DAM INSPECTION REPORT

NHDES NO.:	71.03
NATIONAL INVENTORY OF DAMS ID. NO.:	NH-00544
NAME OF DAM:	Oyster River Dam
TOWN:	Durham
COUNTY:	Strafford
STREAM:	Oyster River

1.0 DESCRIPTION OF PROJECT

1.1 GENERAL

1.1.1 AUTHORITY

GZA GeoEnvironmental, Inc. (GZA) has been retained for dam safety inspections as a sub-consultant to Weston and Sampson Engineers, Inc., under contract dated September 19, 2000.

1.1.2 PURPOSE OF WORK

GZA has undertaken a visual inspection of the Oyster River Dam in Durham, New Hampshire. The primary objective was to observe existing surficial conditions at the dam, and render an opinion concerning maintenance measures, repairs, improvements, monitoring and/or investigations judged necessary to address deficiencies identified during the inspection. This report is subject to the Limitations in Appendix A.

1.2 DESCRIPTION OF PROJECT

1.2.1 LOCATION

Oyster River Dam is located on the Oyster River, just west of the Route 108 bridge, in the Town of Durham, New Hampshire (see Locus Plan - Figure 1).

1.2.2 OWNER/OPERATOR

The Town of Durham, New Hampshire, owns Oyster River Dam. Its offices are located at 25 Newmarket Road, Durham, NH. The dam is operated and maintained by the Town Department of Public Works, with offices at 100 Stone Quarry Drive, Durham, NH 03824, telephone 603-868-5578. The fish ladder is owned and operated and by the New Hampshire Fish and Game Department.

1.2.3 PURPOSE OF DAM

The dam was originally built in 1935. It currently has no purpose except for recreational use. The dam forms the boundary between the estuarine portion of the river downstream, and the freshwater flow upstream.

1.2.4 DESCRIPTION OF DAM AND APPURTENANCES

An Army Corps of Engineers Phase I report was not available from the Corps, the State, or the Town and was assumed to never have been performed. The following information is based on data listed in the National Inventory of Dams. The dam is a concrete buttress, modified Ambursen-style dam, which was built in 1935. It is approximately 140 feet long and 10 feet high and is a run-of-the-river dam with a broad-crested weir spillway. There are no flashboards.

Significant repairs to the dam were conducted in 1974 and included concrete re-forming of the spillway overflow section and buttresses and low-level outlet structures, as well as in construction of a fish ladder. Several photographs taken in 1974, just prior to the renovation efforts, are included in Appendix B.

1.2.5 OPERATION AND MAINTENANCE

The Town of Durham is responsible for the operation and maintenance of the dam. The Town has developed an Operating Procedure Plan (effective May 1, 2000) that was approved on April 24, 2000 by the State of New Hampshire, Department of Environmental Services (NHDES), Dam Safety Section.

1.2.6 SIZE CLASSIFICATION

The State of New Hampshire does not have a size classification system. Based on Army Corps guidelines, the dam is classified as small. The dam has a maximum impoundment of 80 acre-feet and a height of 10 feet. According to the Army Corps, a small size dam is one with a maximum storage between 50 or 1,000 acre-feet or a height between 25 and 40 feet.

1.2.7 HAZARD CLASSIFICATION

According to the New Hampshire Department of Environmental Services regulations (Ch. Env-Wr. 101), the dam is currently classified as a Class B, Significant Hazard Structure. Significant

Hazard is defined as a dam where: *"...the failure of which would result in any of the following: (a.) possible loss of lives; (b.) significant economic loss;(c.) major damage to Class I and Class II state highways; (d.) minor damage to interstate highways; loss of a municipal supply reservoir which constitutes more than 50% of a community's source or whose loss could endanger public health; or (e.) the release of liquid industrial or commercial wastes or municipal sewage from dams which do not meet the criteria in Env-Wr 101.04(e)."*

1.3 PERTINENT ENGINEERING DATA

Pertinent Data:	
TYPE:	Concrete Gravity
LENGTH:	140 feet
HEIGHT:	10.0 feet
TOP WIDTH:	1 foot
Elevations (NGVD):	
STREAMBED:	Not available
NORMAL POOL:	Not available
SPILLWAY CREST:	Not available
TOP OF DAM:	Not available
Drainage Area:	19.3 square miles
Reservoir:	
NORMAL POOL ELEVATION:	Not available
NORMAL POOL STORAGE:	72 acre-feet
NORMAL POOL SURFACE AREA:	24 acres
TOP OF DAM ELEVATION:	Not available
TOP OF DAM STORAGE:	80 acre-feet
TOP OF DAM SURFACE AREA:	Not available
Spillway:	
TYPE:	Broad crested
WEIR LENGTH:	90 +/- feet
CREST ELEVATION:	Not available
Construction Records:	Not available
Operation Records:	Not available

1.4 PREVIOUS INSPECTION REPORTS

There is no Corps of Engineers Phase I report available for the dam. Correspondence between the Town of Durham and the NHDES was reviewed by GZA as part of our scope of work. At the time most recent NHDES inspection of the dam on July 29, 1998, the following deficiencies were noted:

1. There was no written operational procedure plan.

2. Deteriorated concrete was observed along the base of the abutment wall of the gate structure (right abutment spillway wall) and at the base of the eight concrete piers supporting the concrete spillway slab.

3. Minor seepage was evident at the downstream corner of the right masonry abutment wall housing the gate structure.

4. The dam can pass 20 percent of the design storm event with the required one foot of freeboard on the dam. The routed 100-year storm event was estimated to be 1,883 cfs. The dam can pass 385 cfs with no operations and 618 cfs with operation of the two low-level gates.

2.0 VISUAL INSPECTION

2.1 GENERAL FINDINGS

A visual inspection of the dam and spillway was undertaken to identify any apparent surficial structural or hydraulic deficiencies. Present at the inspection, which occurred on October 3, 2000, were William Hover and Peter Baril of GZA, James Keane, of Weston and Sampson Engineers, and Robert Levesque, Town Engineer for the Durham Department of Public Works. Based on the results of the visual inspection, the dam was considered to be in fair to good condition. Photographs taken during the site visit are included in Appendix C. The results of the visual inspection are summarized on a checklist also contained in Appendix B. The following sub-sections summarize the key issues identified during the inspection.

2.1.1 DAM AND SPILLWAY

Generally, the spillway, weir, and fish ladder portion of the dam appeared in good condition. The upstream face exhibited minor efflorescence and spalling below the pool level. The stonewall should be repaired to eliminate a low point at the right abutment. The downstream face of buttresses appeared in fair condition, with deterioration and exposed rebar. Previous buttress repair was performed in the mid-1970s. This issue will require further investigation and repair, in GZA's opinion. Minor leakage was noted on the joint at the third buttress at the spillway, which should be monitored. The spillway exhibited minor growth of slime on its crest and face, which should be removed prior to future dam inspections. There was evidence of erosion along the base of the spillway at the toe of the dam, where some riprap had been dislodged.

2.1.2 APPURTENANT STRUCTURES: LOW LEVEL OUTLET

Some deterioration and loss of concrete was noted at the base of the concrete training wall at the right spillway abutment, at/near the outlet works. The left slide gate does not seat properly and about 20 gpm +/- of leakage was observed at the downstream side of the low-level outlet structure. There was also concrete deterioration and spalling on the downstream face of the outlet as well as evidence of cavitation near the base of the concrete training wall downstream from the

outlet structure. In addition, the floorstand area at the outlet tower should have a safety railing. The low level outlet structure is judged to be in fair condition.

2.1.3 DOWNSTREAM AREA

The area immediately downstream of the dam appeared in good condition. Bedrock outcroppings were noted at the toe of the dam and further downstream within the Oyster River. The Route 108 bridge is approximately 100 feet downstream of the dam. Beyond that, the channel broadens by a factor of two as the river transitions to the estuary.

2.2 OPERATION AND MAINTENANCE

The Town of Durham maintains the dam. According to Mr. Levesque, the two slide gate mechanisms, which comprise the low level outlet, are usually exercised at least twice per year. The impoundment is typically drawn down in the fall to control nuisance vegetation. The gates are typically closed during other times of the year and the water level maintained at spillway crest. The current emergency action procedures for the dam are contained in the Town's Operating Procedure (effective May 1, 2000), which lists the following contacts in case of emergency:

First Contact: Public Works Director through Durham/UNH Dispatch Center; 603-862-1392.

Second Contact: Superintendent of Operations through Durham/UNH Dispatch Center; 603-862-1392

Third Contact: Highway Foreman through Durham/UNH Dispatch Center; 603-862-1392

2.3 HYDRAULIC AND HYDROLOGIC DATA AND OVERTOPPING POTENTIAL

The NHDES has estimated that the dam can pass 20 percent of the 100-year storm event with the required one foot of freeboard on the dam. The routed storm is estimated at 1,883 cfs. The dam can pass about 385 cfs with no operations and 618 cfs with full operation of the two low-level gates. In accordance with NHDES regulations, Ch. Env-Wr 307.02 (Minimum Discharge Requirements), the spillway design flood (SDF) for Class B Structures is the one-half Probable Maximum Flood (1/2-PMF). Thus, in GZA's opinion, the dam cannot safely pass the SDF under its current hazard classification.

2.4 STRUCTURAL STABILITY

Although no stability analyses of the dam could be located, observation of the existing conditions indicates that the dam appears stable at the present time under static loading conditions with impoundment at the spillway crest. It should be noted, however, that dam stability depends on constantly changing internal and external conditions. It should therefore not be assumed that the present condition of the dam would continue to exist in the future.

3.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS,

The visual inspection of the Oyster River Dam revealed it to be in overall good to locally fair condition. No evidence of apparent conditions requiring emergency actions was noted. Based on our visual inspection of the dam and appurtenant structures, the following deficiencies were noted:

1. The mid-1970's repair work on the downstream face of the concrete buttresses is beginning to show signs of aging as evidenced by deterioration of concrete and the exposure of steel reinforcing. It is expected that, with the tidal action at the downstream side of the dam, that this deterioration will continue.
2. Minor seepage through spillway face at construction joint at third buttress pier.
3. Concrete deterioration and spalling on downstream face of outlet works.
4. Deterioration/cavitation of concrete spillway abutment (right side) and training wall at downstream end of outlet. Some deterioration and loss of concrete at base of concrete training wall at right spillway abutment, near outlet works.
5. Leakage of left slide/sluice gate.
6. Some loss of riprap at base of spillway.
7. Minor erosion near right abutment area.
8. As presently classified (as a Significant Hazard Structure), it is unlikely that the spillway can safely pass the design flood, taken to be the ½ PMF.

GZA recommends that the following investigations and remedial measures be performed by a qualified registered professional engineer experienced in dam safety:

1. Continue to monitor the downstream face of the concrete buttresses for continued deterioration; it is likely that some concrete repair work will be necessary on these structures in the future.
2. Conduct a stability analysis of the dam for sliding, overturning, and seismic stability, under both normal pool conditions and hydraulic conditions associated with the spillway design flood.
3. Conduct a detailed hydrologic and hydraulic analysis of the dam's spillway to more fully assess its discharge capacity and to potentially re-establish its hazard classification and magnitude of the spillway design flood. In GZA's opinion, the dam may potentially be reclassified as a Class A, Low Hazard Structure, due to the dam's relative low total height and large total conveyance of the downstream area, where there is little likelihood of loss of life or significant economic loss, based on current downstream development. The analysis should include a dam breach simulation, in accordance with Ch. Env-Wr 301.03, to further evaluate this potential downgrade in hazard classification and magnitude of the SDF[1]. In

[1] The SDF for a Class A Structure is the 100-year storm.

order to downgrade the classification of the dam, the dam breach analysis, along with breach routing and inundation mapping, must be submitted to NHDES for its review.

4. The emergency water control and notification procedures developed in the Town's Operating Procedure Plan (May, 2000) should be incorporated into a formal Emergency Action Plan (EAP) document specific for Oyster River Dam;
5. Install safety railing on gatehouse at low level outlet works;
6. Remove bio-mass layer from spillway surfaces and inspect the spillway and gatehouse with pool drawdown; and
7. Minor maintenance and repair work is recommended for the following areas:
    - Leakage of left slide gate;
    - Replace missing riprap at base of spillway with large sized riprap;
    - Repair to concrete of right spillway abutment as well as downstream face and training wall at low level outlet;
    - Fill in low point along stone wall at right abutment; and
    - Repair downstream buttress faces.

The recommendations and remedial measures recommended are not judged to be critical to the current short-term stability of the dam under normal operating pool level. However, these investigations and repairs should be implemented in a timely manner, to mitigate the onset of more serious problems in the future.

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