaign, for staff training on particular tools, procedures and processes.
7.10 Operations Events	WP describing each of the Ops development and execution phases, to capture specific tasks, dependencies and outputs associated with discrete events such as Launch Campaign Support, Launch and Early Operations Phase.
7.11 Warranty, Sustainment and Disposal	The activities associated with Ground and Ops Segment warranty phase close-out, system sustainment over the mission lifetime (includes technology refresh as necessary), and eventual disposal (orderly decommissioning) of the satellite and Ground Segment.

5. Work Package definition

Once the WBS decomposition process is complete, and the project approved for execution, all individual lowest-level WP require definition and description as a Work Package Description (WPD) document. The characteristics of a good Work Package are similar to those for good requirements definition. A Work Package must have the following features:

- Necessary – it maps to a parent element of the WBS, and contributes to achieving the project's objectives and meeting requirements;
- Unique – it does not overlap tasks in other WP;
- Achievable – it contains clear inputs, tasks and outputs that are within scope;
- Concise – it succinctly defines the task;
- Discrete – the WP is not open-ended, and does not span multiple project phases;
- Defines cost and schedule required to achieve the WP;
- Contains at least 20 FTE of effort, and/or $100K of costs;
- Defines unique accounting codes for cost tracking;
- Is either CWIP or non-CWIP, but not both;
- Identifies the resources (cost, schedule, personnel, equipment) and dependencies needed to execute the WP;
- Ensure every project team member's role appears in a WP;
- Confirm that all external activities are captured in a WP – even if the external activity is a no-cost-to-NESDIS deliverable, it must still appear in the project plan;
- Ensure every project deliverable appears in a WP;
- Have WP for major milestone reviews – as organizing and conducting reviews require cost and schedule expenditure;
- Ensure WPs do not overlap tasks or span multiple project phases; break down common WP into separate WP per project phase;
- Ensure WPs have clear starting and ending criteria – no "indefinite" WP allowed.

Even 'role-based' WP, defining a Level of Effort for specific team members such as the Project Manager, should have finite durations. Consider ending role-based WP at phase boundaries or milestones. Example: while the Project Manager role will continue throughout the project, it may have a different nature, Level of Effort or other considerations per phase, so having several, separate role-based WP per phase allows project costs to be tracked on a per-phase basis, such that phase-based WP can be closed at the end of each phase. Agile or recurring-task type projects could tie the role-based WP to product releases.

The goal of the WPD is to capture the details of the tasks involved in executing each WP, and to understand WP inter-dependencies, risks and cost/schedule drivers, such that the work task can be provided to the project personnel for execution.

This section describes how WPD structures must be defined in tabular format. The example tables may contain WP that are not relevant to all projects, and may omit some that are specific to certain projects. While the example of the required WPD structure is generic, it is meant to stimulate thought about WBS decomposition, and suggest WP which may not have been originally considered.

5.1. Work Package Description format

By the point where the project begins execution, every WP must have an accompanying description (Work Package Description or WPD) to capture its cost, schedule and technical scope. The WPD should contain enough information to enable the WP Manager to assign the task and monitor its execution. Table 5-1 that follows presents the NESDIS WPD template

After KDP-A has approved the project, further project cost, schedule and scope reviews during Phase A (Preliminary Design) will examine all WPD. The WPD must be comprehensive enough for reviewers who must authorize the project, to understand of where the WP fits within the overall tasks, the allocation of resources to the WP, and the role it fulfills.

Table 5-1 WPD Template

WP ID and Owner	The WP position/unique in the WBS (example: 2.1.3) and the Owner (by role or responsible organization)
WP Code	The accounting code for the WP; will be assigned after the project is authorized
WP Inputs	What documents / policies / engineering information are inputs to this WP
WP Tasks:	A bullet-list of key discrete activities performed under this WP
WP Outputs	A list of reports, documents, hardware and/or software products produced by this WP, and any specific acceptance criteria for these outputs
WP Dependencies	Describe what successful execution of this WP depends upon; any assumptions and constraints
WP Schedule	Describe if this WP has dependencies on, i.e. prior WPs that must complete first, and any successor WP, or drives (start/duration/end) any other activities or milestones in the project, or if it is an ongoing task.
WP Resources	Describe WP resource cost in dollars and/or labor hours and/or other designated cost metrics. The WP may also require other resources such as a team of personnel, an area of a clean room, a computing platform etc.
Other Information	Depending on the individual WP, the WP Owner may wish to add additional information such as any technical references, any agreements or contracts which this WP invokes

All WP should appear on the project schedule, and must have costs assigned against them.

The WPD can be presented in an Excel or Word format, at the discretion of the Project Manager. Top-level (Level 1 and Level 2) WBS Elements should be available to the MDA for review at the ATP/KDP A milestone, though lower-level WPs need not be fully defined at this early stage of the project. Lower-level WBS Elements and their WPs for later work could be provided in a “rolling wave” during a multi-phase project, with the appropriate NESDIS Management authority. By using this approach, the detailed WBS decomposition and costing of WP is presented at each major project milestone for the upcoming phase, but subsequent project phases can remain defined at a ROM estimate level, for later refinement as the previous phase progresses.

6. Links between Work Packages and Project Charge Codes

Project Managers must assign costs to each WP within the project, and regularly report project expenditure to the NESDIS Office of the Chief Financial Officer (CFO) during execution. Although this document deals with providing the preliminary project Work Breakdown Structure and Work Packages presented at KDP-A, setting up the costs and cost reporting structure for each WP in advance can enable to project to quickly begin its execution phase once approved.

Once a project is approved for execution, the NESDIS CFO will work with the Project Manager to establish accounting codes or 'charge codes' for the WP. There may not be one-to-one mapping between charge codes and WP, but a single charge code could apply to a common set of similar WP. The PM must map all WP expenditures to one of these accounting codes, so that project expenditure on all activities will be rolled-up to ensure visibility and cost control at CFO level.

6.1. NESDIS CFO FY 2018 Accounting Code Guidance

[A-1] captures CFO recommendations on NESDIS accounting structures and the way project expenditures are tracked. The guidelines in this Handbook, taken from [A-1], apply to all types of project funding mechanism, whether PPA, CWIP or ORF. The project cost estimation process should allocate WP to their specific categories before the execution phase begins, so that the transition to the project execution phase and tracking costs expended against funding type is as seamless as possible.

The key recommendations from the CFO study was that expenditure reporting methods and charge codes be structured to properly distinguish costs related to:

Flight hardware/software/systems and Ground hardware/software/systems
For example, a satellite command and control system is a Ground system, not flight.

NOAA vs. non-NOAA Participants
Critical to differentiate where WP are executed by NOAA, or by non-NOAA partners.

Ground Development
This refers to creating the hardware, software, systems and infrastructure to implement the necessary infrastructure to support satellite missions.

Operations vs Development
Development, in the satellite mission context, refers to the activities undertaken to prepare for post-launch activities. Operations activities occur once the mission is launched. Pre-flight operations infrastructure development and testing counts as Ground System Development. In a software context, operations activities start after the software is released and deployed to the End User.

Sustainment
This refers to activities that occur post-release of a product (or launch of a satellite) to the User. Sustainment means the ongoing support and maintenance of Ground systems (or post-release maintenance of software) after the product is delivered to the End User.

Product Management
Activities focused on the development and release of a specific product or deliverable, such as a software tool or an item of hardware.

Program Management
The activities of the Project Manager and the management team in tracking and reporting the project's status and performance.

Environmental Data Stewardship and Distribution
Tracking WP related to long-term, off-line data archive and distribution. This can be used to track costs of the more generic "data management" category, such as the role performed by the National Center for Environmental Information.

Assigning Accounting Codes to specific project activities must be coordinated with the CFO Data Analysis, Systems and Information Branch (DASIB). Project Managers must work with the DASIB team during a project's Pre-Formulation Phase as the WBS is being created and approved; the PM will have inputs on how to roll-up groups of related WP under specific charge codes. The CFO guidance document provides a Word-format for requesting CBS Project/Task Codes, available at:
http://www.corporateservices.noaa.gov/finance/projtaskdwnld.html

6.2. Allocating Funding Type

Accounting codes and Work Packages must align with the correct allocation of funding type, from between PAC, ORF and CWIP funds. Large and/or long-duration "cradle-to-grave" projects may have activities in each of the three funding type categories. Some guidance regarding the funding type for WP is suggested in the sections that follow.

6.2.1 PAC – Procurement, Acquisition and Construction

As the name suggests, PAC funds are used to bring a new capability, product or service into NOAA and NESDIS. A Work Package that directly supports these activities, such as developing new software, new algorithms, or purchasing a new flight system (example: a satellite or its instrument) is drawn from PAC funds. The majority of new projects in NESDIS will likely be using PAC funds. Here "construction" does not mean the construction of buildings, unless they are specific to a project. It refers to the construction or procurement of a satellite, instrument or a system in-house, as opposed to construction of physical facilities.

6.2.2 ORF – Operations, Research, and Facilities

ORF funding types are for "routine phase" usage of an existing or newly-developed system; performing forward-looking research as the basis for developing new systems or improving existing ones, and for the maintenance and sustainment of existing facilities, hardware and software.

For example, a large flight program developing a Ground and Operations Segment will need to appropriately identify those activities which fall under the ORF category, such as ongoing usage of the completed system for day-to-day operations, and ongoing maintenance and improvements to the system once deployed for operational use. Similarly, hardware development and software/algorithm development projects will also have a sustainment phase.

Some examples of ORF-type activities are suggested below:

- Post-commissioning satellite flight operations (Routine Phase E);
- Software product maintenance and User support, once the product development and deployment has completed and it is in regular use;
- Ground Station equipment maintenance and parts upgrades/replacement as hardware ages out or becomes obsolete
- Long-term data archiving, preservation and distribution activities
- Use of project funds for facilities rental, such as clean-room space for flight hardware development, control facility space, testing areas

6.2.3 CWIP – Construction Work In Progress

Most CWIP projects are associated with the acquisition of capital assets, also known as Property, Plant and Equipment (PP&E). Capital assets are physical items such as buildings and their associated construction costs, and other tangible assets for general use having an estimated useful life of two or more years. The NOAA CWIP policy [A-2] states that “all costs incurred to bring a NESDIS asset to a form and location suitable for its intended use shall be capitalized.”

NOAA satellites are treated as capital assets once the satellite system is declared operational and handed over for routine operations. At that point, the value of the satellite and its instruments must be entered into the NOAA property system [A-2]. This should not concern a Project Manager setting up the costing for a satellite acquisition/development project, though accurate cost tracking during the satellite procurement and development project will enable a realistic assessment of the “value” of the asset when entered into the capital asset tracking system as PP&E.

The criteria for determining an activity to be CWIP are as follows:

- Combined acquisition cost $200,000 or more;
- Estimated service life of 2 years or more;
- Long-term economic benefit to the controlling organization;
- Not intended for sale.

Examples of costs related to NESDIS satellites that must be capitalized (added to the total value of the capital asset) at operational handover, per [A-1], are as follows:

- Acquisition agent costs;

- Launch delays;
- Storage costs;
- Testing costs;

When capitalizing the asset, the remaining useful life of the satellite and its instruments must be considered.

6.3. Mapping charge codes and costs to WP

The Project Management team will work with NESDIS CFO to establish the appropriate mapping between Work Packages and charge codes. Charge codes are unique numeric sequences that are used for cost reporting processes. Charge codes are used when Federal and contractor employees enter their timesheets, to ensure their labor hours are billed to the appropriate projects and tasks within those projects.

Once a project is granted Authorization To Proceed, the Project Manager's Office will develop a mapping of WP numbers to CFO-provided charge codes for the upcoming phase, before the project can begin executing and charging costs for its activities for that phase. The project will work with CFO to decide how much budget is available to spend on each project phase. Margin (management reserve) for potential project-level cost overrun could be assigned to a dedicated charge code, against which costs can be charged only with PM authorization and a strict cost ceiling.

The Project Manager's Office will devise a system to enable tracking the efforts and costs spent on the project as the project executes. This is necessary to monitor project progress against the baseline, to monitor for excessive cost or schedule variance. Cost tracking and reporting is the subject of a dedicated NESDIS Handbook.

APPENDIX A: LIST OF ACRONYMS

The list of acronyms below are found in this document.

AIT	Assembly, Integration and Test
ATP	Authorization To Proceed
CFO	Chief Financial Officer
CWIP	Construction Work In Progress
DB	Database
FOT	Flight Operations Team (also known as Mission Operations & Science Team)
FTE	Full Time Equivalent
HBK	Handbook
KDP	Key Decision Point
LEOP	Launch and Early Orbit Phase (similar to Launch & Orbit Raising)
MDA	Milestone Decision Authority
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
OCR	Optical Character Recognition
ODB	Operations Database
ORF	Operations, Research and Facilities
ORR	Operations Readiness Review
PAC	Procurement, Acquisitions and Construction
PM	Project Manager
TM/TC	Telemetry/Telecommands
V&V	Verification and Validation
WBS	Work Breakdown Structure
WP	Work Package(s)
WPD	Work Package Description(s)

APPENDIX B: NESDIS WBS Structure

The WBS structure presented in Table B-1 shows the NESDIS WBS convention from WP1: Project Management to WP7: Mission Operations, with Level 1 WBS Elements arranged horizontally in the grey columns.

The breakdown of each Level 1 WP into Level 2 WBS Elements proceeds vertically down the page. Level 3 WBS Elements are presented for specific Level 2 WBS Elements, and these are shown in the white columns, immediately across and continuing downwards from, their corresponding Level 2 WBS Element.

For a full view of the NESDIS WBS, consult the Microsoft Excel worksheet that accompanies this document. The WBS spreadsheet is also available from NESDIS-OSAAP.

Project Managers should adhere to structure, naming and numbering convention of this NESDIS WBS. If a WP is missing from this WBS for a particular project, it can be added. If the PM believes a missing WP will be useful across multiple projects, they should notify OSAAP for consideration and possible update of the NESDIS WBS. Existing WP numbering must not be changed. Unused WP numbers should be left out of the specific project's WBS if not relevant.

Table B-1 NESDIS Work Breakdown Structure

WP 1 Project Management	WP1 Level 3	WP 2 System Engineering	WP2 Level 3	WP3 Quality and Mission Assurance	WP4 Science and Stewardship	WP4 Level 3	WP5 Common Services	WP6 Ground Infrastructure	WP6 Level 3	WP7 Mission Operations and Sustainment	
WP 1.1 Project Management Office	WP1.1.1 Project Travel	2.1 Chief Systems Engineer		WP3.1 Mission Assurance	4.1 Science Capabilities Definition	4.1.1 Enterprise Algorithm Requirements Specification	5.1 IT Security Engineering	6.1 Satellite Communications Infrastructure	WP6.1.1 Space-to-Ground Communications	WP7.1 Operations Development Plan	
	WP1.1.2 Contractor Support	2.2 Requirements Management		WP3.2 Product Assurance		4.1.2 Science Algorithm Requirements Specification	5.2 Mission Science Network		WP6.1.2 Network Infrastructure	WP7.2 Ops Tools Development	WP7.2.1 Flight Procedure Dev. Environment
	WP1.1.3 NESDIS and NOAA Taxes	2.3 System/Product Design Phase	2.3.1 Requirements Specification	WP3.3 Quality Assurance/Control		4.1.3 Weather/Science Instrument Requirements Specification	5.3 Mission Science Services		WP6.1.3 Partner Antenna Access Network		WP7.2.1 TM/TC Database
	WP1.1.4 External Management Reviews		2.3.2 Architectural Design			4.1.4 Observing Systems Specification	5.4 Administrative (Internal IT) Networks and Services	6.2 Data Management Services	WP6.2.1 Data Scanning and Routing		WP7.2.2 Flight Dyanmics Database
	WP1.1.5 Project Admin Support		2.3.3 Detailed Design Phase		4.2 Algorithm Development	4.2.1 Operational algorithm specification and validation	5.5 Enterprise Services		WP6.2.2 Product Generation		WP7.2.3 Control System Ops Dev
	WP1.1.6 Contract Technical Management		2.3.4 Unit Coding and Test			4.2.2 Operational algorithm development	5.6 Cloud Services		WP6.2.3 Product Distribution	WP7.3 Satellite Simulator Procurement	WP7.3.1 Sim Requirement Specification
WP 1.2 Lead Budget Analyst			2.3.5 Software Integration			4.2.3 Research to Operations	5.7 Network Engineering		WP6.2.6 Data Analytics		WP7.3.2 Sim Development Management
WP 1.3 Project Comptroller			2.3.6 Software Functional Tests			4.2.4 Algorithm commissioning, verification and ground truth testing	5.8 Secure Ingest Gateway for External Data Sources	6.3 Science Application Assessment Support		WP7.4 Flight Procedure Development	WP7.4.1 Plaform Ops Dev
WP 1.4 Project Admin Overhead		2.4 System Delivery and Verification	2.4.1 User Training and Documentation			4.2.5 Sensor commissioning and calibration	5.9 DoC/NOAA/NESDIS General Counsel - legal, regulatory support	6.4 Satellite Command and Control Systems (Enterprise Infrastructure)			WP7.4.2 Instrument Ops Dev
WP 1.5 Budget Analyst			2.4.1 System Integration and Testing		4.3 Data Exploitation and Research	4.3.1 Algorithm assessment and refinement	5.10 NESDIS IIA	6.5 Short-Term Telemetry and Other Satellite Data Archiving		WP7.5 Ops Databases	WP7.5.1 TM/TC
WP 1.6 Project Comptroller			2.4.2 System Validation and Deployment			4.3.2 Algorithm Proving Ground	5.11 Regulatory considerations: NTIA / FCC Filings / ITU / ITAR / Export Control / CCSDS	6.6 Mission Telecommunications Network			WP7.5.2 Control System Ops DB
WP 1.7 Risk Management		2.5 System Deployments, Sustainment and Maintenance	2.5.1 System Warranty Phase			4.3.3 User Community Engagement		6.7 General Ground Systems IT Support Infrastructure			WP7.5.3 Flight Dynamics DB
		2.6 Interface Management			4.4 Science System Maintenance	4.4.1 System Performance Monitoring and Corrective Maintenance		6.8 Enterprise-level Common Ground Systems for Satellite Missions	6.8.1 Flight Dynamics Systems	WP7.6 Ops V&V Tests	WP7.6.1 Control System Testing
		2.7 Use Case Analysis	2.7.1 Use Case Testing			4.4.2 System Preventive Maintenance and Upgrades			6.8.2 Station Scheduling Systems		WP7.6.2 Ops Procedure Verification
		2.8 End-to-end System Validation Testing				4.4.3 System Quality Assessment and Performance Trending			6.8.3 Multi-Mission/Fleet Planning Systems		WP7.6.3 Ops Scenario Tests
		2.9 Mission CONOPS, pre-Ops Dev operational concept design			4.5 Data Stewardship	4.5.1 Data Stewardship System Requirements				WP7.7 Exercise & Rehearsal Campaign	WP7.7.1 E&R Plan
		WP2.10 Config & Data Management				4.5.2 Data Submission Agreements and Format Definition					WP7.7.2 E&R Scenario Definition & Prep
		WP2.11 Change Management				4.5.3 Data Management Plans Engagement					WP7.7.3 E&R Test Conduct
						4.5.4 Data Archiving and Access Management					WP7.7.4 E&R Evaluation
						4.5.5 Data Stewardship System Management				WP7.8 Ops Documentation	WP7.8.1 User Documentation
					4.6 Joint Center for Satellite Data Assimilation	4.6.1 Observing System or Data Set Definition Support					WP7.8.2 Ops Handbooks
						4.6.2 Assimilation Algorithm Preparation					WP7.8.3 Ops Process Documentation
						4.6.3 Comparative Data Set Identification					WP7.8.4 Training Course Prep & Conduct
						4.6.4 Data Comparison Exercises (Spot-checks)				WP7.9 Ops Team Effort	WP7.9.1 Controllers
						4.6.5 Offline Data Assimilation Testing (Do No Harm tests)					WP7.9.2 Ops Engineers
						4.6.6 Operational Assimilation Testing					WP7.9.3 Flight Director & Mission Managers
					4.7 Cooperative Institutes , Grants, Research Initiatives					WP7.10 Ops Phases	WP7.10.1 Ground Segment Unit Tests
											WP7.10.2 GS Integration Tests & Training
											WP7.10.3 Ops Dev & Validation
											WP7.10.4 System Ops Validation Tests
											WP7.10.5 E&R Campaign
											WP7.10.6 Launch & Early Orbit Phase
											WP7.10.7 Commissioning & Cal Ops
											WP7.10.8 Contingency Ops
											WP7.10.9 Routine Phase
											WP7.10.10 System End-of-Life Ops
										WP7.11 Warranty, Sustainment and Disposal	
											WP7.11.1 Warranty Testing
											WP7.11.2 Sustainment Operations
											WP7.11.3 Upgrade Testing
											WP7.11.4 System Disposal

APPENDIX C: NASA Generic WBS Structure per [R-3]

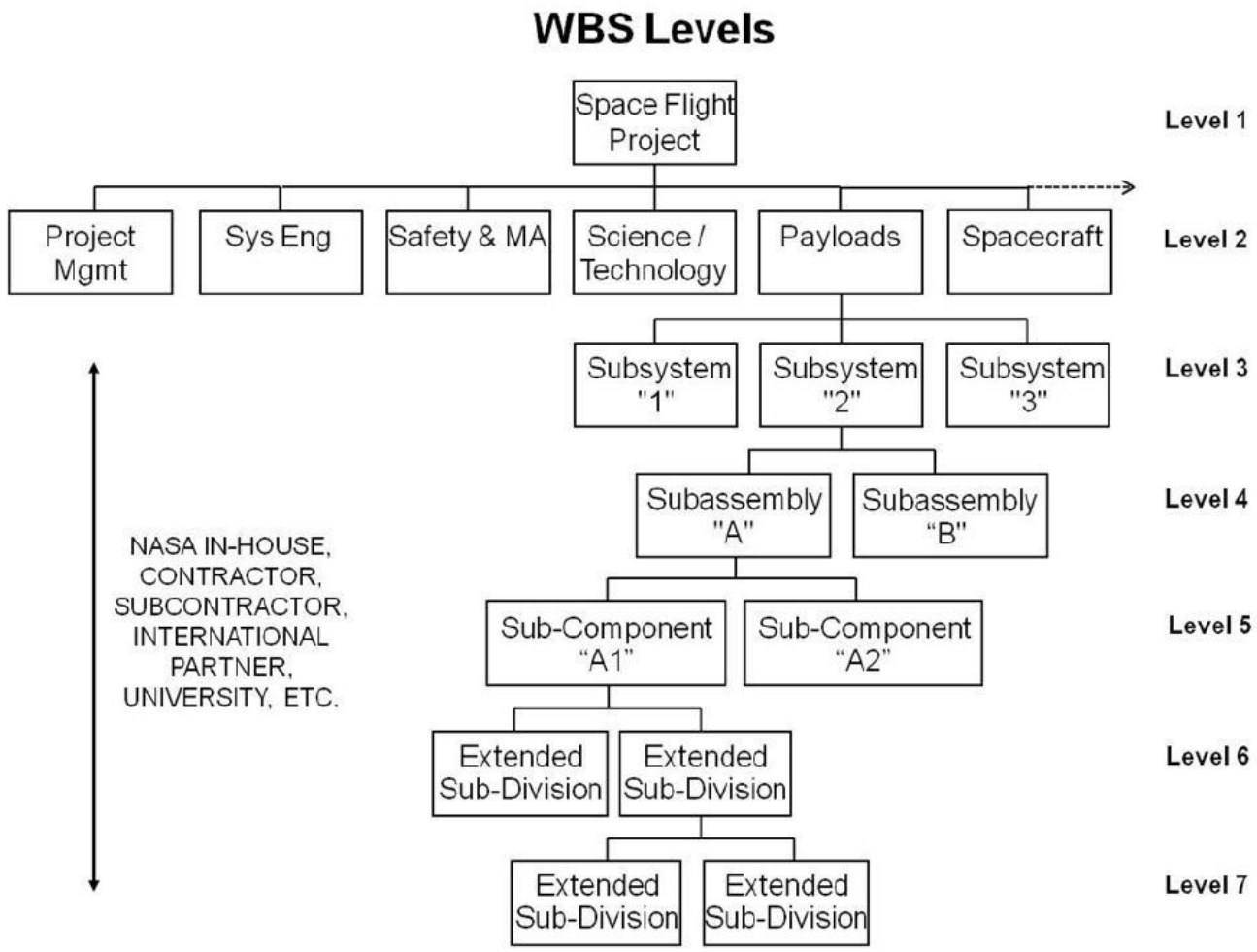

Figure C-1 NASA Generic WBS for Space Flight Projects (not used by NESDIS)

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