NOAA NESDIS
CENTER for SATELLITE APPLICATIONS
and RESEARCH (STAR)

TASK GUIDELINE

TG-2
FOCUSED R&D (STEP 2)
TASK GUIDELINES

Version 3.0

NOAA NESDIS STAR

TASK GUIDELINE TG-2
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TITLE: TG-2: FOCUSED R&D (STEP 2) TASK GUIDELINE VERSION 3.0

AUTHORS:

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VERSION HISTORY SUMMARY

Version	Description	Revised Sections	Date
1.0	No version 1		
2.0	No version 2		
3.0	New Task Guideline adapted from CMMI guidelines by Ken Jensen (Raytheon Information Solutions)	New Document	10/01/2009

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LIST OF ACRONYMS

ATBD	Algorithm Theoretical Basis Document
CI	Cooperative Institute
CICS	Cooperative Institute for Climate Studies
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIOSS	Cooperative Institute for Oceanographic Satellite Studies
CIRA	Cooperative Institute for Research in the Atmosphere
CL	Check List
CLI	Check List Item
CoRP	Cooperative Research Program
CM	Configuration Management
CMMI	Capability Maturity Model Integration
CREST	Cooperative Remote Sensing and Technology Center
DG	Document Guidelines
EPG	Enterprise Process Group
EPL	Enterprise Product Lifecycle
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
PAR	Process Asset Repository
PG	Process Guidelines
PP	Project Proposal
PRG	Peer Review Guidelines
R&D	Research & Development
SEI	Software Engineering Institute
SG	Stakeholder Guideline
SPSRB	Satellite Products and Services Review Board
STAR	Center for Satellite Applications and Research
SWA	Software Architecture Document
TD	Training Document
TG	Task Guideline

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1. INTRODUCTION

The NOAA/NESDIS Center for Satellite Applications and Research (STAR) develops a diverse spectrum of complex, often interrelated, environmental algorithms and software systems. These systems are developed through extensive research programs, and transitioned from research to operations when a sufficient level of maturity and end-user acceptance is achieved. Progress is often iterative, with subsequent deliveries providing additional robustness and functionality. Development and deployment is distributed, involving STAR, the Cooperative Institutes (CICS[1], CIMSS[2], CIOSS[3], CIRA[4], CREST[5]) distributed throughout the US, multiple support contractors, and NESDIS Operations.

NESDIS/STAR is implementing an increased level of process maturity to support the development of these software systems from research to operations. This document is a Task Guideline (TG) for users of this process, which has been designated as the STAR Enterprise Product Lifecycle (EPL).

1.1. Objective

The STAR EPL is designed as a sequence of 11 process steps that take a product from initial conception through delivery to operations. These steps are:

- Step 1 - Basic Research (TG-2)
- **Step 2 - Focused R & D (TG-2)**
- Step 3 - Project Proposal (TG-3)
- Step 4 - Resource Identification (TG-4)
- Step 5 – Development Project Plan (TG-5)
- Step 6 - Project Requirements (TG-6)
- Step 7 - Preliminary Design (TG-7)
- Step 8 - Detailed Design (TG-8)

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[1] Cooperative Institute for Climate Studies

[2] Cooperative Institute for Meteorological Satellite Studies

[3] Cooperative Institute for Oceanographic Satellite Studies

[4] Cooperative Institute for Research in the Atmosphere

[5] Cooperative Remote Sensing and Technology Center

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- Step 9 - Code & Test Data Development (TG-9)

- Step 10 - Code Test And Refinement (TG-10)

- Step 11 - System Integration and Test (TG-11)

The objective of this Task Guideline (TG-2) is to describe how to perform the standard tasks of STAR EPL process step 2, "Focused R&D".

The intended users of this TG are all participants in the STAR EPL process who are involved in performing the standard tasks of step 2. Participants are referred to as STAR EPL stakeholders.

To determine whether or not they should be involved with this step, the readers of this TG should first determine what stakeholder roles apply to their participation in a STAR research-to-operations development project. Generic stakeholder roles are listed in Section 3 of this TG and discussed in Section 3.2 of the EPL Process Guideline (PG-1)[6]. PG-1 and this TG will direct stakeholders to Stakeholder Guidelines (SG) that are pertinent to their roles.

1.2. Version History

This is the first version of TG-2. It is identified as version 3.0 to align it with the release of the version 3.0 STAR EPL process assets.

1.3. Overview

This TG contains the following sections:

Section 1.0 - Introduction
Section 2.0 - References
Section 3.0 - Stakeholders
Section 4.0 - Project Artifacts
Section 5.0 - Task Descriptions

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[6] It is recommended that potential STAR EPL stakeholders either review PG-1 prior to using this TG or use it as a reference while using this TG.

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2. REFERENCE DOCUMENTS

All of the reference documents for the STAR EPL process are STAR EPL process assets that are accessible in a Process Asset Repository (PAR) on the STAR website. http://www.star.nesdis.noaa.gov/star/EPL_index.php.

Process assets include:

- Process Guidelines
- Stakeholder Guidelines
- Task Guidelines
- Peer Review Guidelines
- Review Check Lists
- Document Guidelines
- Training Documents

2.1. Process Guidelines

Process Guideline (PG) documents describe STAR's standard set of practices and guidelines for tailoring them to specific projects.

- STAR EPL Process Guidelines (PG-1)
- STAR EPL Process Guidelines Appendix (PG-1.A)

PG-1 and PG-1.A apply generally to each EPL step. Each stakeholder performing tasks during each step can benefit from a familiarity with these documents.

2.2. Stakeholder Guidelines

A Stakeholder Guideline (SG) is a description of how to perform all STAR EPL standard tasks assigned to a given type of stakeholder. It should itemize the actions to be taken. It should contain appropriate standards, conventions, and (where appropriate) examples. It should point to the appropriate references and the required artifacts.

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Stakeholder roles are identified in Section 3 of this TG. For each type of stakeholder, the appropriate SG provides that stakeholder with a complete description of the standard tasks for that stakeholder role, along with references to all appropriate process assets and project artifacts (c.f. Section 5 of this TG). This functions as a complement to the TGs (c.f. Section 2.3 of this TG), which provide a completion description of all stakeholder tasks for a specific process step.

Table 2.2.1 lists the Stakeholder Guidelines that are relevant to this step.

TABLE 2.2.1 – Stakeholder Guidelines for Step 2

ID	Stakeholder
SG-8	Research Leads
SG-9	Research Scientists
SG-10	Research Testers
SG-11	Research Programmers

2.3. Task Guidelines

A Task Guideline (TG) is a description of how to perform the tasks of a STAR EPL process step. It should itemize the actions to be taken. It should contain appropriate standards, conventions, and (where appropriate) examples. It should point to the appropriate references and the required artifacts. There is one Task Guideline for each step in the STAR EPL. The relevant TG for this step is TG-2 (this document).

2.4. Peer Review Guidelines

For each review (c.f. Section 4), there is a Peer Review Guideline (PRG) that describes the objectives of the review, the required artifacts, standards for reviewers, requirements for approval, and options other than approval. There are no reviews during step 2, but the step 2 activities are preparation for the Gate 2 Review. Therefore, a relevant PRG is:

- Gate 2 Review Guidelines (PRG-3)

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2.5. Review Check Lists

For each review (c.f. Section 4), there is a Review Check List (CL) that captures all the objectives for a review as a set of check list items. Each item in the check list should have a "Disposition" column that contains "Pass", "Conditional Pass", "Defer", "Waive", or "N/A" (Not Applicable). Each item will also have columns for Risk Assessment and for Actions generated. There are no reviews during step 2, but the step 2 activities are preparation for the Gate 2 Review. Therefore, a relevant CL is:

- Gate 2 Review Check List (CL-3)

2.6. Document Guidelines

There is a Document Guideline (DG) for each standard STAR EPL document. Each DG includes a description of the purpose for the document, a standard document outline (table of contents), a brief description of each subsection in the outline, and an Appendix containing an example document.

Table 2.6.1 lists the Document Guidelines that are relevant to this step.

TABLE 2.6.1 – Document Guidelines for Step 2

ID	Document
DG-1.1	Algorithm Theoretical Basis Document (ATBD)
DG-1.2	Software Architecture Document (SWA)

2.7. Training Documents

Training Documents (TD) assist the stakeholders (c.f. Section 3) in performing the process tasks. By using the TDs, the stakeholders should be able to perform the tasks more effectively.

Table 2.7.1 lists the Training Documents that are relevant to this step.

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TABLE 2.7.1 – Training Documents for Step 1

ID	Training Document
TD-11.1	FORTRAN Coding Standards
TD-11.1.A	Transition from Fortran 77 to Fortran 90
TD-11.2	C Coding Standards

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3. STAKEHOLDERS

The STAR Enterprise is comprised of a large number of organizations that participate and cooperate in the development and production of environmental satellite data products and services. Individual project teams are customarily composed of personnel from these organizations, supplemented by contractor personnel. These organizations and project teams are referred to as the STAR Enterprise stakeholders.

An overview of the stakeholder roles is provided in the STAR EPL Process Guidelines (PG-1, c.f. Section 2). A more detailed description can be found in the Stakeholder Guidelines (SGs, c.f. Section 2).

Stakeholders who have a role during step 2 include:

- Research Lead (SG-8)
- Research Scientist (SG-9)
- Research Tester (SG-10)
- Research Programmer (SG-11)
- Research Manager (SG-12)

A *Research Lead* is any person located at a research organization who is leading a group of scientists, programmers, and testers that is working on preparing an algorithm for a STAR/SPSRB Project Proposal to develop a product for transition to operations. If the proposal is approved for development, the **Research Lead** will usually lead the development effort in the role of **Development Lead**.

A *Research Scientist* is a scientist located at a research organization who has been assigned by the **Research Lead** to one or more of the tasks of developing new or improved algorithms, reviewing algorithm development, and preparing STAR/SPSRB project proposals.

A *Research Tester* is any person located at a research organization who has been assigned by the **Research Lead** to one or more of the tasks of identifying test data appropriate to a research algorithm as it is being developed, acquiring and integrating the test data into the research product processing system, creating test plans, executing tests, and analyzing and reporting test results for review.

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A *Research Programmer* is a programmer located at a research organization who has been assigned by the Research Lead to one or more of the tasks of designing research code, writing research code, and supporting **Research Testers** in testing research code.

A *Research Manager* provides project monitoring and control oversight of research projects, including participation in project management (Gate) reviews. Research projects produce R&D algorithms for consideration as potential development projects.

Stakeholder satisfaction is a critical component of the process. The intention is for the process to be more of a benefit that a burden to stakeholders. If stakeholders are not satisfied that this is the case, the process will require improvement.

Stakeholders are strongly encouraged to provide feedback to the EPG. Comments and suggestions for improvement of the process architecture, assets, artifacts and tools are always welcome. Stakeholders can provide feedback by contacting:

Ken.Jensen@noaa.gov

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4. PROJECT ARTIFACTS

Project Artifacts are a set of items that must be produced by the appropriate stakeholders during the product life cycle to support the reviews. They are established and maintained under Configuration Management (CM) by an Enterprise Process Group (EPG) under the direction of a Steering Committee.

The project artifacts are maintained in a project artifact repository. This is a complete set of configuration-managed artifacts developed by each project in accordance with STAR standards. When a project artifact has been approved at a Technical Review or Gate Review, it is placed in the project artifact repository under CM.

Project artifacts that are recommended for development during step 2 are listed in Table 4.1.

TABLE 4.1 – Step 2 Artifacts

Artifact	Type	Review	Baseline Build
Algorithm Theoretical Basis Document v1.1	Document	Gate 2	1.0
Software Architecture Document v1.1	Document	Gate 2	1.0
R&D Code	Code	Gate 2	1.0
R&D Test Data	Test Data	Gate 2	1.0

Algorithm Theoretical Basis Document v1.1: The Algorithm Theoretical Basis Document (ATBD) provides a theoretical description (scientific and mathematical) of the algorithm that is used to create a product that meets user requirements. The ATBD is typically updated from the v1.0 version, as R&D provides additional maturity. At this step, the algorithm's operational potential has been demonstrated to the satisfaction of the Research organization and is now being further developed to support a research to operations development proposal. The purpose of ATBD v1.1 is to demonstrate that the algorithm should be developed for transition to operations. Refer to DG-1.1 for detailed ATBD guidelines.

Software Architecture Document v1.1: The Software Architecture Document (SWA) complements the ATBD by providing the software architecture for the processing code that will implement the algorithm. The SWA may be updated from the v1.0 version, if the additional algorithm maturity warrants additional and/or more detailed software architecture. Refer to DG-1.2 for detailed SWA guidelines.

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R&D Code: Research & Development (R&D) Code (RCOD v2) is research code that implements the algorithm. It should use input data and produce output data that is described in the ATBD and SWA. It should include the processing functionality described in the ATBD and SWA. R&D code is expected to be an upgrade over Basic Research code. Code may include additional functionality to reflect upgraded software architecture and may be revised to comply with SPSRB coding standards. If the project is approved for development, this version of the code will be built into the initial project baseline, It is therefore expected that SPSRB coding standards will begin to be applied to the code. Currently, coding standards exist for Fortran, C, and C++ code, and general programming standards exist for all code. These standards are found on the SPSRB web site at http://projects.osd.noaa.gov/spsrb/standards_prog.htm

R&D Test Data: R&D Test Data (RTEST v2) are the data files used to test the R&D code, including the input data and output data identified in the ATBD and SWA. They may be upgraded from the Basic Research Test Data, if the upgraded R&D code requires this.

Note that these artifacts are typically included in the first STAR Baseline Build (BB 1.0). BB 1.0 provides the artifacts for the STAR/SPSRB Gate 3 Review. In determining the step 2 artifacts to be developed, and consequently the step 2 activities to authorize, Research Managers should consider how the step 2 activities and artifacts support the STAR EPL objectives for the Gate 3 Review. Refer to PRG-5 for Gate 3 Review objectives.

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5.   TASK DESCRIPTION

5.1 Focused R&D Process Flow
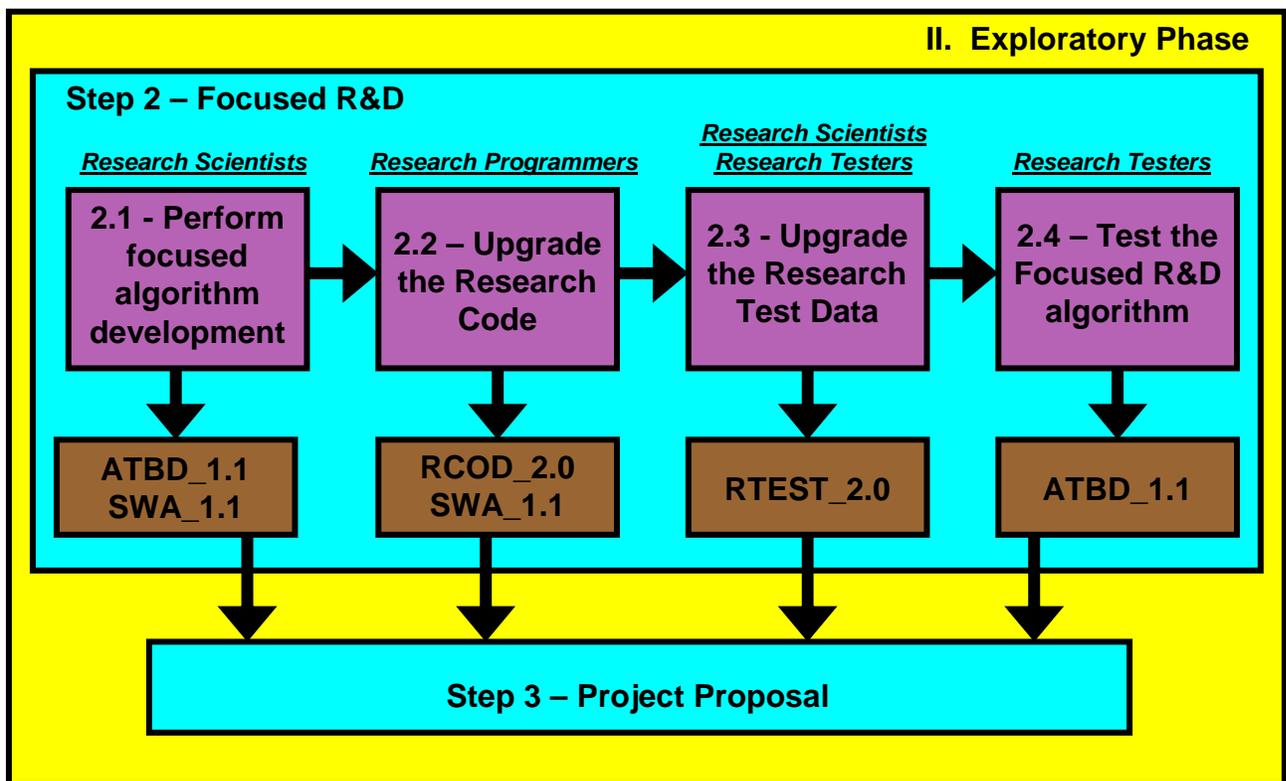
Figure 5.1 shows the process flow for step 2.

Figure 5.1 – STEP 2 Process Flow

5.2 Expected BEGIN State

Algorithm and supporting artifacts have passed a Gate 1 Review.

5.2.1 Task Inputs

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Algorithm Theoretical Basis Document v1.0: The Algorithm Theoretical Basis Document (ATBD) provides a theoretical description (scientific and mathematical) of the algorithm that is used to create a product that meets user requirements. For v1.0, the algorithm is at a "concept" stage and its operational potential has not been assessed. The purpose of ATBD v1.0 is to demonstrate that the algorithm has operational potential and should be further developed to demonstrate operational capability. Refer to DG-1.1 for detailed ATBD guidelines.

Software Architecture Document v1.0: The Software Architecture Document (SWA) complements the ATBD by providing the software architecture for the processing code that will implement the algorithm. Refer to DG-1.2 for detailed SWA guidelines.

Basic Research Code: Basic Research Code (RCOD v1) is research code that implements the algorithm. It should use input data and produce output data that is described in the ATBD and SWA. It should include the processing functionality described in the ATBD and SWA.

Basic Research Test Data: Basic Research Test Data (RTEST v1) are the data files used to test the Basic Research code, including the input data and output data identified in the ATBD and SWA.

Gate 1 Review Report: Gate 1 Review Report (G1RR) is the report of the Gate 1 Reviewers. The G1RR should consist of an assessment of the Gate 1 Review artifacts and a yes/no decision on proceeding to the next phase of the EPL. Refer to DG-1.3 for G1RR document guidelines.

5.2.2 Corrective Actions

The G1RR will document any actions that are needed to reduce risk during step 2. Customarily, these actions will need to be closed before a Project Proposal (PP) is submitted in step 3 for a Gate 2 Review.

5.3 Desired END State

- The research algorithm has been matured and documented in ATBD v1r1
- A software architecture has been matured and documented in SWA v1r1

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- R&D code has been written that implements the algorithm well enough to produce proxy data products to support a PP to STAR and the SPSRB.

- R&D code has been run with research test data to produce the proxy data products

- R&D code test results, documented in ATBD v1r1, demonstrate whether or not the algorithm's operational potential warrants the submission of a PP.

5.3.1 Task Outputs

- Algorithm Theoretical Basis Document v1.1

- Software Architecture Document v1.1

- R&D Code

- R&D Test Data

5.4 Focused R&D Activities

The Focused R&D algorithm may be developed in one of three venues:

- STAR. **Research Managers** include STAR Division Chiefs and Branch Chiefs. **Research Lead** is a STAR scientist. **Research Scientists** are STAR scientists. **Research Testers** are STAR scientists. **Research Programmers** may be STAR scientists, or Research Management may designate contractor personnel for these tasks.

- A Cooperative Institute (CI). **Research Managers** are provided by the CI. **Research Lead** is a CI Scientist. **Research Scientists** are CI scientists. **Research Testers** are CI scientists. **Research Programmers** may be CI scientists, or Research Management may designate contractor personnel for these tasks.

- A research organization other than STAR and the CIs (PUSH User). Compliance with STAR EPL standards is at the discretion of the research organization, but the organization should understand that Gate 2 approval shall depend on a demonstration that the algorithm can be developed according to STAR EPL standards.

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In this step, **Research Scientists** continue algorithm development under the direction of the **Research Lead** with the goal of producing an algorithm of sufficient maturity and operational potential to satisfy Gate 2 reviewers that the project meets NOAA mission goals and is technically feasible for development into an operational product.

The **Research Lead** and **Research Scientists** should consult the Gate 2 Review guidelines (PRG-3) and Check List (CL-3) to help them understand what must be done to prepare the algorithm for the Gate 2 Review.

The initiating event for this step is Gate 1 approval, as documented in the Gate 1 Review Report.

The **Research Scientists** should revise and refine the ATBD and SWA documents. The purpose is to demonstrate to the Gate 2 reviewers that the algorithm should be developed as a STAR research project. ATBD v1r1 should include operational application(s) and algorithm test results, using research-grade code and a TBD number of regional scenes. The set of regional scenes should be sufficiently diverse to demonstrate global operational feasibility. SWA v1r1 should document the algorithm inputs and outputs and at least two levels of processing flow. The **Research Scientists** should take the lead in producing these documents, using DG-1.1 and DG-1.2 as assets.

Research code and test data must be developed to help demonstrate an operational potential. **Research Programmers** upgrade the Basic Research code and test data into more mature R&D code and test data. There is no coding standard for the code at this early phase of the EPL, but it is recommended that the appropriate pre-operational coding standard and code training documents (TD-11.1 and TD-11.1.A for Fortran code and TD-11.2 for C code) be consulted if the programmers do not want the R&D code to be discarded and replaced by new code for subsequent code development. The reason for this recommendation is that compliance with the coding standards will be required to satisfy code review requirements and it is more efficient to incorporate these standards into the research code.

The **Research Testers** should work with **Research Scientists** to develop test data that will enable the algorithm to produce proxy data products and to create a test environment and test results that demonstrate the algorithm's potential to satisfy Gate 2 Review requirements (c.f. PRG-3).

Research Scientists, **Research Programmers**, and **Research Testers** should collaborate to run tests on the Focused R&D algorithm. The tests shall meet Gate 2 requirements as given in the Gate 2 Review guidelines (PRG-3) and Check List (CL-3).

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The **Research Lead** determines when the algorithm is sufficiently developed for Gate 2 review, using PRG-3 and CL-3 as guides. At this point, the **Research Lead** directs the development team to proceed to step 3 "Project Proposal".

Each stakeholder who performed activities during step 2 is encouraged to document an assessment of the experience in a personal record. This assessment should include: what was good, what was bad, what worked, what did not work, what can be improved, how it can be improved.

The **Research Lead** should remind the stakeholders to do this. At the conclusion of Development (step 11), the **Development Lead** will collect the final edited personal stakeholder records and incorporate them into a Development Project Report (DPR).

END OF DOCUMENT