202-2923.5

HORNER & SHIFRIN, INC.
ENGINEERS

5200 OAKLAND AVENUE
SAINT LOUIS, MISSOURI 63110-1490
314-531-4321 • FAX 314-531-6966
www.HornerShifrin.com

W. HORNER YEARS H. SHIFRIN
1933 - 2008

RECEIVED

OCT 16 2008

Stock and Associates
Consulting Engineers, Inc

October 15, 2008

Josh Barcus
Stock & Associates Consulting Engineers, Inc.
257 Chesterfield Business Parkway
Chesterfield, MO 63005

RE: Howard Bend Levee District
Stormwater Design Report
Interconnected Lake System
Creve Coeur Airport Sub-Area

Dear Mr. Barcus:

On behalf of the Howard Bend Levee District, we have reviewed the report and have determined that it has satisfactorily addressed our comments. We are granting approval of the report with a revision date of September 2, 2008.

Please be informed that if any portions of the form or function of the stormwater management plan change, the master plan must be resubmitted for approval. It is also required that, as development occurs, the tables in the report be updated and the report be resubmitted as part of the permit submittal for each specific development.

If you have any comments or questions, please contact me.

Sincerely,
HORNER & SHIFRIN, INC.

Karen Frederich

Karen Frederich, P.E., CFM
Project Manager

c: Dan Devereux

202 2923.05

Metropolitan
St. Louis Sewer
District

2350 Market Street
St. Louis, MO 63103-2555
(314) 768-6200

November 22, 2010

RECEIVED

NOV 29 2010

Stock and Associates
Consulting Engineers, Inc

Stock & Associates, Inc.
257 Chesterfield Bus Pkwy
Chesterfield, MO 63005

Ref.: SPORT PORT 500' N. OF CREVE COEUR MILL
(HOWARD BEND LEVEE DISTRICT) STORMWATER PLAN
New

MSD Ref. No.: P-0027425-00

Gentlemen:

Approval of plans for the subject project is being withheld pending completion of the following requirements:

1. **Please submit stormwater plans and report with updated engineering seal, 2 sets**

As soon as these conditions have been complied with, the plans will be processed for approval and release by the Engineering Department.

Yours truly,

Scott D. Kappelmann, P.E. 768-6371
Engineering Department

pc: Developer
Engineering Department MSD

SCANNED

2923.5

Midwest Testing

8606 Page Avenue
St. Louis, Missouri 63114
www.mwtesting.com

314 739-2727 Office
314 739-5429 Fax
314 739-8589 Accounting Fax

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

February 18, 2011

Department of the Army
St. Louis District, Corps of Engineers
1222 Spruce Street
St. Louis, Missouri 63103

Attn: Mr. Jake Scanlon

Re: Soil Pressure Coefficient Considerations
MT Job No. 12141
Howard Bend Pump Station
Maryland Heights, Missouri

Gentlemen:

We have performed a geotechnical exploration for the site of the referenced project, the results of which are discuss in our report titled *Geotechnical Exploration—MT Job No. 11955—Howard Bend Missouri River Pump Station—Maryland Heights, Missouri* and dated February 9, 2009. In our report we provided soil pressure coefficients (K) for the expected materials at the site.

In response to Chief Jake Scanlon's February 14, 2011 letter, we have compared our specified K for silty clay with the general wedge method of lateral soil pressure determination presented in the US Army Corps of Engineers' Engineering Manual *EM 1110–2–2100: Stability Analysis of Concrete Structures*.

Section 5–3.c (2) of the manual indicates that if the backfill has a sloping top surface; only one soil material; a water–table completely above or below the backfill; cohesionsless backfill; and uniformly distributed, completely covering surcharge the equivalent fluid–pressure coefficient can be determined using the Coulomb Equation. These conditions are met by the analyses performed by Alper Audi, Inc. for the outlet structure.

The manual also indicates that if the backfill has a horizontal top surface; one or more horizontal soil layers; groundwater within or not within the backfill; cohesive or cohesionless fill; and uniformly distributed, completely covering surcharge the equivalent fluid–pressure coefficient can be determined using the Coulomb Equation. These conditions are met by the analyses performed by Alper

Audi, Inc. for the pump station, since the distance to the slope toe exceeds the depth of the base of the pump station.

The K included in our February 2009 report for silty clay was 0.39, but this value assumed a level backslope. The outlet structure is within a 3H:1V slope, where the above value would not apply. We used the Coulomb Equation supplied within Section 5-3 of the Corps Engineering Manual to calculate a value of K for the 3H:1V slope equal to 0.49. We also performed the calculation for a level backslope to confirm our value of 0.39. Our calculations of K are attached.

With a minimum K applied of 0.39 for level slopes or 0.49 for a 3H:1V slope, adequate driving pressure has been used.

We appreciate the opportunity to be of service to you on this project. If you have any questions, please call.

Very truly yours,
MIDWEST TESTING

Kevin P. Daut, E.I.T.
Staff Engineer

Daniel J. Barczykowski, P.E.
Principal

KPD/DJB/

Electronic Copy: USACE St. Louis District/Jake Scanlon
Stock and Associates/George Stock, Doug Bruns, Eric Fischer
Alper Audi, Inc./Rand Jasper

Attachment

Midwest Testing
Geotechnical • Environmental • Materials
8606 Page Avenue
St. Louis, Missouri 63114
314-739-2727 • Fax 314-739-5429
www.mwtesting.com

PROJECT Howard Bend [illegible]p Station
SHEET NO. 1 OF 1
CALCULATED BY KPD DATE 2-15-11
CHECKED BY ______ DATE ______
SCALE NTS JOB NO. 12141

K calculation per EM-1110-2-2100 Section 5-3

(2) Equivalent fluid pressure coefficients from Coulomb's Equation

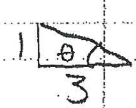
- Backfill w/ sloping top surface
  * one soil type
  * Water table completely above or below backfill
  * Cohesionless
  * Uniform Surcharge.

$\phi_d$ = developed internal friction parameter = 26°

$\delta$ = wall friction angle
β positive ∴ $\delta = \beta$

β = 3V:1H

$$K = \frac{\cos^2(\phi_d)}{\cos\delta\left[1+\sqrt{\frac{\sin(\phi_d+\delta)\sin(\phi_d-\beta)}{\cos\delta\,\cos\beta}}\right]^2}$$




$\tan\theta = \frac{1}{3}$

$\theta = \tan^{-1}\left(\frac{1}{3}\right) = 18.43°$

$$K = \frac{\cos^2(26°)}{\cos(18.43°)\left[1+\sqrt{\frac{\sin(26°+18.43°)\sin(26°-18.43°)}{\cos(18.43°)\cos(18.43°)}}\right]^2}$$

$\boxed{K = 0.489}$ with 3V:1H Slope

Level Backslope

$$K = \frac{\cos^2(26°)}{\cos(0)\left[1+\sqrt{\frac{\sin(26°+0°)\sin(26°-0)}{\cos(0)\cos(0)}}\right]^2} = \boxed{0.390}$$ with level backslope

2923.5

**DEPARTMENT OF THE ARMY**
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF:

February 14, 2011

Operations, Readiness,
Regulatory Division
Readiness Branch

Permit OD-R 08-023, Howard Bend Levee District, Storm Water Pump Station, St. Louis, Missouri

Mr. Gary Hente
Howard Bend Levee District
3411 Creve Coeur Mill Road
Maryland Heights, MO 63146

Dear Mr. Fischer,

The proposal for the work on Howard Bend Levee District proposed storm water pump station modification has been reviewed. All previous comments have been satisfactorily addressed. One outstanding concern is the following:

> In the global stability analysis, the EM 1110-2-2100 section 5-3, recommends that for the general wedge method of lateral soil pressure determination for the driving forces that the equivalent-fluid soil pressure coefficient (K) be used. It is recommended that the structural engineer verify this within the analysis and consult with their geotechnical engineer, if needed, to ensure the proper driving pressure was used.

Recommendation for approval of this permit will be granted if Stock and Associates provides written verification that the above issue has been investigated. Please contact John Osterhage at 314-331-8613 if you have any questions regarding this permit.

Sincerely,

Jake Scanlon

Jake Scanlon
Chief, Readiness Branch

CC: Mr. Eric Fischer
eric.fischer@stockassoc.com

Mr. Doug Bruns
doug.bruns@stockassoc.com

2923.5

ALPER AUDI, INC.
STRUCTURAL ENGINEERS

February 28, 2011

Mr. Jake Scanlon
Chief, Readiness Branch
U.S. Army Engineer District, St. Louis
1222 Spruce Street
St. Louis, MO 63103

**RE: HOWARD BEND LEVEE DISTRICT, STORM WATER PUMP STATION**
**PERMIT OD-R 08-023**
**ST. LOUIS, MISSOURI**

Mr. Scanlon,

This letter is in response to your letter dated February 14, 2011.

For the pump station and the outfall structure, Midwest Testing has provided increased K values that are based on the developed soil strength parameters per USACE EM 1110-2-2100, chapter 5. See attached letter from Midwest Testing.

At the pump station, we reviewed the global stability calculations using the increased K values provided by Midwest Testing. All of the factors of safety required by EM 1110-2-2100 are met.

At the outfall structure, we accounted for the 3H to 1V slope of the levee within the computer program we used. Midwest provided soil loads based on the increased K values. The soil load we used is larger than the sliding forces determined by Midwest Testing. All of the factors of safety required by EM 1110-2-2100 are met.

Sincerely,

Andre Audi, P.E., S.E.
for Alper Audi, Inc.

STATE OF MISSOURI
ANDRE AUDI
NUMBER
EN 023879
REGISTERED PROFESSIONAL ENGINEER

AA/kaa

K:\2009 Projects\09119 MO River Pump Station\Documents\Correspondence\09119 RLJ Pst letter 02-28-11.doc

1804 Borman Circle Drive • St. Louis, Missouri 63146 • 314/432-8600 • Fax: 314/432-8630
E-mail: aai@alperaudi.com • Website: www.alperaudi.com

2923.5

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

March 7, 2011

REPLY TO
ATTENTION OF:

Operations, Readiness,
Regulatory Division
Readiness Branch

Permit OD-R 08-023G, Howard Bend Levee District, Storm Water Pump Station, St. Louis, Missouri

Mr. Gary Hente
Howard Bend Levee District
3411 Creve Coeur Mill Road
Maryland Heights, MO 63146

Dear Mr. Hente,

The proposal and additional submittal for the work on the Howard Bend Levee District storm water pump station modification has been reviewed. Our Engineering Division recommends approval of the subject permit request.

Actual approval or disapproval of the permit is the responsibility of the levee district. Also, this permit does not consider any regulatory requirements. Contact Rob Gramke at 314-331-8187 to ensure no regulatory permits are required. Please contact John Osterhage at 314-331-8613 if you have any questions regarding this permit.

Sincerely,

Jake Scanlon

Jake Scanlon
Chief, Readiness Branch

CC: Mr. Eric Fischer
eric.fischer@stockassoc.com

Mr. Doug Bruns
doug.bruns@stockassoc.com