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A Joint Program for Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing

Foreign Commodity Production Forecasting

June 1981

VOLUME I

PROJECT PROCEDURES DESIGNATION AND DESCRIPTION DOCUMENT

J. T. Waggoner and D. E. Phinney

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16 Abstract

This document contains the procedures documentation of the AgRISTARS - Foreign Commodity Production Forecasting Project. Specifically it includes the technical/management documentation of the remote sensing data analysis procedures prepared in accordance with the guidelines provided in the FCPF Communications/Documentation Standards Manual (JSC-17141). The document contains those procedures presently under test or evaluation within the FCPF project up through June 1981.

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FCPF PROJECT PROCEDURES
DESIGNATION AND DESCRIPTION DOCUMENT

VOLUME I

Job Order 70-221
Job Order 72-422

THIS DOCUMENT PROVIDES THE FCPF TECHNICAL/MANAGEMENT STANDARDS DOCUMENTATION OF PROJECT PROCEDURES THROUGH JUNE 1981

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June 1981

LEMSCO-16852

TABLE OF CONTENTS

1. INTRODUCTION

1.1 PURPOSE AND SCOPE

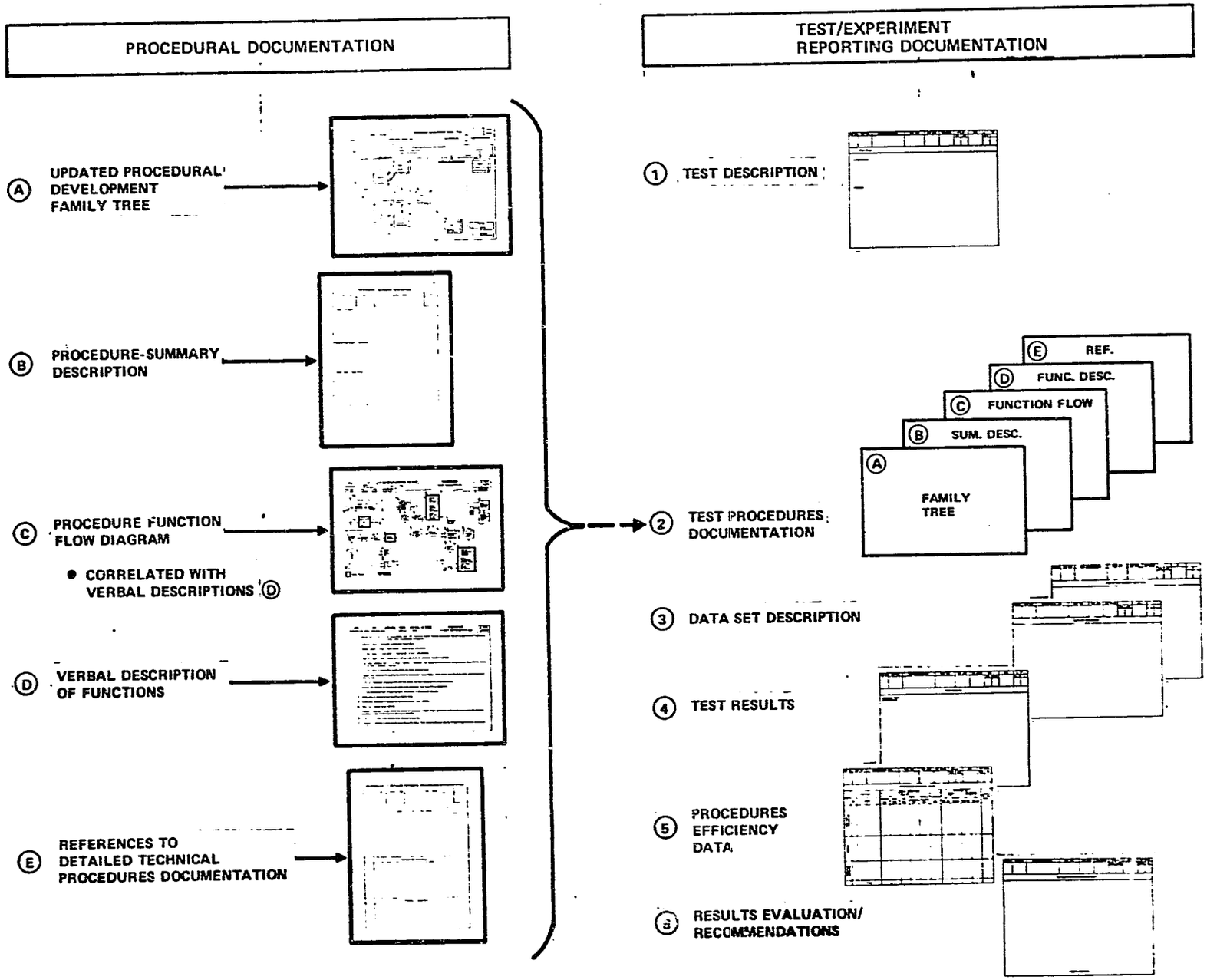
The purpose of this document is to provide the technical/management documentation of FCPF procedures prepared in accordance with the guidelines provided in the FCPF Communications/Documentation Standards Manual (JSC-17141).

Volume I of this FCPF procedures document contains the official documented procedures that have been developed in the SR/FCPF projects of the AgRISTARS program up through June 1981.

1.2 DOCUMENT DESCRIPTION

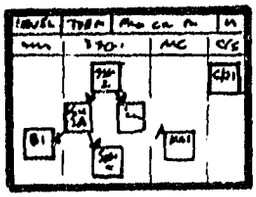
The FCPF Procedures Designation and Description Document is structured for user convenience. It consists of standard documentation sets that are arranged by procedural type and level (e.g., subsystem, component, subcomponent) then crop types or other technically differentiating categories. In Figure 1 a summary is presented of the basic documentation elements in the FCPF Procedures Description and Test Documentation. One may note that the procedural documentation is an integral part of the test documentation as well as being included within the FCPF Procedures Designation and Description document.

FIGURE 1. FCPF STANDARDS BASIC
DOCUMENTATION ELEMENTS SUMMARY



The basic procedures documentation set is structured as follows and consists of:

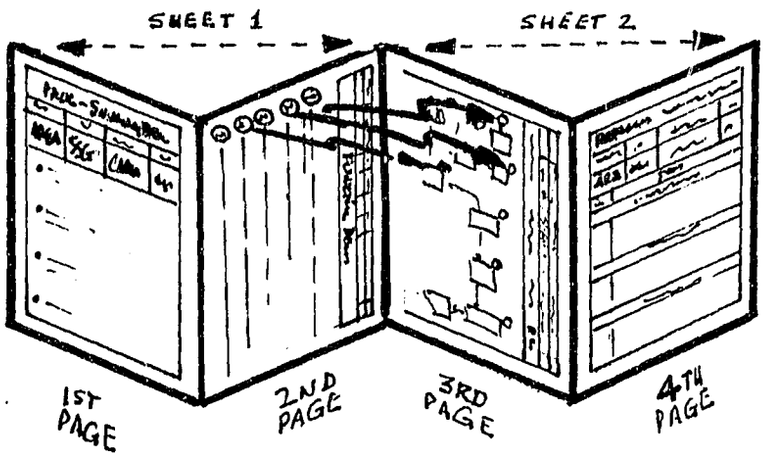
① Procedural Development Family Tree



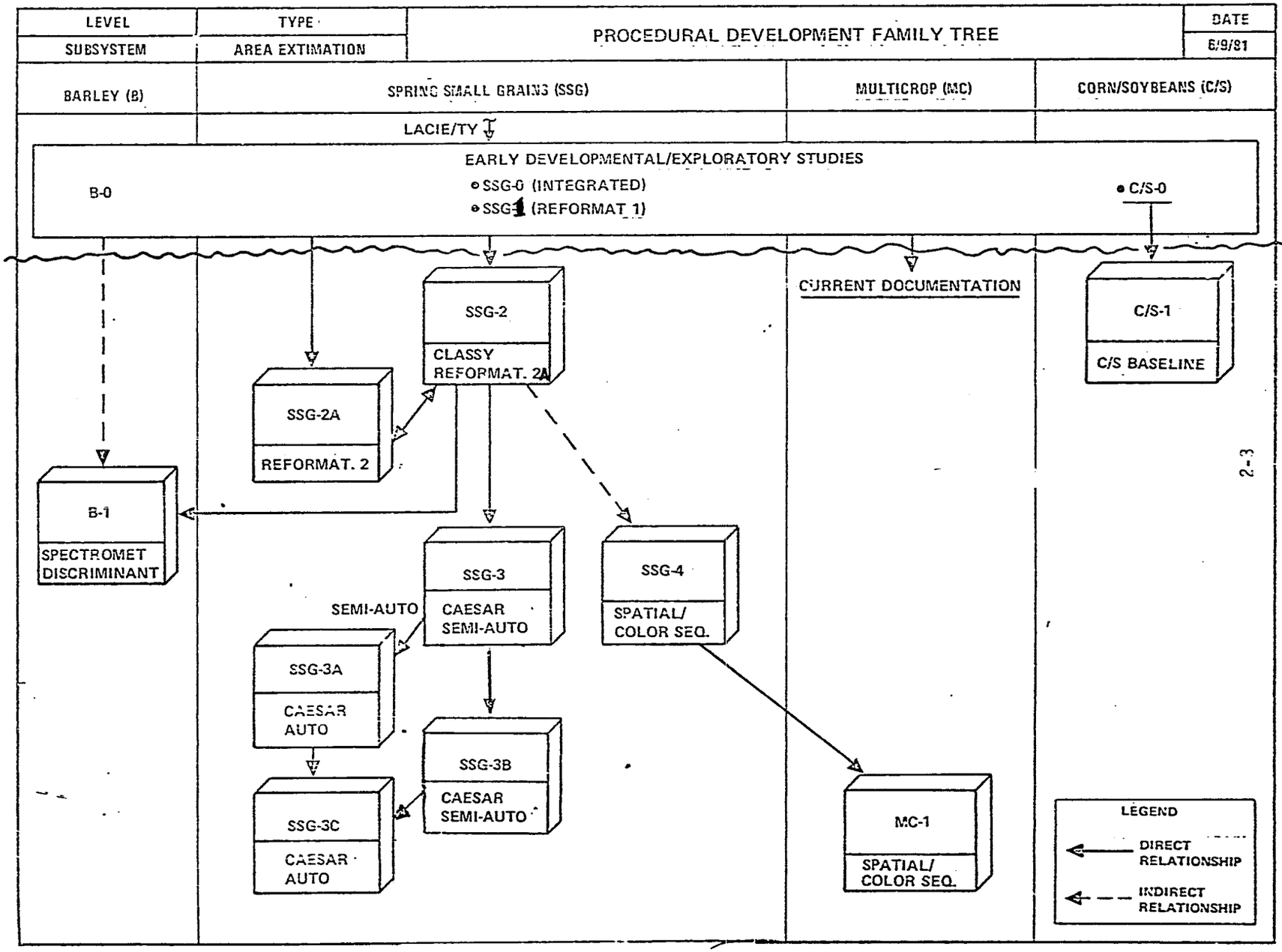
② Procedural Log

(Shows in which volume of the FCPF Procedures Documents that the latest procedural documentation may be found.)

③ Procedures Descriptive Documentation Set (4 pages)



2. AREA ESTIMATION PROCEDURES
(Subsystem Level)



PROCEDURE LOG: AREA ESTIMATION		TYPE COMM/DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	2.1 SPRING SMALL GRAINS							
	(Subsystem Level)							
SSG-2	"CLASSY"/Reformatted (2A)	X						
SSG-2A	Reformatted (2)	X						
SSG-3	CAESAR (Semi-Auto)	X						
SSG-3A	CAESAR (Auto)	X						
SSG-3B	CAESAR (Semi-Auto)	X						
SSG-3C	CAESAR (Auto)	X						
SSG-4	Spatial/Color Sequence	X						
	2-4							

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-2	"CLASSY"/REFORMATTED (2A)	SUBSYSTEM

- Purpose/rationale: To establish the FY81-82 U.S. SSG's Pilot Baseline Procedure by consolidating the improvements in labeling logic resulting from the pilot shakedown tests and the proportion estimation technique selected based on the results of the 1980 SSG's Exploratory Experiment.

- Relationship to past procedures:
  - --In general, this procedure was derived from an earlier manual procedure (SSG-1) which utilized objective labeling concepts from the early C/S procedure as well as the basic structure of the integrated procedure (SSG-0).
  - --The procedure embodies automation of the labeling subcomponents which were manual in earlier procedures as well as substantial modifications of the labeling logic itself.

- Data/resource requirements:
  - --Crop calendar data functions are required and are satisfied by a met driver biowindow mid-point model.
  - --Daily Met. data (temp) from standard operational network is required to support acquisition selection.
  - --Landsat digital and film products are required from a minimum of 3 acquisitions/segment satisfying a predefined distribution criteria during the growing season.
  - --Approximate manual ops. time per segment = _____.
  - --Approximate CPU ops. time per segment = _____.

- Summary of performance to date:

  Not yet tested

LEVEL	TYPE	TYPE CODE	REGION	PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	2		"CLASSY"/REFORMATTED (2A) CONT.	4/20/81

(18) Disk file containing spring grain or non-spring grain label for each pure target pixel.

(19) Spectral aids generated for each pixel. Greenness/brightness trajectory, target scatter, and multitemporal greenness and brightness plots.

(20) Manual analysis utilizing textural information from imagery to label pixel with no pure neighbor. Relabeling of pasture-confused pixels.

(21) Disk file containing final labels.

(22) Bayes proportion estimation using "Classy" cluster statistics, prior distributions, and procedure labels.

(23) Disk file or hard copy containing final segment proportion estimates.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	2		"CLASSY"/REFORMATTED (2A)	4/20/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50° F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Difference between greenness and soil line (green number) tabulated for selected pixels.

(10) Manual verification of automated acquisition selection, with override as necessary.

(11) Mixture decomposition of spectral data into normally distributed clusters.

(12) Allocation of sample pixels based on cluster size.

(13) Hard copy reference to analyst of candidate pixels to be labeled.

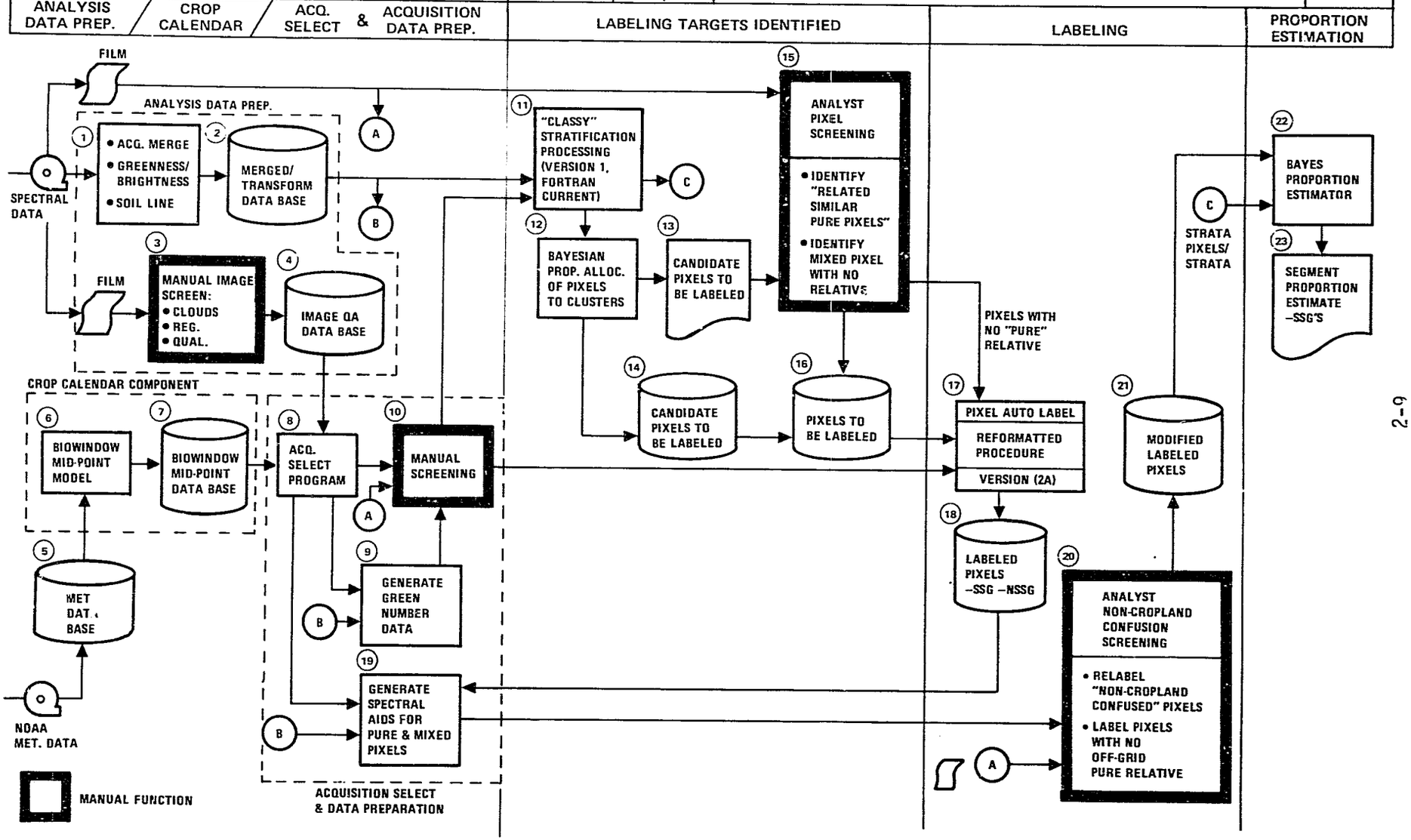
(14) Disk file of pixels to be labeled.

(15) Manual screening of target pixels for purity of signature. Mixed pixels associated with nearly pure pixels for labeling purposes. Some pixels may not have pure neighbor.

(16) Disk file of pixels to be labeled after manual screening.

(17) Automatic labeling of pure pixels using objective logic. Two major pathways may be followed depending on acquisition history.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	2		"CLASSY"/REFORMATTED (2A)	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-2	"CLASSY"/REFORMATTED (2A)	SUBSYSTEM

Ref. number	TITLE
	Technical description of documentation
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure used in Test 2, Part 2 of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
TBP	o Baseline Proportion Estimation Procedure for the 1981 U.S./Canada SSG Pilot Experiment.
642-6919	o Technical Memorandum: Mathematical Description and Program Documentation for CLASSY, An Adaptive Maximum Likelihood Clustering Method.
	o The Tasselled Cap - A Graphic Description of the Spectral-Temporal Development of Agricultural Crops as Seen by Landsat.
	o A Sequential Bayesian Model for Stratified Proportion Estimation.
	Software documentation
JSC-17322	o User's Guide and "As Built" Executive File Design Specification for the Spring Small Grains (SSG) Pilot Experiment Processing System.
TBP	o Automated Reformatted Labeling System.
TBP	o Spectral Aids: As Built Design Specification for Pixel Selection and Display System.
	Procedural consultant(s)
	W. L. Palmer E. R. Magness B. S. Ontko R. R. J. Mohler D. C. Helmer J. M. Disler

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-2A	REFORMATTED (2)	SUBSYSTEM

• Purpose/rationale:

--To provide a shakedown test of the labeling subcomponents that would be used in the FY81-82 SSG's pilot experiments.

• Relationship to past procedures:

--It is a simplified version of SSG-2 designed to test the labeling subcomponent.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Mid-Point Model.
--Daily Met. data (temp) from standard operational network is required to support acquisition selection.
--Landsat digital and film products are required from a minimum of 3 acquisitions/segment satisfying a predefined distribution criteria during the growing season.
--Approximate manual operation time per segment = _____.
--Approximate CPU operation time per segment = _____.

• Summary of performance to date:

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	2	A	REFORMATTED (2)	5/22/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50°F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions automatically selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Manual screening of target pixels (209) for purity of signature. Selects pure pixels for labeling.

(10) Automatic labeling of pure pixels using objective logic. Two major pathways may be followed depending on acquisition history.

(11) Disk file containing spring grain or nonspring grain label for each pure target pixel.

(12) Spectral aids generated for each pixel. Greenness/brightness trajectory, target scatter, and multitemporal greenness and brightness plots.

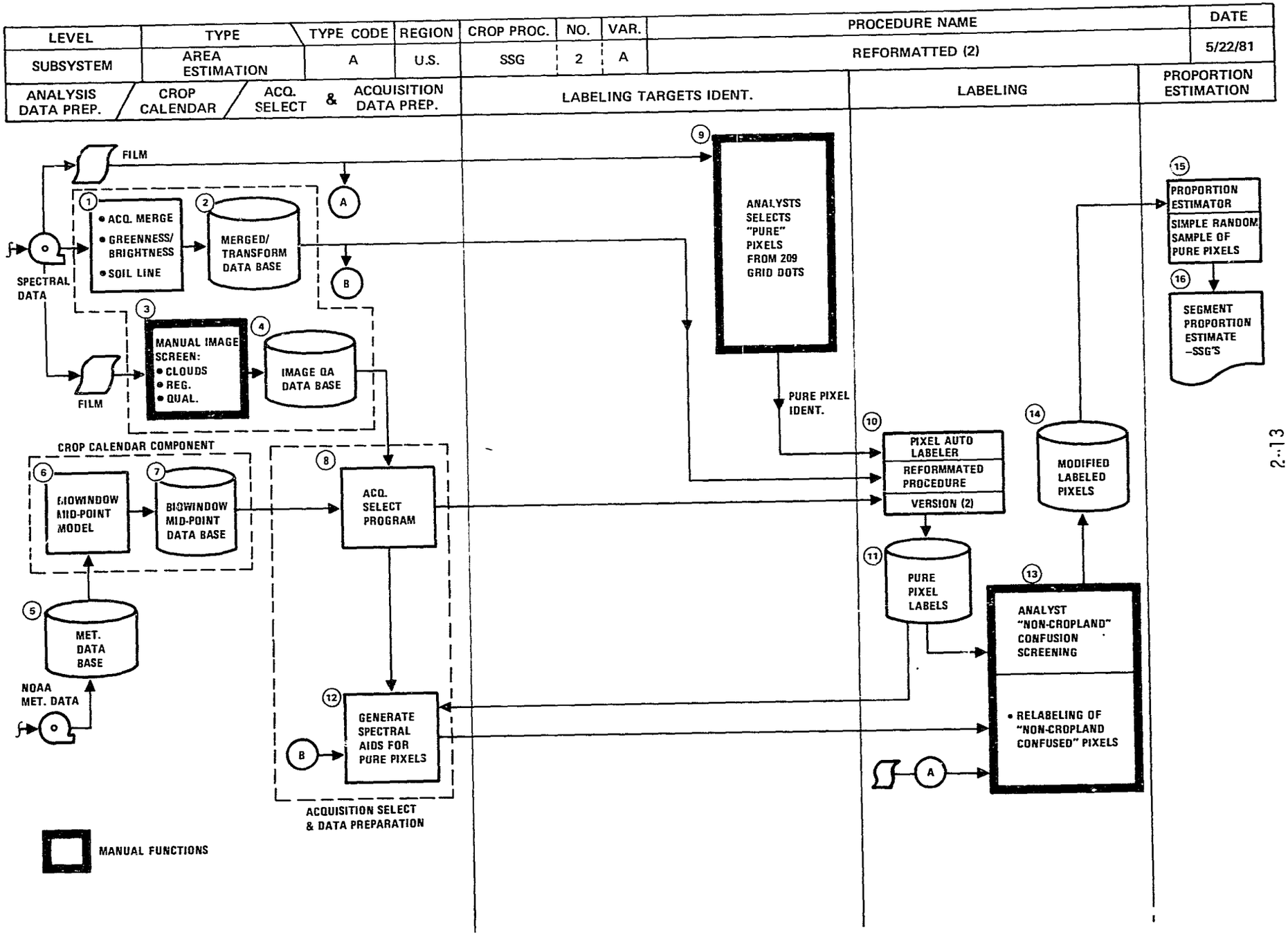
(13) Manual analysis utilizing textural information from imagery to label pixel with no pure neighbor. Relabeling of pasture-confused pixels.

(14) Disk file containing final pixel labels.

(15) Proportion estimation using single random sample of the "pure" subset of 209 pixels to make proportion estimate of SSG's.

(16) Disk file or hard copy containing final segment proportion estimates.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	2	A	REFORMATTED (2)	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-2A	REFORMATTED (2)	SUBSYSTEM

Ref. number	TITLE
Technical description of documentation	
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure used in Test 2, Part 2 of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
642-6919	o Baseline Proportion Estimation Procedure for the 1981 U.S./Canada SSG Pilot Experiment.
	o Technical Memorandum: Mathematical Description and Program Documentation for CLASSY. An Adaptive Maximum Likelihood Clustering Method.
	o The Tasselled Cap - A Graphic Description of the Spectral-Temporal Development of Agricultural Crops as seen by Landsat.
Software documentation	
JSC-17322	o User's Guide and "As Built" Executive File Design Specification for the Spring Small Grain (SSG) Pilot Experiment Processing System.
TBP	o Automated Reformatted Labeling System.
TBP	o Spectral Aids: As Built Design Specification for Pixel Selection and Display System.
Procedural consultant(s)	
	W. L. Palmer E. R. Magness B. S. Ontko R. F. J. Mohler D. C. Helmer J. M. Disler P. H. Ishikawa K. S. Nedelman S. L. Greenberg

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-3	CAESAR (SEMI-AUTO)	SUBSYSTEM

• Purpose/rationale:

--To develop an efficient semi-automated labeling and proportion estimation procedure based on parts of the SSG-2 logic.

--To simplify the proportion estimator.

• Relationship to past procedures:

--Uses, with minor changes, the augmented portion of SSG-2 labeling logic to label pixels.

--A manual screening of the acquisition selection is used.

--Uses a systematic random sample of pixels (209 dots) with a relative count for the proportion estimator.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Mid-Point Model.
--Daily Met. data (temp) from standard operational network is required to support acquisition selection.
--Landsat digital and film products are required from a minimum of 3 acquisitions/ segment satisfying a predefined distribution criteria during the growing season.
--Approximate manual operation time per segment = _____.
--Approximate CPU operation time per segment = _____.

• Summary of performance to date:

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	3		CAESAR (SEMI-AUTO)	5/22/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50° F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Difference between greenness and soil line (green number) tabulated for selected pixels.

(10) Manual verification of automated acquisition selection, with override as necessary.

(11) Automatic labeling of pure pixels based on the Augmented Decision Logic Path of the Reformatted Labeling Logic (Version Zero).

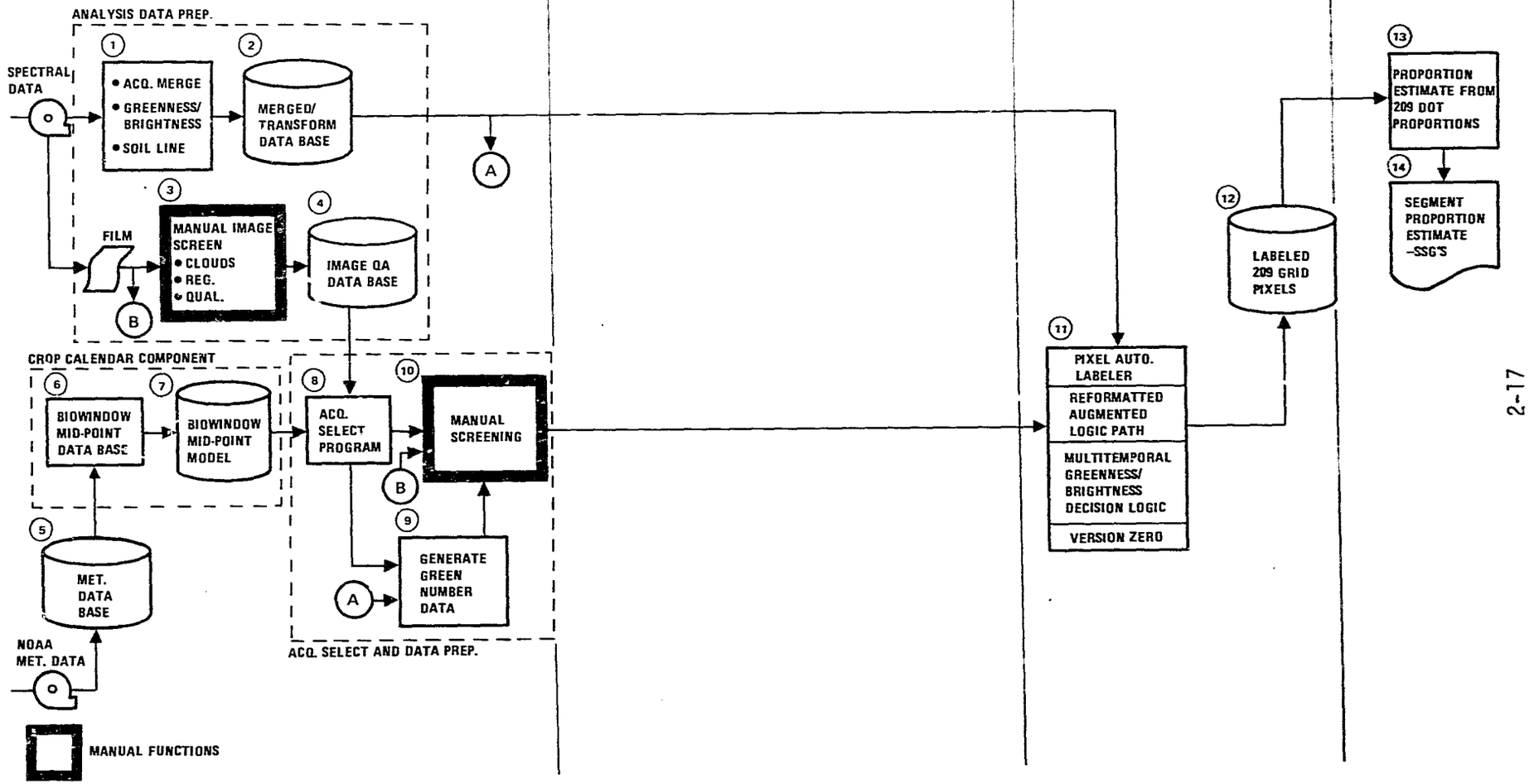
(12) Disk file containing final labels for 209 grid pixels.

(13) Proportion estimate based on relative count of 209 pixels.

(14) Disk file containing SSG's proportion estimates for segments.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	3		CAESAR (SEMIAUTO.)	5/22/81

ANALYSIS DATA PREP. / CROP CALENDAR / ACQ. SELECT & ACQUISITION DATA PREP.	LABELING TARGETS IDENTIFIED	LABELING	PROPORTION ESTIMATION



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-3	CAESAR (Semi-Auto)	Subsystem

Ref. number	TITLE
Technical description of documentation	
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure Used in Test 2, Part 2, of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
TBP	o CAESAR
Software documentation	
TBP	Documentation for the Computerized Area Estimation Using Augmentation to Reformatted Logic (Caesar) System.
Procedural consultant(s)	
	W. F. Palmer R. J. Mohler B. S. Ontko E. R. Magness G. W. Mink J. M. Zullo D. C. Helmer R. L. Fagan J. M. Jones G. D. Spikes

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-3A	CAESAR (AUTO)	SUBSYSTEM

• Purpose/rationale:

To completely automate the labeling, acquisition selection, and proportion estimation functions of SSG-3.

• Relationship to past procedures:

This is the same procedure as SSG-3 except there is not a manual acquisition selection screening.

• Data/resource requirements:

- Crop calendar data functions are required and are satisfied by a met driven bio-window mid-point model.
- Daily met data (temp.) from standard operational network is required to support acquisition selection.
- Landsat digital and film products are required from a minimum of 3 acquisitons/ segment satisfying a predefined distribution criteria during the growing season.
- Approx. Manual Ops. Time per segment = _____
- Approx. CPU Ops. Time per segment = _____

• Summary of performance to date:

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	3A		CAESAR (AUTO)	4/20/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50° F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Automatic labeling of pure pixels using the Modified Reformatted Augmented Logic Path (Version Zero).

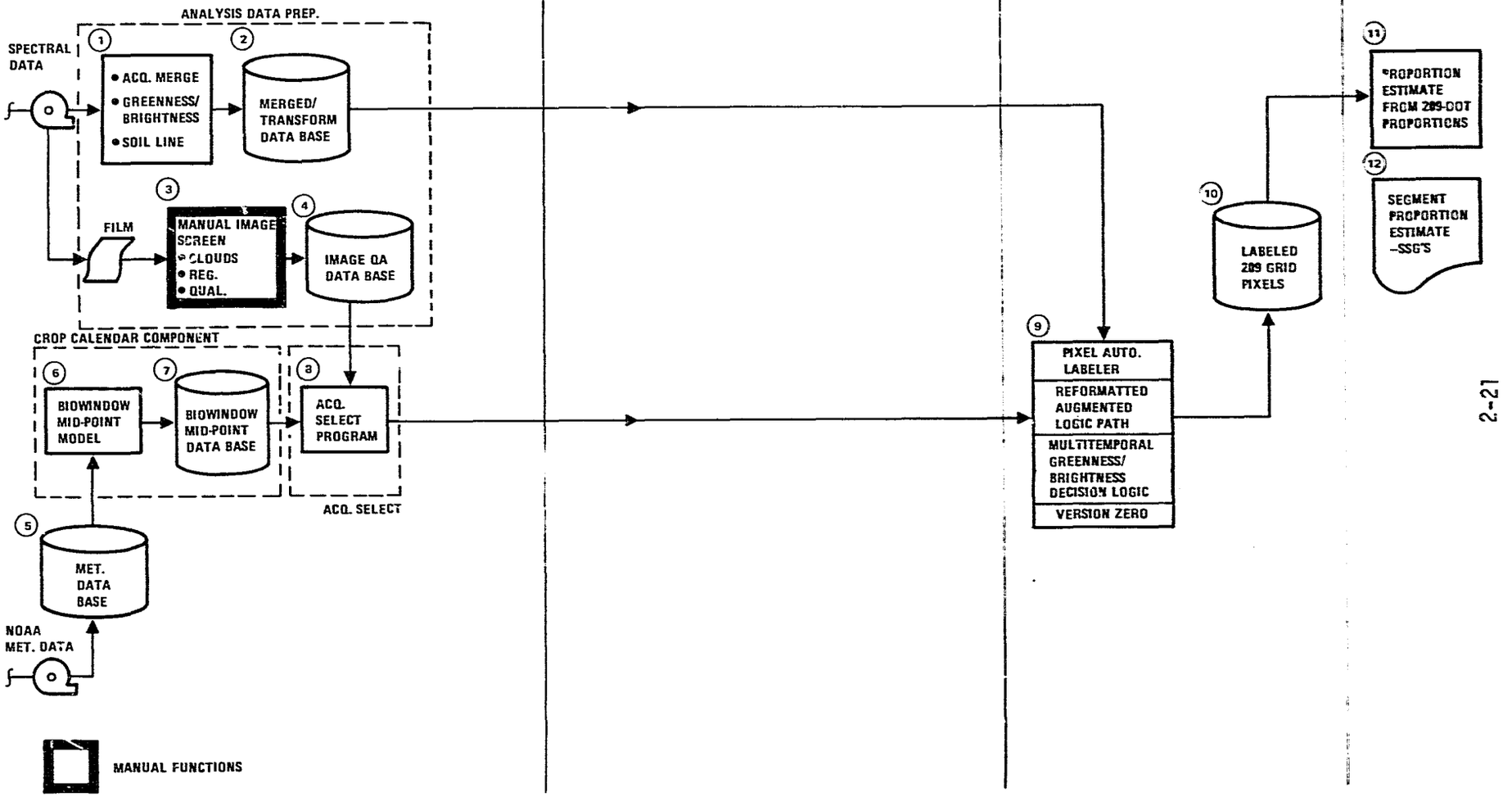
(10) Disk file containing final labeled 209 grid pixels.

(11) Proportion estimation based on relative count of 209 pixels.

(12) Disk file and hard copy containing SSG's proportion estimate.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	3	A	CAESAR (AUTO.)	5/22/81

ANALYSIS DATA PREP. / CROP CALENDAR / ACQ. SELECT & ACQUISITION DATA PREP.	LABELING TARGETS IDENT.	LABELING	PROPORTION ESTIMATION



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-3A	CAESAR 1A (Auto)	Subsystem

Ref. number	TITLE
Technical description of documentation	
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure Used in Test 2, Part 2, of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
TBP	o CAESAR
Software documentation	
TBP	Documentation for the Computerized Area Estimation Using Augmentation to Reformatted Logic (Caesar) System.
Procedural consultant(s)	
	W. F. Palmer R. J. Mohler B. S. Ontko E. R. Magness G. W. Mink J. M. Zullo D. C. Helmer R. L. Fagan J. M. Jones G. D. Spikes

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-3B	CAESAR (SEMI-AUTO)	SUBSYSTEM

• Purpose/rationale:

--To increase the accuracy of SSG-3 and SSG-3A by:

- o Studying the effects of acquisition selection requirements
- o Attempting to fix the problem of commission of pasture to SSG.

• Relationship to past procedures:

--This procedure is the same as SSG-3 except with:

- o Modified acquisition requirements (which become refined strata dependent)
- o Some modifications to the decision logic to fix the commission error of pasture to small grain.
- o An increase of the samples to be labeled to 836.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Mid-Point Model.
--Daily Met. data (temp) from standard operational network is required to support acquisition selection.
--Landsat digital and film products are required from a minimum of 3 acquisitions/segment satisfying a predefined distribution criteria during the growing season.
--Approximate manual operation time per segment = _____.
--Approximate CPU operation time per segment = _____.

• Summary of performance to date:

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	3B		CAESAR (SEMI-AUTO)	4/20/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50° F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Difference between greenness and soil line (green number) tabulated for selected pixels.

(10) Manual verification of automated acquisition selection, with override as necessary.

(11) Automatic labeling of pixels using (Version One) of the Reformatted Augmented Labeling Logic Path.

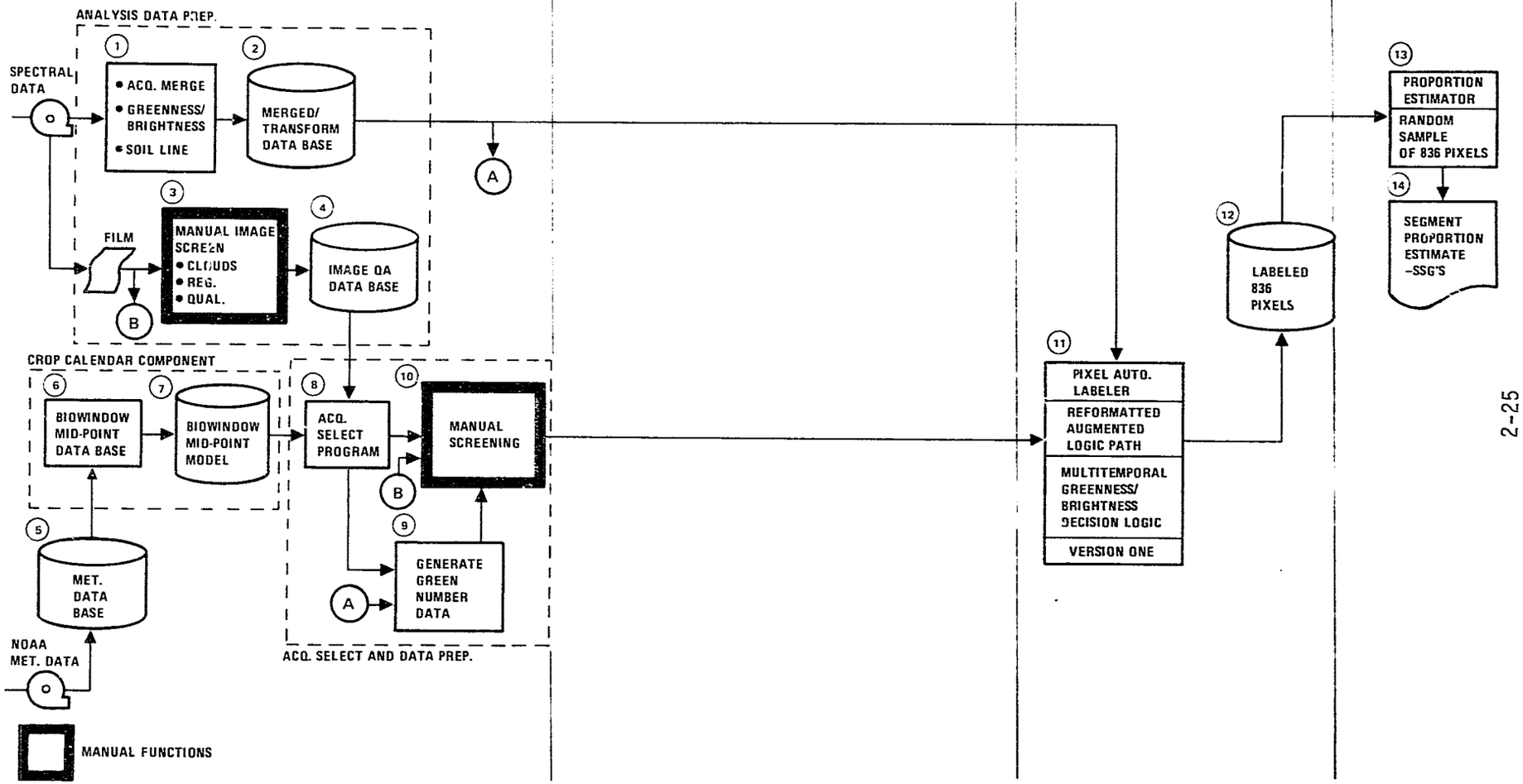
(12) Disk file containing final labels for 836 sample pixels.

(13) Proportion estimation using relative count of the 836 sample pixels.

(14) Disk file and hard copy of SSG's proportion estimate for segments.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	3	B	CAESAR (SEMIAUTO.)	5/22/81

ANALYSIS DATA PREP. / CROP CALENDAR / ACQ. SELECT & ACQUISITION DATA PREP.	LABELING TARGETS IDENTIFIED	LABELING	PROPORTION ESTIMATION



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-3B	CAESAR (Semi-Auto)	Subsystem

Ref. number	TITLE
Technical description of documentation	
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure Used in Test 2, Part 2, of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
TBP	o CAESAR
Software documentation	
TBP	Documentation for the Computerized Area Estimation Using Augmentation to Reformatted Logic (Caesar) System.
Procedural consultant(s)	
	W. F. Palmer R. J. Mohler B. S. Ontko E. R. Magness G. W. Mink J. M. Zullo D. C. Helmer R. L. Fagan J. M. Jones G. D. Spikes

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-3C	CAESAR (AUTO)	SUBSYSTEM

• Purpose/rationale:

--To automate the acquisition selection function of SSG-3B

• Relationship to past procedures:

--This procedure is the same as SSG-3B with the exception:

o Manual screening of acquisition function has been deleted.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Mid-Point Model.
--Daily Met. data (temp) from standard operational network is required to support acquisition selection.
--Landsat digital and film products are required from a minimum of 3 acquisitions/segment satisfying a predefined distribution criteria during the growing season.
--Approximate manual operation time per segment = _____.
--Approximate CPU operation time per segment = _____.

• Summary of performance to date:

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	3C		CAESAR (AUTO)	4/20/81

(1) Merge spectral data for all acquisitions (limit 15). Perform Kauth-Thomas transform. Retain greenness and brightness. Calculate soil line as 1% lower limit of greenness histogram.

(2) Tape data base of merged/transformed image data.

(3) Manual quantification of data quality, registration, and cloud.

(4) Disk data base of image quality information for each acquisition.

(5) Tape data base of daily temperature and precipitation for synoptic weather stations.

(6) Biowindow midpoint dates (4 cardinal windows) calculated from accumulations of daily temperatures (base 50° F). Dates interpolated to segment location.

(7) Disk data base of biowindow center dates for each segment/year.

(8) Acquisitions selected for processing based on biowindow center dates, cloud cover, and minimum data requirements of labeling logic.

(9) Automatic labeling of pixels using (Version One) of the Reformatted Augmented Labeling Logic.

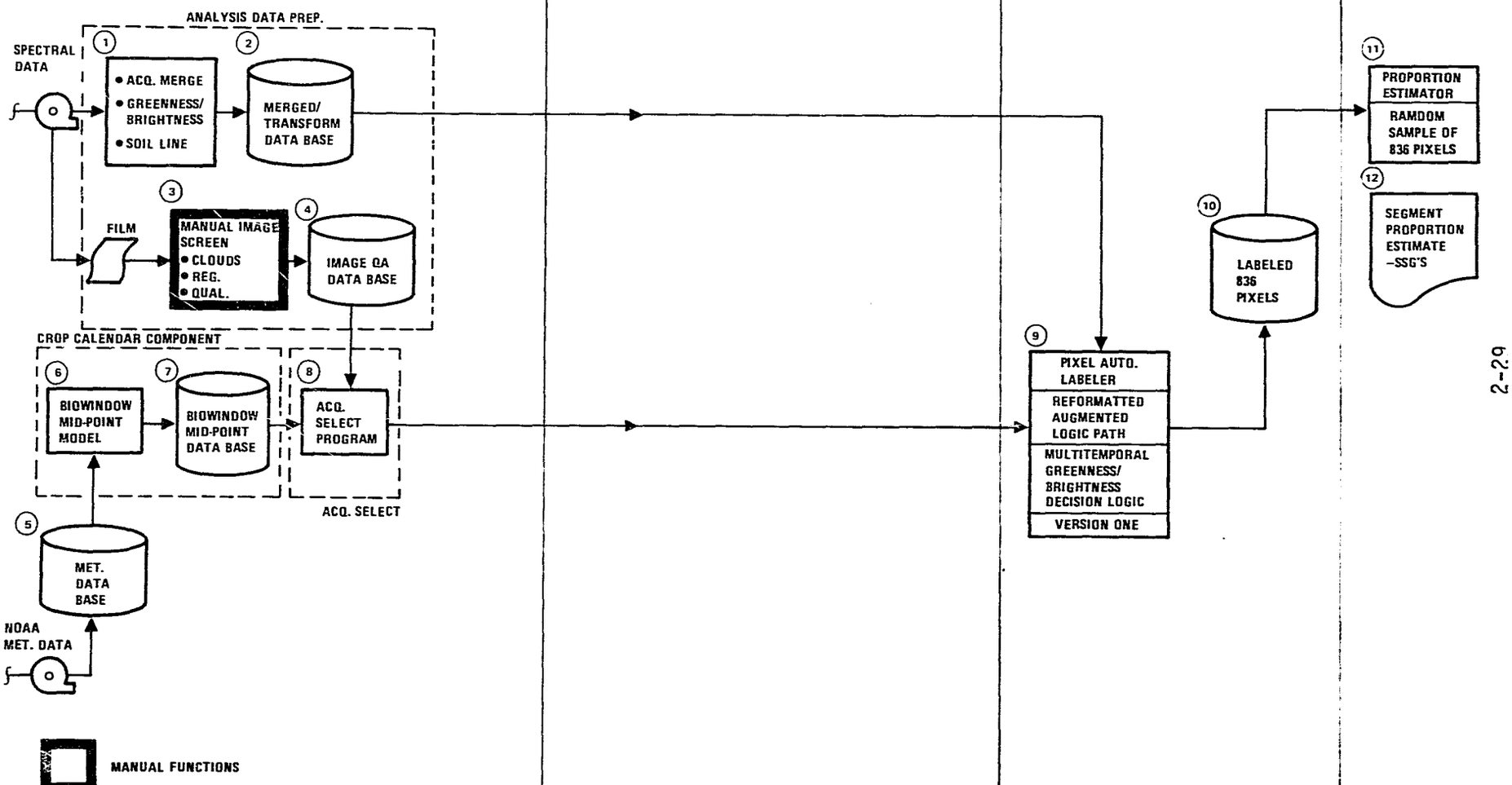
(10) Disk file containing final labels for 836 sample pixels.

(11) Proportion estimation using relative count of the 836 sample pixels.

(12) Disk file and hard copy of segment SSG's proportion estimates.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	3	C	CAESAR (AUTO.)	5/22/81

ANALYSIS DATA PREP. / CROP CALENDAR / ACQ. SELECT & ACQUISITION DATA PREP.	LABELING TARGETS IDENT.	LABELING	PROPORTION ESTIMATION



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-3C	CAESAR (Auto)	Subsystem

Ref. number	TITLE
Technical description of documentation	
JSC 16827	o A Description of the Reformatted Spring Small Grains Labeling Procedure Used in Test 2, Part 2, of the U.S./Canada Wheat and Barley Exploratory Experiment.
TBP	o Reformatted Spring Small Grains Labeling Procedure Augmentation.
TBP	o CAESAR
Software documentation	
TBP	Documentation for the Computerized Area Estimation Using Augmentation to Reformatted Logic (Caesar) System.
Procedural consultant(s)	
	W. F. Palmer R. J. Mohler B. S. Ontko E. R. Magness G. W. Mink J. M. Zullo D. C. Helmer R. L. Fagan J. M. Jones G. D. Spikes

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	SSG-4	SPATIAL/COLOR SEQUENCE	SUBSYSTEM

• Purpose/rationale:

--To model and automate analysts subjective labeling logic in terms of spatial and temporal color sequences and to correct for negative bias due to acquisition history/planting date distribution interactions.

• Relationship to past procedures:

--This is a new procedure that incorporates the Integrated Procedure Logic (SSG-0) and the Biowindow Product 1 appearance teams.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Duration Model.
--Daily Met. data (temp) from standard operational network is required to support acquisition selection.
--Landsat digital products are required from a minimum of 3 acquisitions/segment in at least two biowindows from Biowindows 2, 3, 4.
--Approximate CPU operation time per segment = 10 minutes.

• Summary of performance to date:

o Based on about 60 1978-79 segments, the procedure had an RMSE of about 10% (absolute proportion error) with little bias.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION		US/CAN	SSG	4	-	SPATIAL/COLOR SEQUENCE	

(1) Visual determination of acquisition quality with respect to clouds, misregistration, and noise.

(2) File of acquisition quality ratings.

(3) Meteorological data for each segment (maximum/minimum temperatures).

(4) Meteorological model for predicting the beginning and end dates of each spectral biowindow.

(5) Data base containing biowindow dates for each segment.

(6) Acquisition selection algorithm to choose best available combination of acquisitions, or reject segment as nonprocessable.

(7) Listing of acquisitions chosen for each segment.

(8) Merging of spectral data for each segment.

(9) Merged spectral data for all chosen acquisitions.

(10) Normalization through division by channel means followed by conversion to channel rankings codes.

(11) Definition of boundaries of vegetated areas in each acquisition using channel ranking codes.

(12) Overlaying of vegetated areas on all acquisitions to define fields which follow homogeneous sequences of vegetated and nonvegetated areas.

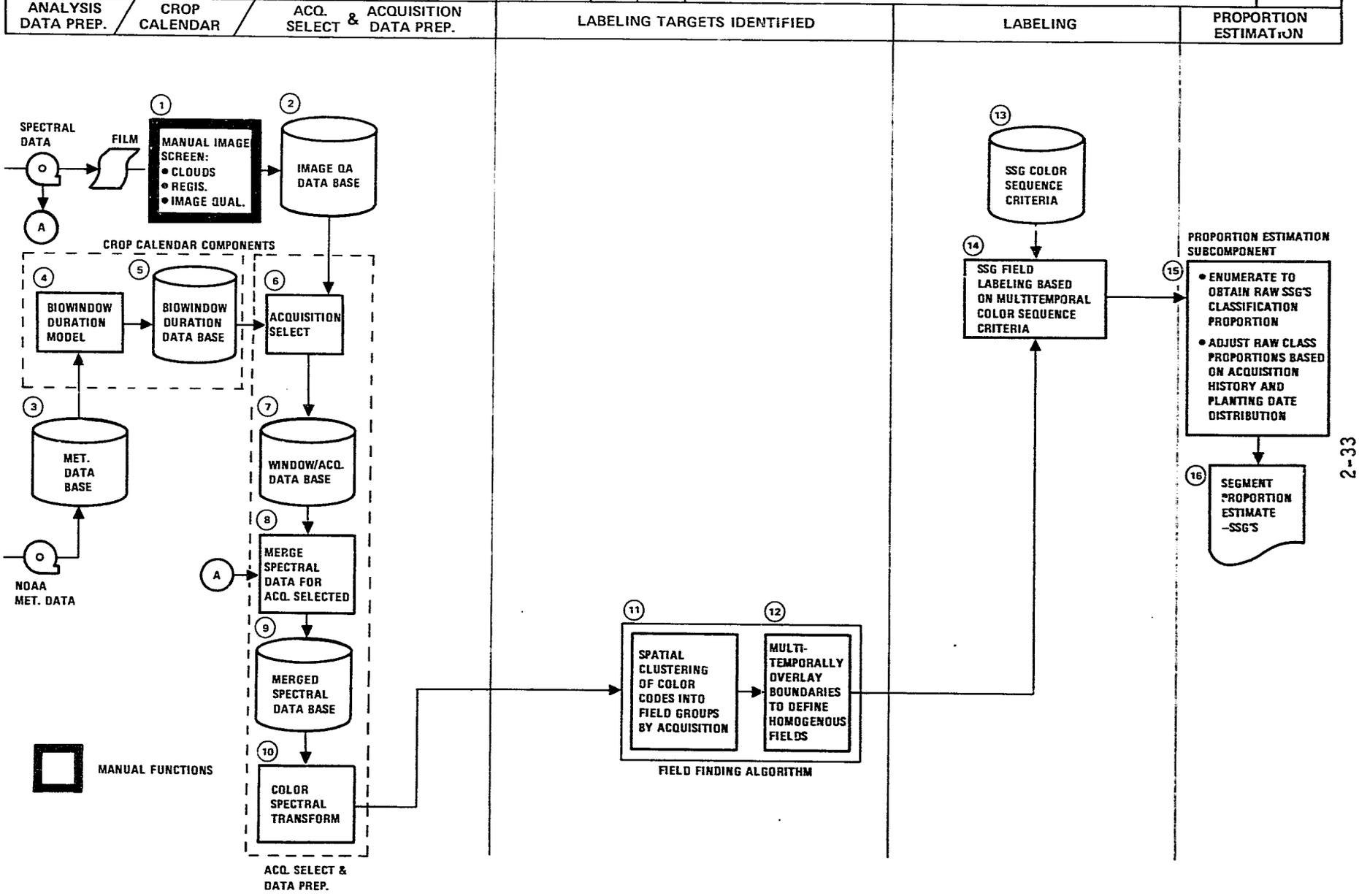
(13) Predetermined labeling logic algorithm that states which vegetation/nonvegetation sequences are to be considered spring small grains.

(14) Labeling of each field as spring sm ains or other.

(15) Summing of number of pixels contained in fields labeled spring small grains to obtain conservative estimate of SSG proportion. This is followed by an increase in the estimate based on the calculated omission rate which is modeled using interaction of acquisition history and predetermined planting data distribution. This accounts for fields which were missed due to early or late planting.

(16) Final spring small grains proportion estimate for each segment.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	SSG	4		SPATIAL/COLOR SEQUENCE	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	SSG-4	Spatial/Color Seq.	Subsystem

Ref. number	TITLE
	Technical description of documentation
1	Technical Report - Interpretation of Landsat Digitial Data Using a Cubic Color Model Based on Relative Energies. Cate et al. AgRISTARS SR-L0-004h8, JSC-13776, Feb. 1980.
2	Spatial/Color Sequence Proportion Estimation Techniques T. B. Dennis AgRISTARS SR-L0-04028, JSC-16848, Dec. 1980
	Software documentation
3	As-Built Design Specification (in review)
	Procedural consultant(s)
	R. B. Cate T. B. Dennis

PROCEDURE LOG:		FCPF COMM/DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	2.2 BARLEY:							
	(SUBSYSTEM LEVEL)							
B-1	BARLEY-SPECTROMET DISCRIMINANT							
	2-35							

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
Area Estimation	B-1	Barley Spectromet Discriminant	Subsystem

• Purpose/rationale:

- To provide an automated Barley/Other SSG's separator function integrated with the SSG-2 procedures.

• Relationship to past procedures:

- Uses previous study information on identification of optimum Barley/other SSG's separation window.
- This technique utilizes a standard discriminant statistical function applied to both transformed spectral and meteorological variables.

• Data/resource requirements:

Same as SSG-2 plus ...

- An acquisition during the Barley separation window (during approximately a 2-week post-reading time frame) is required.
- An additional met variable is calculated from the existent met data for the Barley separation acquisition date.
- Procedure adds a few records to CPU processing time of SSG-2.

• Summary of performance to date:

Subcomponent test on Barley spectromet discriminant function has shown to be of similar capability as was best previous manual procedure (B-o)

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	US/CAN	B	1		BARLEY SPECTROMET DISCRIMINANT	5/22/81

FUNCTION DESCRIPTIONS

(31) Bayes proportion estimate for barley and other SSG using "CLASSY" cluster statistics, prior distributions and discriminant labels.

(32) Disk file or hard copy containing final segment barley and other SSG proportion estimates.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	US/CAN	B	1		BARLEY SPECTROMET DISCRIMINANT	5/22/81

FUNCTION DESCRIPTIONS

(18) Disk file containing spring grain or nonspring grain label for each pure target pixel.

(19) Spectral aids generated for each pixel. Greenness/brightness trajectory, target scatter, and multitemporal greenness and brightness plots.

(20) Manual analysis utilizing textural information from imagery to label pixel with no pure neighbor. Relabeling of pasture-confused pixels.

(21) Disk file containing SSG final labels.

(22) Check for barley separation window acquisition.

If no barley separation window acquisition:

(23) Bayes proportion estimation for SSG using "CLASSY" cluster statistics, prior distributions, and procedure labels.

(24) Disk file or hard copy containing final segment SSG proportion estimates.

If barley separation window acquisition:

(25) Disk file containing base 40 F accumulated degree day value for barley separation acquisition.

(26) Extract rows Landsat data for each pixel labeled SSG by procedure.

(27) Disk file containing spectral data for each SSG pixel.

(28) Correct spectral data for sensor, sun angle haze and perform Kauth-Thomas transform.

(29) Disk file containing predetermined coefficients for a linear discriminant function including strata a priori probability of barley.

(30) Linear discrimination of barley/other SSG in greenness, brightness, degree day feature space.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	US/CAN	B	1		BARLEY SPECTROMET DISCRIMINANT	5/22/81

FUNCTION DESCRIPTIONS

(18) Disk file containing spring grain or nonspring grain label for each pure target pixel.

(19) Spectral aids generated for each pixel. Greenness/brightness trajectory, target scatter, and multitemporal greenness and brightness plots.

(20) Manual analysis utilizing textural information from imagery to label pixel with no pure neighbor. Relabeling of pasture-confused pixels.

(21) Disk file containing SSG final labels.

(22) Check for barley separation window acquisition.

If no barley separation window acquisition:

(23) Bayes proportion estimation for SSG using "CLASSY" cluster statistics, prior distributions, and procedure labels.

(24) Disk file or hard copy containing final segment SSG proportion estimates.

If barley separation window acquisition:

(25) Disk file containing base 40°F accumulated degree day value for barley separation acquisition.

(26) Extract rows Landsat data for each pixel labeled SSG by procedure.

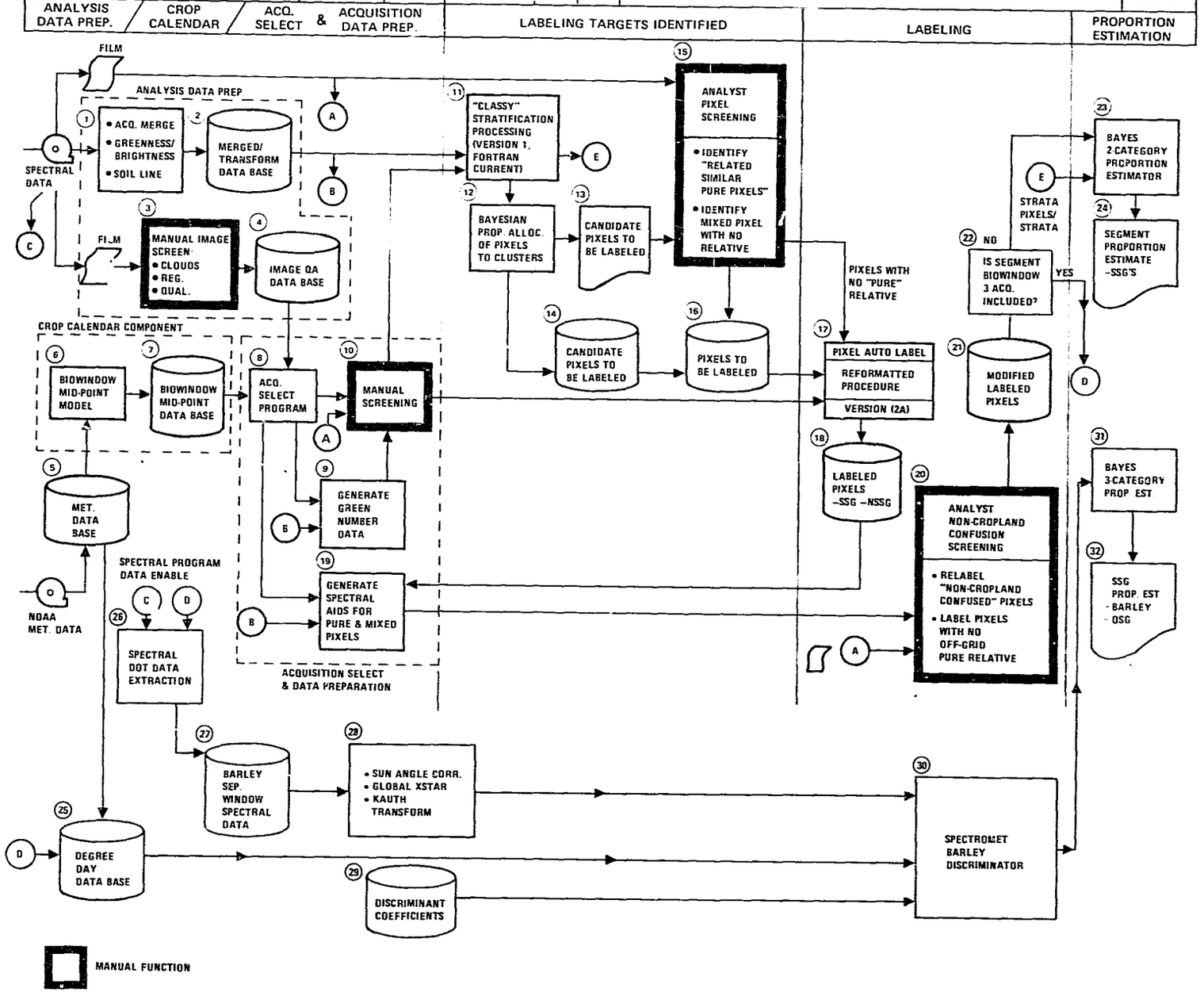
(27) Disk file containing spectral data for each SSG pixel.

(28) Correct spectral data for sensor, sun angle haze and perform Kauth-Thomas transform.

(29) Disk file containing predetermined coefficients for a linear discriminant function including strata a priori probability of barley.

(30) Linear discrimination of barley/other SSG in greenness, brightness, degree day feature space.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	B	1		SPECTROMETRIC DISCRIMINANT	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Est.	B-1	Barley Spectral Discriminant	Subsystem

Ref. number	TITLE
Technical description of documentation	
JSC-17155 Vol.1	See SSG-2 References (Page 2-10) for information on the SSG-2 portions of the B-1 procedure. FCPF Test Report #2 spectromet barley/other SSG discriminant (Developmental subcomponent test documentation)
Software documentation	
	TBD
Procedural consultant(s)	
	D. E. Phinney

PROCEDURE LOG:		FCPF COMM./DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	2.3 CORN/SOYBEANS:							
C/S-1	CORN/SOYBEAN BASELINE	X						
	2-45							

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	C/S-1	U.S. CORN/SOYBEANS BASELINE CLASSIFICATION	SUBSYSTEM

• Purpose/rationale:

--To generate near-harvest segment proportion estimates for corn and soybeans in the U.S. Corn Belt (Iowa, Illinois, Indiana) using Landsat MSS data. This is the first of the corn/soybean technologies designed for large scale demonstration pilot experiments.

• Relationship to past procedures:

--The basic structure of the labeling strategy was adopted from C/S-0. The TY Exploratory Corn/Soybean Classification Procedure.
--The target delineating and proportion estimation strategies were adopted from the LACIE Small Grains procedure, Procedure M, ERIM.

• Data/resource requirements:

--Requires historical crop calendars.
--Landsat MSS digital data and PFC film products 1 and 3 required from a minimum of 2 acquisitions/segment with one acquisition from the summer corp growing season.

--Approximate manual operation time per segment = 15-20 hours.
--Approximate CPU operation time per segment = 30 minutes.

• Summary of performance to date:

Pilot shakedown test results indicated slight overestimation of corn and underestimation of soybean proportions even with ground truth labeled targets.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	US	C/S	1		CORN/SOYBEANS BASELINE CONT.	

(19) Manual final labeling of blobs and indication of confidence in label.

(20) Weighted aggregation of blob labels (large blobs).

(21) Segment proportion estimate by extension labeled blobs to unsampled (little) blobs and aggregating stratum.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	US	C/S	1		CORN/SOYBEANS BASELINE	

(1) Historical crop stage data at lowest possible geopolitical level. Development stage model output at segment level. All possible crops.

(2) Manual image screen to delete excessive cloud.

(3) Manual acquisition selection based on crop calendar and imagery data in an interative analysis.

(4) Screen algorithm for cloud identification. Sensor calibration, Sun-angle correction, and XSTAR haze correction.

(5) Temporal pattern class (TPC) features extracted in transformed brightness/GRABS space for each pixel.

(6) Temporal pattern class feature report summarizing multitemporal vegetation/nonvegetation.

(7) Manual stratification of TPC into major crop groups.

(8) Spectral scatter plots for summer crop group.

(9) Strata map production for major crop groups.

(10) Manual selection of TPC for blob labeling spectral aids plots.

(11) Spectral aid creation for selected strata.

(12) Hard copy spectral aids.

(13) Manual determination of corn/soybean discriminant line.

(14) Manual determination of acquisition with best corn/soybean separation. Selection of acquisition subset for determining field-like patterns (blobs).

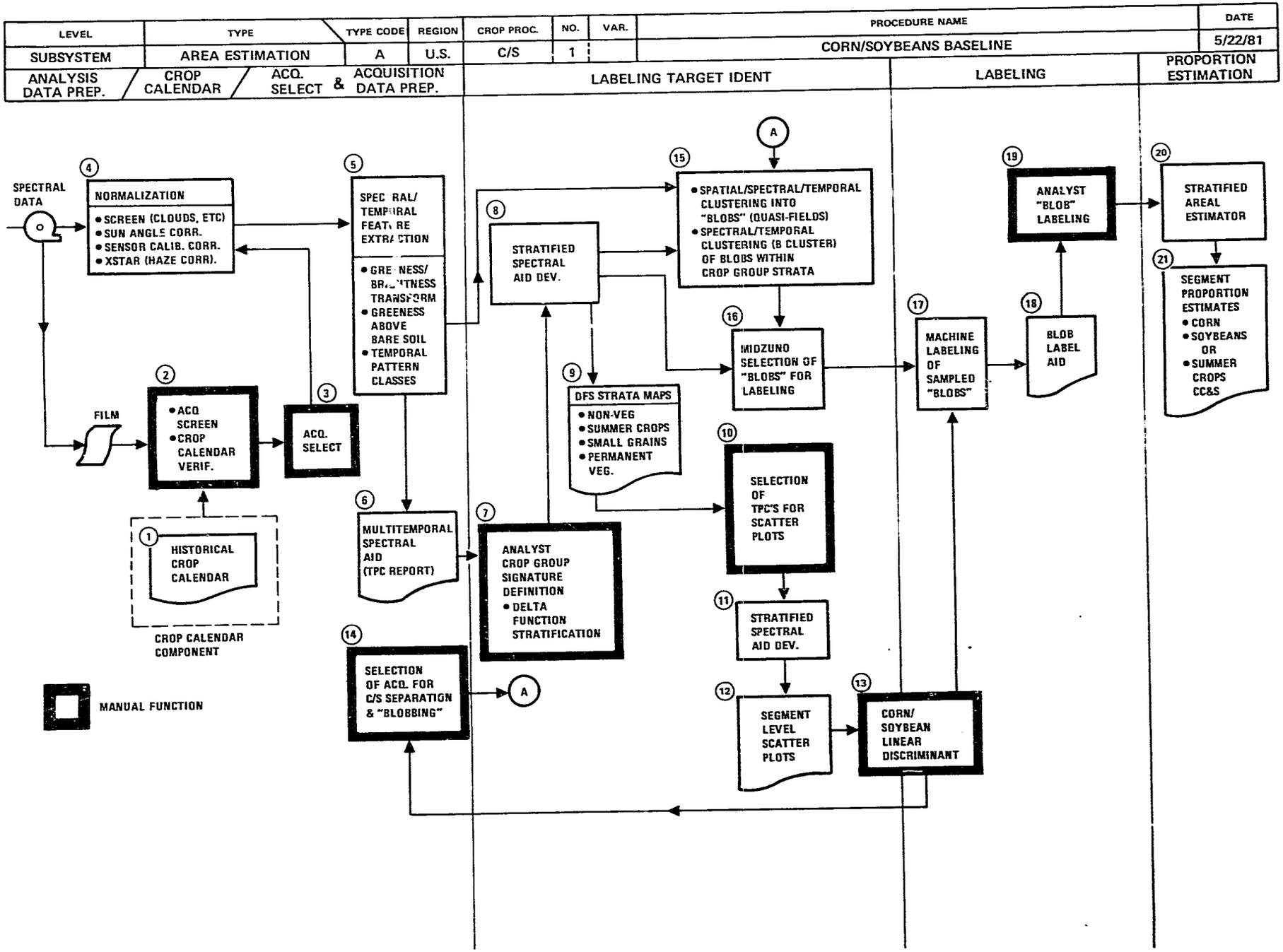
(15) Creation of target blobs. Two group formed based on blob size. Stratification of big blobs by crop group.

(16) Sampling of blobs proportion to stratum size.

(17) Preliminary labeling of blobs by machine.

(18) Spectral labeling aids and PFC overlay for selected blobs.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	C/S	1		CORN/SOYBEANS BASELINE	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
Area Est.	C/S-1	U.S. Corn/Soybeans Baseline Classification	Subsystem

Ref. number	TITLE
Technical description of documentation	
NAS 9-15476	Cicone, R., C. Hay, R. Horvath, M. Metzler, O. Mykolenko, J. Odenweller, and D. Rice. 1981, March. Users Manual for the U.S. Baseline Corn and Soybean Segment Classification Procedure. ERIM/UCB, AgRISTARS.
Software documentation	
	TB Delivered
Procedural consultant(s)	
	ERIM - R. Cicone, M. Metzler UCB - C. Hay, J. Odenweller Lockheed - S. Green, K. Nedelman, D. Norwood, G. Livingston

PROCEDURE LOG:		FCPF COMM./DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	2.4 MULTICROP:							
MC-1	MULTICROP SPATIAL/COLOR SEQUENCE	X						

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	MC-1	MULTICROP SPATIAL/COLOR SEQ.	SUBSYSTEM

• Purpose/rationale:

o Expand (SSG-4) automated analyst logic approach to multicrop situation (WSG, SSG, Corn, Soybeans, Other).

• Relationship to past procedures:

o MC-1 is directly related to SSG-4 being an expansion of that technology to address the five crop categories noted above.

• Data/resource requirements:

--Crop calendar data functions are required and are satisfied by a Met. driven Biowindow Duration Model.
--Daily Met. data (temp.) from standard operational network is required to support acquisition selection.
--Full segment processing requires digital products from four acquisitions (one per biowindow) partial response estimates possible with 3 acquisitions.
--Approximate CPU operation time per segment = 10 minutes.

• Summary of performance to date:

o Based on six 1978 segments had overall RMSE of about 7% (absolute proportion error) with little bias.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	MULTICROP	MC	1		SPATIAL/COLOR SEQUENCE	

(1) Visual determination of acquisition quality with respect to clouds, misregistration, and noise.

(2) File of acquisition quality ratings.

(3) Meteorological data for each segment (maximum/minimum temperatures).

(4) Meteorological model for predicting the beginning and end dates of each spectral biowindow.

(5) Data base containing biowindow dates for each segment.

(6) Acquisition selection algorithm to choose best available combination of acquisitions, or reject segment as nonprocessable.

(7) Listing of acquisitions chosen for each segment.

(8) Merging of spectral data for each segment.

(9) Merged spectral data for all chosen acquisitions.

(10) Normalization through division by channel means followed by conversion to channel rankings codes.

(11) Definition of boundaries of vegetated areas in each acquisition using channel ranking codes.

(12) Overlaying of vegetated areas on all acquisitions to define fields which follow homogeneous sequences of vegetated and nonvegetated areas.

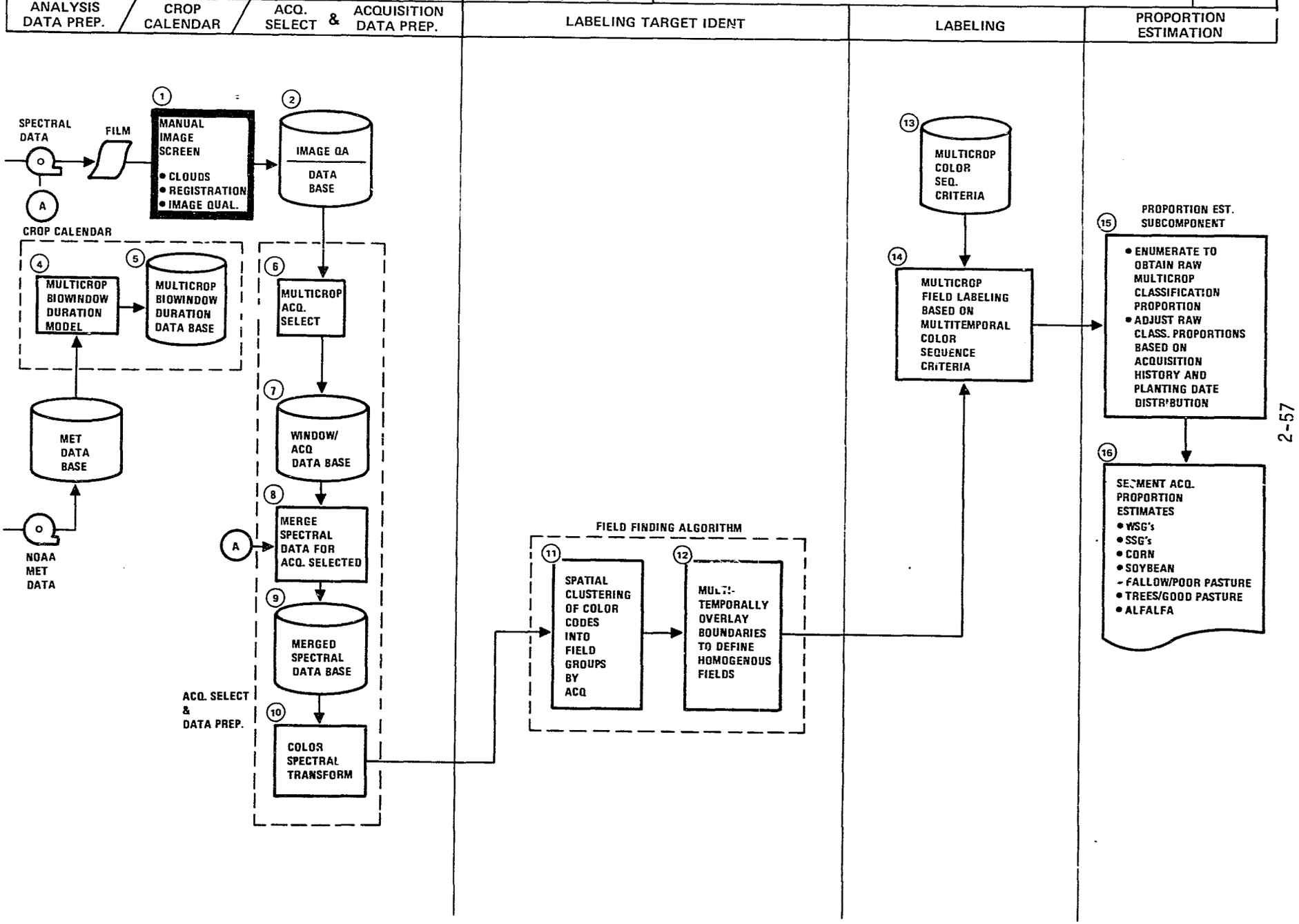
(13) Predetermined labeling logic algorithm that states which vegetated/nonvegetated sequences are to be considered WSG, SSG, corn, soybeans, fallow/poor pasture, trees/good pasture, alfalfa, and other.

(14) Labeling of each field.

(15) Summing of number of pixels contained in fields that are labeled as to each crop type to obtain conservative estimate of proportion. This is followed by an increase in the estimate based on the calculated omission rate which is modeled using interaction of acquisition history and predetermined planting date distribution. This accounts for fields which were missed due to early or late planting.

(16) Final proportion estimate for each segment.

LEVEL	TYPE	TYPE CODE	REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
SUBSYSTEM	AREA ESTIMATION	A	U.S.	MC	1		MULTICROP COLOR SEQUENCE	5/22/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AREA ESTIMATION	MC-1	MULTICROP SPATIAL/COLOR SEQ.	SUBSYSTEM

Ref. number	TITLE
Technical description of documentation	
JSC 17155 Vol. I	MC-1 shakedown test presentation 5/27/81. Test Report #3 o See technical documentation for SSG-4 for related information.
Software documentation	
	TBD
Procedural consultant(s)	
	R. B. Cate T. B. Dennis

3. SAMPLING

SAMPLING PROCEDURE CODING GUIDELINES

SAMPLING				
Crop	Year	Within Stratum Varcal	No.	Var.
o Single Crop	o Single Year	o Indirect (Govt. statistics)	1	A
o Multi-Crop	o Multi-Year (current year)	o Direct (Landsat Prop. Est.)		
	o MΔ Multi-year (Change estimate)	o Direct-Auto (Auto Prop. Estimators)	N	Z
		o Both A -Indirect -Direct-Auto. Prop. Est.		
		o Both -Indirect -Direct Landsat		

LEVEL	TYPE	PROCEDURAL DEVELOPMENT FAMILY TREE	DATE
COMPONENT	SAMPLING		

SINGLE CROP									MULTI-CROP								
SINGLE YEAR VARIANCE CALCULATION			MULTI-YEAR CURRENT VARIANCE CALCULATION			MULTI-YEAR CHANGE VARIANCE CALCULATION			SINGLE YEAR VARIANCE CALCULATION			MULTI-YEAR CURRENT VARIANCE CALCULATION			MULTI-YEAR CHANGE VARIANCE CALCULATION		
INDIRECT	DIRECT		INDIRECT	DIRECT		INDIRECT	DIRECT		INDIRECT	DIRECT		INDIRECT	DIRECT		INDIRECT	DIRECT	
	HIST.	AUTO.		HIST.	AUTO		HIST.	AUTO.		HIST.	AUTO.		HIST.	AUTO		HIST.	AUTO
SSB-1 1978 SAMPLE DESIGN (WHEAT-TY)									MSI-2 1980 MULTICROP SAMPLE DESIGN (C/S)								

PROCEDURE LOG: SAMPLING		FCPF COMM./DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	(Component Level Procedures)							
SSB-1	1978 Single Crop - Sampling Design	X						
MSI-2	1980 Multicrop - Sample Design	X						

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
SAMPLING	SSB-1	1978 Single Crop Sampling Design	Component

- Purpose/rationale:

TBD

- Relationship to past procedures:

TBD

- Data/resource requirements:

TBD

- Summary of performance to date:

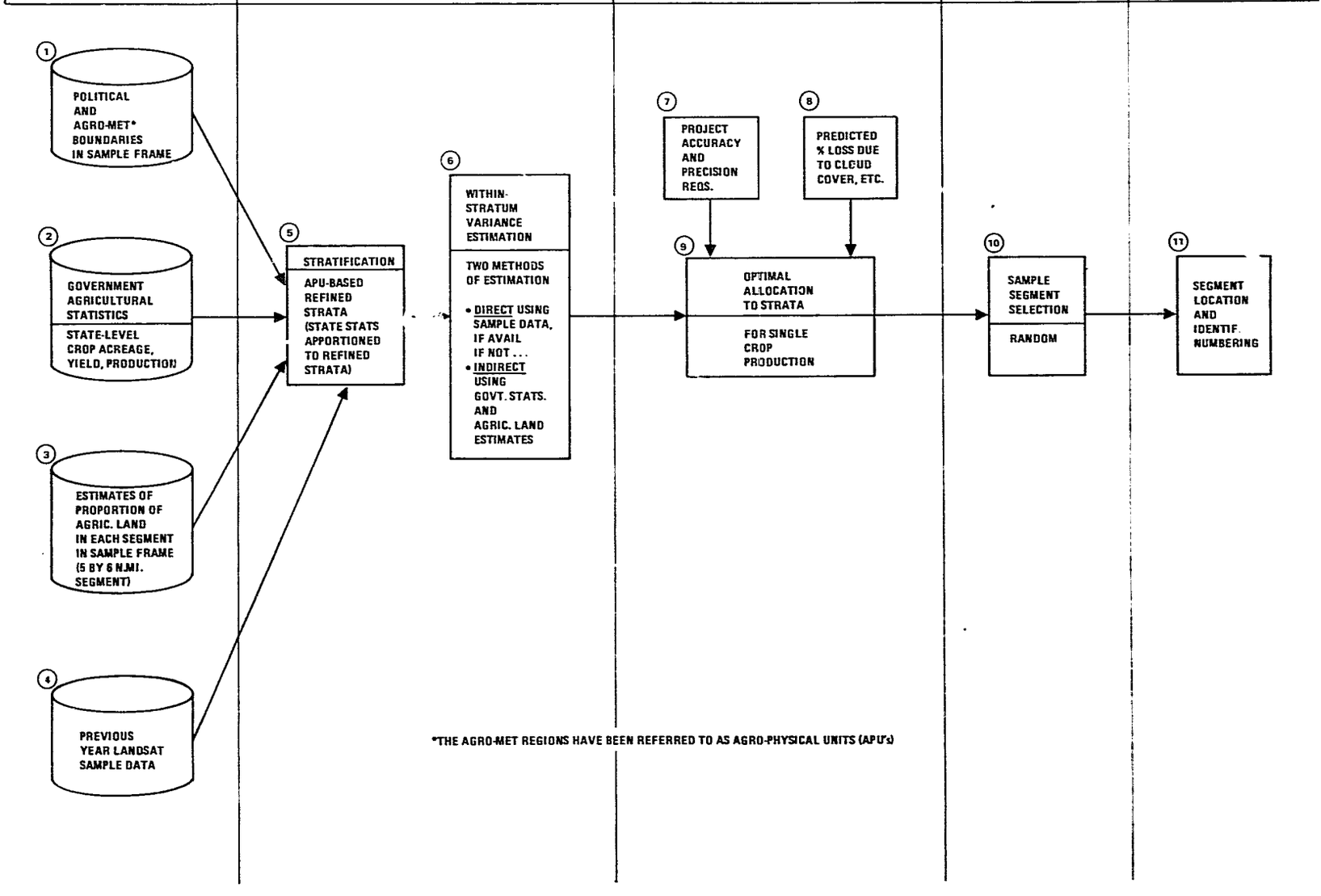
TBD

LEVEL	TYPE	CODE	REGION	CROP	YEAR	S-VAR.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	SAMPLING	S	SSG	S	S	B	1		1978 SINGLE CROP SINGLE SAMPLE DESIGN (WHEAT TY)	6/10/81

FUNCTION FLOW DESCRIPTIONS

TBD

LEVEL	TYPE	CODE	REGION	YEAR	RESP.	S-VAR	NO.	VAR	PROCEDURE NAME	DATE
COMPONENT	SAMPLING		USGP	S	S	B	1		1978 SINGLE CROP SAMPLE DESIGN (WHEAT TY)	4/24/81



*THE AGRO-MET REGIONS HAVE BEEN REFERRED TO AS AGRO-PHYSICAL UNITS (APU's)

REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
SAMPLING	SSB-1	1978 SINGLE CROP - SAMPLING DESIGN	C 'PONENT

Ref. number	TITLE
	Technical description of documentation
	TBD
	Software documentation
	TBD
	Procedural consultant(s)
	J. T. Malin

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
SAMPLING	MSI-2	1980 MULTICROP SAMPLE DESIGN (C/S)	COMPONENT

- Purpose/rationale:

  TBD

- Relationship to past procedures:

  TBD

- Data/resource requirements:

  TBD

- Summary of performance to date:

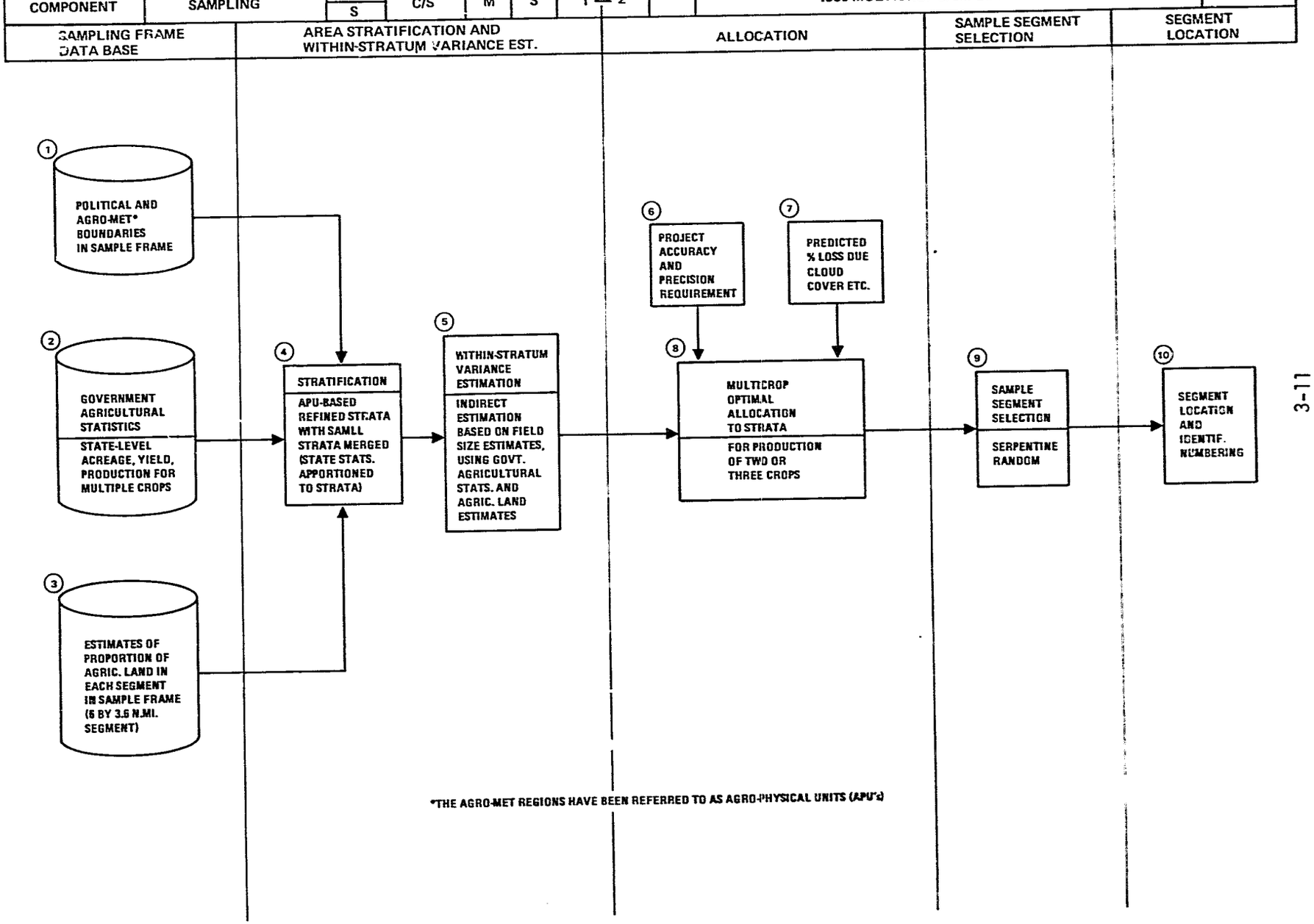
  TBD

LEVEL	TYPE	CODE	REGION	CROP	YEAR	S-VAR.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	SAMPLING	S	C/S	M	S	I	2		1980 MULTICROP SAMPLE DESIGN (C/S)	

FUNCTION DESCRIPTIONS

TBD

LEVEL	TYPE		REGION	CROP	YEAR	S-VAR	NO.	VAR	PROCEDURE NAME	DATE
COMPONENT	SAMPLING	CODE S	C/S	M	S	1	2		1980 MULTICROP SAMPLE DESIGN (C/S)	6/10/81



*THE AGRO-MET REGIONS HAVE BEEN REFERRED TO AS AGRO-PHYSICAL UNITS (APU's)

REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
SAMPLING	MSI-2	1980 MULTICROP SAMPLE (C/S) DESIGN	COMPONENT

Ref. number	TITLE
Technical description of documentation	
JSC-16343	Chhikara, R. S.; and Perry, C. R.: Estimation of Within-Stratum Variance For Sample Allocation. NASA Technical Report, JSC-16343, July 1980. Hartley, H. O.; Hughes, T. H.; and Sielken, Jr., R. L.: A Complete Implementation of the Multicrop Sampling Strategy. Texas A&M University, May 1979.
Software documentation	
LEMSCO 16221	o Malin, J. T.; Smith, J. H.; Cheffin, R. E.; Norwood, D. F.; and McLean, T.K.: AgRISTARS/FCPF Sampling and Aggregation Software Systems Modules Description.
Procedural consultant(s)	
	J. T. Malin D. E. Norwood

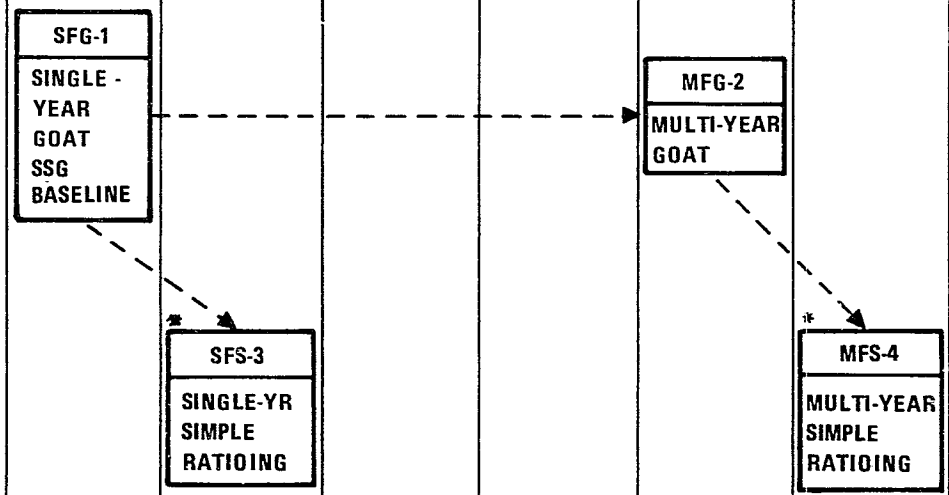
4. AGGREGATION PROCEDURES

AGGREGATION PROCEDURE CODING GUIDELINES

AGGREGATION				
YEAR	RESPONSE	AG. TECH.	No.	VAR.
o Single Year	o Partial (Unseparated Crop Est.)	o GOAT	1	A
o Multi-Year	o Full (Separated Crop Est.)	o SRAT (Simple Ratioing)		
	o Both (Partial & Full)		N	2

LEVEL	TYPE	PROCEDURAL DEVELOPMENT FAMILY TREE	DATE
COMPONENT	AGGREGATION		5-28-80

SINGLE YEAR				MULTI-YEAR/CURRENT YEAR DATA				MULTI-YEAR/CHANGE DATA			
PARTIAL		FULL		PARTIAL		FULL		PARTIAL		FULL	
GOAT	SRAT	GOAT	SRAT	GOAT	SRAT	GOAT	SRAT	GOAT	SRAT	GOAT	SRAT



*THESE ARE COMPONENTS DESIGNED AS EVALUATION TOOLS WITH RESPECT TO SFG-1, MFG-2.

PROCEDURE LOG: AGGREGATION		FCPF COMM/DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC. DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	(Component Level Procedures)							
SFG-1	Single Year-Goat (SSG Baseline)	X						
MFG-2	Multi-Year Goat	X						
SFS-3	Single-Year-Simple Ratioing Technique	X						
MFS-4	Multi-Year-Simple Ratioing Technique	X						
	(Subcomponent Level Procedures)							
G-1	Grouped Optimal Aggregation Technique (GOAT)	x						
MB-2	Simulation of EST's Data Bases	x						
	4-4							

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	SFG-1	SINGLE YEAR-GOAT (SSG BASELINE)	COMPONENT

- Purpose/rationale:

TBD

- Relationship to past procedures:

TBD

- Data/resource requirements:

TBD

- Summary of performance to date:

TBD

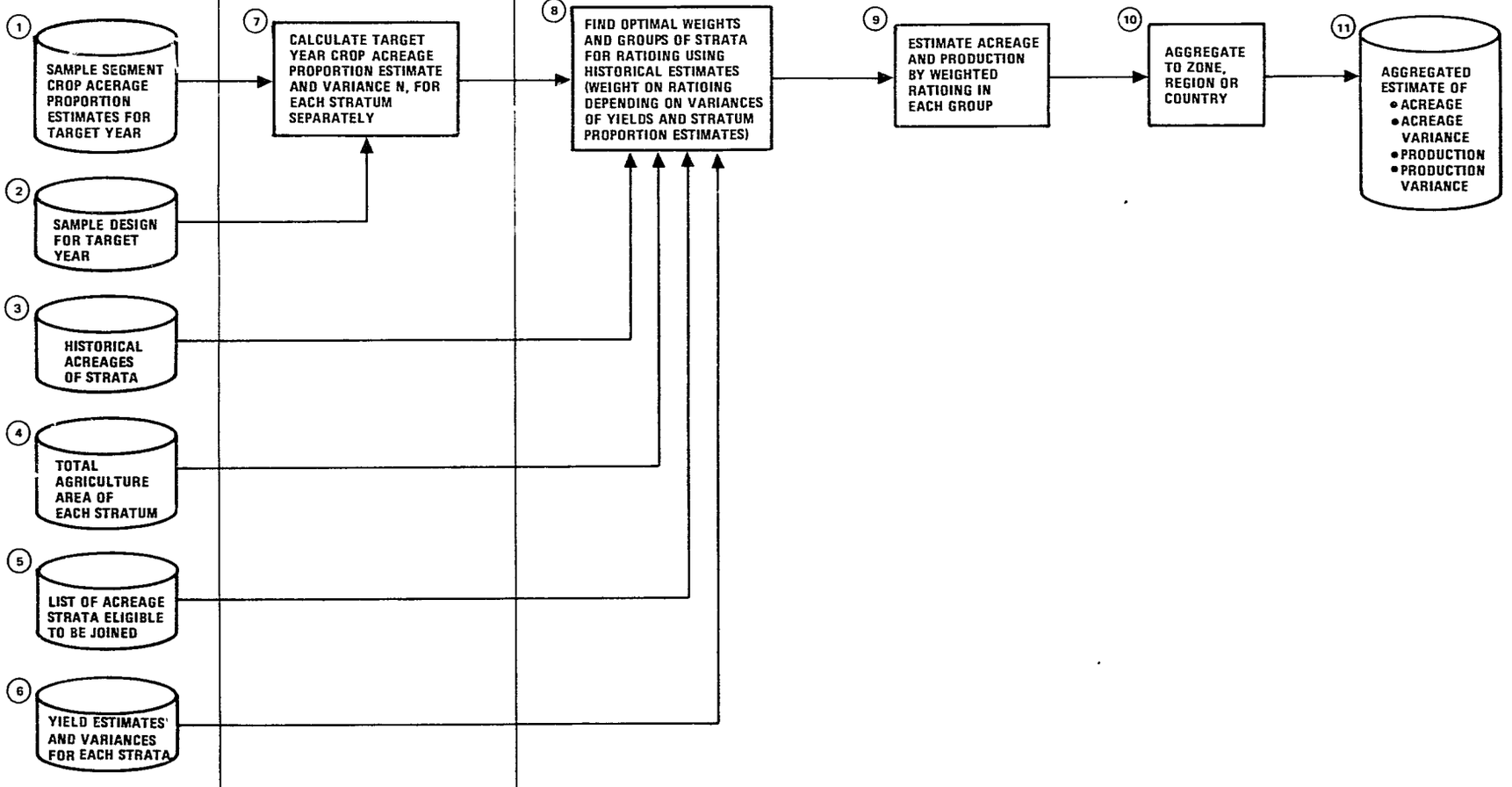
LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	SSG	S	F	G	1		SINGLE YEAR - GOAT (SSG BASELINE)	6/19/81

FUNCTION DESCRIPTION

TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	SSG	S	F	G	1		SINGLE YEAR – GOAT (SSG BASELINE)	6/9/81

DATA BASE DEVELOPMENT	SINGLE YEAR AGGREGATION OF ACREAGE PER STRATUM	GOAT AGGREGATION OF ACREAGE AND PRODUCTION TO ZONE, REGION, COUNTRY



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	SFG-1	SINGLE-YEAR GOAT (SSG BASELINE)	COMPONENT

Ref. number	TITLE
Technical description of documentation	
JSC-16867	Feiveson, A. H. - Weighted Ratio Estimation for AgRISTARS (February 1981)
Software documentation	
LEMSCO	
Procedural consultant(s)	
	T. C. Baker

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MFG-2	MULTI-YEAR-GCAT	COMPONENT

- Purpose/rationale:

TBD

- Relationship to past procedures:

TBD

- Data/resource requirements:

TBD

- Summary of performance to date:

TBD

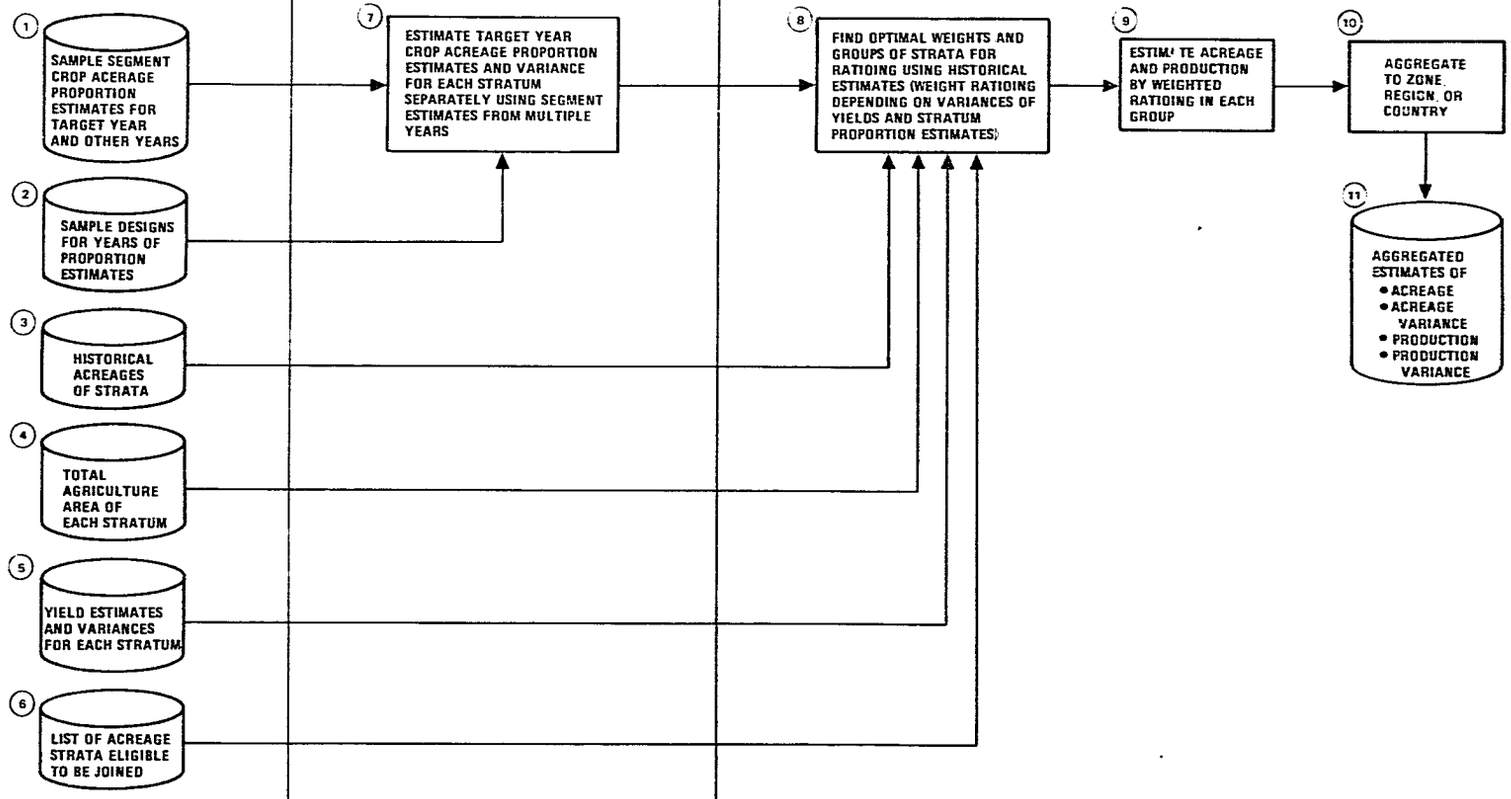
LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	M	F	G	2		MULTI-YEAR GOAT	6/9/81

FUNCTIONS & DESCRIPTIONS

TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	M	F	G-2			MULTI-YEAR – GOAT	6/9/81

DATA BASE DEVELOPMENT	MY ESTIMATION OF ACREAGE PER STRATUM	GOAT AGGREGATION OF ACREAGE AND PRODUCTION TO ZONE, REGION, COUNTRY



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MFG-2	MULTI-YEAR-GOAT	COMPONENT

Ref. number	TITLE
Technical description of documentation	
JSC 16861	Feiveson, A. H.: Weighted Ratio Estimation For AgRISTARS, February 1981.
Software documentation	
LEMSCO 16221	Malin, J. T.; Smith, J. H.; Cheffin, R. E.; Norwood, D. F.; McLean, T. K.: AgRISTARS/FCPF Sampling and Aggregation Software Systems Modules Description January 1981
Procedural consultant(s)	
	T. C. Baker

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	SFS-3	SINGLE YEAR-SIMPLE RATIOING TECHNIQUE	COMPONENT

- Purpose/rationale:

  TBD

- Relationship to past procedures:

  TBD

- Data/resource requirements:

  TBD

- Summary of performance to date:

  TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	S	F	S	3		SINGLE YEAR - SIMPLE RATIONING TECHNIQUE	6/19/21

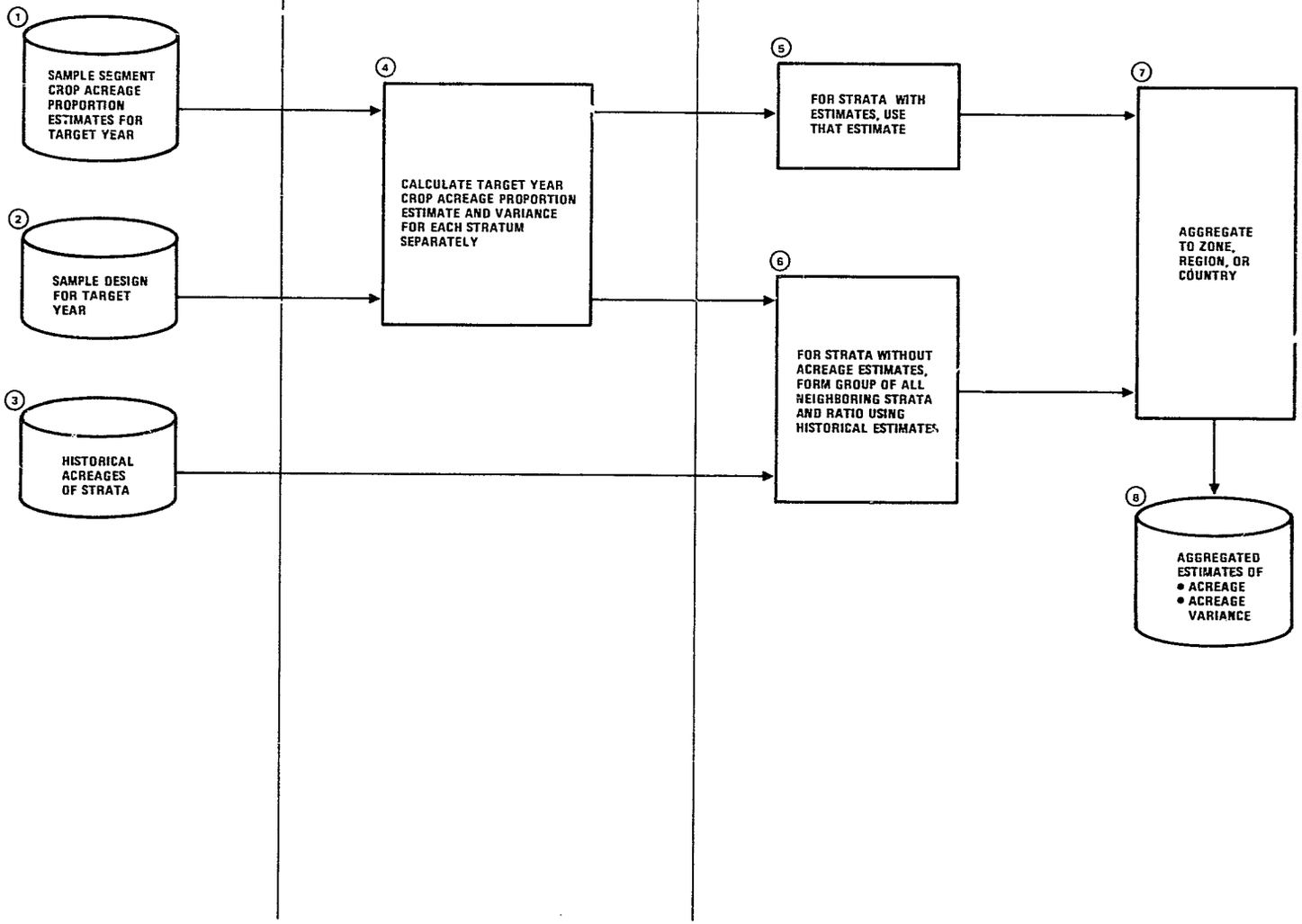
FUNCTION DESCRIPTIONS

TBD

PROCEDURE CODE

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	S	F	S	3		SINGLE YEAR- SIMPLE RATIONING TECHNIQUE	6/9/81

DATA BASE DEVELOPMENT	SINGLE YEAR AGGREGATION OF ACREAGE PER STRATUM	SIMPLE RATIOING AGGREGATION OF ACREAGE AND PRODUCTION TO ZONE, REGION, COUNTRY



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	SFS-3	SINGLE YEAR-SIMPLE RATIOING TECHNIQUE	COMPONENT

Ref. number	TITLE
	Technical description of documentation
	TBD
	Software documentation
	TBD
	Procedural consultant(s)
	T. C. Baker

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MFS-4	MULTI-YEAR-SIMPLE RATIOING TECHNIQUE	COMPONENT

- Purpose/rationale:

  TBD

- Relationship to past procedures:

  TBD

- Data/resource requirements:

  TBD

- Summary of performance to date:

  TBD

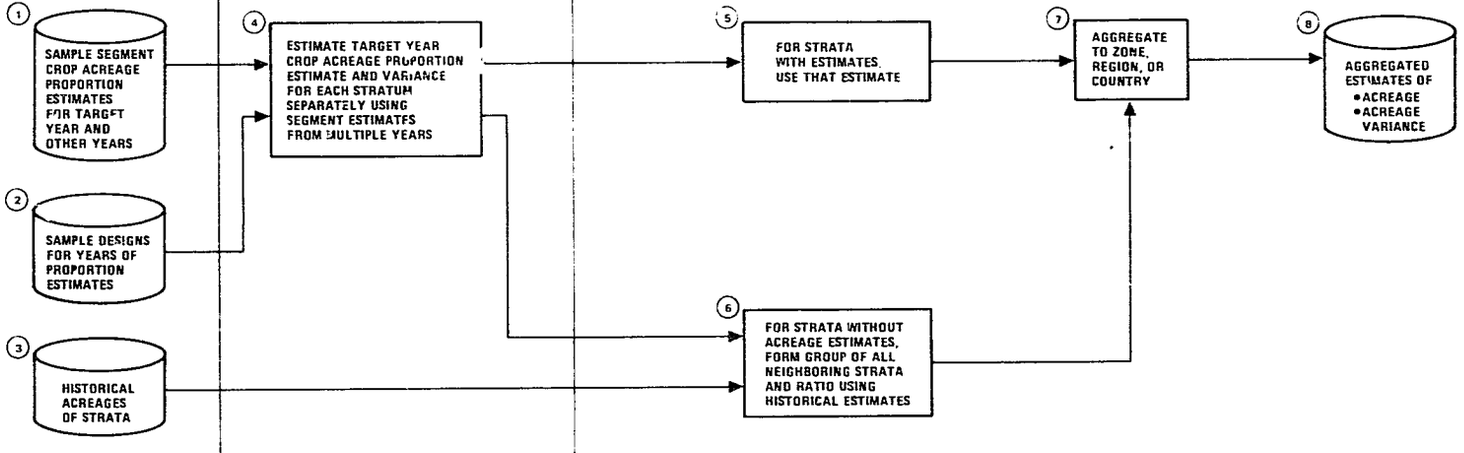
LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	M	F	S	4		MULTI YEAR _ SIMPLE RATIOING TECH	6/9/81

FUNCTION DESCRIPTION

TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	AGGREGATION	CODE AG	GEN	M	F	S – 4			MULTI-YEAR AGGREGATION OF ACREAGE PER STRATUM	6/9/81

DATA BASE DEVELOPMENT	MULTI-YEAR AGGREGATION OF ACREAGE PER STRATUM	SIMPLE RATIOING AGGREGATION OF ACREAGE AND PRODUCTION TO ZONE, REGION, COUNTRY



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MFS-4	MULTI-YEAR-SIMPLE RATIOING TECHNIQUE	COMPONENT

Ref. number	TITLE
	Technical description of documentation
	TBD
	Software documentation
	TBD
	Procedural consultant(s)
	T. C. Baker

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	G-1	GOAT	SUB-COMPONENT

- Purpose/rationale:

TBD

- Relationship to past procedures:

TBD

- Data/resource requirements:

TBD

- Summary of performance to date:

TBD

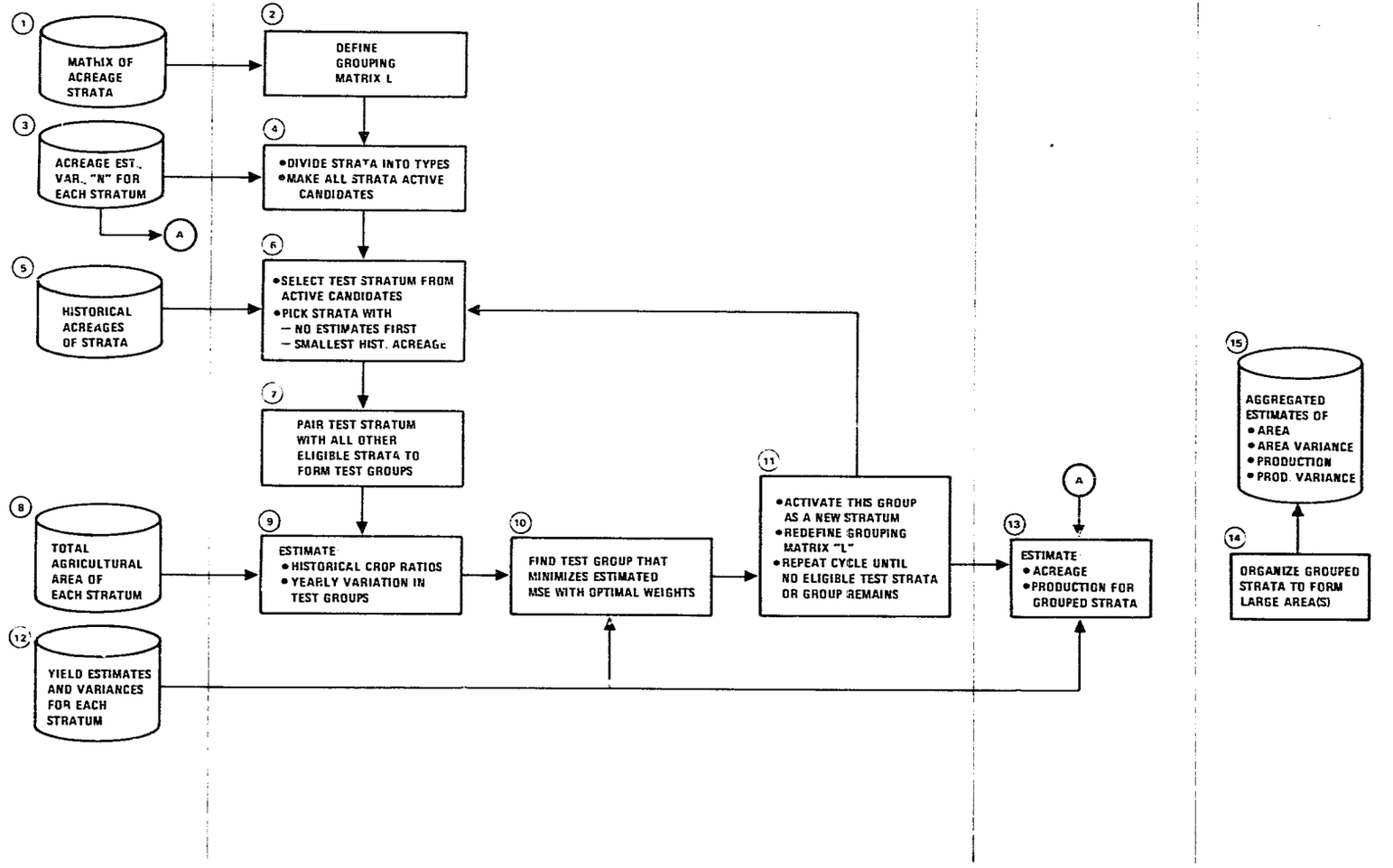
LEVEL	TYPE	CODE	REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
SUBCOMPONENT	AGGREGATION	AG				G	1		GROUPED OPTIMAL AGGREGATION TECH (GOAT)	6/9/81

FUNCTION DESCRIPTIONS

TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
SUB-COMPONENT	AGGREGATION	CODE AG	GEN.			G	1		GROUPED OPTIMAL AGGREGATION TECHNIQUE	6/9/81

DATA BASE DEVELOPMENT	STRATA GROUPING	ACREAGE/PRODUCTION EST. FOR STRATA GROUPING	AGGREGATION TO LARGE AREA



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	G-1	GROUPES OPTIMAL AGGREGATION TECHNIQUE	SUB-COMPONENT

Ref. number	TITLE
Technical description of documentation	
JSC-16861	Feiveson, A. H.: Weighted Ratio Estimation For AgRISTARS, February 1981
Software documentation	
LEMSCO 16221	Malin, J. T.; Smith, J. H.; Cheffin, R. E.; Norwood, D. F.; and McLean, T.K.: AgRISTARS/FCPF Sampling and Aggregation Software Systems Modules Description.
Procedural consultant(s)	
	T. C. Baker J. H. Smith

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MB-2	SIMULATION OF ESTIMATES DATA BASES	SUB-COMPONENT

- Purpose/rationale:

TBD

- Relationship to past procedures:

TBD

- Data/resource requirements:

TBD

- Summary of performance to date:

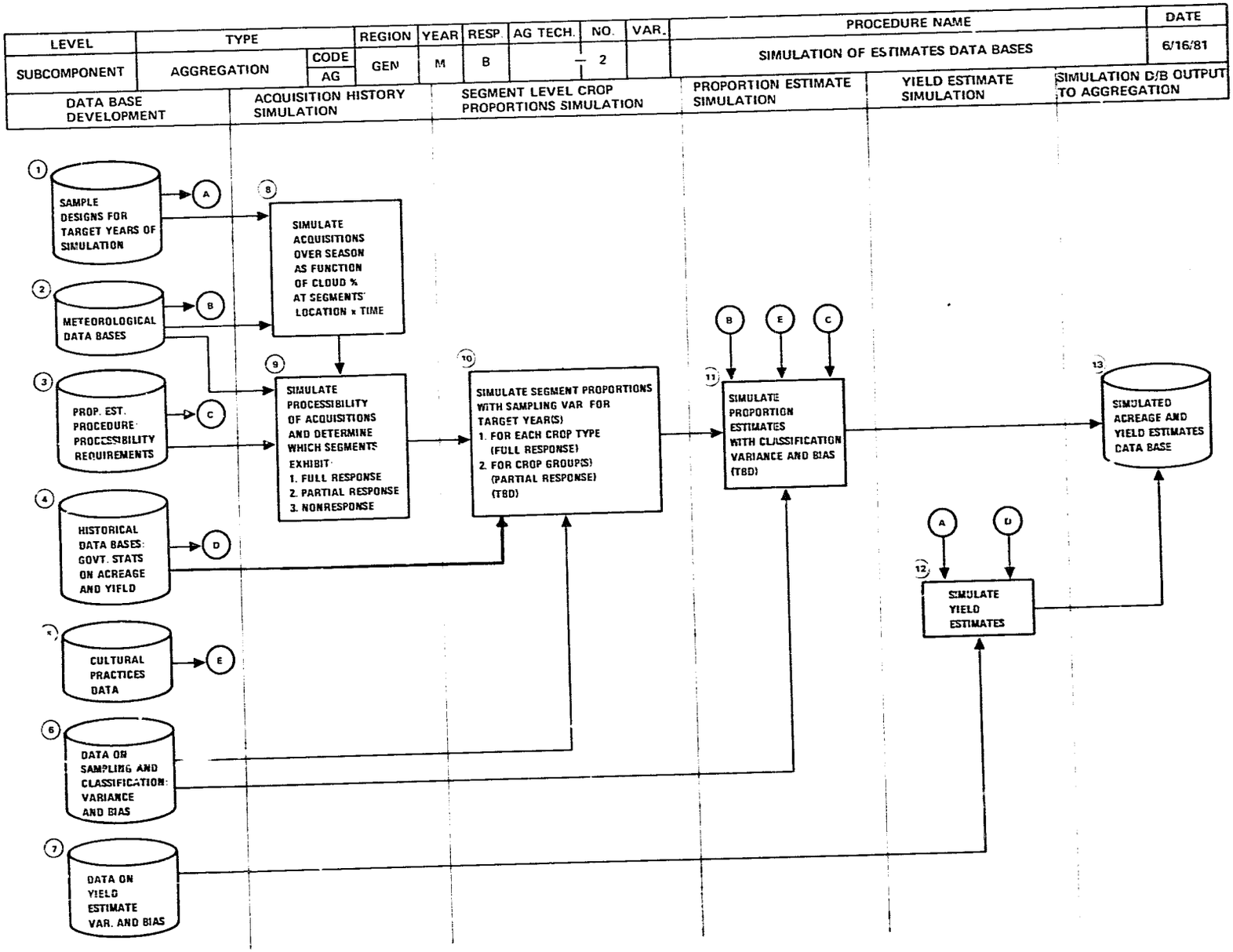
TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG. TECH.	NO.	VAR.	PROCEDURE NAME	DATE
SUBCOMPONENT	AGGREGATION	CODE AG	GEN.	M	B	--	2		SIMULATION OF ESTIMATES DATA BASES	6/16/81

FUNCTION DESCRIPTIONS

TBD

LEVEL	TYPE		REGION	YEAR	RESP.	AG TECH.	NO.	VAR.	PROCEDURE NAME	DATE
SUBCOMPONENT	AGGREGATION	CODE AG	GEN	M	B	—	2		SIMULATION OF ESTIMATES DATA BASES	6/16/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
AGGREGATION	MB-2	SIMULATION OF ESTIMATES DATA BASES	SUB-COMPONENT

Ref. number	TITLE
	Technical description of documentation
	TBD
	Software documentation
	TBD
	Procedural consultant(s)
	J. H. Smith

C-2

5. DATA

TBD

6. CROP CALENDAR

TBD

7. PRODUCTION ESTIMATION BY UNIT AREA

TBD

8. PERFORMANCE ESTIMATION EVALUATION

LEVEL	TYPE	PROCEDURAL DEVELOPMENT FAMILY TREE	DATE
COMPONENT	PERF. EST. / EVAL		

TBD

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PROCEDURE LOG: PERFORMANCE EST./EVALUATION		FCPF COMM/DOC. STDS. VOLUMES CONTAINING OFFICIAL PROC DOCUMEN.						
PROC. CODE	PROCEDURE NAME	I 6/81	II	III	IV	V	VI	VII
	(Component Level Procedures)							
SEGSIM 1	Thematic Mapper - Segment Simulation	X						
SEGSIM 1A	Thematic Mapper - Seg. Sim. - Crop Growth	X						
SEGSIM 2	Segment Simulation	X						

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 1	TM SEGMENT SIMULATION	COMPONENT

•Purpose/rationale:

Simulate Thematic Mapper data in order to determine the utility of such data.

•Relationship to past procedures:

This is an initial development.

•Data/resource requirements:

Supporting Field Research Data Base and the Experiments Image Data Base.

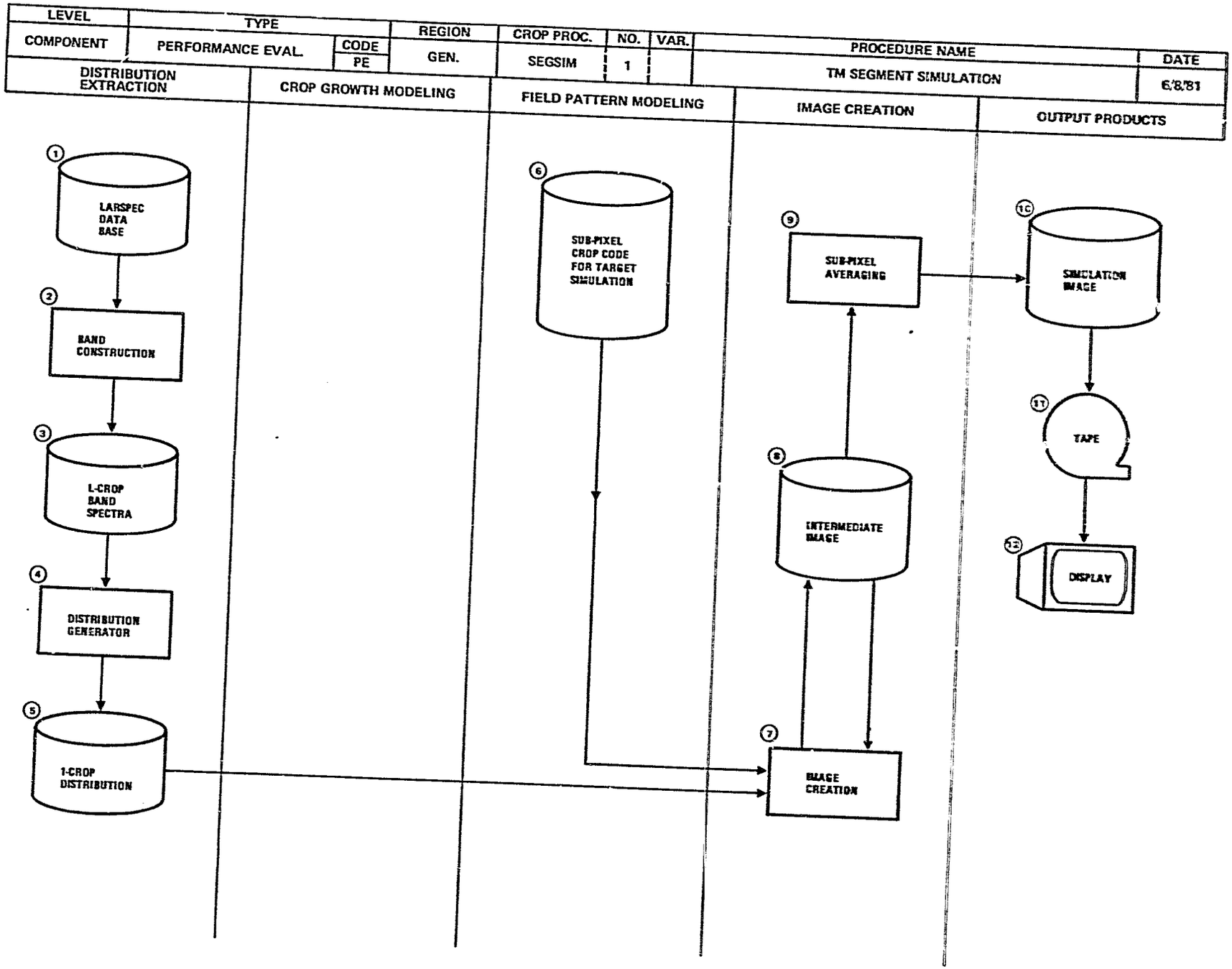
•Summary of performance to date:

One segment simulated by SR, and one by FCPF with satisfactory results.

LEVEL	TYPE		REGION	YEAR	RESP.	PROCEDURE	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	PERFORM EST/EVAL	CODE PE	GEN			SEGSIM	1		TM-SEGMENT SIMULATION	6/8/81

FUNCTION DESCRIPTIONS

1. The Supporting Field Research data base at LARS acquired by helicopter-mounted field spectrometer system.
2. An algorithm converts FSS data to thematic mapper counts.
3. A data file containing FSS data converted to TM counts (1 file per field).
4. Algorithms for extracting cumulative distributions from TM counts and for linearly interpolating between cumulative distributions.
5. A data file containing a cumulative distribution for each TM band (1 file per field per date).
6. "UGTT" or other Universal format image containing crop codes at the subpixel level for the scene to be simulated.
7. An algorithm which reads the subpixel crop codes and an input distribution and randomly samples TM counts from the given distribution for those subpixels with the appropriate crop code. (This algorithm must be run once for each crop to be simulated.)
8. The output image from #7 is stored on disk and read back in by the algorithm when adding a new crop to the simulation.
9. When all crops have been painted on the image, this algorithm averages the subpixel counts to produce a pixel level image.
10. A pixel level Universal format disk file containing the simulated image.
11. The image is stored on tape.
12. The tape can be sent to PFC or displayed on the I-100.


LEVEL
TYPE
REGION
CROP PROC.
NO.
VAR.
PROCEDURE NAME
DATE
COMPONENT
PERFORMANCE EVAL.
CODE
PE
GEN.
SEGSIM
1
TM SEGMENT SIMULATION
6/8/81
DISTRIBUTION EXTRACTION
CROP GROWTH MODELING
FIELD PATTERN MODELING
IMAGE CREATION
OUTPUT PRODUCTS
1
LARSPEC DATA BASE
2
BAND CONSTRUCTION
3
L-CROP BAND SPECTRA
4
DISTRIBUTION GENERATOR
5
1-CROP DISTRIBUTION
6
SUB-PIXEL CROP CODE FOR TARGET SIMULATION
7
IMAGE CREATION
8
INTERMEDIATE IMAGE
9
SUB-PIXEL AVERAGING
10
SIMULATION IMAGE
11
TAPE
12
DISPLAY

REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 1	TM-SEG. SIMULATION	COMPONENT

Ref. number	TITLE
	Technical description of documentation
	Six Channel Thematic Mapper Simulation, G. D. Badhwar, K. E. Henderson, W. R. Johnson, M. L. Sestak, SR-L1-04098, JSC 17139
	Software documentation
	Programmer's Internal Documentation Only
	Procedural consultant(s)
	W. R. Johnson, T. B. Dennis

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 1A	TM-SEG. SIMULATION-CROP GROWTH	COMPONENT

•Purpose/rationale:

To add to the TM simulation effort the capability to model crop growth as a function of time and allow crop growth variation across a segment.

•Relationship to past procedures:

This is an add on development for SEGSIM 1 which is being worked on by SR. It will use Badhwar's Model to fit crop growth as a function of time, and replace the distribution sampling with the capability to determine crop statistics as a function of time and simulate by sampling from a normal distribution with appropriate statistics.

•Data/resource requirements:

Supporting Field Research Data Base and the Experiments Image Data Base.

•Summary of performance to date:

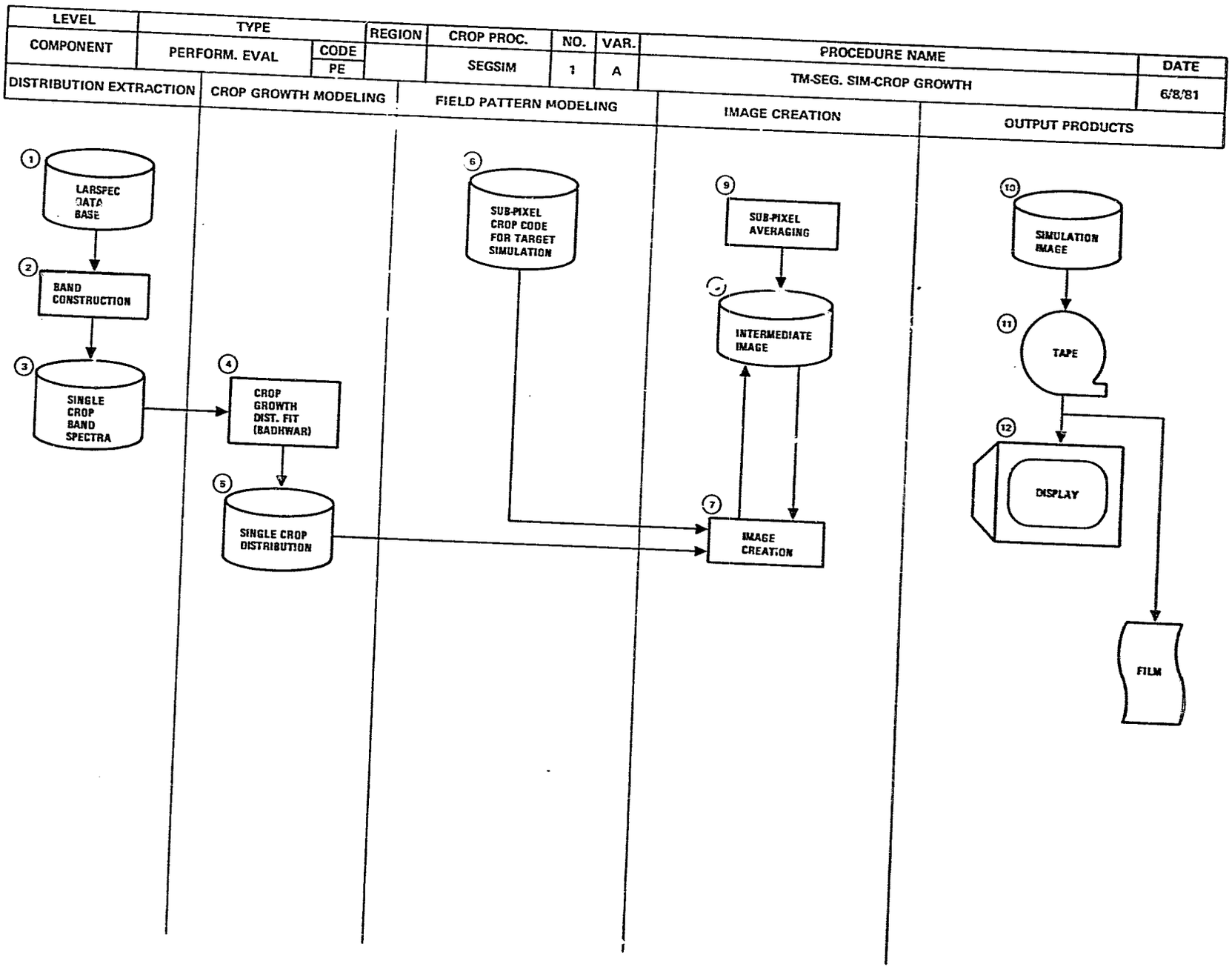
This system is still in the development stage.

LEVEL	TYPE		REGION		RESP.	PROCEDURE	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	PERFORM EST/EVAL	CODE PE	GEN			SEGSIM	1	A	TM-SEG. SIMUL – CROP GROWTH	6/8/81

FUNCTION DESCRIPTION

1. The Supporting Field Research data base at LARS acquired by helicopter-mounted field spectrometer system.
2. An algorithm converts FSS data to thematic mapper counts.
3. A data file containing FSS data converted to TM counts (1 file per field).
4. Algorithms for extracting cumulative distributions from TM counts and for linearly interpolating between cumulative distributions.
5. A data file containing a cumulative distribution for each TM band (1 file per field per date).
6. "UGTT" or other Universal format image containing crop codes at the subpixel level for the scene to be simulated.
7. An algorithm which reads the subpixel crop codes and an input distribution and randomly samples TM counts from the given distribution for those subpixels with the appropriate crop code. (This algorithm must be run once for each crop to be simulated.)
8. The output image from #7 is stored on disk and read back in by the algorithm when adding a new crop to the simulation.
9. When all crops have been painted on the image, this algorithm averages the subpixel counts to produce a pixel level image.
10. A pixel level Universal format disk file containing the simulated image.
11. The image is stored on tape.
12. The tape can be sent to PFC or displayed on the I-100.

LEVEL	TYPE		REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	PERFORM. EVAL	CODE PE		SEGSIM	1	A	TM-SEG. SIM-CROP GROWTH	6/8/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 1A	TM-SEG. SIM-CROP GROWTH	COMPONENT

Ref. number	TITLE
	Technical description of documentation
	Six Channel Thematic Mapper Simulation, G. E. Badhwar, K. E. Henderson, W. R. Johnson, M. L. Sestak, SR-L1-04098, JSC-17139.
	Software documentation
	Programmers Internal Documentation Only
	Procedural consultant(s)
	W. R. Johnson

PROCEDURE - SUMMARY DESCRIPTION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 2	SEGMENT SIMULATION	COMPONENT

- **Purpose/rationale:**

To add the capability to use actual Landsat data in this simulation and to add the capability to simulate data at the field level rather than the crop code level.

- **Relationship to past procedures:**

This is an add on development for SEGSIM 1 proposed by FCPF. It will read ground truth and Landsat images to produce distributions by field and ground truth. It will simulate an entire segment at once by extracting "ground truth" fields for the target segment and matching these fields to appropriate field distributions.

- **Data/resource requirements:**

Experiments Image Data Base.

- **Summary of performance to date:**

This sytem is still in the development stage.

LEVEL	TYPE	CODE	REGION	YEAR	RESP.	PROCEDURE	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	PERFORM EST. EVAL.	PE	GEN.			SEGSIM	2		SEGMENT SIMULATION	6/8/81

FUNCTION DESCRIPTIONS

1 Four channel Landsat image tapes.

2 "UGTT" corresponding to the segment whose Landsat data is being used.

3 An algorithm for extracting fields from the UGTT and field distributions from the image tape.

4 An output file containing field distributions available for simulation.

5 A set of control cards are manually produced matching target fields to distributions.

6 Control card file.

7 "UGTT" or other universal format image containing crop codes at the subpixel level for the scene to be simulated.

8 An algorithm extracts fields from the subpixel crop code image.

9 An algorithm reads the control cards and paints each subpixel by randomly sampling from the distribution assigned to the appropriate target field by the control cards.

10 A subpixel level simulated image is created.

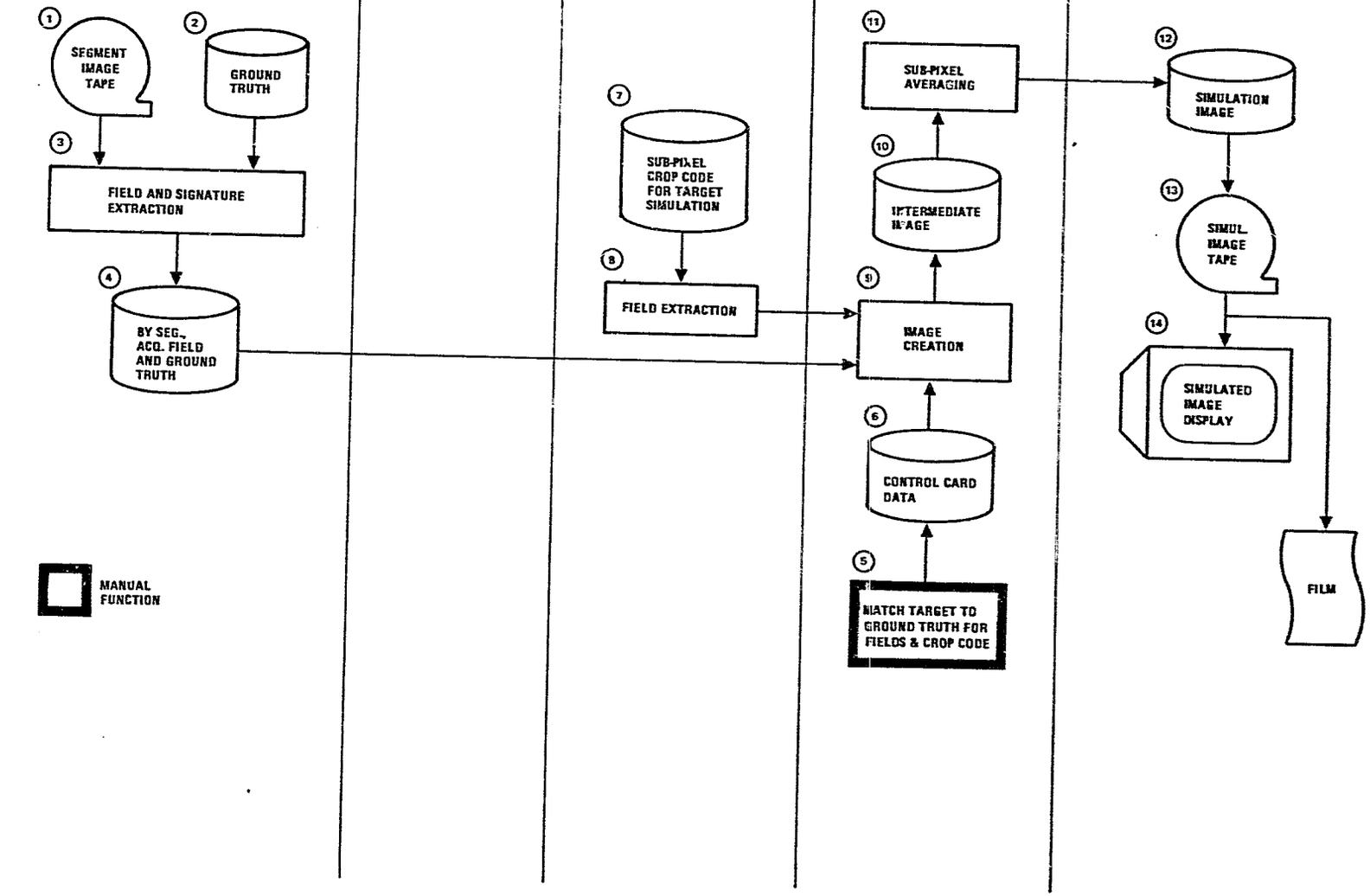
11 An algorithm averages the subpixel counts.

12 A pixel level simulated image is created.

13 The image is stored on tape.

14 The tape can be sent to PFC or displayed on the I-100.

LEVEL	TYPE		REGION	CROP PROC.	NO.	VAR.	PROCEDURE NAME	DATE
COMPONENT	PERFORM. EVAL.	CODE PE	GEN.	SEGSIM	2		SEGMENT SIMULATION	6/8/81



REFERENCES TO DETAILED TECHNICAL PROCEDURES DOCUMENTATION

Procedure type	Procedure code	Procedure name	Level
PERFORM ESTIMATION EVALUATION	SEGSIM 2	SEGMENT SIMULATION	COMPONENT

Ref. number	TITLE
	Technical description of documentation
	Six Channel Thematic Mapper Simulation, G. D. Badhwar, K. E. Henderson, W. R. Johnson, M. L. Sestak, SR-L1-04098, JSC 17139.
	Software documentation
	Programmers Internal Documentation Only. In Developmental Stages.
	Procedural consultant(s)
	T. B. Dennis

9. SYSTEM EVALUATION

TBD