AREA FORM **AREA NAME: IPC UPPER DAM DISTRICT**

1. Type of Area Form

Town-wide: ☐
Historic District**:** ☒
Project Area: ☐

2. Name of area:IPC Upper Dam

3. Location: Lake Street (Rt. 3A)

4. City or town: Bristol

5. County: Grafton

6. USGS quadrangle name(s): Bristol, New Hampshire

7. USGS scale: 7.5-Minute Series

8. UTM reference: N:4831142; E:300495

9. Inventory numbers in this area:

10. Setting: On a narrow strip of land between the east bank of the Newfound River and Rt. 3A, approximately 2 miles north of the village square of Bristol.

11. Acreage: 2 acres

12. Preparer(s): Bruce G. Harvey

13. Organization:Kleinschmidt Associates

14. Date(s) of field survey: April 22-23, 2008

15. Location map

16. Sketch map

17. Methods and Purpose

The survey of the IPC Upper Dam was carried out as a part of the planning process for the proposed removal of the dam. While the dam once was used to form an impoundment for hydroelectric generation (see historical background and architectural description below), the owner no longer generates electricity at the facility, and the dam thus serves no economic purpose. The dam was partially breached following the floods of May, 2006, for safety reasons, and the NH DES has identified the dam as potentially hazardous. Given the deteriorating condition of the dam, the DES has recommended its complete removal.

The survey consisted of two components: on-site investigation, and background research. The on-site investigation consisted of a thorough pedestrian survey of the facilities associated with the IPC Upper Dam: the brick powerhouse, the dam, the concrete abutments, the concrete guides for the sluiceway, and the impoundment. This included an investigation of the different materials and construction methods used in the construction of the various facilities, together with field photography of the various site components during both low-water and high-water conditions using a combination of a digital camera and both 35 mm and 4x5 black and white film.

The background research consisted of a review of written histories of the Town of Bristol, with a focus on the Town's industrial and manufacturing development. In addition, the survey included a review of all available maps and historical photographs showing both the IPC Upper Dam and other dams and manufacturing plants located on the Newfound River in the Town of Bristol. The DES provided a database list of other similar dams and hydroelectric facilities in the region for an analysis of the dam in its historical context. Finally, the research also consisted of a review of secondary literature on the history of hydroelectric development in Vermont and in the United States. Research was carried out at the Minot-Sleeper Library (Bristol), the Bristol Historical Society (Bristol), Grafton County Public Records Office (North Haverhill), and the New Hampshire State Public Library (Concord).

18. Geographical Context

The IPC Upper Dam is situated on the Newfound River, the outflow river of Newfound Lake, and a tributary of the Pemigewasset River. The Newfound River is 3.2 miles (5.1 kilometer) in length and is part of the western subbasin of the Upper Merrimack Drainage Basin. The river drops significantly in elevation through the town of Bristol before it confluences with the Pemigewasset River. The area in general is referred to as "The Lakes Region" and Newfoundland Lake in particular is the third largest lake totally contained within the state of New Hampshire.

The soils within the boundaries of the project area are few as the area is mainly comprised of wetland and water, at least seasonally when water levels are higher. The soils exposed at times of lower water levels are classified as being disturbed by past ground disturbance activities associated with the construction and maintenance of the IPC Upper Dam (see Plate 4). Other soils situated outside the water in the eastern portion of the APE are also considered disturbed since they are adjacent to the road bank of Route 3A (Lake Street). With that being said, according to the Web Soil Survey (United States department of Agriculture - National Resource Conservation Service 2008) the area adjacent to the

project area determined as being sensitive for archaeological resources contains excessively drained, Adams loamy sand.

19. Historical Background

The principal historical context for the IPC Upper Dam is the industrial development in the Town of Bristol, linked closely to the development of the Town's water power. The following brief historical overview is drawn primarily from Musgrove (1904) and Monroe and Hostutler (1993).

The earliest European explorers in the area arrived in the early eighteenth century during the colonial wars with the region's Native Americans. Captain John White, based in Lancaster, MA, first identified Newfound Lake in 1725 during a scouting expedition, while colonial settlers began moving into the Pemigewasset River valley by the middle of the eighteenth century. The first formal land purchase in the area, however, following on the massive grant of land to John Mason in 1629, was in 1753 when a syndicate of New Hamphsire men acquired 30,000 acres of land including, among others, the lower portion of Newfound Lake and the Town of Bristol. This early syndicate clearly recognized the industrial potential of the Newfound River as it dropped from Newfound Lake to the Pemigewasset River, as they apportioned mill lots at the junction of the Newfound and Pemigewasset Rivers. One of the first surveyors for the syndicate, Major John Tolford, built the first two mills, a saw mill and a grist mill, at the falls of the Newfound River in the 1760s. They were located in what is now the Village of Bristol, with a mill dam across the north channel of the Newfound River near the upper bridge on Water Street.

The junction of the Newfound and the Pemigewasset Rivers was a natural hub of settlement, where the transportation capacities of the Pemigewasset met the industrial potential of the Newfound. What is now Bristol very quickly emerged as an industrial center for the region, while it served also as a stopping-off point for settlers moving further north into New Hampshire. By the early nineteenth century, the new village of Bridgewater (now Bristol) boasted the original saw and grist mills, three blacksmith shops, a harness shop, two tanneries, a shoe shop, and a fulling mill, together with several taverns, a doctor, a lawyer, and a schoolhouse. Manufacturing in what is now the Central Square area exploded in the early nineteenth century, as more investors arrived to build factories that would take advantage of the area's hydromechanical power. The area at and just above the falls of the Newfound River bristled with manufacturing establishments, including carding mills, tanneries, a carriage factory, a foundry, a wheelwright, together with the Bristol Manufacturing Company, which built a three-story wool factory on the south bank of the Newfound River at the Pemigewasset River.

While the earliest focus of industrial activity was the falls at the southern end of the Newfound River, the outlet Newfound Lake at the river's northern origins, just upriver of the IPC Upper Dam, soon drew attention as well. By the middle of the nineteenth century this area featured a similar complement of saw mills, woolen mills, blacksmith shops, and others.

This industrial potential, based on water power, drew the attention of a second generation of industrialists from Lowell, MA. In the early 1850s, a group of Lowell capitalists formed the Lake Cotton and Woolen Manufacturing Company of New Hampshire (Lake Company), which acquired the water rights of four of New Hampshire's largest lakes, including Newfound Lake, together with the rivers that drained them, including the Newfound River. They purchased these water rights as a way to control the supply of water to the textile factories in Massachusetts. In order to manage the water supply

more effectively, the Lake Company built dams at the outlets of the four lakes; the Lake Company built a dam at the outlet of Newfound Lake in 1857, which it rebuilt in 1858-59. At the same time, the company lowered the bottom of the Newfound River by three feet downstream of the dam, to improve the flow conditions. In addition, they provided payments to the dam owners below the Newfound Lake Dam as a way to compensate for the irregular flow conditions in the Newfound River (Steinburg 1991: 99. 112).

This out-of-state ownership of the water rights of the Newfound River was a source of antagonism during the middle and late nineteenth century, including threats of violence at the Company's various dams (including the Newfound Lake Dam in 1870, when Bristol mill owners broke into the dam's gatehouse and hoisted the gates to release flow into the Newfound River). By the 1860s and 1870s, however, the greater threat was from lawsuits filed by local manufacturers. In Holden v. Lake Company of 1873, the Lake Company was forced to pay restitution to Bristol's manufacturers for the damage caused by the irregular flows in the Newfound River (Steinburg 1991: 246, 250). The Lake Company relinquished control of the Newfound Lake Dam shortly thereafter.

Bristol gained its first railroad connection in 1848, when the Franklin & Bristol RR connected the village to the Boston, Concord & Montreal RR; this local branch then became part of the Northern RR in 1849. These improved transportation connections to outside markets, particularly in Boston, then made even larger-scale industrial activity possible in Bristol.

By the last half of the nineteenth century, following national trends, Bristol's industrial capacity increased in scale, and by the early twentieth relatively few, and larger, manufacturing enterprises remained. Also by the late nineteenth century, Bristol developed two distinct industrial areas. The area surrounding the falls of the Newfound River, around which the village square developed, remained the industrial hub of the Town, as numerous small factories continued to line the falls immediately downstream of the Central Square bridge. These factories represented such industries as axles, straw boards, gloves and tanning, hose, and one of the nation's leading crutch manufacturers (Fogg 1874: 77). The spatial pattern in this section of the Town clearly represented the early nineteenth century approach, with many small factories crowding along a stream, each with limited needs for hydromechanical power.

The Town's second industrial area, however, represented the larger industrial scale that defined the late nineteenth and twentieth centuries. Immediately upstream of Central Square, the Newfound River passes through a relatively level stretch, with few opportunities to harness reliable hydropower. Beginning approximately two miles upstream of the Central Square, however, the Newfound River passes over a series of small falls and rapid descents over the course of about a mile. This series of elevation changes in the River, outside the confines of the Town's existing early nineteenth century industrial developments, provided the opportunity in the later nineteenth century for a smaller number of new and larger developments. Three plants in particular were located in this stretch of the Newfound River: the Dodge-Davis Manufacturing Company (woolens), the Train-Smith Company (paper), and the Mason-Perkins Paper Company. Each of these three factories consisted of complexes of multiple buildings and used short canals and raceways to draw water from the Newfound River, and return it downstream. Few remnants of these plants remain, limited to the portion of the lower dam that remains near what is now Bristol Hill Road which provided water for the Dodge-Davis plant, and a storage building and dam abutments associated with the Mason-Perkins Paper factory.

All of these plants relied on hydromechanical power in order to operate. Water, which was pooled up behind a dam, was fed by a raceway past a water wheel which was directly connected through

gearing and belts to the manufacturing equipment. While technical developments during the nineteenth century significantly increased the ability of hydromechanical systems to transmit power, they remained inefficient power sources. In addition, hydromechanical systems had to be located immediately adjacent to the source of water in order to retain any type of efficiency. However, this changed with the advent of commercially-available electricity in the 1860s, and the development of hydroelectric power in the 1880s.

The earliest hydroelectric plants were developed in the early 1880s, using the power of falling water to turn water wheels connected to an electric generator rather than to a series of gears. The residential, commercial, and industrial uses of hydroelectric power were limited at first by a reliance on direct-current generators (direct-current is very inefficient when transmitting over distances) and by the limited amounts of water to power electric generators which was available using existing dam technologies. By the late 1890s, the new alternating current technology had been proven, and new plants consistently used AC generators so as to be able to transmit the electric power to remote users. By the early twentieth century, meanwhile, developments in the use of concrete and new civil and structural engineering advances allowed for dams of greater height. The amount of electricity that a hydroelectric plant can generate is principally a function of the combination of head, or the vertical distance between the surface of the pond and the tailrace below the powerhouse, and the volume of water that flows over that distance. The new, larger dams of the early twentieth century allowed for increases in both of these categories, while the earlier hydroelectric dams remained limited by the earlier hydromechanical dam prototypes.

Unfortunately, little information on the early history of hydroelectric development in New Hampshire is readily available. The City of Berlin, NH appears to have been the first city in the state to have electric street lighting, beginning in the late 1870s. Berlin also was a leader in the development of hydroelectric power in New Hampshire, as H.H. Furbish, the owner of the Forest Fiber Company, created a hydroelectric power for his mill on the Androscoggin River; the date is uncertain, though it apparently was in the 1880s ("Berlin History," http://www.berlinnh.gov/Pages/BerlinNH_WebDocs/BerlinHistory). The site was later redeveloped for hydroelectric power in the early 1980s. Other hydroelectric plants appear to have been constructed in the late nineteenth century, including the Sewall's Falls Hydro Station (1891/1894, dam breached 1984), Gregg's Falls Dam in Goffstown (dam and powerhouse constructed 1897, dam replaced in 1917, powerhouse replaced in 1918), and the Littleton Hydro Station (late 1880s, replaced with a new hydro station in 1936).

The IPC Upper Dam also was constructed during this period of experimentation in hydroelectric plant design and engineering (Hay 1991:27-41), and must be counted as one of the state's earliest hydroelectric facilities, and among the oldest extant hydroelectric facilities. Colonel Samuel P. Train of Boston first proposed an electric light plant in Bristol in 1889, and the Bristol Electric Light Company was organized locally later that year. The Company first generated electricity using a small hydroelectric dynamo in the basement of the Taylor and Gordon shop in the Village, where they leased water power on a 10-year lease. The amount of water was small, however, relative to the increasing power needs of the community, and as the lease period came to an end, the company purchased land along the Newfound River upstream of the Mason-Perkins Paper Company Mill, approximately 0.75 mile downstream of Newfound Lake. The property had been a sawmill featuring a timber crib dam; the remains of that earlier dam have recently been found, and recorded as an archaeological site. The Bristol Electric Company built a new dam just downstream of the older mill dam, which provided for approximately 14 feet of head, together with a brick powerhouse containing a vertical AC generating unit with an installed capacity of 150 kW. The new dam was constructed under the supervision of

Clarence N. Merrill, while George A. Emerson set up the generator and placed it in operation; both of these men were Bristol residents (Musgrove 1904: 428-429). The entire facility was completed and put in operation in 1900.

The Bristol Electric Light Company had a chance to establish a market for its electricity during its first decade with a small dynamo using an existing dam, before going to the expense of creating the new facility. The electricity generated by the Bristol Electric Light Company was used initially for street lighting, with eventual manufacturing and residential customers, in Bristol and soon in New Hampton. The *Bristol Weekly Enterprise* of January 4, 1900, for example, printed a letter from a New Hampton resident who recommended that his Town purchase electricity from the Bristol Electric Light Company for its street lights, comparing the existing lamps unfavorably to the potential new electric lights: "Our present system of lamps are nearly all extinguished by ten or half past ten every night, and if one happens to be out a little late upon his arrival he finds the village in darkness, while the electric light would burn till half past twelve o'clock every night. Here then we discover *two* advantages: more light and longer duration." The writer concluded his argument with a prediction: "Since the local and long distance telephones have been placed in our village, they have become an *actual necessity*, and we hardly conceive how we got along so many years without them. Just so it would be with the Electric light, what once placed on our streets and in our dwellings, we should say, why did we not have it before?"

The ownership of the dam and powerhouse have changed several times during the past century; by the 1920s it was owned by the Public Service Company of New Hampshire (Sanborn Map, 1929), who in turn sold it to the International Packing Corporation which was then acquired by Freudenburg NOK. Despite these changes in ownership, however, and unlike its contemporary hydroelectric plants in the 1890s and early 1900s in New Hampshire, the plant continued to operate until recently, and has retained its original configuration and equipment.

20. Applicable NHDHR Historic Context(s)

92. Hydropower in New Hampshire

21. Architectural Description and Comparative Evaluation

The powerhouse is a simple brick building, one story in height and generally square in plan. It is a small building, measuring approximately 20 feet square, and is surmounted by a front gable roof. The main façade of the building faces Lake Street (Rt. 3A) on the east side of the building and features a central single wooden door flanked on each side by a single double hung 6/6 window set within a shallow arch. The remaining three sides of the building each feature two shallow arched window openings; the south (downstream) and west elevations have single double-hung 6/6 windows, while the north (upstream) elevation windows have been partially replaced. The main entrance of the building is at ground level, while the other elevations drop off sharply to the river and feature an exposed concrete foundation. The north elevation, facing upriver, overlooks the grated metal intake, while the south elevation overlooks the tailrace channel which empties back into the Newfound River. The foundation at the rear of the building facing the river is directly connected to the left (east) abutment of the dam. The interior of the building is nearly completely occupied by the single, circular generator unit which rises approximately seven feet above the concrete floor. A tall, narrow control board constructed of stone is located in the northeast corner of the building.

The dam is a timber crib structure with rock fill. It was designed originally with a concrete crest to be approximately eight feel high, with provisions for an additional six feet created by a stop log structure. The stop log structure consisted of a frame, most likely wood, that supported the logs between the two concrete abutments that flank the dam. Sometime during the twentieth century the original wooden frame was replaced with a combination wood and steel frame; this replacement frame was then removed following the flood of May 2006. The dam is in poor condition, with the timber cribs exposed on the downstream face, though the concrete cap remains on the upstream face.

The dam creates a pond of water that directed the water of the Newfound River into the grated metal intake which is located on the north (upstream) elevation of the powerhouse. Water then flowed through the intake into a penstock, the tube that fed into a turbine that forced a bladed runner, located directly beneath the generator in the powerhouse, to spin. The spinning runner is connected to a vertical metal shaft that transfers the spinning motion of the runner up to the generator, which is located on the powerhouse floor. The generator contains two sets of magnetized copper coils: a rotor (connected to the shaft coming up from the runner) which rotates within a stator. The electricity which is generated when the rotor spins within the stator is transferred through the control board, also located in the powerhouse, and out to transformers for delivery to the end users.

When it was built, the dam complex included a bypass channel that allowed the operators to divert the water of the Newfound River before it reached the dam. This allows for basic maintenance work on the dam in the dry, at least during low-water periods. Access to the bypass channel is through a gate opening cut into the right (west) bank of the impoundment, approximately 30 feet upstream of the dam. The concrete guide for the bypass channel consists of two concrete walls that form a channel approximately six feet wide and approximately 15 feet long. Each of the walls forms a V-shape, so as to create a wider opening that funnels water into the channel. A metal bridge spans the bypass channel guide, and rests on the two concrete walls and a metal pole in the center.

The bypass channel is an unlined natural channel that circles around the dam on the right (west) side. Water from the impoundment upstream of the dam enters the bypass channel through the two concrete guides, then curves to the south around the west side of the embankment next to the dam, and then returns to the Newfound River approximately 25 feet downstream of the dam, on the opposite bank from the tailrace channel.

The timber-crib construction of the dam is typical for this period and the size of the river. The powerhouse, meanwhile, is a simple, utilitarian building with limited architectural details. It is similar to other small hydroelectric powerhouses from the early twentieth century found throughout the northeast.

22. Statement of Significance

The project area contains no previously identified historic sites, properties, or districts. The 1993 Bristol Townwide Area Form did not include this property in its inventory. No other buildings exist within the project area.

Criterion A: History

The IPC Upper Dam is closely connected to the industrial development of the Town of Bristol, both by providing power to the Town's factories and by being developed by local manufacturing and commercial leaders. Bristol clearly was an important regional manufacturing center, with a number of regionally and nationally important manufacturing companies. The Bristol Electric Light Company, which designed and constructed the hydroelectric facilities at the IPC Upper Dam, emerged from this industrial environment and was tied to it through the company's early leadership.

Criterion C: Engineering Design

The greater significance of the IPC Upper Dam, however, is its status as an intact, early hydroelectric facility. Relatively few hydroelectric plants from 1900 or before exist throughout the country, and this may be the oldest remaining intact hydroelectric plant in the state. The IPC Upper Dam shows the engineering innovations used to fit this early technology to specific site conditions.

23. Periods(s) of Significance

1890-1910

24. Statement of Integrity

The IPC Upper Dam has retained good integrity overall, particularly in its site plan. Each of the components of the site is in its original location and, with one exception, in its original condition. The powerhouse has remained essentially intact, containing its original generating unit, control board, floor plan, and fenestration. Moreover, it continued to generate electricity until relatively recently. The integrity of the dam, however, while present and retaining some of its original materials, has been compromised through the removal of the stop log frame and the loss of some of the contents of the timber cribs.

The integrity of the impoundment as a landscape feature is more difficult to assess. While the hydrological evidence suggests that the Newfound River meandered broadly through this reach, given the presence of wetlands that border on the River, the dam clearly created a pond that was distinctly visible and that changed the nature of the River in this reach. As originally designed with the stop logs in place, the elevation of the pond was approximately 554 above sea level. Following the May 2006 flood, the upper six feet of timber stop log portion was removed, lowering the elevation of the impoundment to approximately 548 feet, thus significantly reducing its surface area. During low-flow conditions in particular, the impoundment reverts back to a condition that suggests the original river. The integrity of the impoundment has therefore been impaired by the loss of the upper six feet of the dam.

25. Boundary Justification

The boundary of the IPC Upper Dam District has been drawn to encompass all of the elements which historically contributed to the operation of the hydroelectric facility.

26. Boundary Description

The boundary of the IPC Upper Dam District includes the area in which the existing powerhouse, the dam with its two concrete abutments, the concrete guides for the bypass channel, the bypass channel as a landscape feature, and the reach of the Newfound River from the point upriver where the impoundment is first visible downriver to the point below the dam and the bypass channel outlet where the natural flow of the Newfound River resumes, together with the lateral expanse of the river that traditionally formed the impoundment.

27. Bibliography and/or References

Fogg, Alonzo J. 1874. *The Statistics and gazetteer of New Hampshire*. Concord, NH: D.L. Guernsey.

Hay, Duncan. 1991. *Hydroelectric Development in the United States, 1880-1940*. NY: Edison Electric Institute.

Monroe, Lynne Emerson and Elizabeth Hostutler. 1993. Bristol Townwide Area Form. Typescript MS in the collections of the New Hampshire Division of Historical Resources, Concord.

Musgrove, Richard W. 1904. *History of the town of Bristol, New Hampshire*. Published by the author, 1904. Facsimile edition, Somersworth, New Hampshire: New Hampshire Publishing Company with the Bristol Historical Society.

Sanborn Fire Insurance Company, Map of Bristol, NH. 1929. Viewed on April 30, 2008 in the collections of the New Hampshire State Library, Concord.

Steinburg, Theodore. 1991. *Nature Incorporated: Industrialization and the Waters of New England*. New York: Cambridge University Press.

28. Surveyor's Evaluation

NR listed:	district	☒	NR eligible:		NR Criteria:	A	☒
	individuals		district	☒		B	☐
	within district	☐	not eligible	☐		C	☒
Integrity:	yes	☒				D	☐
	no	☐	more info needed	☐		E	☐

If this Area Form is for a Historic District: # of contributing resources: 3_____
# of noncontributing resources: 0_____

Photo 1: Description: IPC Upper Dam, Powerhouse, Facade
Roll: 1 Frame: 17 Direction: Looking West Date taken: 4/23/2008 Negative stored: KA

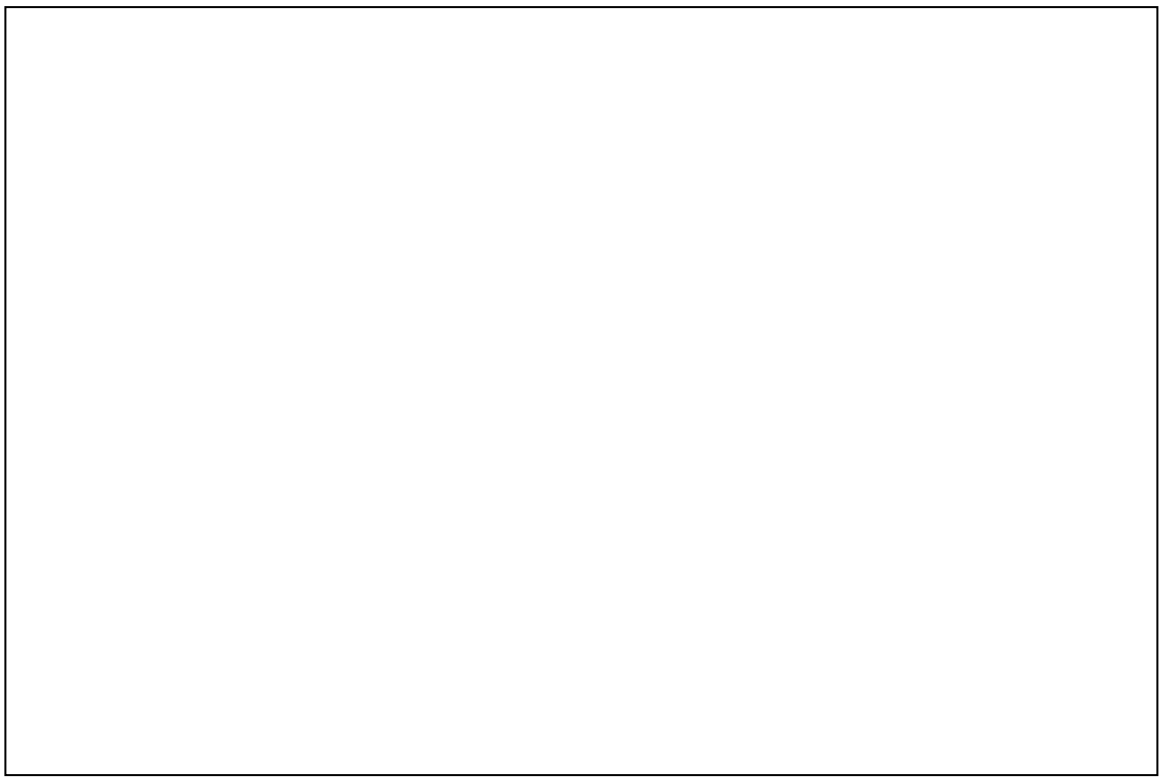

Photo 2: Description: IPC Upper Dam and Powerhouse, looking upstream
Roll: 1 Frame: 20 Direction: Looking NE Date taken: 4/23/2008 Negative stored: KA

Photo 3: Description: IPC Upper Dam, Powerhouse
Roll: 1 Frame: 11 Direction: Looking SW Date taken:4/23/2008 Negative stored: KA

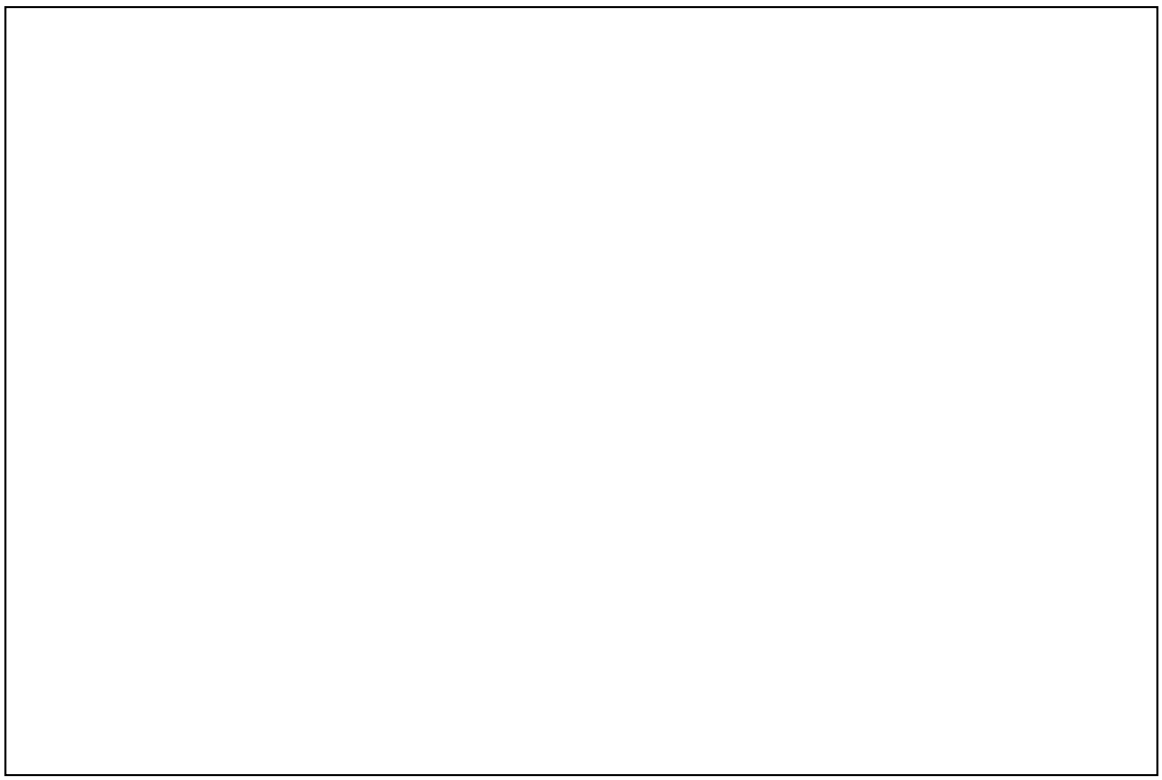

Photo 4: Description: IPC Upper Dam, Powerhouse Interior, Generator Detail (w/measuring stick)
Roll: 1 Frame: 6 Direction: NA Date taken: 4/23/2008 Negative stored: KA

Photo 5: Description: IPC Upper Dam, Powerhouse Interior, Control Board detail
Roll: 1 Frame: 9 Direction: NA Date taken: 4/23/2008 Negative stored: KA

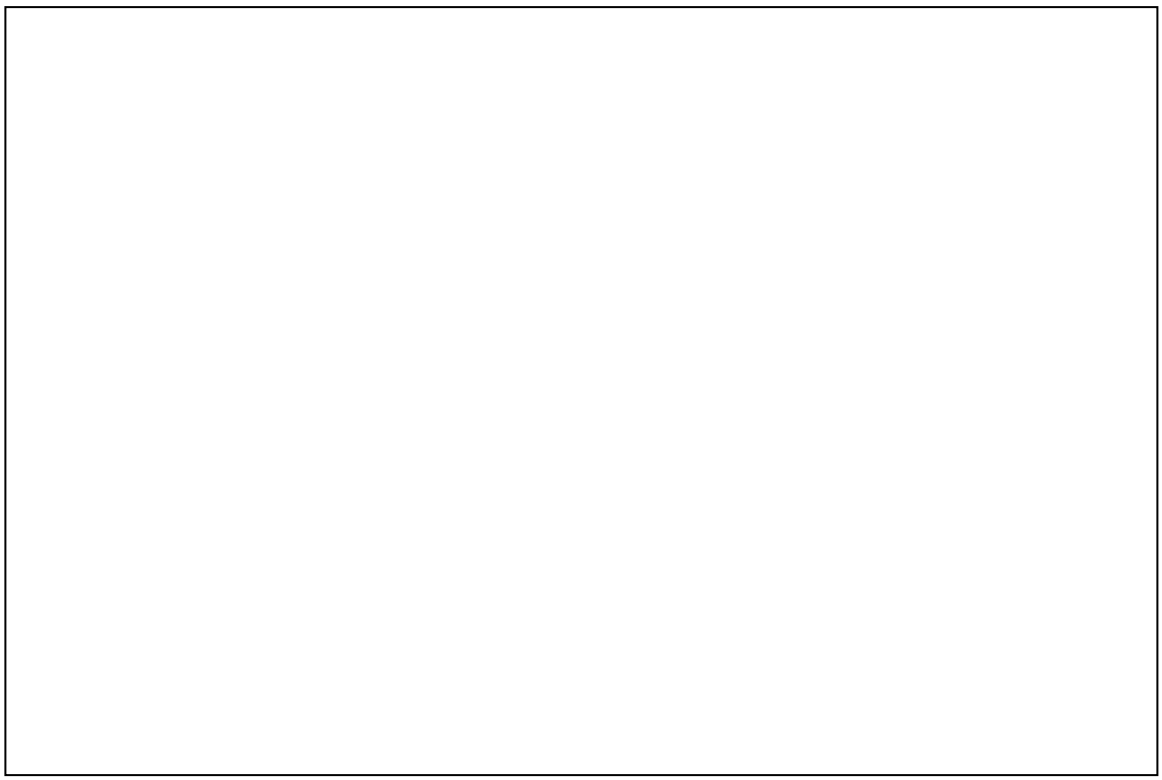

Photo 6: Description: IPC Upper Dam and Powerhouse
Roll: 1 Frame: 24 Direction: Looking NE Date taken: 5/7/2008 Negative stored: KA

Photo 7: Description: IPC Upper Dam, Impoundment, West Abutment and Bypass Gate
Roll: 1 Frame: 13 Direction: Looking W Date taken: 4/23/2008 Negative stored: KA

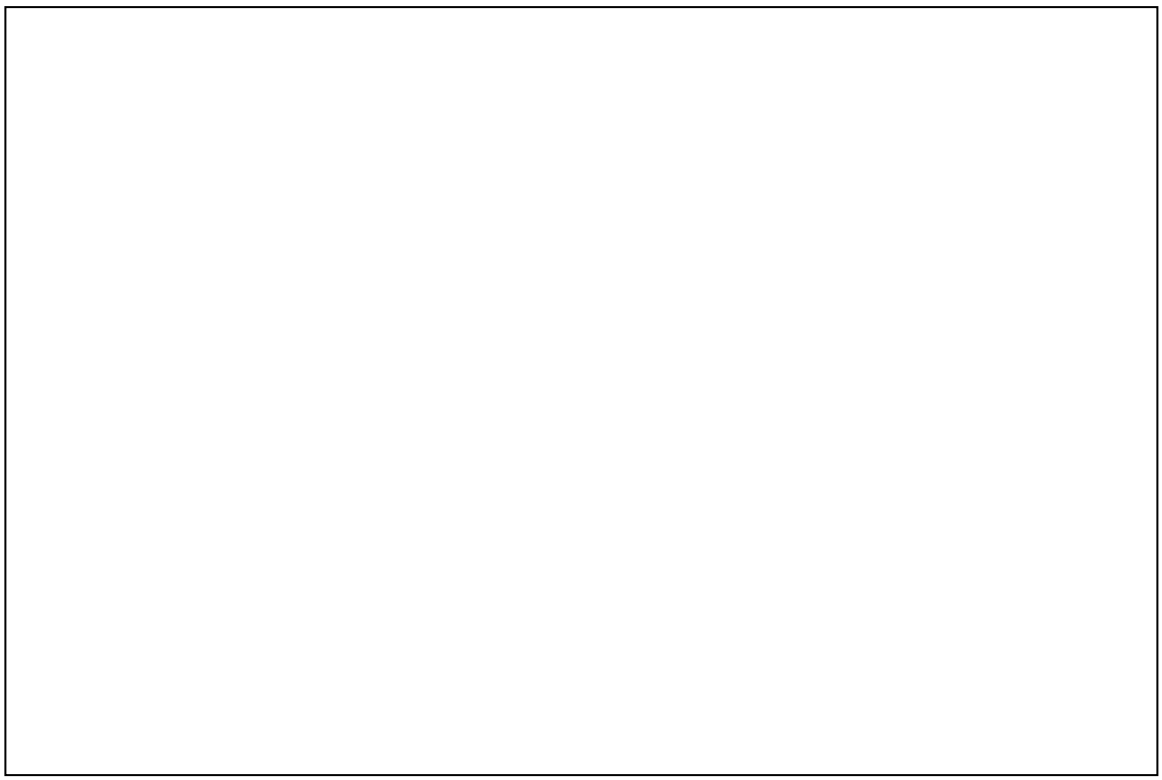

Photo 8: Description: IPC Upper Dam, Showing Bypass Channel
Roll: 1 Frame: 15 Direction: Looking W Date taken: 4/23/2008 Negative stored: KA