ST. PAUL'S CATHOLIC CENTER
FACILITY ASSESSMENT

NOVEMBER 29, 2012

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EXECUTIVE SUMMARY:

HVAC:

The existing HVAC system components are either in need of replacement or will need replacing in the near future. The following are the recommendations being made in this report.

Heating Source:

Replace the existing steam heating boiler with a new high efficiency (90%+ efficient) natural gas heating water boiler. Cost $ 104,000.

Cooling Source:

Remove existing Direct Expansion (DX) cooling equipment and install a small packaged air cooled chiller which would provide chilled water to the building for cooling purposes. Cost $120,000.

Building HVAC Systems:

Install Central Station Air Conditioning (CSAC) units in similar locations to the existing units. Existing ductwork would be utilized and new Variable Air Volume (VAV) boxes with hydronic heating coils would be installed. Cost $120,000.

Install a new DX cooling with gas heating rooftop unit to provide supplemental cooling and heating to the Sanctuary. Cost $100,000.

Replace the existing DX cooling and gas heating rooftop which serves the Gathering Space. This new unit would also condition the office space adjacent to the Gathering Space. Cost $42,000.

Replace the existing Rectory unit with two residential style units. Cost $20,000.

Total Mechanical Cost: $506,000

ELECTRICAL:

Various code violations exist in the building and should be addressed. In addition, it is recommended that the parallel fused service entrance switch be replaced. Cost $25,000.

The existing fire alarm system is a zoned non addressable system and has a current inspection from Koorsen, however if any expansion is required a new system should be installed. Cost $35,000.

The existing lighting system is outdated and can be replaced with a more efficient system. A revised lighting system can be combined with occupancy sensors to provide even more energy savings. Cost $155,000 to $190,000

Total Electrical Cost: $215,000 to $250,000

SOUND & ACOUSTICS:

Recommendations:

Removing carpet/refinish floors: Cost $40,000 to $70,000

Replace 7,000 square foot of ceiling: Cost $29,000

Add suspension "cloud" system in central part of Sanctuary: Cost $40,000 to $90,000

Add engineered diffusion 2' x 2' tile at lower musician area: Cost $16,000 to $18,000

Renovate or replace sound system: Cost $54,000 to $93,000

New Parish Hall audio system: Cost $6,700
Option to test, demo and relocate existing audio in lieu of new system: Cost $4,500

New Parish Hall video system: Cost $4,800

Add noise control to confessional room: Cost $1,000

Add rear wall absorption for Sanctuary: Cost $8,700 to $14,500

Contingency: Cost $20,000

Total Sound & Acoustics Cost: $218,000 to $347,000

TOTAL RECOMMENDED PROJECT COST: $939,000 TO $1,103,000

BUILDING DESCRIPTION:

St. Paul's Catholic Church was built in 1967. The building consists of a first floor comprised of a Sanctuary to the west, Administration spaces and a Gathering space. There is a two story element on the north east corner of the building which is used as a rectory. The first floor contains the common spaces while the second floor is dedicated to sleeping quarters and baths. The lower level of the building consists of a large meeting space, kitchen, library, office areas and mechanical spaces. There is a room along most of the west wall which was originally a porch but has since had a glass wall added and is currently being used for storage. An addition was completed in 1992 adding the Administration areas and the Gathering space.

SYSTEM DESCRIPTIONS:

In general, while some individual pieces have been replaced, the building's mechanical, electrical and plumbing systems are the original systems as installed in 1967 and 1992. Various modifications/upgrades have been done over the years.

Mechanical:

The heart of the steam heating system is a 1,800 MBH Kewanee boiler that was installed in 1991, a condensate pump and associated supply and return piping. All of the original air cooled condensing units have been replaced at some point. The lower level, Sanctuary, and Rectory mechanical systems consists of central station air conditioners utilizing DX cooling coils with matching air cooled condensing units, and steam heating coils. The Gathering area is served by a DX rooftop unit with gas heat which was installed in 1992. A forced air furnace with DX cooling and gas heat serves the Administration area, which was also installed in 1992. A small wall mounted split DX system was installed in the day chapel located behind the sanctuary to provide additional cooling.

Deficiencies were noted when RE Dimond and Associates met with the staff of St. Paul's Catholic Center and conducted an investigative walk through. It was noted that, during the cooling season, the Sanctuary has problems remaining cool during services and other times and when the room is occupied. The Administration area has issues with keeping all occupants at a comfortable temperature. Also, the Rectory has similar issues with different occupants being either too hot or too cold, particularly with temperature differences between the floors.

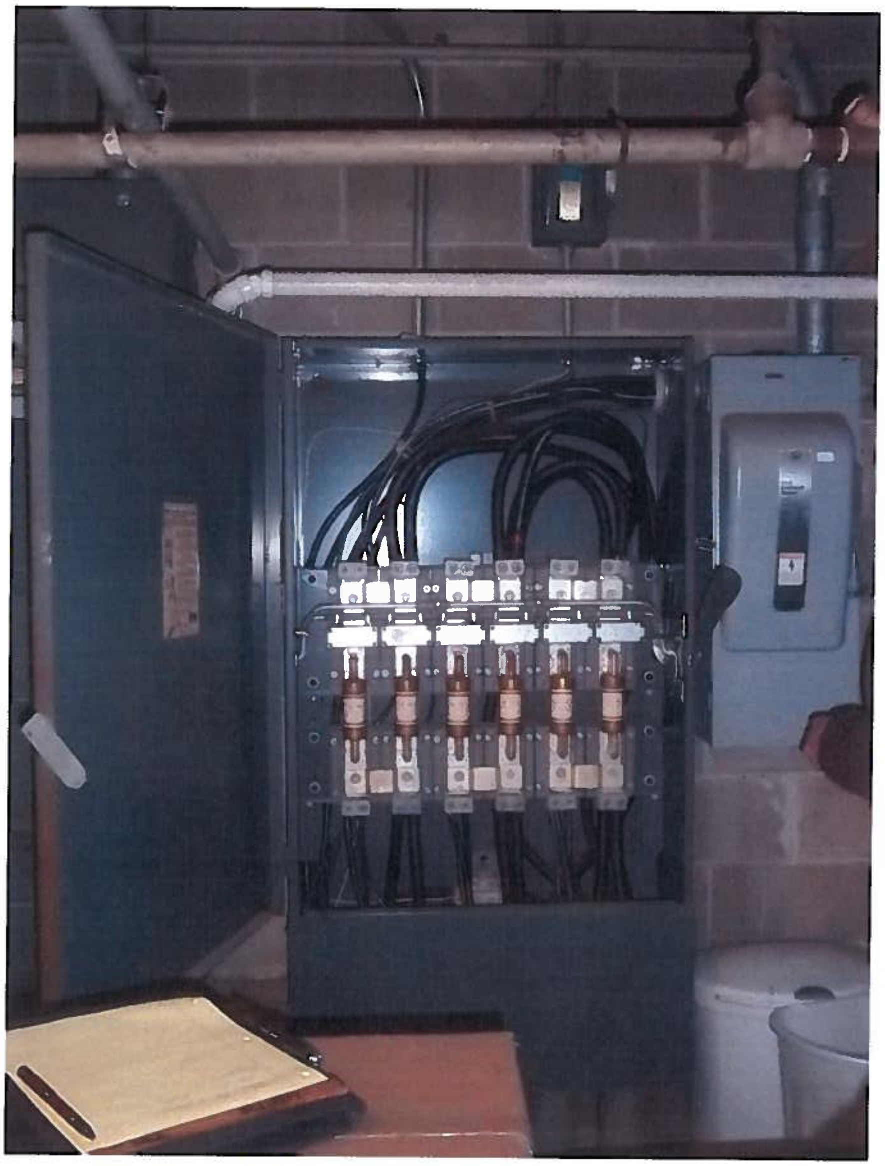
Plumbing:

Plumbing piping is original to the building. An A.O. Smith Cyclone Xi water heater was installed in 2009. No modifications to the plumbing systems are recommended at this time.

Electrical:

Power Distribution: (In Boiler Room)

120/208v, 3P, 4W, 800A main fused switch (fused with twin 400A fuses/phase) fed from a dedicated 150 KVA pad mounted transformer.



The line side is tapped with 1-100A 3P fused disconnect feeding the elevator and 1-200A 3P fused disconnect feeding Panel F. The load side is tapped by 30A 3P fused disconnect (no label). A main 800A disconnect feeds the ITE clampmatic 800A "fuse center" disconnect section (120/208V, 3P, 4W).

1-100A 3P – "Panel E"
1-100A 3P – "Panel H"
1-100A 3P – "Temp. Dimmer"
1-200A 3P – "Dimmer Panel"
1-200A 3P – "Main AC East"
1-400A 3P – "Main for AC 1-2-3"
1-100A 3P – Unidentified
1-200A 3P – Unidentified

Based on current bills, the average cost of electricity to the church is $.08775/kwh to $.0966/kwh depending on monthly usage. Higher usage results in lower per-kwh rate because of rate structure.

Various code violations still exist as pointed out in the F&G report dated October 13, 2008. At the time of the R.E. Dimond visit, one of the violations (the temporary dimmer panel feed with 'SOW' cord) had been removed. The other violations noted (common neutrals and grounds in panels, breakers with more than one conductor, and no grounding bushings at panels) still exist and should be corrected.

In addition it is recommended that the parallel fused service entrance switch be replaced with an 800A main fused switchboard to eliminate parallel fuses and provide additional fused switches to eliminate the various taps on this switch. Estimated cost $25,000.

<u>Fire Alarm</u> (In Boiler Room)

Simplex 4002 with annunciator in boiler room with old Faraday single 120v circuit fire alarm panel next to Simplex.

- Lower level smoke detector
  Kitchen heat detector
- Upper level heat detectors
- Upper level smoke detectors
- Air duct smoke detector
  Upper level kitchen

This is a zoned, not addressable, system.

This system has a current inspection from Koorsen. It is recommended that any expansion will require the installation of a new addressable fire alarm system. Estimated cost $35,000.

<u>Lighting</u> (Throughout Building)

The lighting has been surveyed and recommendations made in the F&G report dated October 13, 2008, the Carbon Footprint Report dated 2010, and the Buildings and Grounds Priority List, not dated.

These recommendations are seconded by this report in that more efficient lighting sources are available and should be used. Estimated cost: $130,000 to $150,000.

In addition, occupancy sensors should be used for lighting control throughout the building and photocell-on, time clock-off control should be used for all exterior lighting. Estimated cost – $25,000 to $40,000.

Technology: (Throughout Building)

The current technology distribution is described as adequate by building staff.

CONDITION ANALYSIS:

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) provides information for the anticipated service life of mechanical equipment (2011 HVAC Applications, 37.3, Table 4).

Equipment Type	Median Service Life (Years)	St. Paul's Equipment Age (Years)
Fans	25	**45**
DX Coils	20	**45**
Forced Air Furnace	18	**20**
Roof Top Air Conditioners	15	**20**
Air Cooled Condensing Units	20	14
Steam Coils	20	**45**
Steam Boiler (Fire Tube)	25	21
Condensate Pump	25	**15**
Burner	21	**21**
Ductwork	30	**45**

Note that in the chart above, equipment age more than the median service life is in bold. In reviewing the above chart, almost all of the currently installed HVAC equipment is past its median service life. A complete HVAC system retrofit is suggested.

POSSIBLE REPLACEMENT SYSTEMS:

Several potential replacement HVAC systems will be considered in this report. When analyzing a potential HVAC system, several aspects are investigated such as initial cost, ease of installation in a retrofit application, energy efficiency, and ease of maintenance. Each of, or a combination of the following systems can be installed in the Church.

HEAT:

The current Kewanee fire tube steam boiler is in good condition, and could reasonably be expected to be in service for another 5-10 years. In its current condition, this boiler is operating at an efficiency of approximately 60-65%. However, if doing a major retrofit of the Church's HVAC system it would be recommended to replace the current steam boiler with a new high efficiency (90%+ efficient) natural gas heating water boiler. Insulated heating water distribution piping would be installed throughout the building. Heating water would be circulated throughout the building to provide heat and assist in zone control and humidity control. Using water instead of steam is a simpler and easier to maintain means of heating and more easily controlled.

COOLING:

Cooling for the Church can be provided by more than one means. One option is to replace the current DX cooling equipment with similar equipment. Central station air handling units would be provided with DX coils. Small diameter insulated refrigerant piping would be installed throughout the building, similar to what is currently installed throughout the building.

Another option is to provide a small packaged air cooled chiller. Equipment located in the building will have chilled water cooling coils. Insulated chilled water distribution piping would be installed throughout the building. There are two options related to a chiller installation. One is to have a chiller with a remote evaporator barrel located inside the building. This would require space in a mechanical room. If space is not available for an evaporator barrel, this can be part of the packaged air cooled chiller which would sit outside the building. If this option is utilized, the chilled water will have to be comprised of a solution of glycol antifreeze and water to prevent freezing where the chilled water is exposed to exterior conditions.

TERMINAL SYSTEMS:

4 Pipe Fan Coil System:

This system would involve the installation of 4 pipe fan coil units throughout the building. Individual fan coil units can be installed to provide appropriate zoning. Code required ventilation air would be ducted to each fan coil unit from a dedicated 100% outside air unit. This unit will temper and dehumidify the make-up air as needed to maintain appropriate indoor air quality.

The advantages of this system are:

1. Appropriate zone control
2. No floor area required for terminal units
3. Good air quality
4. No compressors in occupied spaces (makes for a more quiet system)
5. Less expensive than the VAV system being considered.

The disadvantages of this system are:

1. No economizer (use of outdoor air cooling below 60°F)
2. No transfer of internal cooling loads to perimeter heating zones during winter
3. Could require use of chilled water year round.
4. More expensive than the VRF system being considered.
5. Higher maintenance cost than the VAV system being considered because of the following:
    a. Air filters are located in each fan coil located throughout the building.
    b. Each fan coil has a small fan, which means a greater chance for a failure.

<u>Variable Refrigerant Flow Units:</u>

A variable refrigerant flow system (VRF) has terminal equipment similar to the 4 pipe fan coil units. Instead of using chilled and hot water to heat and cool, refrigerant is circulated throughout the building to each unit. This system gains efficiency by having the ability to shift energy throughout the building and provide simultaneous heating and cooling. Individual VRF units can be installed to provide appropriate zoning. Code required ventilation air would be ducted to each fan coil unit with a similar system as described in the 4 pipe fan coil section. Small air cooled condensing units will need to be installed outside of the building in lieu of a heating water boiler and air cooled chiller.

The advantages of this system are:

1. Appropriate zone control
2. No floor area required for terminal units
3. Good air quality
4. Energy efficient
5. Least expensive installation cost relative to the other possible systems.

The disadvantages of this system are:

1. No economizer (use of outdoor air cooling below 60°F)
2. Similar to the Fan Coil System, higher maintenance cost than the VAV system being considered because of the following:
    a. Air filters are located in each fan coil located throughout the building.
    b. Each fan coil has a small fan, which means a greater chance for a failure.

RECOMMENDED SYSTEM:

Air Handling Units with VAV Zone Control:

This system would involve the installation of central station air conditioning (CSAC) units in similar locations to the existing units, throughout the building. Existing ductwork would be utilized from the CSAC unit(s) to new VAV boxes. Heating water piping would be run to heating coils at the VAV boxes. The boxes would provide zone control. The CSAC unit(s) would provide heating and cooling with heating water coils, chilled water coils and outside air (economizer mode). The current CSAC units are suspended from the structure above. This installation does not allow for the replacement of a coil. Even though the new units would be installed in a similar fashion, they would be designed so that the coils can be replaced through the bottom of the unit.

The advantages to this system are:

1. Good zone control
2. Good air quality
3. No fans or compressors in occupied spaces
4. Allows use of free cooling (economizer cycle)
5. Much of the existing ductwork could be reused.
6. Units could be located in same space as existing units.
7. Reduced maintenance costs because:
    a. Air filters are more centrally located.
    b. Less fans in the system means less change for a failure.

The disadvantages of this system are:

1. Higher initial cost than the other two proposed systems, however, this higher cost would be offset by the reduced maintenance requirement and lower energy consumption when compared to the possible systems previously discussed.

AREA SPECIFIC SYSTEMS:

Sanctuary System:

The Sanctuary will require a supplemental means of cooling. The current system does not have adequate capacity to provide cooling while occupied during the cooling season. Also, the existing air system is far too noisy for a Sanctuary. The current arrangement of a CSAC unit located in the basement which provides cooling through the floor will be retained at a reduced air flow to mitigate the noise. This new unit would be installed at a similar location and will utilize chilled and heating water. Much of the existing ductwork can be reused. Additionally, a roof mounted air conditioner can be installed north of the Sanctuary. Air will be supplied from the unit thru the Sanctuary ceiling. This new roof top unit will utilize DX cooling and gas heat and will only operate during services and at other times when the lower level CSAC unit cannot maintain setpoint. Using a packaged DX/Gas rooftop unit is a more cost effective option as compared to installing a roof top unit with chilled and heating water coils.

Rectory System:

In lieu of any of the three considered systems, two residential style central furnaces could be provided for the Rectory. A separate furnace would be provided for each floor of the Rectory, which would help with the current issue of occupants being too hot and too cold simultaneously. This is a more cost effective option to installing a VAV CSAC with chilled and heating water coils.

Gathering Space and Office Area:

This area is currently served by a DX roof mounted unit with gas heat. A similar system is being proposed. The office area is currently served by a residential furnace which does not allow for adequate zone control. Independent zones for this area can be provided by the new roof top unit that would serve the Gathering Space. This is a more cost effective option to installing a roof top unit with chilled and heating water coils.

ADDITIONAL REQUIREMENTS FOR RECOMMENDED SYSTEM:

The recommended system will require a small packaged air cooled chiller to sit outside. This piece of equipment can be located where the existing air cooled condensing units 4, 5 and 6 are located, east of the Sacristy. An evaporator barrel will located inside the building if possible to avoid adding glycol to the system. In addition, chilled water pumps will need to be located in the building. The removal of the existing steam boiler and condensate pump will free up significant space in Mechanical room L03. The new heating water boiler, which is much smaller in size, will also need to be installed in this room. Heating water pumps, system fill and expansion control will be installed in the boiler room as well.

COST SUMMARY:

The following is a summary of the cost to install the recommended system. If desired, the retrofit of the mechanical system can be done in four separate phases.

Phase 1: Replacement of CSAC's and steam boiler and the addition of an air cooled chiller.

Removal of existing steam boiler, condensate pump, piping, etc:	$ 8,000
3 CSAC units located in the lower level:	$ 120,000
Install new air cooled chiller and chilled water distribution piping:	$ 120,000
Install new high efficiency heating water boiler and distribution piping:	$ 96,000
Total for Phase 1:	**$ 344,000**

Phase 2: Addition of supplemental rooftop unit for the Sanctuary.

Install new rooftop unit:	$ 60,000
Associated ductwork:	$ 40,000
Total for Phase 2:	**$ 100,000**

Phase 3: Replace existing rooftop that serves the Gathering Space.

Install new rooftop unit:	$ 35,000
Office zoning:	$ 7,000
Total for Phase 3:	**$ 42,000**

Phase 4: Replace existing Rectory unit with two residential style units:

Install two residential units:	$ 18,000
Extend gas pipe to new units:	$ 2,000
Total for Phase 4:	**$ 20,000**

GRAND TOTAL FOR ALL PHASES:	**$ 506,000**

SOUND, NOISE AND ACOUSTICS:

This section reports the findings from a site study that will improve acoustical considerations at St Paul's Catholic Center in Bloomington, IN., with the intent to improve participation for worship. An aged sound system is also recommended for renovation at the same time as acoustics are addressed, so as to integrate sound and acoustical needs in a cohesive fashion.

A site survey of the Nave and sanctuary was performed October 25th, 2012. Electronic measurements, impulse testing, critical listening, inspection, an interview with Father, and appraisal of current sanctuary layouts, needs and expectations were made. Associated spaces in the rear Sanctuary and Parish Hall were reviewed.

Initial estimates are based on similar projects with similar conditions and under presumptions. (Note: Estimates are only guidelines at this time, never quotes. Estimates must be integrated with other scopes and should be updated for a design budget, after reviews with RE Dimond).

SUMMARY

The acoustical signature of any sanctuary should support music and speech and most certainly impacts worship participation. Room reverberance and reflection should match room functions for style of music used. A balance between acoustics, music and speech is always required for speech clarity. Sound, acoustics and noise should always be designed then integrated to avoid compromise in room form and function.

For St. Pauls, we found "good bones" and strong potential due to cubic room volume in the central Nave. But we found very little supporting acoustics to encourage participation, singing, choral rendition or other musical response. Further, the side seating areas are completely disconnected for these worship functions. Also, we found the sound system very aged. It lacks uniform seat coverage, especially on side seat areas. The sound system also fails to localize naturally to a talker or Cantor in a majority of seats. This creates distraction and disconnect especially for youth, a foreign dialect talker or person with compromised hearing ability.

In summary, we see good potential for positive change at relatively low cost. We encourage any renovation to integrate an acoustical scope because it can be relatively easy to obtain a major improvement. But the current Nave best described as a "dry," room and side seating very "decoupled" from the main room, and this is more than we normally would see for most sanctuaries. This decoupled condition is exacerbated with absorptive ceilings and very low ceiling heights also make the side seat areas a completely different acoustic response, (and congregant response), as compared to the middle Nave area.

Recommendations for the Nave include (but are not limited to) removal of carpet, changing acoustical ceilings, (either new grid tile or a cloud ceiling system), and replacing sound system components in a systematic, cohesive approach. This means sound system design is decided by acoustical impact first, then a sound system design with options should be considered.

SITE FINDINGS

1. The sanctuary (Nave) has three (3) distinct "chambers", all inside one larger room. The middle chamber has a high ceiling tile grid. Two other "side chambers", (low ceilings), have a very large amounts of (undesired) acoustical absorption inside each chamber.

2. The Nave's three (3) distinct "chambers" do not acoustically couple together as they should. They do not relate to each other, acoustically. This means a very strong disconnect for full room support and performance as a whole. This effect erodes most acoustical support to the East and West seating areas. Acoustically, any congregant in the side areas may as well be in an entirely separate room, and outside of a common worship experience when compared to the middle seating section. This is illustrated by the choir's desire to move to the upper dais location near the Altar in the middle of the room, (and which remains a compromise position).

3. Reverberation metrics for the entire space are low. For side seating areas they are virtually nonexistent, (i.e. < one half second, plus low room cubic volume/per seat).

4. A majority of room surface finishes are absorptive ceiling tile, padded pews and full carpet. This imposes a sense of disconnect during singing and worship with limited acoustical support nearby. This imposition is much worse in side seat areas.

5. Ceilings and floors are the first areas to consider for lowering absorption and increasing reflection in a controlled fashion. A designed approach, with predictive modeling in advance is required to find enough surface area in proper locations to be treated.

Key acoustic design goal is a change of ratios. This includes hard to soft surfaces, increase far to near surfaces impact, and a change for all sound system direct to reflection ratios. Loudspeaker coverage is also outside normal, (+/- 3dB) coverage. Sound mapping for uniform loudspeaker layouts is not sufficient alone for a design in this space and a cohesive design with acoustics and electronics is required.

6. The sound system has fundamentally poor speaker locations. Speakers generally have poor coverage in side seat areas and poor direct to reflected projection, without "localization" to the dais. We found this an intrusion on natural speech and can accentuate disconnection. This disconnect includes from Priests, lay talkers on the dais, the Cantor lead position in the front of the room, and also the choir to the congregant. Localization to sources on the dais would help this room dramatically improve the worship experience.

7. The audio system is a "mix" of several systems over several decades. Some reuse is possible, but the primary speech delivery system is at least 50-60% past its normal life cycle expectation, (usually 15-20 years). Replacement should be sooner rather than later, due to such extended age. Overall quality of electronics is modest at best, and somewhat poor for the more aged components. The more recent addition, (black cabinets on middle walls) is a moderate quality but is analogue based with many adjustment needs to operate and maintain performance. This is illustrated by plastic security covers to prevent tampering, (which remain accessible).

A digital system with software presets is now a common for churches. This would allow predefined adjustments with a more consistent window of success. This means consistent performance and optimized volunteer adjustments. Musician adjustments for taste would of course remain.

8. Remedies can be considered in phases or as a complete project. However, an acoustical remedy always works best when the degree of improvement is enough to be heard and includes a sound system plus acoustics and low noise as a unified design goal.

This means significant surface area must be addressed for acoustical treatment and only then should loudspeaker coverage and locations be determined. Small or incremental steps may become inconsequential. We did find enough free surface area in the ceiling and floors to impact the space. In fact, we see candidates for treatment as generally lower cost than we normally find and this allows a disproportionate acoustical improvement to possible resources, in our opinion.

9. Some sound system components could be relocated to the Parrish Hall, for use in a smaller, less demanding room. This is a low cost condition in all cases.

10. Owner stated concerns:

- There is poor "connection" between congregants and room for worship singing. This appears to hinder or limit engagement.
- Increased participation during worship is desired.
- Musicians and choir report music balance difficult or can't hear well for blend.
- Choir seating has moved to upper dais to "hear better". (May not be the best liturgical position).
- A mix of age, groups and style are typical.
- A more progressive worship experience is generally accepted.
- Speech clarity is poor in some areas.
- Parish Hall sound system is very aged.
- Video presentation should be considered in Parish Hall.
- Confessional space "leaks" sound and may not be confidential!

ANALYSIS:

We found three distinct seating zones in the Nave - one with high ceiling and two with very low ceilings. Acoustically, this means the Nave is not one room, but three distinct disassociated "chambers." Each chamber sounds completely different from the adjacent space. There is poor acoustical coupling between each chamber, and any sound in one area is not mixed or shared between other chambers. This results in poor balance, low distribution of energy, and the inability of music to resound. Any musician in a side area cannot hear the other room areas. So cues, balance and ensemble suffer. Congregants can feel as if they are singing alone, or in a small room instead of with a congregation in the next room or area.

- A small "side opening" exists for each side chamber to the middle room. This limits sharing acoustics between other zones, and is why the choir prefers the dais location between two spaces.
- There is high absorption in each small side chamber, relative to the middle Nave. This exacerbates "decoupling" between all spaces and lowers participation.

- Comparing each chamber's cubic room volume (ft3) substantiates this. It is easily concluded that the total room is "dry," but the side chambers are virtually anechoic, or completely lifeless and devoid of reflection for music support.

    - Middle chamber can be estimated as 200 cubic feet/seat.
    - Side chamber can is estimated at only 50-75 cubic feet/seat. This is a ratio of 1 to 8 and should be 1 to 2, or 1 to 3. For a 1 to 8 ratio this means the side room reflection heard in the middle is reduced by 30 dB and therefore virtually not audible.
    - For comparison, typical Catholic style of worship, choral music and light opera with speech delivery often range from 300 ft3/per seat to 500 cubic ft3/per seat, not 50 per above. For reference, a pipe organ would use even higher numbers for 2-3 second reverberation times, or 600 ft3/seat.
    - Reverberation is defined as the time it takes for any sound impulse to recede to quiescence, (-60 dB). The time in this room is short, (about 1second RT60). It should increase approximately 30-50% to a mid range value in our opinion. Staying under 2 seconds with the right loudspeaker design would preserve speech clarity and allow better support for music.
    - Speech clarity would improve with a new sound system in a more reflective room. Also, the current sound system would suffer in a more reflective room, lowering speech clarity even further without remediation.
    - It should be noted, people in this room do not significantly change the total room reverberation, due to existing padded pews always in place. This is a positive and allows better results for any new steps. It allows higher success with lower potential cost for remediation because pew absorption is now in place and ready.

- Acoustical ceilings are absorptive tile grid, (mineral fiber NRC 0.65 estimated). Comparing each surface area (ft2) continues to illustrate each chamber has a very different acoustical signature, in spite of uniform hard surfaces (stone).
- Carpet was found in most areas. Carpet is considered a destructive acoustical finish in this room, except as footfall noise control.
    - Carpet is absorptive at the frequency ranges needed for vocal support, (2,000 to 8,000 Hz).
    - Carpet is also the <u>closest</u> absorbing finish to congregants, talkers, vocalists and worship response. Carpet therefore negatively impacts speech and choral more quickly as a nearby destructive path.
- Reverberation of the middle chamber is dramatically higher than in the (2) side chambers. This is due to its cubic volume, higher ceiling, and longer sound paths. But this middle section "hears" side chambers as fully absorbing and therefore has its remaining reflectance reduced by them.
- Current sound system does not handle the entire room. It has only partial coverage. The current sound system also exacerbates some acoustic issues, so while the room acoustics and sound system coexist, the sound system is not integrated for all seats.

    - Sound system (4) side wall speakers cover the center Nave seating, only. (Two rear black speakers are time synchronized by electronics to a front pair - but these are not coupled to the Dais, to a natural talker, choir, or any side seat areas).
    - A series of poorly located "distributive speakers" in lower ceiling areas sound unnatural and are heard as distractions. They are low power and also without localization to the dais. They ignore proper seat coverage.

- Sound system electronics are aged. Some components are over 30 years old, and manufactured in 1970's. Other electronics were manufactured in 1980's and some in the 90's.

- This is past any reasonable reuse or further life expectancy. The latest addition is an analogue system boasting quality as determined by late 1990's era designs. Most systems can last 15-20 years or less, but almost never past 20 years with satisfactory expectations due to heat, dirt, and component failure.

- With more contemporary worship needs, the sound system is not adequate. The older speech rated system is vintage Bogan, which was designed for only speech and before electronic music items were considered as part of a worship service. Newer electronics include Ashley, dbx and EAW Inc., but these are not a full install for all functions.

RECOMENDATIONS:

Moderately increase the overall reflectance of Nave in a controlled fashion with predicted results. Cost estimates depend on which new surfaces are desired and the minimum need for just noticeable improvement vs. a major improvement. This project has potential for very good results, with an associated ceiling scope for HVAC performed at the same time.

Any HVAC scope must preserve worship and speech clarity with low background noise. Background noise metrics should be no more than "NC 30, (37 dBA) max, with NC 25 (32-33 dBA), preferred in all cases. Air supply in a high ceiling can be a quieter and less costly due to distance above listeners. The opposite occurs in side seating, so noise abatement is critical in these low ceiling areas.

1. Remove carpet, at least under pews. This is important in seats and choral music areas. Keep carpet when footfall noise is a concern in peripheral areas or borders. Replace with wood, tile, stained concrete or other hard surface as desired, pending floor surface inspection. While dais is optional for this recommendation, it should be considered if the choir will remain on the Dais.

2. Modify or replace all acoustical ceilings. Coordinate new lighting. Estimates are lower if existing 2 x 2 grid remains, (see #a, below). Item #c suspends an "acoustical cloud" or planar surface, either below existing grid, or it can replace it. Cost can be controlled by limiting surface areas, using lower density coverage, or simplifying suspensions. Budget for item #a assumes scaffold, clean grid and add support wires where needed, includes scaffold, and removes 1/3 of the pews for access.

The option for eliminating acoustical tile ceiling in the middle Nave uses suspended cloud/planes in concert with duct and lighting fixtures design in gaps. This is less expensive for light and duct installation. Clouds can also be another acoustical ceiling tile grid and divided in sections.

a. Most basic start is a change to more reflective 2 x 2 tile with lower absorptive (NRC) value. This starting point can be a mix between existing and new.

i. Mix and type would be determined by calculations in concert with other options taken, or not.

ii. This start point is likely not enough to solve all stated issues alone and certainly depends on carpet replacement.

b. If carpet removal is not approved, ceiling changes should be a more complete change out.

c. A more impacting option limited to the middle Nave ceiling are suspended "cloud" ceilings with rectilinear shapes or patterns that compliment the Nave. Our first recommendation would be a staggered planar look that creates a more interesting, dense and acoustically diffuse ceiling for the Nave. A cost concession could leave the grid in place.

i. A cloud look has many options and opportunities. It can be flat, uniform or add visual interest by contrast. It can vary heights between each cloud unit as an interesting offset, which is preferred. It can be any number of surfaces, color, shapes or subtle additions in parts. Suspension from high ceiling area should be specific angles and surface area.

ii. The lower ceiling areas (side chambers) can remain a ceiling tile replacement in existing grid, (pending carpet decision). This is inexpensive and highly recommended.

iii. If gaps for new lights and HVAC are used, they should be minimized as they become more absorptive or will negate acoustical reflection needs. If HVAC supply is noisy, these gaps can also increase noise.

iv. Middle ceiling height allows higher noise to be tolerated, due to distance above seats in middle Nave, but not in side seats. Please note, NC 25-30 is the recommendation for all seat areas, not just at one ceiling height.

v. Renderings can show various options for color, contrast, and interest.

d. Add more engineered diffusion tiles on low ceilings near the music and choral areas to support and blend. These are quickly integrated into ceiling grid, and have much higher diffusion capability for music. Estimates are $40.00/ft2, but only for smaller areas over musicians.

e. NOTE: If music and choir floor locations are adjusted, all ceiling adjustment depend on any new locations. This also impacts connectivity, AC power, wire and plates, as well as acoustics.

3. Replace or renovate sound system. No less than new speakers and a central digital processor should be considered, with design using professional services and competitive bidding. We have checked access for path and conduit and this appears to have low impact for cost.

f. Replace all speakers for the existing Nave sound system. Choose types and location <u>only after acoustical approaches are decided,</u> as it is imperative to choose in concert with new acoustic elements.

g. Update electronics with software presets using digital control, (DSP). Use optimized, simple presets for lay person and daily services or facilities staff access. Other presets allow complex adjustment for larger functions.

h. Maintain or improve musician "head-end" electronic functions for local control and mix. Relocate current DSP electronics processor to a smaller system in the Parrish Hall.

i. Replace amplifiers for speech delivery. Reuse amplifiers in Parish Hall or for musician monitor, or secondary feeds to conserve budget.

j. Add AC power and surge protection for software controlled electronics.

k. Include a single button, master AC power on/off control with light.

l. Improve or reuse auxiliary systems, (remote speakers, key microphones, sanctuary distribution feed, and certain media and recording feeds).

m. Reuse existing Infra-red ADA system

n. Replace jacks and connectivity for reliability. Test and reuse existing conduit and wire, whenever possible. Coordinate with musician locations, carefully.

o. Downsize or relocate main equipment housing in closet.

p. Provide software selected presets between daily service and full Mass with musicians. Musicians select a preset and maintain their own "mix", within a fully integrated system approach balanced to the room.

    i. Reuse of existing musician system may save $15-20,000, pending test of each component.

q. Install or relocate for Parish Hall audio and video system with wire, AC, wallplates, projector, motorized screen, remote.

4. Should the existing Nave front wall art fabric be modified or placed on track, provide a radius hard wall for a major acoustic reflector into the Nave. This wall could add light wall wash or an up light option, or a more dramatic look as required for the Catholic Liturgy. If fabric remains lightweight, this would not interfere with an acoustical diffusion wall when art fabric is in place. Rear wall acoustic treatment option is governed by this decision.

5. Confessional: Confirm largest leaks with a field test. Doors require a full seal. Increase barrier by adding an air gap and appropriate 2nd window surface. Estimates are low cost windows, perhaps < $1,000 for in house facilities).

6. A late arriving destructive echo on rear wall was found due to the length of the room. This detracts from intelligible speech in some cases. Treatment is $20-$30.00 ft2, and estimated as 500 ft2, depending on fabric or wood looks.

PRELIMINARY BUDGETS

1. Remove carpet/refinish floors. (Cost estimated only) $40-$70,000

2. Replace 7,000 ft2 ceiling with new tile matrix, (reuse grid?) $29,000

(NOTE: Lower ceilings require this, upper ceiling may not, pending #3)

3. Add suspension "cloud" system under existing @ middle Nave. $35/ft2/32ft2
   (Pending load, ft2 desired, lighting, demo and HVAC layout). $40-90,000

4. Engineered diffusion 2 x 2 tile - lower musician area, ($40/ft2/400 ft2) $16-18,000

5. Renovate aged sound system during acoustical renovation $54-68,500

6. OR, replace, improve and commission new sound system $79-93,000

7. New Parish Hall AV system- Audio only, (plates, wire, electronics) $6,700

8. New Parish Hall AV – Video only, (plates, projector, wire, screen, AC) $4,800

9. Or, test, demo, and relocate existing audio to Parish Hall instead $4,500

(NOTE: Choose only 7 or 9, not both)

10. Add noise control to confessional room $1,000

11. Add rear wall absorption for Nave- cloth covered, not wood $8,700

12. OR rear wall absorption for Nave- perforated wood instead $14,500

(NOTE: Choose only 11 or 12, not both)

13. Contingency for power, conduit, unknowns etc. $20,000