TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __FHWA_____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project #	**Transportation Pooled Fund Program - Report Period:**
TPF-5(164)	☐Quarter 1 (January 1 – March 31) 2013 ☐Quarter 2 (April 1 – June 30) 2013 √Quarter 3 (July 1 – September 30) 2013 ☐Quarter 4 (October 1 – December 31) 2013

Project Title: *Fish Passage in Large Culverts with Low Flows*		
Name of Project Manager(s): *Kornel Kerenyi*	**Phone Number:** *(202) 493-3142*	**E-Mail** *kornel.kerenyi@fhwa.dot.gov*
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**

Project schedule status:

√ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**

Project Description:

A primary objective of this aspect of the fish passage study is to determine the local velocities and flow distributions in corrugated metal pipes and pipe arches. This information is proposed for use to supplement the guidance in the publication FHWA- NHI 01-020 Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5. Conventional open-channel culvert hydraulics provides the tools and software needed to compute the average velocity of flow at any culvert cross-section for higher flows, given the culvert shape, roughness, slope and boundary conditions. In order to more accurately evaluate the ability of fish to traverse corrugated metal culverts, it is desirable to look at the changes in the local average velocity of the flow adjacent to the culvert wall under low flow conditions. Other studies have documented the tendency of fish to seek out a swimming location with the lowest velocity of flow. The location of lowest velocity can generally be found immediately adjacent to the culvert wall.
The specific objectives of this task order are to develop local average velocity design charts for various hydraulic conditions in support of the "Fish Passage in large Culverts for low Flows" study, which will be incorporated into the FHWA publication HEC-26 "Culvert Design for Aquatic Organism Passage".

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

- Refined roughness simulation scheme was developed and carried out. The permeability of the gravel is considered with proper layout of the roughness elements.

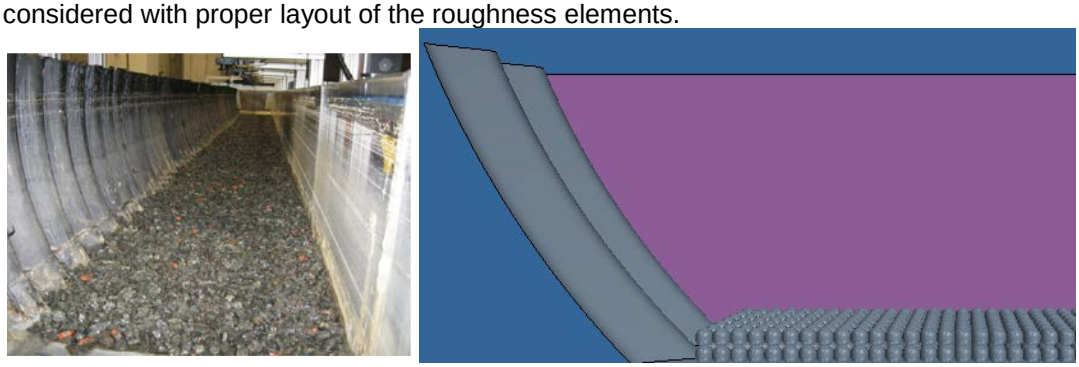

Figure 1 Roughness simulation

- After thorough discussion, a CFD testing scheme was determined. A matrix of various flow and embedment conditions was produced. CFD simulations were then carries out accordingly.

Table 1 Test result

Type	Run ID	V (m/s)	Depth	D_{50}	Composite n (CFD)	Composite n (HEC26)
No Embedment	C8F00V1D1	0.305	0.20	0	0.072	0.034
	C8F00V1D2	0.305	0.39	0	0.038	0.034
	C8F00V1D3	0.305	0.61	0	0.035	0.034
	C8F00V2D1	0.914	0.20	0	0.052	0.034
	C8F00V2D2	0.914	0.39	0	0.042	0.034
	C8F00V2D3	0.914	0.61	0	0.035	0.034
	C8F00V3D1	0.457	0.20	0	0.053	0.034
	C8F00V3D2	0.457	0.39	0	0.038	0.034
	C8F00V3D3	0.457	0.61	0	0.034	0.034
	C8F00V4D1	0.610	0.20	0	0.050	0.034
	C8F00V4D2	0.610	0.39	0	0.039	0.034
	C8F00V4D3	0.610	0.61	0	0.035	0.034
Full-pipe, No Embedment	C8F00V1	0.30	2.44	0	0.033	0.034

15% Diameter Embedment	C8F15V1D1P1	0.30	0.20	0.022	0.033	0.034
	C8F15V1D2P1	0.30	0.39	0.022	0.031	0.032
	C8F15V1D3P1	0.30	0.61	0.022	0.028	0.032
	C8F15V1D1P2	0.30	0.20	0.022	0.026	0.029
	C8F15V1D2P2	0.30	0.39	0.010	0.026	0.029
	C8F15V1D3P2	0.30	0.61	0.010	0.024	0.029
	C8F15V1D1P3	0.30	0.20	0.010	0.038	0.038
	C8F15V1D2P3	0.30	0.39	0.034	0.039	0.035
	C8F15V1D3P3	0.30	0.61	0.034	0.039	0.034
30% Diameter Embedment	C8F30V1D1P1	0.30	0.20	0.034	0.035	0.034
	C8F30V1D2P1	0.30	0.39	0.022	0.027	0.032
	C8F30V1D3P1	0.30	0.61	0.022	0.026	0.031
	C8F30V1D1P2	0.30	0.20	0.022	0.035	0.028
	C8F30V1D2P2	0.30	0.39	0.010	0.021	0.028
	C8F30V1D3P2	0.30	0.61	0.010	0.026	0.029
	C8F30V1D1P3	0.30	0.20	0.010	0.033	0.038
	C8F30V1D2P3	0.30	0.39	0.034	0.028	0.035
	C8F30V1D3P3	0.30	0.61	0.034	0.028	0.034
Composite n with Velocity	C8F15V1D1P3	0.30	0.20	0.034	0.038	0.038
	C8F15V2D1P3	0.91	0.20	0.034	0.038	0.038
	C8F15V3D1P3	0.46	0.20	0.034	0.038	0.038
	C8F15V4D1P3	0.61	0.20	0.034	0.038	0.038

- Roughness of AOP with ledges for crawling are also modeled.

Table 2 Roughness with ledges for crawling

Embedment	Run ID	D_{50}	τ_w(Pa)	V (m/s)	n
15% Pipe Diameter Embedment	C8F15E1V1P4T1	0.058	0.906	0.305	0.029
	C8F15E1V1P4T2	0.000	0.791	0.305	0.027
	C8F15E1V1P4T3	0.058	0.972	0.305	0.030
	C8F15E1V1P4T4	0.058	0.847	0.305	0.028
	C8F15E2V1P4	0.058	0.914	0.305	0.029
	C8F15E3V1D1P4	0.058	17.584	0.305	0.093
	C8F15E3V1D2P4	0.058	8.310	0.305	0.067
	C8F15E3V1D3P4	0.058	4.852	0.305	0.053

Anticipated work next quarter:

- Amend previous report with new data.
- Circulate the report again for potential further comments.

Significant Results:

Necessary data for formulating Manning's roughness coefficient.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation:

Additional design aids that may be incorporated into FHWA HEC-26 "Culvert Design for Aquatic Organism Passage".