Memorandum

U.S. Department
of Transportation

**Federal Highway
Administration**

6300 Georgetown Pike
McLean, Virginia 22101

Subject: **ACTION**: LTPP Directive P-35
Office Procedures for Processing and Performing
Quality Assurance Checks on Profile Data

Date: August 6, 2003

From: Larry Wiser Larry J. Wiser
Long Term Pavement Performance Team

Reply to
Attn of: HRDI-13

To: Dr. Frank Meyer, PM - LTPP North Atlantic Regional Contract
Dr. Frank Meyer, PM - LTPP North Central Regional Contract
Mr. Mark Gardner, PM - LTPP Southern Regional Contract
Mr. Kevin Senn, PM - LTPP Western Regional Contract

Attached is the Long Term Pavement Performance (LTPP) Program Directive P-35, for the implementation of Office Procedures for Processing and Performing Quality Assurance Checks on Profile Data. Please ensure that all personnel involved are aware of this new directive.

Should you have any questions or would like to discuss this directive, please do not hesitate to contact me at 202-493-3079.

Attachments

LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area:	Monitoring	Directive Number:	P-35
Date:	August 6, 2003	Supersedes:	N/A
Subject:	Office Procedures for Processing and Performing Quality Assurance Checks on Profile Data		

INTRODUCTION

The LTPP Manual for Profile Measurements, Operational Field Guidelines (hereafter referred to as the Profiler Manual) describes field operational procedures for the collection of longitudinal profile data by an inertial profiler, collection of longitudinal profile data with a Dipstick®, and collection of transverse profile data with a Dipstick®. In the LTPP program, the ProQual software is used to process data collected by these three methods, and to perform quality assurance checks on those data.

Currently, each regional support contractor (RSC) uses an International Cybernetics Corporation (ICC) MDR 4086L3 inertial road profiler to collect longitudinal profile data. The Profiler Manual describes the procedures to be followed for equipment calibration, daily checks to be performed on equipment, software parameter settings, header information to be entered into the software, procedures for collecting data, procedures to process data through ProQual in the field, procedures to perform field quality control checks on the data, record keeping procedures and data backup procedures. The field quality control checks to be performed on the data are specified in the Profiler Manual and they include: evaluation of repeatability of profiles and IRI, review of spike report generated by ProQual, comparison of current profile data with those collected during previous visits, and comparison of IRI values along the left and right wheel paths with IRI values obtained during previous visit to that section. The profile data is then sent to the office where the data is reviewed and data files to upload to the LTPP Pavement Performance Database (PPDB) are created.

A Dipstick® is used to collect longitudinal profile data on LTPP sections that are located in Hawaii, Alaska and Puerto Rico and other sites where profilers cannot be used. They also serve as backups to the ICC profilers, but they are rarely used for this purpose. However, they are used to collect longitudinal profile data at test sections that are established to compare the four LTPP profilers (such comparisons generally take place annually). The Profiler Manual describes the procedures to be followed for collecting longitudinal profile data with the Dipstick®, including

pre-operational and post-operational equipment checks, site layout, procedures for performing data collection, and procedures to evaluate if the collected data fall within the allowable closure error. LTPP Forms DS-1 through DS-7 in the Profiler Manual are used for longitudinal profile data collection with the Dipstick®. Apart from checking for closure error, processing of the collected data is not performed in the field. After completion of data collection, these forms are sent to the office where the data are entered into ProQual for processing. After quality control checks are performed on the data, files for upload to the PPDB are created.

Transverse profile data at flexible pavement test sections in the LTPP program are collected using a Dipstick®. The Profiler Manual describes the procedures to be followed in the field to collect transverse profile data using the Dipstick®, including pre-operational and post-operational equipment checks, site layout, procedures for performing data collection, procedures to evaluate if the collected data fall within the allowable closure error, procedures for record keeping and data backup. LTPP Form DS-8 in the Profiler Manual is used to record transverse profile data in the field. Processing of the collected data is not performed in the field. The completed forms are sent to the office, where the data is entered into ProQual for processing. After quality control checks are performed on the data, files for upload to the PPDB are created.

Procedures for collecting data in the field, as well as the quality control checks to be performed in the field are described in detail in the Profiler Manual for all three data collection methods – longitudinal profile data collected with inertial profiler, longitudinal data collected with a Dipstick® and transverse data collected with Dipstick®. However, a LTPP document that describes data processing procedures and quality assurance procedures for use in the office is currently not available. Accordingly, the purpose of this directive is to provide guidelines for processing and performing quality assurance checks in the office for all three data types to ensure consistency and uniformity amongst the four RSCs.

These guidelines should be viewed as the minimum required amount of data checking to be performed by the regions. The RSCs may already have procedures in place that exceed the minimum requirements described in this directive. In such circumstances, the RSCs should continue to use those procedures in addition to those presented in this directive. The guidelines for processing and performing quality assurance checks are presented separately for each data type. As described previously, processing and evaluation of profile data for all three data types is performed using ProQual. For each type of profile data, general guidelines on the menus and features in the ProQual software needed to perform data processing and quality assurance checks are described. Detailed information on the operation of the ProQual software is presented in the ProQual Manuals.

Quality Assurance Procedures for Inertial Profiler Data

The following are the recommended procedures to be used in the office for processing and performing quality assurance checks on longitudinal profile data collected with inertial profilers.

1. *Check Analysis Parameter Screen and Equipment Screen in ProQual*

   After starting ProQual, check if settings in Analysis Parameter Screen and Equipment Screen are set to values described in the Profiler Manual. In ProQual, the Analysis Parameter Screen

is located under System/Setup/Analysis Parameters while the Equipment Screen is located under System/Equipment.

The following parameters in the Analysis Parameter Screen should be checked to see if they are set to the correct value: Running Average, Sample Length, Fault Threshold, Spike Threshold 1, Spike Threshold 2, Tolerance on Mean, Tolerance on Standard Deviation, Slope Variance Interval, Mays Coefficients and RMSVA Base Length. (The values for Sample Length, Fault Threshold, and RMSVA Base Length are not used in computations, but it is recommended that they be kept at the values shown in the Profiler Manual).

The Equipment Screen should be checked to see if the following parameters are set to the correct values: Manufacturer, Description, Serial #. The value for either Vertical Photocell Offset or Horizontal Photocell Offset is used only when data being processed were collected with ICC MDR 4086L3 profiler. When data from the ICC profilers are being processed, the values in these two fields should be checked to see if they are set to the correct value. For other profiling devices, there should be no values shown in these two fields.

2. *Compute Roughness Indices*

In ProQual, select data set to be analyzed and click on "All" icon to compute all roughness indices (i.e., IRI, RMSVA, Slope Variance).

3. *Review Header Information and End of Run Comments*

The header information and End of Run Comments for all profile runs can be reviewed by selecting the "Browse" option in the "Run Details" menu of ProQual. The following are the fields that need to be reviewed; they are presented in the order they appear when the "Browse" option is selected.

Time: The time of profiling shown is obtained from the computer in the profiler during testing. Review time to see if it is reasonable. If unreasonable, the time shown in the computer of the profiler should be checked for possible errors.

Sequence: Check if sequence identifier is correct. The value in this field is not uploaded to the PPDB. However, an incorrect value may affect the archival procedures used in the RSCs.

Software: Check if software version is correct.

Filter: The value in this field should be 100. If not, it means that the Filter Wavelength was set incorrectly when the data were collected. If a value other than 100 has been used to collect the data, discard the data; profile data will have to be re-collected. Also, check the settings of the Filter Wavelength in the profiler software to ensure that it is set to a value of 100.

Crew: Check if operator and driver initials have been entered correctly. Operator and driver should be identified by two characters each; first letter of their first and last names. Operator and driver names should be separated by a forward slash and typed in capital letters (e.g.,

CK/RS). If profiling is done as one person operation, operator and driver name should be the same (e.g., CK/CK).

Road: This field should show the route number where section is located (e.g. I-88). Check if information is correct.

Lane: This field refers to the lane that was profiled. Valid entries are INSIDE or OUTSIDE. Check if the entry in this field is correct.

Direction: This field refers to travel direction when profiling site. Valid entries for this field are NORTH, EAST, SOUTH, or WEST. Check if travel direction is correct.

Begin: This is entry made for field Beginning Description in profiler software. Check to see if the entry in this field matches what is specified in current version of LTPP Profiler Manual.

Note: Version 4.0 of Profiler Manual indicates this field should be blank. However, the ICC software does not function properly when this field is blank. Therefore, the profiler operator currently enters the milepost location or some other entry into this field. The correct entry for this field in the ICC software will be specified in the next version of the Profiler Manual.

End: This is entry made for field Ending Description in profiler software. Check to see if the entry in this field matches what is specified in current version of LTPP Profiler Manual.

Note: Version 4.0 of Profiler Manual indicates this field should be blank. However, the ICC software does not function properly when this field is blank. Therefore, the profiler operator currently inputs an entry such as “None” into this field. The correct entry for this field in the ICC software will be specified in the next version of the Profiler Manual.

Surface: This field shows surface condition of road. Valid entries are V. GOOD, GOOD, FAIR and POOR. As this field is selected in the profiler software by toggling through the four possible values, an entry will always be present for this field. This is a subjective entry made in the field by the operator based on a set of guidelines included in the Profiler Manual. It is recommended that the value assigned to the section during the previous site visit be reviewed when checking this field. Otherwise, there could be variability in the value assigned to this field from one year to another; e.g., V. GOOD during latest visit, but value for previous visit was GOOD.

Temperature: This field shows air temperature at time of profiling in degrees Celsius. Check if value appears reasonable based on season/month of testing. If the temperatures appear to be questionable, check with operator who collected the data.

Clouds: This field shows cloud condition at time of profiling. Valid entries are CLEAR, P. CLOUDY (Partly Cloudy), or CLOUDY. As this field is selected in the profiler software by toggling through the three possible values, an entry will always be present for this field. However, there is no easy way to check if entry is correct.

Weather: The value in this field corresponds to field "Other Weather Conditions" that was entered in the ICC software. In the ICC software, the operator has the option of toggling through the following entries and selecting the appropriate one: CONDITIONS OK, STEADY CROSSWIND, WIND GUSTS, HOT AND HUMID, HAZY, LOW SUN ANGLE. As this field is selected in the profiler software by toggling through the six possible values, an entry will always be present for this field. If there are questions about an entry, check with profiler operator to verify entry is correct. The information in this field should be used when evaluating profile data (see step 5).

Start Method: The start method for profile data collection is always PHOTOCELL. The code assigned to photocell is 1. Verify that this field shows 1. If a method other than Photocell has been used to collect the profile data, discard the profile data; profile data will have to be re-collected.

Stop Method: The stop method for profile data collection is always DISTANCE. The code assigned to distance is 3. Verify that this field shows 3.

Stop Distance: The stop distance for GPS and SMP sections is 152.40 meters; verify that value is correct. If an SPS project, see if value appears reasonable; stop distance shown for SPS projects is length of entire profile run.

Wavelength Initialization: For ICC profilers this field should show a value of 2. For K. J. Law profilers this field shows a value of 0.

Average Speed: This field shows average speed during profiling, which should normally be 80 km/h. However, higher values are also possible as the Profiler Manual indicates the operating speed may be increased to 88 km/h depending on traffic conditions. If a speed higher than 88 km/h is entered, the reason for the higher speed should be checked. If the speed is less than 80 km/h, the reason for the lower speed must be checked to verify it was due to the posted speed limit.

Run End Note: This field shows entry made in field by operator at end of a profile run. The operator has the option of choosing one of the following entries from the pull-down menu in the ICC software: RUN OK, PAVEMENT SURFACE DAMP, TRAFFIC CONGESTION: SPEED VARIABLE, DIFFICULT TO MAINTAIN CONSTANT SPEED: UPGRADE, DIFFICULT TO MAINTAIN WHEEL PATH LOCATION, LATE PHOTOCELL INITIATION. If none of them is appropriate, the operator has the option of typing in an entry. If the Run End Note is not one of the six ICC options, check if Run End Note follows guidelines described in section 2.2.7.8 of Profiler Manual. The comment in this field will be useful when graphically comparing profile plots (step 5) and when evaluating IRI values of profiler runs (step 8).

Operator Note: This field shows comments made by operator in the field after data have been reviewed through ProQual. Review comments and see if they follow the guidelines presented in Section 2.2.7.8 of the Profiler Manual. Comments will be useful when graphically comparing profile plots (step 5) and when evaluating IRI values of profiler runs (step 8).

Device Code: The code shown in this field should be "P".

Manufacturer: This field shows the profiler manufacturer and should reflect value set in Equipment Parameter screen of ProQual. Check if manufacturer shown is correct.

Model: This field shows profiler model and should reflect value set in Equipment Parameter screen of ProQual. Check if model shown is correct.

Model Code: This field shows model code assigned to profiler and is related to entry selected in the Model field.

Sample Size: This field shows sample interval for profile data, which was assigned to "Sample" in the Analysis Parameter screen. Sample size should show a value of 150.

If there are errors in any of the headers that can be corrected, go to "Identification and Conditions" menu under "Run Details" tab and correct the header. If there are errors that cannot be corrected (e.g., not using photocell to initiate data collection, using an incorrect filter) discard data; profile data will have to be re-collected.

4. *Check Profile Data Interval*

Go to "Profile Details" tab in ProQual and check if data are at 150 mm intervals and that data for 152.4 m are available (Sections 2 and 5 in SPS-6 projects should have data for 304.8 m). Although Analysis Parameters screen was checked to see if running average was set to 150 mm, there is always the possibility that this value was not set to the correct value in the field. A review of the Location field in the "Profile Details" tab will verify that the Running Average was set to 150 mm.

5. *Perform Graphical Run-to-Run Comparison of Profile Data*

The graphical run-to-run comparison of profile data involves making a visual comparison of the data obtained for the multiple runs. This comparison is performed separately for the left, right and center paths. The "Graphic Profiles" option in ProQual is used to do the comparison. The profiles should be evaluated for repeatability. End of Run and Operator Notes entered by the operator in the field should be reviewed when the comparison between profiles is made. In addition, the Field Activity Report should also be reviewed to see if the operator has made any additional comments related to profiler runs in that report. If variations between the profile runs are noted, the runs showing the variability should be reviewed to see if any of the following conditions contributed to the variability: DMI shift, testing out of the wheel path or variability that is not pavement related.

6. *Evaluate Spikes in Profile*

The "Spikes" tab under "Data Sets" in ProQual shows the locations where spikes were detected in the profile. Review Operator Notes to determine cause(s) of spikes. If spikes were noted, it is mandatory that operator note if spikes were pavement related. When performing the run-to-run profile comparison, evaluate if spikes occur at same station for different runs.

The results of the previous distress survey can also be used as a tool to evaluate if pavement features caused the spikes. The visit-to-visit profile comparison described in the next step can also be used to check if spikes were noted in the previous visit.

If the cause(s) of the spikes is determined to be non-pavement related, logically mark the locations where spikes are noted. This is done in the "Profile Details" tab in ProQual that shows the profile elevations; the spike is logically marked by changing entry in "Include" from "True" to "False." When a data point is logically marked, the data point is not used when computing profile indices.

7. *Perform Graphical Visit-to-Visit Comparison of Profile Data*

The visit-to-visit profile check involves making a visual comparison of profile data from the current visit with data from the previous visit. The "Graphic Profiles" option in ProQual is used for this comparison. Profile data for the previous visit is obtained from the PPDB. The comparison is made only along the left and the right wheel paths, as center path data for the previous visit is not available in the PPDB.

Data obtained for multiple profile runs from the previous site visit should be evaluated and one representative profile run should be selected to perform the visit-to-visit comparison (it is permissible to select more than one run for the comparison). Profile data for the previous site visit should be overlaid with at least three good profile runs from the current data set, and the data for the two site visits should then be evaluated to (1) determine if similar profile features are present in both data sets and (2) determine if profile shapes are similar. This comparison should be performed separately for each wheel path.

If there are differences in profile features and shapes between the two data sets, the cause(s) for the difference should be evaluated. When ICC profiler data are compared to data collected with K. J. Law T-6600 profilers, differences in long wavelengths may be seen. However, the profile features for both devices should be similar. When the comparison involves only ICC profiler data, both profile features as well as profile shapes should be similar. If a good match is not obtained, use data from two previous site visits and perform comparison. If no explanation for the differences in profiles is found, paper copies of the profiles should be submitted to appropriate RSC personnel for review.

When reviewing data for sections that were sub-sectioned (e.g., SPS sections), the visit-to-visit graphical profile comparison can be used to determine if sub-sectioning was performed correctly. If horizontal offset of profile features is noted between visits, this may indicate a problem with sub-sectioning. If horizontal shift in profile data is noted between visits for a section, check if it occurs for other sections in the SPS project. Based on feedback provided by the regions on typical profile shifts noted between visits, a shift of up to 1-m between visits is acceptable. If a sub-sectioning problem is suspected, re-evaluate the sub-sectioning performed for the SPS project (or other cases where sub-sectioning was performed).

8. *Review Profile Indices*

If a spike was logically marked, the "All" icon in "Analysis" submenu of "Data Sets" tab has to be selected again to re-compute roughness indices. If no spikes were logically marked, it is

not necessary to re-compute the roughness indices. Print Site Visit Report and Site Summary Report.

Use Site Visit Report to review the following: IRI Statistics (such as minimum IRI, maximum IRI, mean IRI, standard deviation of IRI, and IRI coefficient of variation), Run-to-Run Confidence Limits, and the IRI values obtained along left and right wheel path as well as the mean (both) IRI between runs. Use Site Summary Report to review the values computed for IRI, Spike Count, RMSVAs, Mays Output and Slope Variance. Compare IRI values obtained from the current visit with those from previous visit. If difference in IRI value exceeds 10% for a wheel path (when mean IRI from all good runs are compared), check to see if cause for IRI change can be identified. If no explanation is found, paper copies of profiles including a graphical profile print out should be submitted to appropriate RSC personnel for review.

9. *Assign RCO Code and RCO Comment*

A RCO Code has to be assigned to each profile run after quality assurance checks are performed on the data. Those checks include:

- Review operator comments.
- Compare IRI values and review IRI coefficient of variation for replicate profile runs collected during site visit.
- Compare profile data of replicate runs collected during site visit.
- Review spikes in profile data and review operator comments regarding spikes.
- Compare profile data with those collected during previous site visit(s).
- If required, review distress maps to investigate spikes in the data.

Once these tasks have been completed, assign a RCO Code to each profile run using the guidelines presented in LTPP Directive P-27. The RCO Code is assigned in the “Results and Status” tab of the “Run Details” sheet in ProQual.

In addition, make a RCO comment if required for each profile run. The following are reasons for making a RCO comment:

- Indicate locations where spikes were logically marked.
- Indicate improper DMI calibration
- Indicate if spikes are pavement related
- Indicate cause(s) for variability in profiles

The RCO Comment is assigned in the “Results and Status” tab of the “Run Details” sheet in ProQual.

10. *Select Runs for Upload to PPDB and Create Upload Files*

From all available profile runs select five profile runs for upload. Thereafter, create RIMS upload files. Check ProQual Export Review Summary Report for errors and exceptions. Resolve any remaining issues and recreate RIMS upload files, as needed.

11. Submit RIMS files to Appropriate RSC Personnel for Review and Upload to PPDB

If any problems are encountered during upload of RIMS data to PPDB they should be resolved and the corrected data should be uploaded to PPDB.

12. Backup Data

The profile data files collected by the profiler (hereafter referred to as raw profile data) as well as all files generated by ProQual should be backed up. For data collected with the K. J. Law T-6600 profiler, the raw profile data files that need to be backed up are those with an extension of 'p.' For data collected with the ICC profiler, the raw profile data files that need to be backed up are the files with extensions of 'p', 'e' and 'v'. All files generated by ProQual related to each site as well as the files in the SYSDB directory of ProQual should be backed up in conjunction with the raw profile data files.

Quality Assurance Procedures for Longitudinal Dipstick® Data

The following are the recommended procedures to be used in the office for processing and performing quality assurance checks on longitudinal profile data collected with a Dipstick®.

1. *Check if Dipstick® Passed Pre and Post Measurement Checks and if Data Met Closure Error*

   Check Form DS-7 to verify that Dipstick® passed zero check and calibration check prior to and after data collection. Check Form DS-1 to verify that closure error was within acceptable value.

2. *Enter Header Information*

   This section presents general procedures on navigating through the different ProQual menus and specifies the information that needs to be entered into header fields. Details on procedures for navigating between menus are presented in the ProQual Manuals.

   To enter header information of a site into ProQual, select "Manual" from main menu, and then select "Longitudinal" option. Thereafter, select site from the left side of the screen (if the site has not been created in ProQual, create site by selecting "System" in Main menu and then selecting "Sites" option).

   Select "Insert Data Set" icon (+ icon) and edit/enter information in the following fields in the Manual Data Set part of the screen:

   Name: The default entry shown in this field contains the LTPP Section ID, Current Date and Current Time. (For example, if the + icon was selected on 13 May 2003 at 1:36:10 PM for site 261000 the entry shown in this field will be, 261000 Manual Data Set: 13/May/2003 1:36:10 PM.) Edit date and time in this field to show data collection date and time at which data collection was started. This information is contained in Form DS-1.

Sample Interval: This field shows a default value of 304.8 mm. The spacing between the two footpads of all Dipsticks® used in the LTPP program is 304.8 mm. No change is required to this field.

Date: Enter date of data collection from sheet DS-1.

Time: Enter time data collection started from sheet DS-1.

Equipment: Select appropriate Dipstick® model number from pull down menu such that Model Number and Equipment # corresponds to the Serial Number and Model Number shown in Form DS-1. If the required Dipstick® Model Number and Serial Number is not available in the pulldown menu, then the appropriate Dipstick® information should be entered in the Equipment Parameters screen of ProQual.

Check if all entries are correct and save data. After data are saved, the Manual Header entry fields will appear on the screen and the information in following fields have to be edited or entered: Road Name, Site Type, Visit, Run Length, Units, Lane, Direction, Crew, Clouds, Temperature, Weather, Surface Type, Surface Condition, Operator Comment and Run End Comment.

Road Name: Enter highway or route designation in this field. Enter information in capital letters (e.g., INTERSTATE 57, US 395, S.R. 31).

Site Type: The drop down menu gives the following options: SPS, GPS, SMP, CAL, WIM. Select appropriate site type. This information is not entered into the PPDB.

Visit: Select appropriate sequential visit identifier. (e.g., A for first visit to site, B for second visit, C for third visit, etc). Check if visit identifier is correct and enter value. This information is not entered into the PPDB.

Run Length: This field is used to enter the length of the test section in meters, which will usually be 152.4 m. Once the data set is saved, this value cannot be edited. Therefore, make sure that the correct value is entered as it is used to generate the data entry tables in the "Profiles" tab.

Units: This field shows a default value of mm. All Dipsticks® used in the LTPP program show readings in millimeters. Therefore, no change is required to the value shown in this field.

Lane: Use pull-down menu and enter lane, which can be either 'OUTSIDE' or 'INSIDE'. Check if lane is correct.

Direction: This is traffic direction of test section. Use pull-down menu and select NORTH, EAST, WEST or SOUTH. Check if direction is correct.

Crew: Operator and recorder should be identified by two characters each; first letter of their first and last names. Operator and recorder names should be separated by a backslash and typed in capital letters (e.g., CK/RS).

Clouds (Cloud Conditions): Valid entries for this field are CLEAR, P. CLOUDY, or CLOUDY. Use pull-down menu in ProQual to select appropriate entry; there is no easy way to check if entry is correct.

Temperature: The pavement surface temperature, in degrees Celsius, obtained with an infrared device is entered in this field. Check if temperature appears to be reasonable based on season/month when test was performed and, if reasonable, enter value.

Weather Comment: ProQual contains the following predetermined comments: CONDITIONS OK, STEADY CROSSWIND, WIND GUSTS, HOT AND HUMID, HAZY, LOW SUN ANGLE. Select appropriate comment using the pulldown menu. If there is a weather related comment that is different from those available in the pull-down menu, type the comment in this field using capital letters.

Surface Type: Use pull-down menu to select surface type; A-CC for asphalt surfaced pavements and P-CC for portland cement concrete surfaced pavements.

Surface Condition: Enter condition of pavement as either V. GOOD, GOOD, FAIR or POOR. Use pull-down menu to select entry. Since this is a subjective entry made in the field by the operator, it is recommended that the value assigned to the section during the previous site visit be reviewed when checking this field. Otherwise, there could be variability in the value assigned to this field from one year to another; e.g., V.GOOD during latest visit, but value for previous visit was GOOD.

Operator Comment: Enter operator comments, if the operator made any comments, in capital letters.

Run End Comment: Enter Run End Comment, if the operator made a comment, in capital letters.

Once all header entries have been entered and checked, save header information.

Note: Longitudinal Dipstick® data collection form DS-1 in Version 4.0 of the Profiler Manual does not contain fields for recording most of the header information. The next version of the Profiler Manual will contain an updated data collection form and it will provide guidance on how the header information should be filled out in the field.

3. *Enter Longitudinal Dipstick® Data*

Enter the Dipstick® survey readings recorded on Forms DS-2 through DS-6 into the "Profiles" sheet. The exact sign convention used in the data sheets should be followed when entering the data (i.e., a negative value in data sheet should be entered as a negative value into ProQual). Once data have been entered for both the left and the right wheel paths, print data by clicking on Printer icon. Check Dipstick® data values along left and right wheel paths in printout with values in Forms DS-2 through DS-6 to make sure all data have been entered correctly.

4. Sum Dipstick® Data and Filter Profile Using Surface Dynamics Filter

After checking data and making corrections as needed, click on sum button to obtain elevation profile as well as elevation profile that has been filtered with the Surface Dynamics upper wavelength cut-off filter (i.e., this action will cause the four data columns right of the left profile reading column to be populated with data). The Surface Dynamics filter included with the ProQual software was used in the K.J. Law T-6600 profilers as the upper wavelength cut-off filter. Thereafter, click on Update Main Tables icon to update the main tables with the filtered profile data.

Note: ProQual 2002 provides the option of filtering the Dipstick® elevation profile with either the Surface Dynamics or ICC filter. Longitudinal Dipstick® data are collected on a regular basis at test sections in Alaska, Hawaii, and Puerto Rico. In order to provide consistency in data collected at these sites, the Surface Dynamics filter must be used to filter Dipstick® profiles.

5 Compute Ride Indices and Review Data

The data set can now be treated as a profiler run that was obtained using an inertial profiler by selecting "Profiles" menu from the main menu of ProQual, and then selecting the "Data" submenu. Select data set to be analyzed and in "Analysis" submenu of "Data Sets" menu select "All" icon to compute all roughness indices (i.e., IRI, RMSVA, Slope Variance). Review if spikes are present in profile. If spikes are present, check to make sure that spikes were not caused by errors during data entry. Print Site Summary Report to review the values computed for IRI, Spike Count, RMSVAs, Mays Output and Slope Variance. Plot profiles along left and right wheel paths and review profile plots.

6. Compare Data With Data From Previous Visit.

Compare IRI values obtained along each wheel path with those obtained during previous site visit. If difference is greater than 10% for a wheel path, investigate reason for difference. Graphically compare profiles along each wheel path with those generated from previous site visit. If major differences are noted between the two data sets, and no explanation for differences is found, paper copies of the profiles should be submitted to appropriate RSC personnel for review.

7. Review Operator Comment and Run End Comment

The Operator Comment as well as the Run End comment was entered into the header menu in step 2 (Enter Header Information). Based on the review of the profile data, make changes to the Operator Comment or Run End Comment if needed.

8. Assign RCO Code and RCO Comment

A RCO Code must be assigned to the profile data after quality control checks have been performed on the data. Those checks include:

- Review operator comments.
- Compare IRI values along each wheel path with those obtained during previous site visit.
- Review spikes in profile data and review operator comments (if any) regarding spikes.
- Compare profile data with those collected during previous site visit(s).
- If required, review distress maps to investigate spikes in data.

Once these tasks are completed, assign RCO Code to profile runs using guidelines presented in LTPP Directive P-27. The RCO Code is assigned in the "Results and Status" tab of the "Run Details" sheet in ProQual.

In addition, make RCO comment if required. The RCO Comment is entered in the "Results and Status" tab of the "Run Details" sheet in ProQual. The RCO comment should address any anomalies noted in the data.

9. *Create PPDB Upload Files*

   Select longitudinal Dipstick® profile file for upload and create RIMS upload file. Check the ProQual Export Review Summary Report for errors and exceptions. Resolve any remaining issues and recreate RIMS upload files, as needed.

10. *Submit RIMS files to Appropriate RSC Personnel for Review and Upload*

    If any problems are encountered during upload of RIMS data to PPDB, problems should be resolved and corrected data should be uploaded to PPDB.

11. *Backup Data*

    Backup all files related to the site that were created by ProQual (these files should be in the subdirectory associated with that site). Store the field data sheets and ProQual generated reports in appropriate files.

Quality Assurance Procedures for Transverse Dipstick® Data

The following are the recommended procedures to be used in the office for processing and performing quality assurance checks on transverse profile data collected with a Dipstick®.

1. *Check if Dipstick® Passed Pre and Post Measurement Checks*

   Check Form DS-7 to verify that Dipstick® passed zero check and calibration check prior to and after data collection.

2. *Enter Header Information*

   This section presents general procedures on navigating through the different ProQual menus and specifies the information that needs to be entered into the header fields. Details on procedures for navigating between menus are presented in the ProQual Manuals.

To enter header information for a site into ProQual, select “Manual” from main menu, and then select “Transverse” option. Thereafter, select the site from the left side of the screen (if the site has not been created in ProQual, create site by selecting “System” in Main menu and then selecting “Sites” option).

Select “Insert Data Set” icon (+ icon) and edit/enter information in the following fields in the Manual Data Set part of the screen:

Name: The default entry shown in this field contains the LTPP Section ID, Current Date and Current Time. (For example, if the + icon was selected on 13 May 2003 at 1:36:10 PM for site 261000 the entry shown in this field will be, 261000 Manual Data Set: 13/May/2003 1:36:10 PM.) Edit date and time in this field to show data collection date and time at which data collection was started. This information is contained in Form DS-8.

Station Interval: The default value shown in this field is 15.24 m. This is the station interval at which transverse data are collected at LTPP sections. No changes are needed to this field.

Tests: The number of readings taken for a transverse profile. Enter number of readings by reviewing data on Form DS-8.

Date: Enter date of data collection from sheet DS-8.

Time: Enter time data collection started from sheet DS-8.

Equipment: Select appropriate Dipstick® model number from pull down menu such that Model Number and Equipment # corresponds to the Serial Number and Model Number shown in Form DS-8. If the required Dipstick® Model Number and Serial Number is not available in the pulldown menu, then the appropriate Dipstick® information should be entered in the equipment parameters screen of ProQual.

Check if all entries are correct and save data. After data are saved, the Manual Header entry fields will appear on the screen and the information in following fields have to be edited or entered: Road Name, Site Type, Visit, Run Length, Units, Lane, Direction, Crew, Clouds, Temperature, Weather, Surface Type, Surface Condition, Operator Comment and Run End Comment.

The entries for Road Name, Site Type, Visit, Lane, Direction, Crew, Clouds, Temperature, Weather, Surface Type and Surface Condition are available in Form DS-8. Check if entries meet the following criteria (taken from section 3.5.2.2 of the Profiler Manual) and enter information into appropriate field in ProQual.

Road Name: This is highway or route designation. Enter information in capital letters (e.g., INTERSTATE 57, US 395, S.R. 31). This information is not entered into the PPDB.

Site Type: The drop down menu gives the following options: SPS, GPS, SMP, CAL, WIM. Select appropriate site type. This information is not entered into the PPDB.

Visit: Sequential visit identifier. (e.g., A for first visit to site, B for second visit, C for third visit, etc). Check if visit identifier is correct and enter value. This information is not entered into the PPDB.

Units: This field shows a default value of mm. All Dipsticks® used in the LTPP program show readings in millimeters. Therefore, no change is required to the value shown in this field.

Lane: Use pull-down menu and enter lane, which can be either 'OUTSIDE' or 'INSIDE'. Check if lane is correct. This information is not entered into the PPDB.

Direction: This is traffic direction of test section. Use pull-down menu and select NORTH, EAST, WEST or SOUTH. Check if direction is correct. This information is not entered into the PPDB.

Crew: Operator and recorder should be identified by two characters each; first letter of their first and last names. Operator and recorder names should be separated by a backslash and typed in capital letters (e.g., CK/RS).

Clouds (Cloud Conditions): Valid entries for this field are CLEAR, P. CLOUDY, or CLOUDY. Use pull-down menu in ProQual and enter cloud conditions; there is no easy way to check if entry is correct. This information is not entered into the PPDB.

Temperature: The pavement temperature in degrees Celsius obtained with an infrared device is entered in this field. Check if temperature appears to be reasonable based on season/month when test was performed and enter value. This information is not entered into the PPDB.

Weather Comment: ProQual contains the following predetermined comments: CONDITIONS OK, STEADY CROSSWIND, WIND GUSTS, HOT AND HUMID, HAZY, LOW SUN ANGLE. If comment indicated in From DS-8 corresponds to one of the predetermined comments, use pull-down menu and select appropriate one. If comment is different, type comment noted in Form DS-8 (use capital letters). This information is not entered into the PPDB.

Surface Type: Use pull-down menu to select surface type noted in Form DS-8. A-CC for asphalt surfaced pavements and P-CC for portland cement concrete surfaced pavements. This information is not entered into the PPDB.

Surface Condition: Enter condition of pavement as either V.GOOD, GOOD, FAIR or POOR. Use pull-down menu to select entry that was made in Form DS-8. Since this is a subjective entry made in the field by the operator, it is recommended that the value assigned to the section during the previous site visit be reviewed when checking this field. Otherwise, there could be variability in the value assigned to this field from one year to another; e.g., V.GOOD during latest visit, but value for previous visit was GOOD. This information is not entered into the PPDB.

There are three more header fields in the header menu: Operator Comment, Run End Comment and RCO Comment. It is recommended that these three fields be completed after the transverse Dipstick® data has been entered and evaluated.

Once all header entries have been made and checked, save header information.

Note: There are many header entries that are not entered in the PPDB. However, these entries may be useful if the ProQual files are reviewed at a future date.

3. Enter Transverse Dipstick® Data

The transverse Dipstick® data collected in the field and recorded in Form DS-8 are entered into ProQual through the Profiles tab. The readings taken from Edge of Pavement to Center Line should be entered in the left column. The data for the return run (center of pavement to edge of pavement) should be entered in the right column. All measurements should be entered exactly as recorded in Form DS-8, with negative values in Form DS-8 entered into ProQual as negative values.

All three boxes on top of the graph should be checked so that elevations are displayed for the (1) run from edge of pavement to centerline, (2) from centerline to edge of pavement and (3) sum of two elevation measurements.

Once data have been entered, review and see if graphical "Sum" plot is a horizontal line. If not horizontal and spikes are noted at some locations, the data at those locations may have been incorrectly entered. If so, check if data have been entered correctly.

After data have been checked for accuracy, click on "Verify Profiles." Confirm that closure error limit has been met. If not, recheck data entry. If the data do not meet the closure limit, the data from that run should be submitted to the FHWA with a copy to the LTPP Technical Services Support Contractor.

Enter data for other transverse locations. Follow the procedures outlined above to check those data.

4. Use Graphic Profile Option to Check Profiles

After data for all transverse profile runs have been entered, use "Graphic Profile" option to plot profile data. When this option is selected, a graph showing the profile plots for all transverse locations is displayed. Check if profiles reasonably match between stations. If a plot for any specific station appears to be different from the rest of the profiles, check data that were entered for that location.

5. Run Rut Analysis

Click on "Rut Analysis" icon to compute rut depths and then print Rut Report using the Rut Report icon. Review rut depths computed along left and right wheel paths at different transverse locations. If rut depth at any location appears to be different from those for the other locations, check if data have been entered correctly.

If RSC maintains record of rut depths computed by ProQual for previous site visit, compare current rut depths with those from previous visit. The comparison should be made at each transverse location for each wheel path. If there are large differences, investigate if correct data have been entered.

6. *Enter Operator Comment, Run End Comment and RCO Comment*

   Operator Comment, Run End Comment or RCO Comment are not uploaded to the PPDB. Therefore, entries made to these fields are only useful if the ProQual data files are reviewed at a future date. If the operator has made comments in Form DS-8 related to data collection, enter comments in the Operator Comment field. If all comments cannot be entered into this field, enter remaining comments in the Run End Comment field. Also, enter a RCO Comment if needed to comment on the data.

7. *Create PPDB Upload Files*

   Run "IMS Export" to create RIMS files. Resolve any remaining issues and recreate RIMS upload files, as needed.

8. *Submit RIMS files to Appropriate RSC Personnel for Review and Upload*

   The RIMS files should be submitted to appropriate RSC personnel for review and then uploaded to the PPDB. Resolve any issues that may arise during upload.

9. *Backup Data*

   Backup all files related to the site that were created by ProQual (these files should be in the subdirectory associated with that site). Store the field data sheets and ProQual generated reports in appropriate files.

Question concerning this directive should be addressed to the FHWA LTPP staff member responsible for profiler operations with a copy to the LTPP Technical Support Services Contractor. If there are problems with the implementation of this directive, please submit a Profiler Problem Report (PROFPR) form in accordance with the guidelines contained in the latest version of the LTPP Manual for Profile Measurements.

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